Community-Based Narratives: A Study of Collaborative Content Creation in Visual Media Production

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Abstract

Collaborative content creation is the act of multiple individuals engaging in the creation of visual media narratives. Visual media production encompasses a myriad of styles and genres of content. In this dissertation, research into three synchronous and asynchronous approaches to collaborative content creation are presented. Synchronous collaboration refers to collaboration conducted simultaneously by remote parties while asynchronous refers to work undertaken by remote collaborators at different times. Of the three methods presented in this paper, two of the methods implemented resulted in collaborative student-made documentaries. First, asynchronous collaboration is explored in the curation of crowdsourced assets after the 3.11 earthquake and tsunami in Japan in the production of “lenses + landscapes”. Crowdsourcing is a means to utilize existing media assets to deliver a narrative experience that consists of many small parts, but whose overall impact as a whole is greater than the sum. Second, a combination of synchronous and asynchronous remote co-located collaborative content creation is examined in the production of “places + perspectives”. The implementation of large, remotely located touchscreens in collaborative sessions by teams in Japan and the United States is illustrated and analyzed. The third approach, consisting of real-time synchronous collaboration, is made up of a series of usability studies with participants engaging in real-time collaborative content creation through the use of a “shared” interface. By presenting the findings and details of the experiments on collaborative storytelling, the goal is to demonstrate different methods for creating and curating collaborative content in and over remote locations to allow for a unique and enhanced user experience for content
creators, collaborators and viewers. The community of user-generated content creators in the dissertation is represented by graduate students from the Graduate School of Media Design at Keio University and undergraduate students at the University of California, San Diego. The aim of the dissertation is to present three collaborative models of digital narrative content creation that demonstrate the way in which users have more control over their content and have a more immersive experience with the content. The goal of this study is to establish collaborative content creation as an interdisciplinary field of study and research as well as provide content creators, both existing and new, with the tools and knowledge to work with other individuals in the pursuit of collective visual storytelling.

Keywords:

Collaborative Content Creation, Visual Media Production, User-generated Content (UGC), Content Curation, Remote Co-location, Computer Supported Collaborative Work (CSCW)

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Chapter 1 - Introduction

1. Background

1.1. Collaborative Content Creation

This dissertation presents research into three models of collaborative content creation in visual media production. Collaborative content creation is defined as the collective effort of multiple, remotely located individuals in the creation of digital video works. The three collaborative models of digital narrative content creation demonstrate the way in which users, working together in groups, have more control over their content through their interactions with one another as well as a sense of shared ownership that arises from their roles as producers of content. First, curation of crowdsourced assets after a major natural disaster is explored in the production of “lenses + landscapes”. Crowdsourcing is discussed as a means to utilize existing media assets to deliver a narrative experience that consists of many small parts, but whose overall impact as a whole is greater than the sum. Second, remote co-located collaborative content creation is examined in the production of “places + perspectives”. The implementation of large, remotely located touchscreens in collaborative sessions is illustrated and analyzed. The third model of collaborative content creation involves utilizing open source software to facilitate real-time content collaboration of digital video assets through joint manipulation resulting in a cooperatively created rough cut. Three usability studies with real-time content collaboration are presented and explained.
The goal of the research presented henceforth is to establish collaborative content creation as an interdisciplinary field of study and research as well as provide content creators, both existing and new, with the tools and knowledge to work with other individuals in the pursuit of collective visual storytelling.

1.2. Visual Narratives

Narratives are intertwined with the human experience. Stories, recipes, traditions, history, and knowledge have been passed down and shared for generations by people of various backgrounds through narratives. Narratives have taken the form of spoken stories through oral tradition, visual stories through primitive drawings, sculpture and later, paintings. Some even consider science and research as another form of narrative, further solidifying narrative’s incorporation into our human fabric\(^1\). With advances in technology, the use of photographs, audio recordings, and motion pictures combined many of the earlier narrative models into the forms available today. Present day visual narratives encompass a large range of forms from static pictures to movies to those composed solely of computer-generated effects. The common traits shared by all the different types of visual narratives is that they can be seen by the human eye and that they are made up of a connected series of stories, events and characters - either true or imagined\(^2\).

1.3. Technology Driven Change

In the last decade, video technology, particularly video cameras and video capture technology, has advanced dramatically in terms of media and capabilities. No longer are videotapes and videotape playback machines necessary to create and watch video content. Besides the streamlining of
equipment and accessories needed to capture video, the technology has reached a point of affordability and portability where almost anyone can possess some type of video recording device and have it on their person at almost any time. Video cameras, which once were a heavy burden on wallet and strain on one’s arm, now cost the same amount as a dinner for two and can fit into a pocket. By 2006, close to half of all households in America owned a camcorder. With camera-enabled mobile phones and smartphones becoming more prevalent, almost anyone, anywhere has the tools necessary to record digital video.

The proliferation of the internet through the expansion of broadband infrastructures and high(er) speed mobile internet in the past decade has complemented the advancements in video technology. In the mid-2000s, the rise of internet video sharing sites has made it possible for anyone to share and distribute their digital video content with people anywhere at any time. These recent digital innovations have brought new trends in the forms and shapes that narratives can take. Video sharing sites in the last few years, such as YouTube and Vimeo, have made it easy for almost anyone to share their experiences, likes, dislikes, opinions, and creative work with the whole world. According to networking trends, by 2017, close to 70% of all internet traffic will be from digital videos. Never has it been easier for people to show their neighbors, next door and around the world, what and how they see the world. This new found convenience of effortlessly sharing videos has caused a shift in the content producer and content consumer paradigm.
1.4. Redefining the Role of Content Creator(s)

Technological affordances have changed the way in which people live their lives. Especially in young people, but also more and more in the adult population, the *always-on* culture has transformed people’s relationship to technology and media. It is a matter of fact that people are always connected to one another both in real interactions facilitated by technology as well as in the online space. The devices and equipment used by individuals in school or work settings spill over into their personal lives and leisure activities.\(^7\)

The shift in the production and consumption of media contents as a cultural phenomenon of the digital era is described by Jenkins\(^8\) as one of the traits of the convergence culture. Jenkins’ descriptions of the shift in the role of the audience applies to the argument for creating a framework for the collaborative creation of user-generated content. The phenomenon of textual poaching\(^9\) that developed in the early days of the internet and gave fans, enthusiasts and couch -critics a voice that they otherwise would not have. Later, with ongoing advancements in technology and a maturing media user/consumer fanbase, the emergence of a “collective intelligence”\(^10\) is seen manifesting itself. Not only is it important to view and study media in the traditional producer-consumer relationship, but one must also examine the relationship and interactions of the media consumers with one another, to the media producers, and to the media and media content.

This shift in roles for the audience from passive to active can be and should be applied to not only individual attempts and works created, distributed and shared with the convenience of modern affordances, but also to participatory
engagements in which groups of individuals collectively carry out creative work. With the current state of the art, the time is right for integrating collaborative methods and techniques into the realm of user-generated content.

1.5. **Shifting Trends in Media: User-Generated Content**

In the past, the viewership had to make the best of what was offered in terms of video content. Motion picture content, whether in the form of film or television, was a result of a creative process fully controlled by the producer. Many times, it was the content rights’ holders (major film studio, TV network, etc.), not the artists or creative forces behind the narrative, who dictated the way in which the production was carried out. This centralized model of authorship meant that the audience played a passive role and was at the mercy of the producers in terms of content choices available to them.

Until recently, the criteria for judging content as ‘interesting’ depended on the choices made available by the content producers. Now, however, the audience has the choice, equipment and requisite knowledge to create content that they find interesting. The consumers are also producing and changing the landscape of the video content market through the use of digital video technology. Content distribution, as well as authorship, is shifting form a hierarchical model to include collaborative models that are based on shared authorship\(^1\). Instead of only relying on existing or traditional modes of narrative expression such as books, magazines, radio, television and movies for entertainment and information, people are now presented with a wider variety of content options from which to choose from. There are multiple distribution channels to search and watch contents, and a legion of devices by which contents can be
consumed. For consumers of video-based content, long-established models of acquiring knowledge passively has reached its point of obsolescence.

The transition to more video-based contents has increased the number of content choices for people. YouTube, the most widely recognized video sharing platform, has 72 hours of video added every second. In the current content streaming revolution 12, there is no doubt that selection has exponentially increased quantitatively in a short period of time. Despite the increase, the quality of available videos online is not commensurate to the quantity. This is demonstrated by the fact that 30% of videos on YouTube draw 99% of the audience 13.

The disproportion in the relation between content quantity and content quality is reflective of a prevalent issue with user-generated content 14. While the proliferation of video technology and the increase in broadband infrastructure into households accounts for the rise in the number of content produced by users (i.e. non- traditional contents producers), the content has yet to reach its potential in providing qualitative value for the audience. User-generated content is expanding the viewer’s horizons as to what is happening around them and the world. Users are able to create identities for themselves through a culture of content sharing. The user-generated content uploaded to and shared gives viewers of the content a glimpse into the person behind the video 15. However, when content production comes to mind, many viewers are not only looking for more resources from known or available sources, but many also want more engaging content. In order for the content to engage the audience, the audience needs to have a genuine connection with the content. The audience, as content producers and consumers, need to be stimulated by and
actively engaged in the content process. Content creation must encompass collaborative and interactive components in order to create an environment that nurtures social interaction in the process of creative narrative construction through the promotion of participatory activities.

1.6. Community

The term community, as applied in this research, refers to group or groups of individuals who share common interests or goals and want to engage in the collaborative creation of visual media content. These communities are not limited by geographic location, cultural background or technical acumen. The core factor that links these individuals is their passion for creating content collaboratively in a participatory setting. The “content communities” in which these people find themselves set the stage for collaboration on visual media productions. By working together, even when apart, members of these communities have a voice and part in the content they produce and share with one another, and the world. In the same way that social TV tools try to create an environment of watching TV alongside other separated individuals as if present in the same physical space, collaborative communities strive to create an atmosphere of working shoulder-to-shoulder in a group setting. The opportunities presented in the creation of user-generated content as a means for individuals to become producers of visual media are multiplied and enhanced when working collaboratively as the sharing of ideas, responsibilities and tasks can aid in the creative work.

Target of the community, as presented in this paper, is graduate students of visual media production. The community of user-generated content creators in the dissertation is represented by semi-professional contents creators: from
graduate students in the Graduate School of Media Design at Keio University involved in a project with a mission to create contents on a collaboration basis, to undergraduate students at the University of California, San Diego. Both are lead by professors with a goal to produce visual media content, in a limited time with limited resources, by collaborating remotely to produce communal output. Specifically, the community members represented in the research in this paper, are/were students from the Keio University Graduate School of Media Design and the undergraduate students from University of California, San Diego.

1.7. Shared Authorship

In a community setting, creators of user-generated content collaborative contribute to the production of visual media. In this communal environment, without the restrictions of a traditional legacy and industry production rules and limitations, UGC producers can come together to create their own collaborative visual narratives. Through the act of participating in the joint production of creative content, community members become stakeholders in the story and its making. A feeling of shared authorship is manifested through people working together and knowing that their individual contribution is an integral part in the final outcome of the collaborative created content. This idea of shared authorship also brings with it a heightened sense of responsibility to other collaborators as well as the content being produced. As community members willingly choose to participate in the production of collaborative content creation, they implicitly understand that their work reflects not only themselves, but all the individuals involved in the undertaking. Collaborators, regardless of the degree or amount of their contribution want to do their best in
order to create a finished final quality product as well as not let down their fellow contributors.

From this community of individuals sharing a vision, content created collaboratively takes on a new dimension. For viewers and consumers of said content, the qualitative importance is found in not only the narrative of the final version produced by the community, but also in the community of creators who contributed their time and effort to produce the content.

1.8. Collaborative Community Content

The redefining of the role content creators, together with shifts in media trends, easier access to production technology and equipment and the explosion of user-generated content as an undeniable form of media have affected the types of visual narratives people can create. Communities of fans have the ability to tell their stories about a group or band they like.

For the making of the 2006 documentary “Awesome; I Fuckin' Shot That!” the pioneering musical group Beastie Boys gave 50 of their fans hand-held Hi-8 cameras to film a 2004 concert at Madison Square Garden. Due to the video recording quality and editing technology of the time, the video was anything from what a professionally filmed multi-camera concert film looks like. However, what is conveyed is through the shaky footage is the multiple points of view of the fans and their common passion for the group and their music.

Harnessing the power of user-generated content and video sharing, Eric Whitacre’s Virtual Choir projects utilized YouTube as the central meeting point for hundreds of remotely located choir members to come together and
perform in unison. Time, effort, user participation and collaboration enabled Whitacre to present a social and global choir.

Johnny Cash was a singer and figure that influenced not only various genres of music, but also culture. After his death, fans of the man in black came together, on-line, in the Johnny Cash Project\textsuperscript{20}. The project was a meticulous communal tribute of piecing together frame-by-frame drawings uploaded by contributors to create a collaborative music video for Cash’s song “Ain’t No Grave”.

\section*{1.9. Research Problem}

The traditional models of content delivery and creation as well as the roles of content producer and content consumer are shifting in an environment of increasing user-generated content. Nowhere is this change more pronounced than the field of visual media production. While the amount of user generated content is growing, there is an imbalance with respect to its quality and variety. A major cause of this disparity is the lack of attention or, moreover, neglect of the role that collaboration can play in the content creation process.

\section*{1.10. Research Method}

Experiments on three models of collaborative content creation in visual media production are discussed in this paper. In the explanation of the production of the short 4K documentary “lenses + landscapes”, collaboration through the curation of crowdsourced assets after a major natural disaster is explored. Employing large touchscreens to facilitate collaboration between remote teams in Japan and the United States is examined in the production of the short documentary “places + perspectives”. Three usability studies are presented and
explained in the investigation of the third model of collaborative content creation involving the implementation of open source software to facilitate remote real-time content collaboration of digital video assets through joint manipulation resulting in a cooperatively created rough cut.

Collaboration, as discussed in this paper, can be either synchronous or asynchronous. Synchronous collaboration is understood as real-time collaboration where remote users, working together on a visual media project at the same exact time. The three usability studies on real-time collaborative content creation employ synchronous collaboration. Remote users simultaneously work and manipulate digital video assets together on a shared interface. Asynchronous collaboration denotes collective visual media production undertaken by remote users at separate times. The production of “lenses + landscapes” is an example of asynchronous collaboration. Story content is first crowdsourced from multiple contributors and then curated by a production team. A combination of synchronous and asynchronous collaboration is present in the production of “places + perspectives”. Remote users on both sides of the Pacific, meet in online sessions to discuss and storyboard ideas for their collective work. The separation of many time zones leads to the distribution of collaborative tasks for one team when the other is off-line.

1.11. **Research Goal**

By presenting the findings and details of these three experiments on collaborative storytelling together with related work and an analysis of the collaborative methods employed in the production of the collaborative works, this paper can demonstrate different methods for creating and curating
collaborative content in and over remote locations to allow for a unique and enhanced user experience for content creators, collaborators and viewers. Through this explanation, this dissertation strives to establish collaborative content creation as a recognized interdisciplinary field of study and research from which members of academia, as well as content creators, both existing and new, can gain the tools and knowledge to work with other individuals in the pursuit of collective visual storytelling. The focus of creative endeavors, particularly in visual media production, should not be judged solely on the final product that comes at the end. Rather, what happens on the way to the end has a great impact on the discipline as the journey contains invaluable lessons to help improve the field of technology-supported visual media production.

1.12. Dissertation Structure

This dissertation is structured into five chapters. The current chapter, Chapter 1, begins the conversation about collaborative content creation with a research statement, a description of the shift in the role of content consumers from passive viewers to active participants, the rapid emergence and growth of user-generated content and communities of users that benefit from the establishment of an environment that encourages and promotes cooperative visual work.

• Chapter 2: Literature Review

Subject matter related to collaborative content creation including platforms for collaboration, collaborative interaction in storytelling activities for children, creating a sense oneself being there in remote collaboration, curating crowdsourced social media content in times of disaster, and tools to help multiple users work together in visual media production are included in this chapter.

• Chapter 3: Explorations into Collaborative Content Creation
Research conducted into three methods of collaboration are described in detail in this chapter. Synchronous and asynchronous elements of collaboration are described in the production of collaboratively produced short documentaries, “lenses + landscapes” and “places + perspectives”. Three usability studies using open source software to facilitate real-time collaborative content creation and produce rough cuts are discussed. The background and implementation of the three methods are discussed. The processes that constitute the collaboration as well as results of each method of collaboration are reviewed.

- **Chapter 4: Analysis**

  The contribution to the study of collaborative content creation in visual media production is presented in this chapter. The elements that constitute the methodologies for collaborative content creation are analyzed. Factors that drive individuals to work together on collaborative visual narratives are explained. Requirements for engaging in collaborative content creation are discussed. Possible use scenarios for visual media productions in which collaborative work can be incorporated are construed and the limitations of collaboration in visual media are taken into account.

- **Chapter 5: Conclusion**

  The final chapter discuss the way in which groups of people, such as citizen journalists and members of local communities, can benefit from collaborative content creation. Examples of collaborative media production between professionals and non-professionals are explained to show how the gap between the two groups can be narrowed. Recent applications and tools to support collective visual narrative construction are presented. The social impact of collaborative content creation and summary of the research conclude the paper.
Chapter 2 - Literature Review

2. Overview

Collaborative content creation in visual media production is an emerging field. The work presented in this dissertation aims to lay the groundwork to establish the discipline. Due to its relative nascency, research directly related to the practices of creating digital video content collaboratively prove challenging to find. This chapter introduces and examines previous research from a variety of subjects and fields. This interdisciplinary analysis takes an in-depth look at selected works from fields such as collaborative media and storytelling, interaction design for children, remote co-located collaboration, the curation of crowdsourced information in disaster management and tools to facilitate the collaboration of digital visual content. While the areas of study may vary widely in their scope and subject matter covered, this selection of topics is interconnected in relation to creating a base layer from which to understand and study collaborative content creation.

2.1. A Framework for Collaboration

To begin to make sense of how a system or structure works, it is helpful to understand the framework which scaffolds it. By delving into research on digital productions based on collaborative media and prototypes of collaborative storytelling, a clearer picture of the platforms that support, enable and encourage collaboration in content creation can be achieved.
2.1.1. Collaborative Media

Through their research and implementation of the youth driven cross-media platform Avatopia and designing collaborative media in a professional setting with the Kliv project\textsuperscript{21}, Löwgren and Reimer discuss the need for designing collaborative media. The authors explain the concept collaborative media as digital media where consumers, once passive participants can now also produce; They state that in a collaborative media setting, people, regardless of whether they are directly involved traditional media industries or not, can participate in the design of tools and infrastructures which become the components of current and future media productions.

The example of Avatopia demonstrates how a niche group can utilize different media distribution channels to reach a wider audience. A group of 20-30 teenagers designed and managed an online forum using avatars (new media) to talk about subjects that were passionate to them. The other component of Avatopia involved a weekly 30 minute television program on Sweden’s national broadcaster, SvT. The television platform allowed the young activists to bring their message to a wider nationwide audience and encourage more participation in the online forum.

The Kliv Project was a cooperative undertaking between the Interactive Institute at Malmö University and Malmö University Hospital. Various experiments were conducted to learn ways for the hospital staff to be more efficient in their duties while working collaboratively. Instead of an outside entity creating training materials for the staff, staff members with knowledge of certain equipment and procedures would work together to create, edit and share training videos they made cooperatively. The process of learning by doing
not only instilled a sense of empowerment in the staff, but it also allowed for better and more useful video content as the people filming knew what was needed and how it should be presented. This example of participatory design illustrated themes of self-sufficiency and community responsibility.

The authors make the point that collaborative media is only possible through collaboration. The idea of designing collaborative media needs to be addressed and developed in order to move towards a framework for collaboration in the media landscape.

2.1.2. Collaborative Storytelling Platforms

A technical approach to creating interactive narratives and non-linear stories is presented in the research on StoryTec\textsuperscript{22}. StoryTec introduces a computer aided platform for authoring and experiencing interactive, non-linear stories. The two main components of the platform are an authoring platform to manage content and a runtime engine to execute and perform the interactive stories. The research addresses the need for authoring tools in the creation of interactive content that can easily be used by anyone as the tools that exist require a proficiency in programming ability and technical acumen.

A GUI with a pluggable framework allows users to connect various components that make up the story. The authoring portion is broken down into 5 sub-categories: Story Editor; Stage Editor; Action Set Editor; Property Editor; and Asset Manager. The structure of the narrative can be managed in the Story Editor through an interactive 2D representation of the story graph. Scenes can be created and visualized, in 2D or 3D, in the Stage Editor. Objects can be inserted to an exact position and represented in their actual size via a drag and
drop mechanism. The story logic are defined and represented in the Action Set Editor. Through the use of a dragging function, the Asset manager works with the Story Editor and the Stage Editor by allowing various types of assets can be imported to the asset library. Details such as the name of a character or volume of a sound can be modified in the Property Editor. The narrative comes to life through the runtime engine.

The authors of StoryTec emphasize the need for easy-to-use authoring tools to assist those without technical skills in the creation of non-linear narratives. The system, however, does not implicitly factor in multiple users creating an interactive narrative and therefore is not conducive to collaborative content creation. Cheng et. al provide a means for concurrent collaborative writing by multiple collaborators in their research on the graph-based visualization tool Storeys. By incorporating a simple branching structure that allows for the creation and arbitrary linking and creation of idea nodes, the Storeys interface assists people in their creative endeavors by making the writing and brainstorming process into a playful activity that is not solitary. Whereas existing writing tools and word processing applications work on a linear and sequential modus, Storeys breaks away from the traditional practices by making the sentence the focus of the work.

The goal of Storeys is to help people collaboratively write. The system is designed so that after a sentence or phrase is inputted into the interface, it can only be modified for about one minute after the action is complete. This enables the users to expand on their ideas and think of alternatives without being confined to a rigid structure. Also, the lack of editing suggests moving on with ideas versus going back and second guessing one-self or some else. Multiple
users, whether in the same physical space or remotely co-located, can contribute to the development of a narrative.

Implemented with D3.js and Ruby on Rails, Storeys unobtrusively and subtly measures the progress of the narrative by a change in colors of the branches as the story moves farther from the root. The interconnection of ideas is realized with the ability to branch to any node. While Storeys may not be suitable for the production of complete and detailed narratives, the collaborative mechanism allows for remote users to engage in an interactive storyboarding session for creative endeavors in a myriad of disciplines including the creation of visual media content.

2.1.3. Visual Collaborative Storytelling

The assimilate project explores collaborative visual narrative construction with a tangible interface. Up to four participants can visually construct narratives in a 3D virtual space in a tabletop touch-based interaction environment. The system proposed by the author, Hills, promotes group conversation by allowing participants to construct visual narratives. The interface access an online database. The participants enter a search term and the content appears in bubble-like moving circles that appear to float in water. The content consists of narrative templates contained in a database tier. In the application tier, the users’ interactions and gestures are combined with the information from the database and represented fluidly in the touch interface. The users can express themselves individually as well as work collaboratively. The bubbles can be manipulated based on size and content, text or video, to offer multiple points of view. Consensus of participants’ ideas is demonstrated when multiple circles are merged to form a bigger circle. The assimilate system,
like Storeys, can be used as a collaborative space to share ideas and brainstorm. The multi-tiered architecture of the system allows users, with minimal or no technical background, to interact with the interface and one another without worrying about how to get the information they need. The non-linear nature of the interface and visual manifestations allow for generative ideation through interaction.

2.2. Interaction Design for Children

The study of interaction design and children (IDC) provides many insights and lessons that can help shape the groundwork for the emerging field of collaborative content creation in visual media production. Children, from very early stages of their development, collaborate with those around them in play activities and later in formal educational settings. Many of these activities take advantage of the burgeoning creativity and imagination involved in storytelling.

In his review of children’s collaboration practices, Göttel\textsuperscript{27} recognizes a relationship between storytelling and collaboration that exists in IDC research. It is important, he believes, to understand the benefits of traditional storytelling with respect to the affordances of digital storytelling. Digital storytelling, through children’s interaction with computers and technology can build upon and enhance children’s creativity, imagination social interaction and full body engagement with their peers, adults, artifacts and environment.

Remote authoring, peer authoring, and enriched experiences are identified as three prevalent features associated with children in digital storytelling environments. These environments must include authoring tools that aid
children in creating, sharing and performing. It is through fostering these collaborative practices that digital storytelling can build upon the foundation of traditional storytelling.

2.2.1. Tangible Collaboration

To promote the creation of narratives by preschool age children in a participatory setting, Sylla shares her findings on a study that implements a tangible system for collaborative storytelling. In order to expand upon the highly imaginative nature of children in fantasy storytelling activities in collaborative environments, a tangible system composed of different sets of picture blocks and a platform on which they can be placed was connected to a computer that animates the stories.

The picture blocks consisted of four categories: nature elements (e.g. clouds); objects such as an apple and a flowerpot; inspired by fairy tales with which the children could relate, the characters included a dwarf, a wolf, a princess and a some others; the sceneries, the settings for the stories, included a dessert, a forest and a few more. Familiarity with the subject allowed for children to immediately get involved in the collaborative activity of mixing and re-working stories to come up with new shared narratives. The tangible interface, with its bright pictures and use of artifacts recognizable to children removed any impediments to imaginative interaction.

The findings evince that the tangible system with familiar artifacts promoted and atmosphere of peer support and learning. Problem solving skills were also noticed when deciding the narrative path. The platform promoted collaboration in children working together to develop new(er) stories from a pre-existing
knowledge. The freedom of the platform, in that there were no pre-determined linear narrative structures and the ability of the children to collaboratively work with various elements of the story such as characters and/or scenes, demonstrated a sense of empowerment in the children through the final animated user-generated content that could then be shared with friends and family.

Synchronous and asynchronous collaboration with a soft quilt-based interface in storytelling activities for young children is discussed in Ryokai and Cassell’s research on StoryMat\textsuperscript{29}. StoryMat is a large play mat where children, either by themselves, or in simultaneous pairs, can create original narratives through interaction with the mat. Sounds and actions are recorded by the mat and can be replayed later. The replayed narratives can be built upon and modified by other children at different times by incorporating some of the elements of those that were on the mat previously or a new stories can be generated.

StoryMat addresses the needs of children who, due to health-related circumstances or other reasons, do not always have playmates with whom they can interact. The child-driven computer-supported system also fills a void by using a child’s own voices as that of narrator(s) and children’s natural movements to create a narrative flow. Children themselves are the inputs for StoryMat. A traditional computer input made up of a keyboard, mouse cables and hardware is not present. This removes any learning or skill obstacles for children and allows them to seamlessly create with their voice, body and imagination.
The StoryMat interface, at first glance, is no different from the variety of play mats that many people with young children will have in their home. The interface is made up of a colorful mat with certain designs and patterns that appeals to children. Soft toys on top of the mat can be picked up by children and used as characters or objects in their narratives. The movement of the toys, along with the narration of a child’s voice, is recorded. The mat itself serves as the backdrop or scene where the narrative occurs. As nothing is labeled or explicitly identified. Children can assign roles, names and identities without restriction. Sensors in the soft toys record movement. The recording of narration begins when a toy is squeezed. The squeezing action also records the two dimensional coordinates of the map and acts as a story marker. Once the squeeze grip is released the coordinates and voice are recorded into a movie file that can later be activated and shown through overhead mat facing projection. The projection of stored narrative content is triggered when other, successive, children squeeze a soft toy in the same area. The previous narrative content is manifested through the projection as in the form of a stuffed animal that travels course of the recorded path guided by the voice of the narrator.

Based on the findings of a user study involving children between the ages of five and eight - in both individual and pair configurations - the authors found the following: peer stories are available to those who use StoryMat in singular situations; when children play together, children collaborate with one another in the narrative process as well as incorporate their own characters and objects$^{30}$.  

The research on a novel virtual and physical interface by Casell et al.$^{31}$ continues to explore systems that incorporate tangible artifacts in lieu of
traditional computer input devices and set-ups in order for children to easily engage in a collaborative narrative experience. The Sam system is made up of two components: a toy castle with a plastic figurine; and a virtual animated playmate, Sam, who is projected on a wall behind the physical castle. The projection also encompasses a castle which is, in fact the other half of the physical castle with which children can interact. The implementation of an animated character allows children to begin the collaborative activity as children can relate to it. Unlike mainstream animation which children passively consume through various media channels, the animated character enters into a narrative creation environment with the child standing in front of the physical castle.

The system initiates the collaborative play by Sam, seen to be playing with a figurine, asking a child who is standing in front of the castle if they want to play. Sam breaks the ice by introducing himself. After the child’s self introduction, Sam suggests making up a story together. This first step into the narrative collaboration process not only creates a comfortable atmosphere for the child, but helps facilitate the shared reality of the virtual and real world.

The tangible and fantasy worlds are seamlessly joined via a single PC running software written in C++ and Java. Pressure sensitive mats located in front of the physical castle and a microphone alert the virtual playmate, Sam, to the presence of a child. Sam follows the children with his eyes based on their location on the mats. To facilitate imaginative storytelling an RFID tag on the figurine let the system know when it is in the tower. The illusion of the shared reality experienced by children using this system is kept up with the use of a switch in the magic tower door. The switch tells the system is if the door is open.
or closed. Sam voice is recorded from that of a real, human, child. This, in addition to the feedback Sam gives the child through audio threshold detection allows the child to have fun and focus on the activity.

Technology can offer many conveniences in terms of ease and speed in relation to children participating in collaborative activities. Modern technology can also serve as a tool to introduce and provide children with an opportunity to learn about traditional and cultural practices. In a one week field trial with a group of seven to nine year-old schoolchildren in China, Lu et al. share their findings on the ways in which digital technology combined with a traditional art form, shadow puppetry, can help children become aware and learn about cultural heritage while collaborating to create their own narratives. ShadowStory is a hybrid digital storytelling system that promotes imaginative expression and collaboration rooted in centuries-old performance techniques. The aim of ShadowStory was to give children the chance to experience and become immersed in a traditional art form - a time consuming and challenging process - while working with tangible artifacts and digital technology to make collaborative stories.

Extracting the core elements of traditional Chinese shadow puppetry, the ShadowStory system allowed children to create characters (shadow puppets) and props through the use of a tablet PC. In this design phase, the children can begin to understand the difficulty and intricacy of using one’s own hands to create narrative elements. In the performance phase, children use the virtual characters and props they have created and take part in a collaborative storytelling activity. A background is projected onto a screen where children use orientation sensors in their hands to control and manipulate the actions and
movements of their virtual narrative agents. The stories are narrated in real
time while the children, working together, project and play with their digital
shadow puppets.

Children’s feedback to the ShadowStory system and collaborative activity was
very positive. It was observed that were able to creatively collaborate with one
another while forming an appreciation for their heritage and a traditional
artistic practice.

### 2.2.2. Designing Collaborative Technologies

While familiarity with tools and tool use are an important factor in designing
collaborative storytelling environments for children, it is also important to
consider the manner in which children typically work in collaborative settings.
Benford et al. discuss the KidStroy project and design of two types of Single
Display Groupware (SDG) applications KidPad and Klump. Remote co-
located collaborative design in IDC addresses the needs of children who are
individually sitting and/or standing in front of an interface or machine while
separated by a physical distance from their co-collaborators. In many cases,
however, when children gather to work together, one notices a group of
children standing in front of one computer or display. Realizing that there
existed a gap in the design and creation of shoulder-to-shoulder collaboration
systems for children, two systems were created and tested with children
between the ages of five and seven.

In order for children to understand the benefits of working together, a tool
mixing approach was used. Tool mixing refers to the effect and outcome of a
certain action that can only be achieved when more than one artifact is used by
more than one person to perform the action. The result of the action is one that is only made possible through collaboration.

Through the use of multiple mice, multiple users can draw create and link stories together in a two-dimensional space when using the KidPad system. Klump is a collaborative storytelling tool that allows children to create and manipulate 3D characters and objects through actions such as stretching, changing texture, rotating and coloring.

KidPad enables collaboration by permitting simultaneous users to grab multiple mice and work within the same zoomable interface. Tool mixing as a vehicle for demonstrating collaborative output is noticed when two children, using different colored crayons (one of the tools in KidPad), bring their crayons within a close proximity on the shared interface. The area between the different colored crayons becomes filled with a new color that is a mix of the two. While still having the ability to draw what they want, how they want, using the colors they want, children can actually see representation of their collaborative work.

Collaborative output is illustrated in the Klump system in the texturing function. Textures appear on the surface of a character through the interaction with buttons that represent emotions. When two children interacting with the system push a combination of texture buttons, facial expressions only possible through collaboration appear. An example of this is when two children push the happy button, a character looks as if it is laughing; if happy and sad are pushed in combination, a character will have a surprised look on their face.
The collaborative storytelling experience allows children to use technology to use their imagination and create non-linear stories without feeling confined to traditional methods and practices.

### 2.2.3. Remote Collaboration

As societal trends and research suggest, people are socializing and working together even when physically separated. This phenomena is also reflected in children’s play activities. Remote co-located collaborative storytelling in a two-dimensional and three-dimensional context is discussed by Garzatto and Forfori in their work on the FaTe2 project. To support children in creating cooperative narratives the FaTe2 project is an digital amalgamation of Fairy Tales and Technology. The 2D/3D system supports remote authoring as well as shoulder to shoulder collaboration. A maximum of eight children can connect with one another in a virtual world. Personalized and unique avatars created in the 2D mode become the digital embodiments of the children’s fantasy characters in the interactive 3D world. A chat function assists the users in their creative and collaborative endeavors.

Collaboration in FaTe2 can be broken down into four phases. In the initial exploration phase, children can individually build characters and stories through a 2D authoring interface. Collaboration and interaction with other participants takes place in the 3D scenes where the narratives of each individual child can be witnessed and experienced by others. With the help of a repository of scene templates, children can next build their own stories and connect with the stories of others in the story-building phase. Text and voice narration can be applied to the background or characters. After the a story is developed, play is demonstrated with games, some in 2D and some in 3D, in which children
engage other avatars. Deeper and more detailed communication is made possible by the inclusion of a chat tool that can send global messages to all of the participants or to a selected few. The chat tool allows children in remote locations to communicate and build relationships in the real world, in real-time, with their virtual avatar friends.\(^{36}\)

Similar to the study of KidPad and Klump, the 3D world collaboratively created by the FaTe2 project reinforces and scaffolds collaboration as a result of its WYSIWIS (what you see is what I see) nature with the added benefit of giving each user their unique point of view through the gaze of their avatars; the children collaborating will see the same things, but in different ways, thus contributing to the collaborative narrative building experience.

### 2.2.4. Collaborative Video Production

Reverberating the themes of this thesis, the Moving Pictures concept aims to promote meaningful, spontaneous and collaborative digital video content production through the use cameras, tangible artifacts and an interactive table.\(^{37}\) Vaucelle et al. argue that while the the production and development of professional, industry-created media such as TV programs or films is a group endeavor, video content produced by non-professional individuals is typically a solitary activity. By introducing the a participatory multi-user system that enables young people to explore, create, modify and share their digital media with others, the authors aim to show the new possibilities and experiences that result from collaboration.

Moving Pictures is introduced as a multi-user collaborative system supported by computers that is made up of a table top with RFID readers built-in, a
computer, a display, two cameras and RFID markers (or tokens). The table is the central gathering point where all collaborators meet to share their individual digital content they collect. The cameras are built into a PDA hardware interface and are actually a removable part of the table design. Video and audio are recorded on tokens. Mimicking professional production environments, albeit on a much more compact scale, Moving Pictures allows users to acquire content in Shooting Mode, quickly view contents via tokens in VideoJockey mode and creating structured digital video narratives in Storyboard mode.

The authors of the research conducted workshops with 10 to 12-year-old children. Based on the researchers’ observations, it was noted that the children engaging in the activity were motivated and having fun while working. As a result of the fact that the system could be used all together or in pieces, children had the flexibility to work by themselves and collaborate with others. Children were also interested in seeing the content made by their fellow collaborators.

Although the research focused on children, lessons learned can be applied to the greater overall field of collaborative content creation in visual media production. Through participation, the learning curve becomes significantly less steep. Working together, peers engage one another in on the job teaching and training. A traditional single-user task becomes a collaborative undertaking while, at the same time, the passive content consumer becomes an active participant and contributor in their entrainment.
2.3. Co-presence: Being here, showing there

Certain artifacts have the peculiar paradoxical quality of being ubiquitous and wide ranging in terms of deployment and use and, at the same time, being so quotidian that one can easily not give them a thought in daily routine and practice. Whiteboards, the usually glossy or semi-glossy, two dimensional surfaces found on the walls of conference rooms and throughout the halls of academia, have served as testbeds for collaboration for some time. Even in their original state as a space to share words, thoughts and ideas amongst a group of people, whiteboards facilitate collaboration on a shoulder to shoulder level. With the addition of technology, these static boards can become dynamic conveyors of information over long distances. Research on remote collaboration using whiteboards and similar artifacts helps to understand the requirements and challenges of collaborative content creation.

2.3.1. Sharing Screens and Ideas

Whiteboards, a successor and iteration blackboards found in many schools, have been prevalent in society for a substantial amount of time. Even as far back as 20 years ago, whiteboards played a pervasive role in the daily activities of people. In business and office environments, they are creative spaces for teams to problem solve and devise plans. Brinck and Gomez discuss their research on Conversation Board as an interactive multi-user drawing tool for remote collaboration\(^{38}\). Through the use of artifacts that the authors refer to as “conversational props”, remote users can share ideas and work together on their respective Conversation Boards. The research focus on geographically separated office workers.
Collaborative conversation using Conversation board is done through the use of a graphics editor. The graphics editor contains tools and a canvas where the shared conversation occurs. Similar to drawing on a whiteboard, colored markers are used to make sketches. Geometric objects—ovals, lines, arrows, and rectangles—are included to ease the drawing process. A text input tool to edit create and edit text and insert equations is also part of the tool palette. A table tool gives users the ability to include simple tables. Connectors make it possible for users to describe a system or process. Images can be included in the Conversation Board space through an online library of images.

Speed and efficiency of remote collaborators are facilitated by the ability to distribute tasks and have individual control with a shared screen that displays the collaborative output.

Physical, non-digital, blackboards allow for basic functions by users: drawing and erasing. Digitally connected whiteboards build on these basic functions to give users the ability to work together even when apart and provide tools to go beyond what would be possible with analog input methods in a (shorter) given amount of time. The prototype of the VideoWhiteboard introduced by Tang demonstrates how a shared drawing space can connect users at remote sites. Evoking the ancient Chinese art of shadow plays and puppetry, VideoWhiteboard allows physically separated users to interact using a combination of traditional input tools, video cameras for co-presence, and projectors to create a collaborative workspace.

VideoWhiteboard is a computer-supported collaborative drawing system that focuses on natural actions and tools to enable cooperative work. Similar to the
IDC research, familiar artifacts are implemented to allow the users a sense of comfort and ease. Video technology connects users in remote locations with the help of a “virtual whiteboard” or shared drawing space. Each remote user as a whiteboard size drawing tangible interface at their location. Commercially available standard dry erase markers are used for drawing. Virtually co-located users are able to draw, erase gesture and communicate verbally to simulate shoulder to shoulder collaboration as if they were in front of the same physical whiteboard. A projection screen is located in front of each local user. The screen itself functions as a whiteboard as markings can be made on it. A rear-facing video camera and projector are located behind each local screen. The field of view of the video cameras is set to include the whiteboard-screen they are facing in their entirety. These images are sent to the remotely located projectors. Each local user, situated on the opposite side of the screen, not only sees what their work, but also the marks and work of the co-present collaborator. Furthermore, a silhouette of the remote user is projected on the screen. The result is a sense of working together supported by visual manifestations of the work taking place as well as the presence of a collaborator. The shadow figure of the remote user (in relation to a local user) helps to take away from the feeling of being apart and creates a sense of shoulder to (shadow-)shoulder collaboration. Co-presence is further instilled by microphones and speakers on both sides allowing collaborators to speak freely as they work.
2.3.2. Towards Transparent Collaboration

Ishii and Kobayshi’s seminal work on the integration of collaborative and personal workspaces in their extensive research, design and development of ClearBoard over two decades ago demonstrates the potential of remote collaboration technologies to enable a feeling of close, face-to-face human engagement and interaction through the implementation of technology. In their design and experiments on the first prototype, ClearBoard-1, and the next iteration of the system, ClearBoard-2, the authors aim to demonstrate the scope and possibilities of distance-connected groupware hardware and software in the facilitation of remote real-time collaboration.

The metaphor of a glassboard was used in the ideation and concept stage of the design of ClearBoard. The glassboard metaphor was chosen because it represents many of the situations in which people find themselves when working together (especially in an office/professional environment). The act of standing and talking in front of a table and being around a table and talking were the actions that ClearBoard aimed to re-create through remote collaboration.

ClearBoard-1 was designed to meet three requirements: the ability to support direct drawing on a display screen; to achieve eye contact, a video image of the remote user appears to be coming through the screen; and a common drawing orientation to prevent the remote users from seeing a “mirror image” of the other users input. The system for ClearBoard-1 consisted of each remote user being situated in front of a drafting desk like those used by architects set at a backward 45 degree angle (in relation to the person in front of it). An image is projected onto the rear of the angled screen with a polarized film and mirror.
which reflects half of the light and allows the other half to pass through. Markers and cloth erasers allow users to interact and edit content on their screens. ClearBoard-1 proved to be a viable tool for remote collaboration, but some issues were present. While users were able to see the collaborators gaze, the half-mirror and polarizing film caused the projected images to be very dark. The tilt of the screen with respect to the projection angle of the rear projectors made it difficult to see the entire drawing surface on the screen. The marks made by a physical user were only visible locally and not transmitted to the remote collaborator.

Building upon the findings of ClearBoard-1, the design of Clearboard-2 was implemented with the goal of creating a more WYSIWIS cooperative work space. Analog input artifacts were replaced by digital tools such as digitizer pens and TeamPaint, a network-based groupware application for Apple’s older Macintosh computers. Through the addition of these digital tools, ClearBoard-2 could expand on the initial iteration by: having the ability to save collaboratively created drawings; allowing documents created with other editing programs to be included; solving the physical surface-space problem by creating a new blank sheet; and keeping the marking and modifying functions.

ClearBoard-2 was designed with a CRT-based rear-projection display with transparent digitizer sheet in order to overcome the challenges of ClearBoard-1. Using a special video overlay board both remote users can share the drawing while looking at one another.

Testing of the ClearBoard-2 prototype revealed a much more “intimate” or “real” collaboration. The drawing overlay on top of the video image of the
remote user adds a layer of depth while allowing for more fine and detailed markings/drawings than would be possible with physical markers. Co-presence and collaborative work is achieved without having to “be there”.

Tele-Board follows in the footsteps of previous endeavors of re-creating the analog whiteboard group experience with remote users. Gumienney et al. present Tele-Board as hybrid analog/digital system that combines digital video conferencing with a transparent overlay. The system allows separated users to work simultaneously in real-time to interact with one another through body language and gaze. Remote users are also able to simultaneously create and manipulate digital artifacts. Flexibility in the use of video conferencing applications and input methods makes the Tele-board system adaptable to the needs of various groups of collaborators working in different fields and disciplines, with differing levels of finances (to purchase equipment and software) and familiarity with technology.

Three interrelated components make up the Tele-Board system. Software, hardware and full-body video conferencing. There are four pieces that make up the software: a web-based application removing the need to install any software; the Tele-Board Whiteboard Client, developed in Java, that resembles the functions of a traditional whiteboard and; a server that manages all the communication between the remote parties allowing all users to view and manipulate the interactions of others.

To give users the freedom to work within their means, the Tele-Board system was developed with hardware independence in mind. Collaborative teams can choose what type of interactive whiteboard device they would like to use and
what input tools as well. The authors recommend a large, yet moveable panel that allows for multiple simultaneous input devices and pointers (including touch screens).

In their experiments, with Tele-Board, the researchers implemented a free, commercially available VOIP application to transmit video and voice. However, any video conferencing software could be integrated into the system. Synchronous full-body interaction including gaze and gesture recognition of remote collaborators is achieved by the positioning of a camera on each remote/local site. One recommended set-up is to position a camera at an angle so that collaborators can see one-another on one half of their panel while collaborating and interacting on the other half. Tele-Board proposes a practical, semi-DIY and cost-efficient solution to the remote collaboration and communication needs of a variety of people in a wide range of disciplines.

2.3.3. Remote Collaboration Applications

For several years, many commercially available applications and programs that allow two or more remote parties to communicate using VOIP have been available and integrated into their daily lives. Skype42, the decade old (ancient in internet terms) application that revolutionized the way people didn’t pay for long distance and international calls, can justify its ubiquitousness by the fact that it has become a transitive verb (e.g. ‘i’ll skype you when I arrive in London’) and by the fact that it is used on a variety of platforms, devices and machines by people in almost any field, from many backgrounds. With the ability to transmit voice, video, chat and files with multiple users, Skype is one of the most popular VOIP applications used by professionals, academics and ordinary people. One-on-one video calls are free while a group video chat of up
to 10 people is part of a paid subscription. Skype was implemented by the researchers in their experiments with Tele-Board.

FaceTime\textsuperscript{43, 44} is a free, Macintosh-based VOIP application for users of Apple computers and devices (such as the iPhone and iPad) to communicate with one another via voice or video. While the application is easy to use and quality of the video calls is above average due to the built in cameras on Apple devices, FaceTime is restricted to the Apple ecosystem. Also, there is no possibility for group (multi-user) interaction. These factors prevent FaceTime from being a truly multi-platform, distributable application for remote collaboration.

Another tech company which has melded its way into the global lexicon is Google. Google+ Hangouts\textsuperscript{45} is a free instant messaging and video chat platform that is capable of supporting video chat for groups of up to 10 users at once (and more for professional/broadcast purposes). Supporting multi-platform and distributed interfaces over many devices, the popularity of Hangouts as a tool for remote collaboration is increasing.

\section*{2.4. Collaborative Crisis Management}

Natural Disasters are an unfortunate, but prevalent, part of the lives of people around the world. In modern times, when a natural disasters such as an earthquake or typhoon occur, reports of the damage, destruction and lives uplifted and lost become a part of the news cycle. Before the internet age, people who were distanced from such events would only be able to learn about them through traditional news outlets like newspapers, radio or television. While people could read about, hear and see the tragic effects of natural disasters, their participation in the relief and aid process was, although
important, very limited. Volunteering to gather food, supplies and clothing to be sent to the affected area(s) or helping out financially by donating money were some of the only options available.

The recent proliferation of social media alongside the rise and spread of mobile technology both in hardware and network availability, access and speed, has allowed people to participate more actively in post-disaster relief efforts. Many people only post messages of condolence or grief on social-media platforms such as Twitter or Facebook. Many people, however, take a more pro-active role in the relief efforts by providing information that can assist those in need as well as the individuals tasked with providing aid and support to those who have suffered. Despite the best efforts of people who genuinely care and want to help in the relief process, a lack of coordination and relationships with the boots-on-the ground can sometimes lead to further complicating an already difficult situation. In a 2011 report released by the Harvard Human Initiative, a team of researchers express the importance of information from the technical communities and, moreover, the imperative need to create a relationship between those communities and the humanitarian aid professionals in the field to better coordinate and facilitate resources and efforts\textsuperscript{46}.

The need for curating and managing information from non-traditional media channels by a large number of individuals and organizations can also be applied to other socially disruptive events such as political uprisings and crime. The collaborative efforts of digital activists, whether in providing information to aid workers on the ground, reaching those in need or disseminating the actual predicaments of the affected areas and victims plays an important role in crisis management situations.
2.4.1. Crowd and Ground Collaboration

Social media has given individuals the chance to connect and share information unlike any other previous means of communication. Irrespective of one’s location, social status, or (limited) financial means, people can share their thoughts with a selected few or broadcast their message(s) globally. Twitter, the very popular microblogging platform, has been a vehicle for this propagation of communication, albeit in 140 characters or less.

Social media, during times of crisis and disruption, has shown itself to be a useful tool in the dissemination of information. People who in the past would not have been able to assist or help after a natural disaster or tragedy, have the ability to not only offer words of hope, but also take an active, digital role in the relief efforts from the comfort of their computer or mobile device.

Starbird’s research on “crowd computation” examines a new framework for organizing collaborative information sharing and curation by remote digital volunteers and aid workers and individuals physically located in disaster areas. One of the problems with the information provided through social media by global contributors during crisis situations is how to get useful information to those active in the disaster zones while dealing with torrents of information that is often repetitive and inaccurate. Unlike planned collaborative projects that occur in a controlled environment or are given a period of time in which to prepare, the large-scale information sharing and distribution that occurs immediately after a mass disruption event such as a hurricane or earthquake is spontaneous. The wide scope of human interaction via social media, although intended as a means to aid in the acts of recovery and relief, can prove to be a hindrance if the collaboration is not properly coordinated and
information curated. The crowdsourced information, if handled properly can be an asset to volunteers and professional aid workers actively helping victims of large scale disasters by providing them with up-to-date information and aiding in on-the-ground coordination between parallel, but disjointed entities to maximize efficiency and deliver the best possible results.

The need for structuring the “virtual volunteerism” that results from the convergence of information, ideas, and interactions on social media is discussed in Starbird and Palen’s research on the volunteer organization Humanity Road. The authors explain how Humanity Road - a virtual, remote volunteer-based organization - developed from an informal group of people wanting to provide information to help responders and aid staff on the ground to a formal non-profit organization, much like those operating in disaster relief areas. The process of becoming and an official, recognized group was reflected in the need for Humanity Road to create a sense of order in the information that was being disseminated by providing resources for physical volunteers and workers at crisis locations. While the group is virtual and the members can operate without ever meeting in person, a strategy and framework to handle the information load by virtual volunteers is shown to be essential in getting the right information to the right people at the right time on the ground.

Effectively coordinating tweets from “medical Twitterers” on-the-ground in the aftermath of the 2010 Haiti Earthquake is examined in research conducted by Sarcevic et al. After a massive earthquake near the capital city of Port-au-Prince in Haiti on January 12, 2010, it was estimated that more than 222,000 died and over 300,000 people were injured. Adding to the loss of life and injuries was that fact that over half of the hospitals in the country were either
destroyed or very badly damaged. With the healthcare infrastructure and emergency medical services crippled and paralyzed, humanitarian agencies, especially medical professional and teams, responded to the immediate need for care and assistance. With the multitude of volunteers from similar but different organizations, the job of coordinating relief efforts was daunting for those on the ground. Two obstacles that hindered coordination were: the way in which information from aid workers, medical professionals and volunteers was sporadic and incomplete and; the fact that the situation and needs of those on the ground helping those in need were in a constant state of flux - what someone required one tweet ago is no longer useful after 140 characters. To accommodate the ever changing needs of crisis site volunteers in post-disaster scenarios, information providers on the ground need to be able to connect with the proper people and teams seeking said information. In the case of the 2010 Haiti Earthquake, virtual volunteers were acting as intermediaries. Despite the fact that the remote collaborators had good intentions, not being physically present near and around the medical response teams meant they could not get a full understanding of the situation. In order to design an information exchange system in a high-stress and low-mistake-tolerant environment like areas affected by natural disasters, there is, according to the authors, a need for a connector on the ground to coordinate the collaborative crisis management.

### 2.5. Collaborative Tools

The basic act of storytelling and narrative creation transforms into a collaborative exercise with the inclusion of more than one active participant. In order to facilitate collaborative content creation, especially in the production of visual media, the implementation of tangible artifacts and software can greatly
aid the collaborative process in terms of speed, cost and jointly produced output. In addition to the final collaborative work that results from group-based implementations and applications, the process of collaboration sheds light on practices that are time-consuming and counter productive to the task at hand.

2.5.1. Collaborative Crates

While professionals in film and television production may not have the same budgetary restrictions as independent filmmakers or producers of user-generated content, having more (expensive) equipment may not necessarily benefit a production. Tangible, tabletop interfaces are introduced as tools to help production teams in the field by Bartindale et al. in their development and field test of Media Crate. In their research, the authors illustrate the way in which the Media Crate, through its tangible interface, can help cut down on the clutter and confusion of live broadcasts. Through the discussion of implementing Media Crate in a user test with producers of live content, the authors demonstrate the way in which previously difficult and complex task become collaborative and easy to learn.

Media Crate is an all-in-one tangible production unit with tabletop interface crafted inside a typical travel crate used for the moving of electronic production equipment. Media Crate’s interface consists of media sources referred to as “clips”. Each “clip” represents actions integral in the production of live media content. To decrease the learning curve, for veterans of the industry as well as newcomers, tangible tile objects such as Output, Cue List, Control Knob, Copy and Paste are found on the interface. An optical tracking system, high-resolution firewire camera, and 4 arrays of infrared LEDs, are below the opaque surface to track touch input as well as the movement and placement of the
tangible objects. As different production teams and companies use different equipment in different formats to output their content, Media Crate allows plug-ins of external media.

Media Crate was deployed and set-up next to traditional professional production equipment during a week-long multimedia event. The production team found the interface to too cluttered with objects and slow in response time. The size of the tabletop proved too small for more than one individual to work at a time, but was good for distributing tasks. The professionals who used Media Crate had positive feelings towards the potential of the system but did suggest the ability to modify what the tangible objects represented as each production and production team is unique and so too their needs.

StoryCrate builds upon the research and lessons learned from live field test of Media Crate. In this research, Bartindale et al. explain that, by using a tangible tabletop interface, storyboarding becomes a catalyst for team creativity in live film production. Besides driving creativity, Media Crate helps in the expediting of rough cuts - the stage in offline editing where the production begins to resemble a final product - in the field which normally would not be possible until returning to the office/studio for post production. Thus causing the narrative would lose its immediacy and making it difficult or unfeasible to re-think and re-film scenes. Like Media Crate, Story Crate’s transportability, speed and ease of configuration, and ability to be operated outside of a controlled environment are key design features.

Based on the findings of the Media Crate prototype and usability test, Story Crate was designed to better meet the needs of production professionals in
high-stress, short-time quick decision environments. A horizontal display is made possible by two high-resolution projectors placed on the bottom of the crate pointing upwards. In order to see the changes and implementations made with tangible artifacts, two LCD monitors are mounted vertically behind the interactive panel. Using a tracking engine and two infrared cameras, the location of the tangible objects and touch inputs are recognizable. Storyboards and other media content can be pre-loaded into the system to make the production plan visible. A linear timeline, similar to those found in many video editors, takes up the surface of the interface. After testing Story Crate with a professional production team, the researchers found that while it cannot operate as a stand alone media production hub in a professional television or film environment, the potential of Story Crate as tool for visually referring to the storyline and narrative for various members of the crew and showing the changes that were to be made were crucial points. As a single point of reference for the entire, crew filming on location, away from the comforts of their own studio and production equipment, Story Crate succeeds in promoting collaboration of ideas and facilitating creativity while maintaining plot consistency.

2.5.2. Hand-Held Help

The emergence and spread of mobile phones and smartphones has led to the creation of many applications that can support the work of individuals and serve as collaborative tools that are (almost) always with people. Sandboxes is a mobile application that goes beyond the basic sharing functions of mobile phones by adding the ability to collaboratively create media with other mobile users through a WYSIWIS shared collage on the phones’ screens.\textsuperscript{52}
The Sandbox client, implemented in C# on HTC smartphones running Windows Mobile 2003, allows collaborators to capture various media artifacts including text, symbols, pictures and audio. This research by Fono and Counts dates back to 2006. The capabilities and breadth of the mobile devices and applications contained within at the time were limited in their features and processing power and can seem rudimentary compared to those available currently. After acquiring content, users can post them on a canvas. More artifacts can be posted, be moved or resized. To make up for the limited real-estate on smartphone screens, the canvas extends infinitely on horizontal surfaces and different portions can be accessed via scrolling. At the top of the Sandboxes interface, an overview strip graphically represents the contents through boxes of different shapes and colors to give users an idea of the amount of contents and width of the canvas. A decaying function embodies the passage of time while preserving valuable surface space. As new artifacts are added, previous content becomes more transparent and eventually fades away if no modification. All users can see changes made to the shared canvas by other users. Two playback modes allow users to view the collaborative production in motion. The slideshow function moves the canvas from left to right while playing back audio, if included. The historical playback mode, all changes made to the shared canvas by all users are shown in succession from a user-specified start point. The Sandbox prototype demonstrates some of the early research into the field of collaborative content creation with visual media content as achieved by mobile devices with constrained spaces. The collaborative media compositions that result from remote users working together opens the door for future research.
Quitmeyer and Nitsche’s research and work on Documatic\textsuperscript{54} represents the potential for smartphones to be used as tools to aid independent filmmakers in creating digital video content with the look and feel of a professional production in an affordable and quick way while maintaining creative control and allowing for collaboration.

Documatic is a smartphone application available for the Android OS. Keeping with the low budget high quality production that exists in the realm of independent films, the app is free and open-source. Understanding that legacy production practices utilized by professionals in the television and film industry are not always feasible or affordable to independent filmmakers or small teams, Documatic is hardware independent and is built around spontaneity. All that is needed is a smartphone and any camcorder or video recording device that can capture digital video. As independent filmmakers, especially documentarians, are constantly changing/modifying/updating/and adding to their list of shots and scenes, the app permits adding annotations on the fly while filming on location. Rough-cuts are automatically generated by combining the editing and content gathering processes through the use of synchronized smartphone-camera annotation system. Tags can be structured by users not only for identification of certain types of shots and scenes, but also to aid in the creation of the narrative production as well. A Project Generator combines the footage and annotations and creates a “pre-edited” sequence of rough cuts that can be exported as XML files to a timeline in video editors like Adobe Premiere Pro. In order to keep from using up the storage capacity on the smartphones running Documatic, raw footage captured by external cameras is synced with the user-generated tags by aligning the time codes.
The Project Generator is also the engine responsible for facilitating collaboration in Documatic. Multiple users’ Documatic projects can be combined using the Project Generator which can then combine the data, based on the time-codes and tags, to generate a series of collective rough cuts. Although geared towards independent film and documentary makers, enthusiasts and ordinary people interested in creating their own user-generated content can also benefit from Documatic. The creator(s) can stay focused on the narrative of the visual production without being overwhelmed or frustrated during the production process and transition into the post production process. Unlike applications and algorithms which compile, organize and align all the media content a user ingests, the semi-automatic characteristics of Documatic ensure that technology aids people in their creative work without taking away control and creativity.

2.6. Summary

This chapter provided a detailed literature review covering research and related works from various fields and disciplines that present elements to promote collaborative content creation. The three experiments presented in this dissertation, described in the following chapter, share attributes with the body of work found in the this chapter. Some traits are evinced in only one of the collaborative methods. Crowdsourced content, a large interface for ideation and a WYSIWIS interface are only present in the experiments on “lenses + landscapes”, “places + perspectives” and the usability studies on real-time collaborative content creation respectively. Some of the traits, such as synchronous and asynchronous collaboration, are shared by two of the two of the methods. This is the case with synchronous collaboration in “places +
perspectives” and the usability studies on real-time collaborative content creation. *Asynchronous collaboration*, on the other is shared between “lenses + landscapes” and “places + perspectives”. *Multi-user support, task distribution* and *a participatory framework* are qualities shared by all three methods described in the next chapter. The relationship between the research presented in this chapter and the three methods of collaborative content creation put forth in this dissertation illustrate their importance in establishing the collaborative content creation as an interdisciplinary field of study. (Figure 2.1)

![Figure 2.1: Relationship of Research to Works in Literature Review](image)

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Chapter 3 - Explorations into Collaborative Content Creation

3. Overview

During the tenure of the PhD course, the author investigated and examined different scenarios and situations in which collaborative content creation could be applied to visual media production. It was determined that the best course of action in researching collaborative techniques and methods for digital video production was to actively take part in the production of collaborative visual media. Over the course of three years, two collaboratively produced short documentaries and experimentation with a platform for real-time collaborative content creation were completed. The research covers synchronous and asynchronous collaboration techniques used in the production of visual media. This chapter will describe the role of collaboration in the two short student-driven films “lenses + landscapes” and “places + perspectives”. The former is an example of curation in collaborative media and the latter employs remote co-located collaboration through the use of large touch screens. A detailed explanation of the research, through usability tests, carried out on real-time collaborative content production with the use of an open-source application will also be discussed. (Figure 3.1)
Figure 3.1: Infographic illustrating research conducted on collaborative content creation
3.1. Growing Documentary

Modern technology has enabled more people to assist in times of disasters in ways never thought of before. After two major earthquakes in China in 2008\(^5\) and 2010\(^6\), microblogging created a previously unwitnessed online community response and awareness. This is manifested in the “Voluntweeters”\(^7\) who answered the call to (digital) arms after the 2010 Haiti Earthquake by using Twitter to facilitate and organize recovery and rescue efforts on the ground in the Caribbean from all over the world. Crowdsourcing and curating information were also essential in getting the injured and sick in Haiti the proper medical treatment from international medical volunteers who were ready to help but did not know exactly who needed it and where they were\(^8\).

In times of disaster, the natural human inclination is to help those affected. However, when disasters occur, especially those of a great magnitude, coming to the aide of people who have suffered is often overshadowed by the scope of the tragedy itself. After the Great East Japan Earthquake and Tsunami on March 11th, 2011 (3.11), this urge to help in any way shape or form with the recovery and rebuilding efforts was very strong not only for Japanese citizens but for people everywhere. Everyone’s eyes were transfixed by the unbelievable images being broadcast on television and the internet. News media, both Japanese and international, were transmitting real-time images of the havoc caused by the earthquake, aftershocks, and tsunami on the Tohoku region of Japan. Additionally, social media allowed average people to share images taken from their digital cameras, mobile phones and smartphones with the rest of the world instantaneously. The world, at once was inundated with a barrage of
shocking real unfiltered images of the catastrophe unfolding in front of them and the trail of destruction it left in its path.

In order to create the and facilitate a collaborative environment for visual media production, the Growing Documentary concept was introduced as a result of 3.11. The Growing Documentary is a platform for computer supported cooperative work (CSCW) using user-generated content to produce digital video contents that can be remixed, reworked and built upon as the story and story tellers change and adapt\textsuperscript{59}. The Growing Documentary was conceived of as a framework to test and observe the production of user-generated content into a visual narrative representation. Not only did the events of 3.11 have an impact on Japan and the rest of the world because of the unprecedented level of damage caused by both terrestrial and oceanic natural disasters; but also because news of the impact was delivered to people everywhere with unprecedented expedience and quality via a variety of media.

3.2. Crowdsourcing and Curation - “lenses + landscapes”

3.2.1. Background

Inspired by how traditional media outlets were utilizing new social communication tools to broadcast their contents and the way in which people in the most devastated areas, who had no electricity or public services, were using their smartphones or feature phones to receive information and communicate their stories to the outside world, graduate students at Keio University were inspired to create the documentary film “lenses+landscapes”\textsuperscript{60}. The students set out to document the reality of the earthquake, its aftermath, reconstruction and recovery with 4K motion pictures in order to make an
impact by providing a lasting impression on people so that the memory of the
disaster would not fade. In 16 weeks, the students, with a novice level of
documentary film production, were able to create a high quality visual
narrative that reflected the immediacy of the events surrounding the disaster
through the curation of user generated content.

3.2.2. Pre-Production Challenges

In the early planning phase of the project, many logistical problems arose. The
greater Tokyo area, where the students’ university was located, was not very
badly affected, in terms of structural damage, injury and human casualties.
Access to the hard-hit Tohoku region, however, was greatly hindered. Many
basic services that one takes for granted like electricity and transportation
infrastructure were very limited, if not completely wiped out, in the heavily
affected areas. Once it was realized that it would very difficult to bring,
transport and maintain all the equipment and even travel to the local areas in
Tohoku for filming and interviewing, a new production plan was devised.

3.2.3. Production

Building upon the notion that crowdsourcing can play a pivotal role in disaster
management\textsuperscript{61}, high-quality digital still images from three amateur and
professional photographers were collected in the production of the
documentary. Photos were chosen as the message medium of the narrative for
“lenses + landscapes” to communicate the impact of the tragedy while and after
it was happening. Still images captured singular moments in time. By stitching
and blending the images and moments, snapshots of the disaster were
transformed into a visual storyboard of people’s lives, loss and the rebuilding
thereof.
The three photographers -- Max Hodges, Kensuke Mori and Yukoh Nakamura -- all had a personal connection to the affected areas. Max Hodges was an American professional documentary photographer living and working in Tokyo. With virtually no information available, Max hitchhiked his way up to the Tohoku region to capture the raw images of the immediate aftermath of the situation. From the top floor of his former school, Kensuke Mori, at the time a 19-year-old university student, watched and documented his hometown being wiped away by the massive force of the tsunami. In a matter of moments, Kensuke witnessed and captured his life change. Similar to Kensuke, Yukoh Nakamura was also from the Tohoku region. Yukoh’s hometown of Morioka in Iwate prefecture was far away from the pacific coastline of Rikuzentakata and other coastal towns which were heavily damaged, if not almost completely annihilated. Yet Nakamura felt the need to go to the devastated areas and document what had happened for the sake of those who could not and for people everywhere to know what took place. The crowdsourced images procured from the three photographers gave the narrative a human element that could not have been achieved had the footage been documented by someone without a personal connection to the tragedy and region. (Figure 3.2)
By utilizing the images taken by the three photographers, the same story about the earthquake and tsunami and how it damaged land and lives was given a multifaceted point-of-view. The three men served as storytellers adding feeling and emotion to complement the images. Although the three were from different backgrounds, the images and stories they provided through their photographs added layers to the narrative of the tragic event and drew on similar messages of hope for the recovery and rebuilding of the affected areas and people.

Over 2300 hi-resolution digital still images were procured from Max, Kensuke and Yukoh. Taking principles from crowdsourcing, curation of the humansourced the digital assets was facilitated with a cloud server. As the images were high resolution, a dedicated cloud server was setup to allow the photographers to send their files. Due to the large file size, volume per upload
and connection fidelity issues, a proprietary and controlled cloud server proved to be a better choice rather than commercial cloud services or email. The cloud server played an important role for both the photographers and the production team. The three collaborators were able to simultaneously upload multiple files to a secure server. The production team was able to easily sift through the files and choose the images for the documentary while each photographer’s data was being transferred to their own folder.

### 3.2.4. Mix-Media/Hybrid Approach

In order to deliver the most vivid and real imagery to the audience, 4K resolution\(^{62}\) was chosen as the output resolution of the film. 4K was an ideal format because the digital still images taken by the three photographers were within the range of the pixelation required for 4K resolution (4096×2160 pixels). This allowed for little or no alteration, modification or enhancement of the original assets. The audience was able to see the images in their rawest and purest form with crisp clarity. The reality of the situation could be best understood visually through this high resolution medium. 4K has been and continues to be adopted as a digital standard by both the film and television industries.

One of the greatest challenges facing the production of “lenses+landscapes” was the lack of 4K recording equipment. Due to time and budget constraints, a 4K camera could not be acquired for the production of the documentary. As a workaround, a combination of high-resolution digital still images from the photographers combined with 1080p (1920×1080 pixels) HD video interviews and background footage of the photographers was implemented to create a mixed media ultra high-resolution film. In the documentary, still images were
juxtaposed with other still images and/or HD video to create a hybrid visual narrative.

As the HD video scenes were of a lesser resolution than 4K, the screen was divided into 4 quadrants: upper left and right, lower left and right. HD video scenes would be in one or more of these quadrants at any one time. This division of the screen enabled content to be simultaneously presented on the screen at once. By choosing 4K as the output resolution, the multiple scenes on the same screen did not confuse or overwhelm the audience as would be a likely effect with lower quality assets. Through this hybrid approach, the documentary gained a level of narrative depth that would not have been otherwise possible. The stories, like the individuals who shared them with the audience, were dynamic and unique representations of the human condition. (Figure 3.3)

Figure 3.3: A screen capture of “lenses + landscapes” demonstrating the mixed-media/hybrid approach
Time-lapse was chosen as means for visual narration due to the fact the still images when put into sequential order with motion added to them create a feeling of movement. Typically, time lapse effects are used in video and film production as for transitional scenes and segues. Time-lapse scenes show a period of time in a matter of seconds and frames. Still images are usually rendered at a specified frame rate (e.g. 24 frames per second) to create the effect of temporal progression. A 30 second time-lapse scene rendered at 24 frames per second would therefore require 720 still images.

In the production of “lenses + landscapes” however, a novel approach to time-lapse was employed. The director felt that it was important for viewers to not only see the events in action, but to also take in the details and stories that each individual still image conveys. Moving in and around a particular frame was just as important as the recreation of events through sequential frame stitching\(^6\). In order to maintain the essence of the storytellers - the three photographers from whom still images were crowdsourced - a slow, at times almost undulating, combination of time-lapse, Ken Burns-esque panning and zooming\(^7\), and the incorporation of screen halves and quadrants were used. Also, as the earthquake and tsunami were unpredictable natural disasters, the photographers were not commissioned to take a certain number of pictures. They were approached after the incidents and, therefore, the researcher and production team had to work with the raw material that was available. Through this mixture of visual techniques in an ultra high definition motion palette, the audience not only experiences a “rediscovering of cinematic time”\(^8\) provided by the time-lapse of each person’s photographs, but can also empathize with those who were on the ground during the tragic events and their aftermath.
3.2.5. Screening and After-life

“lenses + landscapes” was shown at a special screening during the 2011 Tokyo International Film Festival. At the CineGrid 2013 Workshop, audience members and workshop attendees, as well as those who did not see the movie, also had a chance to interact with the film via Scalable Adaptive Graphics Environment (SAGE)\textsuperscript{66} OptIPortals. Multiple SAGE “walls” that were joined together in San Diego. Through the use of high photonics networks, the film streamed in 4K across the Pacific, and the audience in San Diego was also able to connect with the production team in Japan and interact with them as well as the content\textsuperscript{67}. People had a chance to immerse themselves in the images, videos and sounds of “lenses + landscapes” while interacting with others in Japan in real-time to re-mix and create their own short versions of the story. (Figure 3.4)

Figure 3.4: Interaction with content from “lenses + landscapes” using SAGE walls
3.3. Remote Co-located Collaboration - “places+perspectives”

3.3.1. Background

After the interest shown in the interactive demonstration of contents from “lenses + landscapes” at the Cinegrid 2011 meeting, graduate students from KMD and undergraduate students from UCSD (the University of California, San Diego) decided to start the next iteration under the Growing Documentary framework. The students started work on the short documentary “places + perspectives”. The short documentary “places + perspectives” was a co-located collaborative filmmaking project comprised of students of various academic and cultural backgrounds, many of whom had little or know experience with film making or video production. The members of the two teams in KMD and UCSD collaborated remotely and never met in person.

In the process of devising a theme for the documentary the two teams were free to choose any subject matter. As members of each respective team hailed from different places all over the world and found themselves in new environments, both sides agreed on displacement as the theme for their joint production. The two remote teams wanted to convey the potential that technology posses in creating visual narratives about the human condition.

The majority of participating students were within the 20-30 age demographic and came from diverse backgrounds. Thus, the production was international both in location and people involved. The team sizes changed depending on time and availability on the KMD side. There were at least 4-7 people depending on their time restrictions and the production needs. The UCSD team
had more students with around 11 members, and that number also varied as this project was done on a voluntary basis at UCSD.

3.3.2. Production Process

The Japanese and American teams met online through HD streaming sessions made possible by the 10 GigE network between KMD and UCSD. The early discussions revolved around finding a documentary theme, discussing the production process, deciding on the equipment, and defining a style for the piece. The frequency of consecutive meetings was determined as twice per week until March 2012; the goal at this stage was to collect as much content for the 11th Annual ON*VECTOR Photonics Workshop (February 29 - March 1, 2012). After the event, the meetings were reduced to once per week until the summer of 2012.

Both teams discussed their equipment and chose DSLR (digital single-lens reflex) cameras with 1080/24p HD recording capability as the main video capture devices; a setup is considered to be a hot trend amongst independent documentary makers nowadays. To establish visual unity in the content from both teams, it was necessary to keep the filming process as similar as possible. This was easier to achieve by choosing to film with the Canon 60D and 5D DSLR bodies and 70-200mm zoom lenses, 16-35mm fixed zoom lenses, 24-70mm lenses, 115mm lenses and 100mm lenses for special effects in the b-roll.

Most of the people involved in making this documentary were fresh to the many aspects of documentary making in general, and DSLR shooting in
particular. Consequently, this gave a good viewpoint into some of the difficulties that new filmmakers and amateurs face during the entire film production. Below are some of the key points:

- There were set production roles such as the director, director of photography and production manager while others such as cameraman, audio engineer and set assistant were split amongst different people depending on their availability. For each interview, the following workflow was conducted:
  - The majority of the interviewees were chosen through contacts and social media. The production manager contacts the person of interest via social networks, email, or personal phone call. The prospective interviewee approves and provides a date, time, and place for the interview.
  - The production team arrives and sets up the equipment. The interview is recorded with two cameras and an audio recorder. After getting the interview footage, b-roll footage of interviewee is taken.

3.3.3. Social Media & Sharing Infrastructure

Various methods of communication were used aside from the live streaming sessions. Social media communication tools such as regular email, Google Groups, Google Drive, and Facebook were used to accommodate for the time differences. These communication tools were used due to their familiarity and availability to the participants. Moreover, cloud servers were also employed in
the making of this documentary with one on KMD’s side and another on UCSD’s side.

In order to manage the assets properly through metadata and annotations, the PIX System was used. This professional system is used by many professional production studios to allow for better project management and streamlined online collaboration. It could be used to cover the entire production process but the implementation of PIX within the production of “places + perspectives” came at the later stages after the assets were already gathered.

The introduction of both the cloud sharing and PIX System allowed both UCSD and KMD production teams to focus on the narrative and creative process and less about file management and asset tracking. All these tools had one common goal: to communicate the vision of the production clearly for the best possible outcome.

### 3.3.4. SAGE Implementation

Storyboarding plays a crucial role in any kind of undertaking involving visual narratives. Due to the nature of documentaries, the storyboarding stage usually starts after collecting the assets to find the connection. Seeing and discussing narrative elements is important because “the visual language of cinema is a language of story structure, whose grammar is made up of the shot.” The experimental use of remotely connected SAGE units as visual storyboarding tools to view the assets and interact with them more openly than in a file browser or Non-Linear Editor (NLE) environments allowed for distance-based visual narrative creation and modification. SAGE was essential
for keeping the communication channels open, and allowed each group to easily share video contents.

One distinctive element in the production of “places + perspectives” was the use of SAGE OptiPortals throughout the different stages of production (pre-planning, ideation, and, later, storyboarding). As it was designed to display a large number of media assets, SAGE was a good tool for visual brainstorming and a convenient method for sharing photo and video contents. The SAGE units at KMD and UCSD were connected over the a 10-gigabit network with high bandwidth pipelines.

During the brainstorming stage, SAGE was essential in sharing sample clips of still image and documentary film shooting styles. Storyboarding helped to meet the needs of each member of the separated production team. By visualizing the brainstorming sessions over the SAGE units, participants had a better shared understanding of the direction of the project. The large real estate allowed for the simultaneous viewing of the different movie clips and the interactivity of the screens allowed the clips to be rearranged in different sequences without much effort. This method granted the users with a view of the story flow that is different than viewing it on a smaller PC screen. (Figure 3.5)
3.3.5. Facilitating Collaboration

The MOV (.mov) file format was chosen for the various contents filmed and collected by both teams. Having MOV as the only file format simplified the editing process, and streamlined the production process. Additionally, MOV is one of the supported file formats on SAGE. This meant that the original file could be shared directly, without the need to convert the contents. Sharing the contents in this manner during the weekly meetings established unity in shots.

One of the realizations throughout the production process was the difficulty of the organizing and editing stages. In order to find common themes amongst the collected videos, the PIX System was used for video annotations and metadata tagging. Yet, it was the editing phase that caused the biggest bottleneck to the production. The majority of the production was done in a collaborative manner...
with constructive exchange between both parties, however, the collaboration level gradually decreased at the editing stage.

The editing of the project took place in many stages. The post-production of an average documentary film typically involves reviewing the acquired contents and assembling a story out of seemingly unrelated interviews and other clips. As such, each team conducted a separate internal review and editing session before discussion at a meeting. The editing session was greatly aided by the input of notes and tags on the PIX System. The tags on all the videos are not only searchable, but they also have the added function of being able to be exported into a spreadsheet software, such as Microsoft Excel, so that the tags can be visualized.

After narrowing down the videos of interest, a thematic timeline listing the desired theme and topic order was created by UCSD as a guide for the story sequences. From the biggest umbrella tags, the general categories were established. The proxy videos on PIX System were then re-tagged, with each possible scene from all of the interviews being assigned into one of the general categories. The post-production process was identical to conventional film making, with the contents being arranged in storyboards, then subsequently edited in an editing suite.

### 3.4. Accessibility - Distributed Interfaces

#### 3.4.1. Interoperability

SAGE OptiPortals are ideal research tools for studying and experimenting with the possibilities of non-linear narrative creation and remote collaborative content creation and sharing. SAGE for all its merits, however, has some issues
pertaining to space, power and cost demands that make it prohibitive. Due to its size and amount of power required to run it, a SAGE unit may not be practical for institutions or individuals everywhere. Building on this, using UME Board (Universal Media Board) as a tool for evaluating sharing assets between different interfaces was decided.

### 3.4.2. Integration of SAGE and UME Board

UME Board is a multimedia device that can be used “out of the box”. Like SAGE, UME Board allows touch interaction through the use of infrared sensors. Unlike SAGE, which is an open-source and multi-platform environment, UME Board was, at the time when the research took place, preloaded with Microsoft Windows 7. The hardware also contains a free-writing memo feature which complements joint projects conducted remotely by allowing real-time annotation. Due to its size and (relative) affordability, UME Board is a practical and feasible tool for people who would like to work collaboratively in visual media production.

In order to enhance the collaboration level and number of collaborators, SAGE and UME Board were integrated. As both systems were developed to communicate within their own environments, the initial challenge was to make the two systems interoperable. The goal was to capitalize on the strengths of both systems to maximize the collaborative potential. In the experiment, a SAGE protocol-based unidirectional connection was established between an UME Board in Berlin, Germany and a SAGE OptIPortal in Yokohama, Japan. The experiment was conducted in real-time with assets transferred from the UME Board to SAGE. (Figure 3.6)
3.4.3. Large Screens as Productivity Tools

Part of the appeal of both SAGE and UME Board is the large estate they provide for users. The ability to view content and assets on these large screens at the same time is quite different than working with a smaller desktop or laptop screen. With the proliferation of HDTVs in the last few years, more people incorporated large screen devices into their lifestyles. Yet, the majority of uses are bound to content consumption and viewing rather than content creation. Even with the recent trend of Internet-connected SmartTVs, the uses of such devices is mostly for video viewing\textsuperscript{73}. Furthermore, there has been a strong emphasis on second-screen devices as companions to viewing content on a large screen. Despite this, large screens have not reached their potential in terms of application development and implementation.
Based on what was done with the Growing Documentary and with further research and development of large screen solutions, future HDTVs especially Ultra HDTVs could offer users a new chance to rethink TVs as a more productive tool rather than being solely consumption devices or large screen windows to existing applications. Combined with second screens, the potential for interaction with existing content and collaborative content creation can be realized.

3.4.4. Feeling the Story

Both “lenses + landscapes” and “places + perspectives” took advantage of SAGE OptiPortals at some stage of the production process. In “lenses + landscapes” their was a topic on which the storyline was based — 3.11earthquake and aftermath — but there was a lack of assets to support the narrative. After the production was completed, the potential of taking advantage of and utilizing “extra” or “unused” footage along with portions that made the final cut were made evident by introducing SAGE walls. The SAGE units gave the narrative a new life and direction by putting the power of the storytelling in the hands of the audience.

The scalability, interactivity, and computing power of SAGE along with the large real estate allows a simultaneous view of different media assets. By applying these strengths during the production of “places + perspectives”, SAGE was utilized as a storyboarding tool when discussing the collected assets from KMD and UCSD. The interactive touchscreen enabled the video clips and images to be rearranged in different sequences more easily and flexibly than in an editing suite. This permitted both sides to work on the direction and narrative flow of the movie. The capability to share multiple laptop/desktop
screens on the unit’s touch display provided opportunities to use different software applications that were not natively supported by the OptIPortal environment such as non-linear editors.

In both situations, having the touch capability not only altered the way in which the story was created or the contents accessed, but it also transformed the way in which the concepts were consumed. The user experience became much more immersive by introducing the SAGE OptIPortals. The ability of users, creators and collaborators to literally handle content and the story at their fingertips creates an intimacy between the contents as well as other collaborators interacting with the touch interface.

The Growing Documentary is a step in furthering the field of collaborative content creation. The framework allows collaborators to not only interact with one another in the production of a story, but also with the elements of the story. Moreover, the story itself becomes an interactive experience: ideas, images, videos and sounds can be shared and re-contextualized by the storytellers as well as the audience.

### 3.5. Real-time Collaborative Content Creation

#### 3.5.1. Background

Based on the research and findings of the two productions of “Growing Documentary”, along with the interoperability experiment using SAGE and UME Board\(^74\), focus was placed on exploring methods of facilitating real-time collaborative content creation. While there exist tools, programs and technology that can aid in the collaborative production of visual media, they are either
proprietary and cost prohibitive for non-professionals who want to create user-generated content, or lacking in power, depth and functionality for production professionals who are used to and expect certain performance and tool standards. There are currently a few examples of these types of programs. Adobe Anywhere\textsuperscript{75} by Adobe Systems allows collaborative workflow platform for those who can afford it. WeVideo\textsuperscript{76} is an online video creation platform with free and subscription tiers of membership that allows for some level of cooperation, but does not have provide user with the ability to simultaneously interact when working on the same project. The following entails research conducted to overcome these impediments and build a real-time collaborative content creation that can be used by people with varying skills and needs.

In order to create and promote an environment where people have the ability to collaborate and interact in real-time in the construction of digital visual narratives the open source software Novacut\textsuperscript{77} was chosen. The open source software was originally created as a tool for independent filmmakers using DSLR cameras to make quick rough cuts of the footage they shoot in the field. The program is free, small in file size, does not require a great deal of processing power, and can work on multiple platforms. The greatest attribute of the program, in terms of the research presented in this paper, is the real-time interactivity that facilitates collaboration. Not only are two connected users able to share their screens, but they are also able to interact with one another’s contents and work together to create collaboratively. More than WYSIWYG (What You See Is What You Get), Novacut is an example of WWDIWWG (What We Do Is What We Get). (Figure 3.7)
3.5.2. Implementation

Novacut only runs on Linux operating systems. Two computers (physical machines) running two different versions of Microsoft’s Windows operating system were used to implement Novacut for real-time collaborative content creation. One physical machine had the Windows 7 operating system while the other machine was running Windows 8. To install and use Novacut, the software VMware Player was installed on both physical machines. Through the installation of VMware, both physical machines were able to run Ubuntu, a Linux-based operating system, in virtual machines. Novacut was then installed onto the virtual machines of each respective PC.

Novacut allows people on different machines to interact with one another and their video assets in real-time. Interaction takes place in Novacut in the work, or storyboarding, space of the screen. A user at one machine can place their content in a large storyboarding area in the center of the Novacut screen. The other user at a different machine can do the same with their assets. The assets appear as of “clips”. Each clip is visualized as two still images with one on top of the other separated by a line. The top image is the first frame of that particular clip while the image at the bottom is the final frame. Both users have
the ability to not only view and move their own assets as well as those of the other user, but they are also capable of manipulating any of the assets on in the storyboarding space.

The users can move and drag the clips around the storyboarding space freely. The remote user will see this action on their own screen. Both users can work simultaneously and the movements can be seen on both screens. The users can trim the clips with the use of a mouse scroll wheel. The start and end point for a clip can be determined by scrolling on the top and bottom images in a clip. The storyboarding area also allows users to create a working timeline of their narrative together. This feature allows for collaborative visual ideation. When the storyboarding is completed the users can drag the manipulated contents they choose into a timeline/pre-render section at the bottom of the Novacut interface in order to render a rough cut of their collaborative work.

### 3.5.3. Demonstration

Real-time collaborative content creation with Novacut was demonstrated at the 11th edition of the European Interactive TV Conference (EuroITV 2013). Attendees were able to get a hands-on experience and participate in the process of real-time collaborative content creation during a two hour demo session. Two computers with Novacut installed were set-up for attendees to use. Two people per collaborative session were required for the demonstration. The author and his fellow researchers were present to facilitate the demonstration and help those who required it. Each person would sit in front of one of the machines and collaboratively make a rough cut with the other user. Due to space, time and logistical limitations; both users were seated at the same table away from one another, without the ability to physically look at the other person’s screen.
This was done to achieve a semblance of remote collaboration. The users were with earshot and could see each other. For this reason, no additional communication apparatuses or applications were implemented. In the interest of time, video assets were pre-loaded onto each machine. The content consisted of different clips of the town in which the conference was held - Como, Italy - and various clips of scenes and moments from the actual conference itself. This was done in order to provide the users with a level of comfort and familiarity with clips as those were the contents which with all attendees were familiar. Many people took part in the demonstration. It was the first time any of the people had used a real-time collaborative content creation platform. Although all the assets provided to each group of users was the same, each collaborative rough cut was different and unique due to the nature of the users’ interaction with one another. The participants were pleased and satisfied with how quickly and intuitively they could generate a rough cut despite the fact that no one had ever previously used the program or something similar to it, many did not have experience with digital video editing, and most did not previously know the other person with whom they were collaborating.

3.6. Initial Usability Study

In order to further understand how people interact and collaborate in real-time when creating content, a usability study was conducted. The concept for this user study and the two others discussed hereafter was to re-create, in an lab-based experiment setting, real-life/real-work cases and uses of simultaneous remote content creation in order to gauge users’ needs and determine what factors were working, which were not, which needed to be improved and what functions/tools needed to be added to make a viable system for real-time visual
collaboration. As it is difficult to find the “right” scenarios and uses without actually having people test the system, different methods were implemented to determine what factors gave users the best experience when working together.

The purpose of the usability study was to observe how remotely co-located users interact and collaborate with one another and the role the technology plays in that process. For the study, two participants, with proficiency in editing and using digital editing programs were selected. The participants, a male and female graduate student belonging to the same research lab, did know one another prior to taking part in the study. Neither of the participants had ever used Novacut or similar software/applications that aid real-time collaborative content creation in visual media production.

Besides the participants, three facilitators were also part of the survey. Two of the facilitators acted as observers documenting the participants during the study. Each facilitator was assigned to one of the participants. The third facilitator was tasked with setting up the physical and virtual machines and network connection in order for the collaboration to be possible. This facilitator was also standing by in case of technical issues with the software, hardware or network.

The session began with an overview of the usability test and schedule by the facilitators. During this time, both the participants and facilitators were together in the same room. The participants were then given time to come up with a theme/story production plan. After the participants finished they were separated. From that point forward, the two participants would not be able to
physically see or communicate with one another until the end of the study. Each participant was given a digital camera with which they could acquire assets.

The participants were separated and quarantined from one another in order to simulate co-location over larger geographical distances. They were allowed to communicate with one another using any other method they choose (e.g. mobile phone, SMS, email, chat, etc.) The theme that the participants decided on was an introduction of their graduate school. The male participant recorded video inside the school building while the female recorded outside the school building. The observers shadowed the participants and documented their observations.

After gathering their content, the participants were placed in separate rooms, in front of computers running Novacut. Once the both participants’ assets were in the storyboarding area of the Novacut interface they began to collaborate on creating a joint rough cut. At the beginning of this collaborative stage, both participants had some minor issues getting used to the interface and program. In order to communicate with one another, the two participants used a VOIP app with handsfree earpieces. Initially, there was a sense of being inundated with all the assets on the screen. After some discussion amongst themselves, the participants developed a system for choosing which clips to work on and which to leave alone. They decided to use one section of the storyboarding pane for untouched clips, one for clips with which they were working and there was also an area for clips with which they were not sure what to do. Staying in constant verbal communication, the participants systematically “worked” on clips simultaneously and brought them done to the rendering timeline section of the
interface when the had finished. After creating a working timeline and making some final adjustments, the participants were able to render a short rough cut of less than four minutes after collaborating in real-time for approximately 40 minutes. (Figure 3.8)

![Figure 3.8: A montage of the first usability study](image)

### 3.6.1. Findings - Observations

The facilitators documented their observations during the usability study. From the observations, it was made apparent that while there was a learning curve with respect to using new software and working in a new dynamic, the potential for creating collaborative content simultaneously, even in remote environments, is very strong. The facilitators collectively recognized the lack of instructions and need for guidelines at the beginning of the study. The
participants were asked to decide on a topic to film and collaboratively edit. To simulate a situation where collaborators are separated by physical distance, the participants were also told that they would be separated after the brainstorming/ideation phase and not be reunited again until the end of the study.

The facilitators did not interrupt or take part in the discussion between the two participants. After a brief period of time, the participants indicated that they had come up with their topic and were ready to gather assets. The participants, although told that they were permitted to contact one another, never contacted one another during the content acquisition phase of the study. It was realized afterwards that the participants decided on a theme and where to respectively capture footage, but not on specific shots or styles of shots.

During the collaborative editing phase, the lack of communication and preparation in the pre-production stage caused difficulty in beginning the joint editing phase. Initially, the facilitators shadowing the participants indicated when the collaborative editing would begin. The facilitators, throughout the study, were in constant voice and text/mail based communication with one another. Both remote participants began using the collaborative editing interface without any means of communication. While it was possible to see the actions of the other party, confusion ensued soon after as to who would do what. The facilitators stepped in and suggested opening a line of communication. At that point the female participant, using the VOIP application LINE, contacted the male participant. After verbal communication was established, the editing appeared to progress in a much smoother fashion as each person could ask the other about what clips they wanted to work on.
and how to distribute the tasks. The male participant seemed to take the lead. Rather than give orders or tell the female participant what to do, he played a more subtle role and guided the work. This proved to be very helpful as the female participant, while having an understanding of digital video editing and editors, did not possess a great deal of editing experience.

The mood at the outset of the collaboration filled with frustration and feelings of indecency by both parties due to the fact that there was virtually no direct communication and therefore no clear direction of what to do, let alone how to do it. A noticeable shift in attitude, and subsequent speed and efficiency, was observed after the participants were able to hear one another’s voices and work collaboratively. Aside from minor technical questions about the system and interface, the participants did not engage the facilitators. In under one hour from the beginning of the collaborative creation phase, the participants had created a short (less than three minutes) clip together.

3.6.2. Findings - Participant Feedback

The observations of the researchers were not the only component of the post usability study findings. Participants were also given written (printed) questions to answer as well as a group discussion with the researchers at the end of the study. The notion that collaboration fuels new visual output was backed up by the fact that, when asked about the benefits of creating content collaboratively, the male participant replied he came up with ideas about the content and narrative that he would not have been able to had he been working alone. The female participant responded that working with someone else on a what is usually a singular task (editing, post-production) helped expedite the process by distributing the work. Both participants also noted the important
role of human interaction in the process. The male participant felt that the real-time content collaboration created a support system: one person can take control or lead when the other is tired or stuck at a certain juncture. The female participant echoed a similar thought in stating that having another person there for advice and inspiration is helpful in looking at the content in ways one person could not have done working independently.

An important point of concern was raised by the male participant regarding control and leadership during the collaborative process. He mentioned that because there were no assigned roles such as leader or lead editor/collaborator, it took a while before the cooperative editing process began to move smoothly. While the male participant explained that he did not necessarily want to take control, it was necessary to move forward with the editing task.

The female participant raised an important point when she commented on the nature of interaction and communication. While being able to verbally interact with one another through a VOIP application was very helpful, she commented that she wished she would have been able to see her co-collaborator. She commented that although being able to talk while collaboratively working on the content in the shared space was helpful and greatly reduced confusion, looking at a person while talking and working gives a greater sense of being in the same space. Furthermore, she believed that being able to see the facial expressions and looking at the eyes, or gaze, of the person would have been helpful in making some decisions about what to do with certain clips (e.g. use them or not; where to place them in the timeline; etc.) and give her an indication as to if her remote partner was actively listening to her or just semi-automatically responding with ‘yes’ and ‘no’.
Regarding the interface, both participants felt that it was simple. The male participant with more experience in digital video editing and production than the female, would have liked to have seen some more features resembling basic editing programs and applications. Despite the limitations of the interface, it was seen as being sufficient for the purposes of generating a quick rough cut in a short amount of time. In terms of each person being able to see all the local and remote actions and interactions with the content, the lack of indicators to differentiate who is where and working on what was problematic. Including features that did this would make the collaborative workflow more smoothly and reduce confusion.

3.7. Second Usability Study

Based on the findings, observations and participant feedback from the first usability study, it was decided that a second usability study should be conducted to remedy some of the issues that occurred in the first study and to have more people take part in real-time collaborative content creation in order to better understand users needs. Another reason for conducting the second study was to prepare for a demonstration session to which the author and his fellow researchers were invited. That demonstration session and usability study that goes along with it will be discussed in section 3.8.

Once again two participants were chosen for the usability test. Both participants were graduate students at the same school as the author and research team. Unlike the first set of participants from the initial usability test, the participants collaborating in the second test had many differences. Both participants were male. One of the participants was in his late 30s with 15 years of professional production experience in television news and infotainment broadcasting. The
other participant, with a background in design, was in his mid 20s with less than five years of professional experience in the field. He had almost no direct experience with any level of digital video editing. *To reduce confusion since both of the participants are male, the older participant will be referred to by using the adjective older and the younger participant by younger.*

Similar to the structure of the first usability study, the participants and facilitators/observers first met in a group to discuss the outline of the study. The participants were then given time before being separated to decide on a theme for their collaborative visual narrative. The facilitators, unlike in the first study, gave some examples of possible topics to help the participants in their brainstorming. The researchers also suggested discussing not only the topic, but what kinds of content and shots each person would acquire in order to make the filming process more efficient and ease the collaborative content creation.

As the test took place in the Fall, the participants decided to make their theme Autumn. In Japan, where the study took place, Autumn is a time with many aspects of life attached to it. Along with the changing of the seasons, many foods are associated with the Fall. The participants agreed that the older person would film scenes that reflected the Fall around the station while the younger person would film nature scenes on the suburban campus of the university. This was done in the hopes of showing some variety of shots during collaboration and in the jointly produced rough cut.

Three facilitators were present during this usability study as well. One facilitator shadowed one participant each during the filming stage. The facilitators documented their observations and took video and photos of the
participants. The third facilitator was present once again for technical support and back-up in case problems arose.

After acquiring digital video assets individually, the two participants were brought to separate locations to begin real-time collaboration. Similar to the first study, the participants were separated to create an atmosphere of remote collaboration. The machine and software set-up was the same as in the first study with one difference. The application FaceTime was used by the participants to communicate via video chat. FaceTime was implemented by using a MacBook and an iPhone. The older participant used FaceTime running on a MacBook placed next to the computer used for collaborative content creation. The iPhone used by the younger user was located next to the machine he was using for editing. Using FaceTime, the author explained how the system works to both users simultaneously.

After the explanation, the researchers went back to their role as observers and facilitators and did not interfere with the participants. Like the first study, the beginning of the collaborative work was initially slow going. As neither person had ever worked with real-time content collaboration using digital video, there was a period of adjustment and understanding. Utilizing their video chat connection, the participant were able to develop a system and move on with the task of creating a collaborative video. In approximately 45 minutes after the start of the collaborative phase, the participants were able to render a rough cut of their work. (Figure 3.9)
3.7.1. Findings - Observations

One of the first things observed in this study was the importance of planning in the pre-production stage. Without interfering, influencing or affecting the creative work of the participants, the facilitators suggestions for themes and scenes seems to have aided the participants in their work. During the filming phase, both participants had an idea of what they wanted to film and began to acquire digital video assets quite quickly. Taking more time to think about the rendered rough cut and planning the filming accordingly made for a smooth transition when shifting from the production to the post-production (pre rough cut) stage.
When the users began the collaborative content creation, both were overwhelmed by the amount of clips that were on the screen and took some time to come up with a strategy to go through them and allocate tasks. The older participant, proficient in post-production editing was bothered by the disorganized layout and number of thumbnail clips that appeared in the shared space. At one point, in the beginning of the collaboration, the participants had each chosen so many of their to place on the shared interface that it was hard to determine where, or even what, some clips were.

Incorporating video chat with FaceTime was integral in the collaboration process. The users were able to no only discuss what to do next with the clips on their screens, but they could also talk through problems and address one another directly when speaking.

One issue that was realized by the facilitators during the storyboarding and organization of clips by the participants was one party not being able to see all the clips in the shared space on the right edge of the interface. After investigating that problem, the researchers realized it was a problem with the screen resolution settings and the hardware. While the collaboration was WYSIWIS, differences in physical screens and display settings would prevent one part from seeing all the contents on the interface. As a quick fix, the younger participant was asked by the facilitator shadowing him not to place clips beyond a certain vertical axis on the right side of the screen.

An important feature, previously not conceived, was brought to light in the usability study. Real-time collaborative content creation and, moreover, collaborative activities involving remote users with a video chat/
communication component can be used as a (distance) learning tool. As one of the participants had extensive experience with production and and the other did not, the younger collaborator was learning about editing, transitions, timelines and digital video narrative construction while actively participating in the process.

3.7.2. Findings - Participant Feedback

The participants shared their experience with the facilitators after the study was complete. The older user noted that even with many years of experience, working in real-time and collaborating during the rough cut process was new for him. In the past, from his professional background, editing is usually done by either asking and ordering an editor to work with the content or doing it by oneself. He was also concerned as to how a situation in which two non-professionals or those with very little or no digital video editing experience would fare when engaged in collaborative content creation. He felt there is a chance that it would take longer than completing the task alone. There was a suggestion of including a function that could lock certain clips by one user so that the other person would not be able to modify them, even by mistake.

The experience was also new for the younger user. He stated he enjoyed it and was able to learn a little about editing by seeing it happen in front of him, asking questions and participating. His concern was the user interface. He felt it was hard to distinguish content as the screen became more and more populated with clips. A tagging or labeling mechanism was suggested to easily find certain types of clips. The issue of identification was again present when one part would tell the other person to do something with “this clip” or “that clip”; the general reply from the other party would be “what clip?”.
Both participants believed that the collaborative process worked as a result of the dynamic of the users: one professional, one novice. Even with this dynamic and the older collaborator taking a de facto leadership role in the collaborative process, they both expressed the need to define roles and functions for those involved.

Regarding the role of collaboration, the older participant stated that the rough cut output rendered in a very short time would not have been possible were it not for the co-presence and interaction of the other person. He was cautious to say, however, that he is not sure how or if this would work in a professional production environment where the work and workflow is defined and hierarchical. The younger participant expressed similar reservations with implementing real-time collaborative content creation. For him, the collaboration worked well when one person can guide the other person.

### 3.8. Third Usability Study

The author and his fellow researchers were invited to conduct a demonstration of multi-user real-time collaborative content creation during the CineGrid@TIFF technical meeting held during the 2013 Tokyo International Film Festival in October of that year. The CineGrid@ TIFF meeting is a gathering of primarily technical specialists from industries such as film, television, media/cloud storage, post-production editing and telecommunications. Typically held as a one day meeting during the Tokyo International Film Festival, CineGrid@TIFF focuses on the technological trends that are at the cutting edge of these industries and those which are emerging. (Figure 3.10)
Due to scheduling matters, the demo session was split into two segments of 30 minutes each. With these time restrictions, the authors and research team decided to create a scenario in which the maximum number of people would be able to interact and experience the system within a very short period of time.

Another factor to consider in conducting a usability study at such a venue was the agency of co-location. In the previous usability studies, it was possible for facilitators to separate the participants from one another in order to simulate a feeling of being in a remote environment. With the human traffic and layout of the meeting venue, it was evident that the separation of participants would not be feasible in the limited time span and physical space.
Adding to this complication was the way in which meeting attendees would participate in the usability study. Similar to the first demo session conducted at EuroITV 2013, anybody would have the chance to participate. To work within the parameters of spontaneous volunteer participation and in the interest of time, clips were pre-loaded into the system.

The set-up was similar to that of the first two usability studies. Two windows machines running Novacut on VMWare were placed diagonally opposite each other on the long ends of two tables joined together. To ensure participants would not be able to see one another and create an atmosphere of remote co-location a partition was placed in the middle of the two machines where the two tables were joined. A separate laptop was placed at the side of each machine. The purpose of these laptops being placed close to each machine with Novacut was for the participants to be able to communicate using Skype video chat. Two Skype accounts were created - one for each machine - and the connection was always on to prevent any unnecessary problems or waiting. Headphones with microphones were used between the participants for verbal communication on Skype.

One change that was implemented in the set-up of the computers running Novacut was that the hardware was identical. In previous studies and the demo session at EuroITV 2013, two different machines were used. This was done to guarantee that both participants would see the same exact shared storyboard and avoid the issue of one collaborator not being able to see all the clips in the contained within interface that were observed in the second usability study.
To accommodate the tight scheduling of the demo sessions and maximize the number of attendees who could participate, clips were pre-loaded into the Novacut interface. All of the clips were those taken by the older participant from the second usability study. They were chosen because of their high quality, variety and easy to understand break and transition points. Each user had different content in order for the collaborative activity to be authentic. The number of clips on each machine was also limited to ease the remote collaboration, avoid cluttering the interface and to quickly render a collaborative produced rough cut.

Three facilitators were present during the course of the demo sessions to assist and guide the attendees who were willing to volunteer. After a brief overview of the systems key features and notifying each participant about the Skype video connection, the participants were able to begin collaboratively creating content. Five groups of two people per group took part in the demo session. The pairings were random and spontaneous with no pre-planning. In the short allotted period of time given for the demo sessions 10 people were able to experience and interact with one another and the digital content together. As each group was different, five different rough cuts were generated. (Figure 3. )

### 3.8.1. Findings - Observations

For this particular usability study, the observations were based on the interaction of the facilitators and the participants as well as the participants’ interaction through the use of the collaborative system. The facilitators had to take on a more direct role with the participants as time was limited. In many instances, the facilitators were standing next to the participants throughout the editing and rendering. Nonetheless, the facilitators did not get in the way of the
interaction of the co-collaborators with respect to narrative creation or storyline formation.

The importance of having the ability to not only speak to, but also see the remote user with which one was participating was immediately recognizable. After sitting down in front of a computer with Novacut running on it, the participants were asked to wear the headset and shown the Skype video chat window on the computer next to them. Seeing each other, helped to break the ice and made for a smooth transition into the content collaboration. In some cases, participants in a certain group previously knew one another. For that subset of participants, seeing one another made the remote collaborative process seamless.

The participants came from a variety of professional backgrounds and varied greatly in age. Backgrounds included students, researchers, businessman and (post)production professionals between the ages of 22 and 64. As mentioned earlier, no active or intentional effort was made on the part of the facilitators to group certain people together.

All the groups were able to work collaboratively and render a collective rough cut within an approximate time of frame of 10 minutes. The author had chosen the contents and geared the demo session to hopefully work this way. Although working with the same footage, Each rough cut was unique and the result of a unique group effort.

While observing the participants, it was noticed that some did not fully grasp the real-time interaction of the system. One of the participants, a 24 year-old
businessman, kept waiting for his co-collaborator to finish before working with the clips himself. The facilitators noticed he was talking with the other user and were concerned if there was a technical issue with his computer or the program. When asked if there was anything wrong he replied that he didn’t realize that type of real-time interaction was possible. Although he had been given instructions and shown how the interaction works, he assumed, based on his knowledge of current editing programs and suites, that real-time WYSISWIS interaction at the level being demonstrated was not possible.

Three participants - ages 51, 54 and 64 - seemed to be the most critical when participating in the study. All three of the participants had a background in professional film and television broadcasting and were extremely well versed in the types of production and editing applications available both on the market and in a proprietary capacity. The 51-year-old professional video content producer told the facilitators he wanted more robust features. The 54-year-old post-production specialist felt it was good to see what the other user is doing, but actions were too slow and only simple tasks could be completed. The 64-year-old veteran of broadcast and film technology seemed to enjoy the interaction and conversation but thought the controls were too rudimentary to make meaningful content, especially in professional production settings.

A group of two graduate students with backgrounds in programming, who were researching file transfer techniques for high quality video content, were pleasantly surprised by how easy the system was to use and the ease in working together. The two students, ages 22 and 23, immediately took to communicating over video chat and expressed the need to have a video component as part of the system, to the facilitators.
Based on the overall observations of the 10 participants in five groups by the three facilitators, most of the participants, except for the three older gentlemen with long professional production careers, were seen as having enjoyed the experience of working collaboratively to create digital video content.

3.8.2. Findings - Participant Feedback

Along with the unprompted comments and questions from the participants to the facilitators, each attendee who volunteered their time for the demo was asked to give any comments or suggestions of their experience and/or real-time collaborative content creation in general. Many participants had similar answers in their responses. (Table 3.1)

<table>
<thead>
<tr>
<th>Participant</th>
<th>Group</th>
<th>Profession</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>participant 1</td>
<td>group 1</td>
<td>Graduate Student</td>
<td>34</td>
</tr>
<tr>
<td>participant 2</td>
<td>group 1</td>
<td>Businessman</td>
<td>24</td>
</tr>
<tr>
<td>participant 1</td>
<td>group 2</td>
<td>Graduate Student</td>
<td>35</td>
</tr>
<tr>
<td>participant 2</td>
<td>group 2</td>
<td>Graduate Student</td>
<td>25</td>
</tr>
<tr>
<td>participant 1</td>
<td>group 3</td>
<td>Graduate Student</td>
<td>23</td>
</tr>
</tbody>
</table>

Table 3.1: Breakdown of participants in the third usability study
The need for the ability to preview the clips (playback) and a working timeline was given by both a 34-year-old graduate student and the 54-year-old post-production specialist.

Inclusion of a function or indicator designating the other remote user’s action on the screen was expressed by both a 35-year-old graduate student and the 23-year-old graduate student. The 35-year-old said the ability to see multiple cursors in the shared interface would be helpful to see what the remote user is doing. The 23-year-old believed that indication of the remote user’s actions could be represented by a change in the color of the border of the clip which is being manipulated.
A 25-year-old graduate student, researching the data transfer of large files used in high quality video streaming, brought up an interesting point in his comment about the frame accurate stepping feature. Co-located users can see the movement of a clip, in either forward or reverse, by using the mouse scroll once a clip is selected. Scrolling upwards results in clip moving forward by one frame; scrolling downwards moves the clip one frame back. Pushing the shift key while stepping results in a ten frame jump. This stepping of 1 or ten frames becomes inefficient and tedious when working with long (time) clips. He suggested a scroll feature that adjusts speed and frame numbers according to the intensity or correlated speed of the interaction with the mouse scroll wheel.

3.9. Summary

This chapter offered a thorough examination at three models of collaborative content creation. “lenses + landscapes” demonstrates collaboration through the curation of crowdsourced images. The images captured by the three photographers serve as the underlying visual narrative component that drives the story. The collective effort of two remotely located teams in Japan and the United States to share ideas and collaborate remotely using large screen touch panels as group storyboarding spaces is seen in the production of “places + perspectives”. The usability studies on real-time collaborative content creation with the implementation of an open source application illustrate the way in which collaborative techniques can facilitate the flow of production while giving multiple contributors the opportunity to create, control and manipulate their shared work.

When viewed at in the order that the three methods were investigated and experiments conducted, one can recognize a shift from a completely
asynchronous collaborative environment in the production of “lenses + landscapes” to completely synchronous collaboration in the usability studies on real-time content collaboration. Concurrently, as the interaction between collaborators and the content increased with the progression of different experiments, the production techniques used in the methods shifted from those resembling traditional, or legacy, conventions of visual media production to more non-traditional styles.

![Figure 3.11: Role of Collaboration and Types of Production Techniques in the Three Models of Collaborative Content Creation](image-url)
Chapter 4 - Analysis

4. Overview

In this chapter, an analysis of the three types of collaborative content creation methods is presented. After breaking down the elements of each collaborative methodology, a mixed methodology approach is proposed. Requirements for creating visual media in a collaborative environment are discussed. Strategies for the implementation of collaborative content creation are then explored. Finally, realities and limitations associated with collaborative visual media production techniques and processes are considered.

The research conducted on different methods for collaborative content creation discussed in the previous chapter give a detailed explanation of the processes necessary to produce content in a participatory setting. Similar to the way in which a multi-touch interface can change the experience of browsing a museum collection, the different methods demonstrate new approaches to the traditional experiences associated with visual media production\textsuperscript{79}. The common theme in the production of the two short documentaries and the participant-generated rough cuts created through real-time collaboration is the work being an effort of multiple individuals. The three methods of collaboration discussed in Chapter 3 - curation of crowdsourced content in “lenses + landscapes”, asynchronous remote collaboration in “places + perspectives”, and real-time bi-directional manipulation of media content using Novacut - are unique in their approach but share the common goal of facilitating visual media production amongst groups of people. (Table 4.1)
4.1. Three Methodologies for Collaboration

Before looking at the components that make up the different methods of collaboration contained in this research, it is important to take a step back and ask consider why collaboration in the production of visual media is important. Factors to take into account are the validity of collaborative methods and ways in which the methods themselves can be applied to future research and work in this emerging field.

Kapur et al.’s work on creating a sustainable framework for interactive live network performances with two or more co-located groups provides useful insight\(^8^0\). In their creation and deployment of the software GIGAPOPR, the authors illustrate a low-latency bi-directional framework that can be implemented to realize live, networked music performances by networked co-located performers. From their research, it is evident that while networked
musical performances are different from traditional live events, they do provide a novel experience for both the performers and the audience. It is vital to adopt this line of thinking when considering the role of collaborative content creation with respect to established practices.

Participatory design plays a major role in the construction of collectively created visual narratives. Contrary to legacy practices of visual media production, where roles, responsibilities and workflows are pre-determined and require a strong adherence, participatory design in collaborative content creation emphasizes the people involved in the production process as they are the “people destined to use the system [and] play a critical role in designing it”.

Collaborative content creation is not only distinct in the end product that results from the collective contributions of many people, but the process of creating the content is also integral in understanding the characteristics that make up the output. Olsson demonstrates this unique feature of collaborative content creation in his research user-generated content. His focus on the human-centered design of collective content looks at not only a community of users, but also the community itself as a user by investigating collaborative content interaction where the content represents a social experience.

### 4.1.1. Crowdsourced Curation

The short documentary “lenses + landscapes“ illustrates the role of curation in the acquisition, production and creation of content utilizing crowdsourced assets. The production of “lenses + landscapes” was the most traditional of the three methods discussed in this research. There was a director (the author), camera operators and editors with set roles. The documentary differed from
industry practices in that the narrative was completely dependent on the collaborators from whom the still photographs were sourced.

The director played the role of a curator in working with the material provided by the three photographers. Neither the director, nor the rest of the production/research team had any idea of what types of images they would receive until the digital files were uploaded.

The camera operators (including the director) filmed interviews with the photographers to add to the human element of the story. The interviews and b-roll footage of the content collaborators was interlaced with their collective images to allow them to tell the story instead of a third person narrator who may or may not have had a personal connection disaster.

Working with the director, the editors, contributed to visualizing the narrative and preserving the delicate balance of presenting a high quality professional-grade film while keeping the story intimate and personal to those who witnessed and experienced the events of the day and its aftermath.

The hierarchical structure implemented in the production of “lenses +landscapes” helped expedite the work and finish the work in a relatively short period of time without sacrificing visual or narrative quality. The collaboration that occurred was primarily offline. The photographers were asked for images that they believed to be of significance and important to them. The production staff were entrusted with the visual work of the photographers and had a great responsibility in constructing a visual story that kept the essence of the contributors and their images.
4.1.2. Remote Collaboration

The remotely co-located production of “places + perspectives” took on a more democratic model of collaborative work. From the outset, there was no assigning of directorial roles on either side. This lack of role assignment evinced some of the issues involved in the collaborative production of user-generated content. While there was no shortage of enthusiasm or cooperation by either the US-based or Japan-based student teams, the lack of leadership and management structure resulted in the production process being slow-moving at the beginning. However, an important lesson can be learned regarding behavior in looking at the production process. As the project progressed, students began to take on roles on both sides, as well as on a collective level, in order to finish the documentary. The two teams and their interaction can be said to be a microcosm of how communities behave and act when working together.

The introduction of SAGE as collaborative storyboarding and ideation tool demonstrated the important role technology plays in facilitating and promoting collaboration. The remote teams, in Japan and San Diego, were actually operating with two layers of collaboration. Locally, the teams would have to meet to discuss and plan production. Through the use of SAGE, production and narrative elements discussed on a local level could be shared with the remote team. The SAGE units on the US and Japan sides allowed the teams to see one another’s work as well as develop a joint narrative. Production would have been possible without SAGE units, but the group interaction dynamic on both
a local site level as well as between the remote teams, would have been completely different and the end result would not have been the same. In the filming stage, SAGE allowed the separate co-located teams to see what their remote collaborators had done and give feedback. The teams were also able to construct the timeline and narrative flow as the large interface let them see the story visually. Despite its lack of real-time editing and WYSIWS functionality, the SAGE units were invaluable in both teams observing each others progress towards a shared goal.

### 4.1.3. Real-Time WWDIWWG Collaboration

The usability studies with Novacut provide new and valuable guidance into the potential of what can be achieved when people are able to simultaneously collaborate in the creation of visual media content. The synchronous collaboration made possible with the application demonstrates how collaborative brainstorming of visual content can be realized with the assistance of technology.

Moving beyond WYSIWIS, real-time collaboration, as evinced from the usability studies, illustrates the immediate changes to the collective narrative over which each user has power. WWDIWWG is a better description of the real-time collaboration that occurs when two users have the same level of control over not only their own local contents, but that of the remote user as well. Every decision, whether it is jumping frames within a certain clip, moving the position of a clip in the shared interface, or choice of which clips to place in the timeline to prepare for rendering transforms the narrative for all the users. The ability to express disagreement or displeasure of the action/decision of a remote user through the manipulation of shared content ensures that the
collaborative process is democratic. The outcome of the co-creative labor is a reflection of the consensus of the users.

Although overwhelming at times (especially at the beginning of the collaborative stage), the capacity of each user to influence and shape the narrative through the manipulation of digital media assets and the immediate outcome of those changes manifested to all the collaborators indicates new possibilities for creating content as well as the type of visual narratives that can be produced.

Shortcomings of real-time collaborative content creation are also evident from participant feedback. Some of the people, particularly production professionals, who took part in the usability studies expressed concern over some of the functions or lack of functionality as in the system. The need to give one user control over the final decision regarding clips and the timeline was mentioned. If this function is not available, deciding a point at which to end the editing session, could prove difficult. Many of the production professionals wanted more advanced controls. Frame stepping alone was considered to be insufficient and would not meet industry needs. This could also apply to independent filmmakers who are used to working with professional editing suites and programs.

Another shortcoming of the system as observed by the researchers took place at the end of the collaboration. The collaboratively created rough cuts using Novacut could only be rendered on each users local machine. This is done to minimize the network strain as well as to factor in the different processing capabilities of the computers. While taking the burden off of the system, the
inability to render rough cuts simultaneously results in difficulty for remote users viewing the collaborative output together. An approach to dealing with this inability to watch the rendered rough cuts together can be found in research on collaborative media streaming. As is the case when two individuals, or groups, in separate physical spaces or geographical location are viewing content the ability to view the content together (apart) at the same time allows all involved to not only watch their collective work together, but also have control of the playback. By being able to watch the same stream of the same content and pause and scrub the content, collaborators can comment and give feedback on the content to remote parties as if they were in the same room at the same time without having to wait for one person or group to finish before discussing. Collaborative streaming also increases efficiency in the work process by helping to eliminate and confusion as to what one remote party is referring to or where they are in the playback sequence.

4.2. Motivation for Collaboration

Based on the findings, the circumstances that instigate collaboration between content creators is made evident. There are many factors that can motivate people, and in some cases necessitate, individuals and groups to connect with others to collaborative on visual media productions. The factors that drive people to come together and create visual media content include:

- *Increasing efficiency* - when multiple users are involved in content production tasks can be distributed to those whose backgrounds and skill set best meet the demands of the work.
• **Reducing work time** - The involvement of more people on a project results in less time spent by each individual (as long as everything runs smoothly and efficiently)

• **Decreasing one’s workload** - Instead of taking on too many tasks that not only make it difficult to finish production, but also raise the possibility of negatively affecting the quality of work due to distraction or fatigue; individual users working in a group can concentrate and focus on their own work.

• **Pooling resources** - Financial, technological and skill-based impediments can be overcome by a support system made up of members of a collaborative team sharing their resources, equipment and ideas.

• **Engaging with others** - Collaboration allows people to engage and interact not only with content that may not be their own, but also with those with whom they are collaborating. New relationships - personal, professional or both - can be formed amongst individuals who may not have meet elsewhere under different conditions.

• **Creating social bonds** - Interactions that begin between people and amongst groups as part of a short-term collaborative project can transform into long-lasting, real relationships that continue once the shared work is completed.

• **Enlisting multiple points-of-view** - Having more than one angle is not only important for a finished visual narrative, but the incorporation of different thoughts and ideas can also help the collaborative production process.
4.3. Requirements for Collaborative Content Creation

The three methods of collaborative content previously discussed, and the overall research presented in the this paper, suggest that an explicit detailing of the requirements for collaborating with visual media are necessary. The requirements are factors that enable and facilitate the creation of collaborative visual narratives without impeding the production process. The requirements are as follows:

Allowing for synchronous and asynchronous collaboration - Due to scheduling and time (zone) restrictions, working together at the same time, all the time may not be realistic for certain groups of collaborators. A system that supports real-time interaction as well as offline collaboration could make proper use of each party’s time and ensure that the work is completed on time. Furthermore, simultaneous collaboration should not only be applied to the content creation and editing or manipulation, but users should also have the opportunity to see their collaborative efforts together. Optionally, the use of a virtual peer may help continue the collaboration when not all parties are online at the same time.

Promotion of co-presence - Seeing the person or people with whom a an individual or group is collaborating significantly changes the nature of the collaborative task by adding intimacy and a feeling of being there. Full body interaction and gesture recognition can only add to the collaborative experience. The presence of another collaborator’s voice aids the communication, but actually seeing the other party can give collaborators the ability to work even closer together. The importance of eye contact, especially
cannot be overlooked. Being aware of what a person is looking is an essential non-verbal communication tool\(^86\). Visual/facial engagement would also prove useful when language or cultural barriers exist.

**Supporting multiple users** - Although the numbers may need to be somewhat regulated depending on the type of visual media content being created, collaboration should be able to support more than just two users. Multiple users who without spatial restrictions can add perspective to a narrative and help with the distribution of work\(^87\).

**Scalability** - Similar to SAGE, collaborative tools should be scalable to ensure that the needs of all the users, regardless of their hardware or software, have the ability to work together.

**Integration of new(er) technologies** - A collaborative environment should have the flexibility for users to incorporate existing technologies as well as new devices into the cooperative landscape. In a fashion similar to present-day smartphones\(^88\), future technologies should be easily integrated into current systems.

**Robust Controls** - To accommodate users of varying skill levels and experience in visual media production, a collaborative system should permit professionals and novices to work with people with similar or different abilities. Professionals may require more functions and controls. Non-professionals (beginners, enthusiasts, amateurs, casual users, etc.), on the other hand may only get confused and intimidated by an abundance of features. A system which provides collaborators to adjust settings to their needs would be ideal.
**Multiple input support and user identification** - Traditional input devices like keyboards and mice are still very prevalent in computing and collaborative work. Besides these conventional tools, other input devices and techniques should be supported to allow users to use the tools with which they are comfortable. When users work together, especially in a shared interface, it is crucial for a local user to know where remote users are and see what they are doing. Support for multiple cursors, for example, to distinguish different collaborators cuts down on confusion and aids the collaborative process.

**Hardware independence** - To prevent the exclusion of certain individuals or groups from participating in collaborative work, software and applications should not be tied down to a specific operating system. Ideally, open-source software should be utilized. In the case of collaborative content creation, users should have the freedom to use any recording device (e.g. camera) and output format. It is necessary to have collaborative platform that can acclimate a variety of common and easy to use file formats.

### 4.4. Strategies for Collaborative Content Creation: A Mixed Methodology Approach

There is no general solution or methodology in the creation of digital collaborative media. What works for one group of collaborators may or may not work for another. The needs and means of those collaborating will dictate the best way to move forward with the task of creating collective visual narratives. The best approach that can be offered, then, is a mixed or hybrid approach that incorporates elements and components of the different techniques examined in this paper. Some hypothetical examples based on actual cases where the
collaboration of content was undertaken are offered for the purposes of discussion:

**User-generated content at a film festival** - At a film festival, organizers can include a public space where attendees have the ability to create and remix content. Attendees at different locations of the venue, and even on different days can work together synchronously or asynchronously. The collaborative work can be made up of assets captured by the festival goers and/or provided by the organizers of the event. Organizers can curate the collaborative works and they final product(s) can be viewed by all.

**Hyper-local content** - Modernization and urbanization is visible in the migration of people from rural areas to cities. Some residents, however do not leave and want to stay where they are. The broadcast content, generally provided for these rural inhabitants, does not usually meet their needs in terms of information and variety. If people living in such areas want content that reflects their community, they may have to make it themselves. The residents can take an active role in the creation of community content by utilizing a mixture of various collaborative techniques. If, for example, the goal is to show an event that took place in a community, a number of residents can individually film different aspects and places of the event. Pairs of residents with footage that is similar can use a platform like Novacut to cut out the unwanted footage and create a collaborative rough cut with different angles and points of view. Rough cuts from various groups of residents can be storyboarded locally or remotely with professional broadcasters to form a working timeline. A local television station can then take the various community-sourced and, applying techniques similar to those in the production of “lenses + landscapes”, present a
professionally curated finished visual piece which can then be enjoyed by those in the community as well as shared with others beyond the geographical borders.

4.5. **Limitations**

The research discussed in this paper examines the different methods and techniques associated with collaborative content creation in visual media production as revealed in the findings from various forays undertaken by the author. By no means are these the only or best methods. Rather, the research aims to serve as a resource for those individuals and groups who want to conduct their own research or experimentation into the development of collective visual narratives.

There are many aspects, functions and applications which were not included in the research. The focus of the paper is not only the end product of the collaboration, but the human interaction, with the support of technology, that makes up the collaboration. For this reason, an emphasis was placed on collaborative production techniques which demanded active participation by the collaborators.

One interesting topic that could play a role in creation of collaborative visual stories is the integration of automatic functions for generating narratives from a shared pool or library of user-generated or community content. Allowing automated functions or algorithms that can generate rough cuts or even complete collaborative visual works is a topic that can add to the discussion of how people collaborate.
The collaborative experiments contained in this research dealt with live action non-fiction content. Other forms of visual media, such as animation, may be better suited to collaboration methods different from those mentioned in this paper and may have additional requirements. For example, co-presence through a virtual character or avatar (possibly one from the story itself) may aid in the creation of collaboratively created animations.

Non-traditional methods of collaboration and narrative deployment may require conditions and elements not covered by this research. Public storytelling by spontaneous collaborators on re-purposed artifacts such as older airport split-flap displays, for example, bring with them different challenges and obstacles and may call for non-conventional approaches to collective media creation.

4.6. **Summary**

The contribution of the research discussed in this paper asserts itself in the analysis of the findings put forth in this section. The elements that constitute the methodologies for collaborative content creation based on the research conducted on three models of collective visual production discussed in this dissertation are analyzed. Factors that drive individuals to work together on communal visual narratives are explicated. For those who are motivated to engage in collaborative undertakings, requirements for collaborative content creation are explained. Possible use scenarios for visual media productions in which collaborative work can be incorporated are construed and the limitations of collaboration in visual media are taken into account.
Chapter 5 - Conclusion

5. Overview

Up until this point in the dissertation, three methods of collaboration for visual narrative construction have been comprehensively discussed. The research presents a variety of ways in which digital visual media collaboration is possible by remote users. The methods and techniques were analyzed, requirements for facilitating collaboration were shown, and suggested mixed-methodology practices were applied to hypothetical cases. This final chapter looks at what groups of people can make use of collaborative techniques to assist in their activities and enterprises, the power of collaborative content creation to help bridge the gap between communities of user-generated content producers and media professionals, recent tools that indicate the field is gaining recognition as innovative creative medium, and summarizes the dissertation.

5.1. Benefiting from Collaboration

5.1.1. Citizen Journalism

Journalists today are quite different from those a generation ago. Their appearance at times makes one question if they are even employed, let alone journalists. With many still holding on to the reliable artifacts of pen and paper, the tools of their trade have transformed significantly. They are traveling press offices and film crews with their laptops, tablets and smartphones. Whereas in the past a formal education in journalism or job at a media outlet/conglomerate was necessary to report the news, the global citizen journalists of today can share their stories through a variety of media with a worldwide audience from
anywhere at anytime. There are many guides resources for those with no background in journalism to become their own media sources in a digital age where the old models of new reporting and delivery do not apply\textsuperscript{94}.

Digital journalism has opened the door and provided opportunities for independent and grassroots journalists to make a name for themselves and tell stories that mean something to the journalists themselves as well as their audience\textsuperscript{95}. What the independent free press core lack, when compared to their established brethren, is credentials and the company name and funds that go along with it.

New forms of technology supported journalism, according to Harper\textsuperscript{96}, provides three elements that can redefine the role of the reporter and the audience. First, the audience can challenge the establishment with access to more power in the news (reporting/checking) process. Second, users can incorporate new, mixed approaches to storytelling. Third, anyone with a device connected to the internet can become disseminators of information through non-traditional methods.

With the incorporation of collaborative techniques, individual independent journalists can come together and pool their resources to tell a multifaceted story that may not have been otherwise feasible. Through pooling their resources, digital citizen journalists can also investigate stories, like the contamination of pet food\textsuperscript{97}, that mainstream news outlets may not cover because they could be considered to be an inefficient use of resources. Remotely connected journalists in different parts of a city or country can connect with one another. Employing the techniques presented in this paper, they can raise the
bar of their information by providing details and features impossible to achieve alone.

It is not only journalists, however, who can benefit from implementing collaboration. The audience is no longer plays the role of passive consumers of news media, but has the ability to contribute, criticize and continue the discussion in an interconnected participatory setting\textsuperscript{98}. Consumers of news media can become active participants and report the news that has meaning for them to the world\textsuperscript{99}. Over the last few years, uprisings and people-driven regime change has demonstrated the power of the individual and crowd as messengers of information and agents of change\textsuperscript{100}. The convergence of digital technology and collaborative content creation techniques is, and can further, shift the medium of news from one that is based on the gatekeeping of information to a multiple contributor model of gatewatching\textsuperscript{101} of sharing and delivering news with more depth created (in part, at least) by those who have a stake in the content.

5.1.2. Community Content

The collaborative reporting and dissemination of information can also benefit audiences on a smaller scale. It has been shown that the collaboration of community content can provide useful information to people living or working in the same geographic area. The crowdsourcing of data and information on crime incidents or accidents from people on the ground can help those residing or traveling through unsafe neighborhoods traverse their way in, around and through certain areas with minimal risk\textsuperscript{102}.
The community-sourcing of information can also be applied to visual content production. The affordability, portability and ease of use of digital technology have made everyone into a photographer or videographer. Although initially enthusiastic about their new toys or gadgets, the artifacts are either forgotten about or the data is never viewed/modified. A major factor in this lack of motivation to do something with the footage one captures is the difficulty and time cost associated with editing and making a final product. If, however, the troublesome process could be made into an enjoyable group activity with family, friends and community members, people would be more prone to not only show what they film, but strive for a high level of quality as the effort is not solitary and ownership is shared. Through the implementation of collaborative content capture and editing techniques, people with similar interests can create content that is not only interesting for the person filming, but also those who have a relationship with the people, places and events being filmed. Looking at the example of a school play helps to illustrate the collaborative output of community created content. The typical scene in the audience at school play or concert for young children is exemplified by parents or guardians vying for the best seat/position from where to film their child or children. Standing on the stage, looking out into the audience, one can see a sea of video cameras and other recording apparatuses. While each adult may want to film the performance itself, what usually occurs is a video recording consisting primarily of their star. There is nothing implicitly negative about this output as it does serve as a digital family artifact. However, if (some of) the adults were able to pool their resources and produce a collaborative video, the people filming as well as those performing would be able to enjoy much more dynamic and multi-faceted content that features their
own children and others and takes in the performance as well. The monotony of a single camera viewpoint or shooting style could be broken by alternative angles and views of actions that could not possibly be captured by one person alone.

5.1.3. Bridging the Storytelling Gap

Collaboration in the creation of visual media affords advantages in distribution and quality to non-professionals or independent (financially challenged) artists not possible otherwise. While the term user-generated content is still relatively young in the scope of modern human history there are many resources available for those who want to remotely collaborate on a music video or produce crowdsourced content Collaborative practices in visual media production can also help bridge the existing content gap between industry and the average person. Instead of looking upon one another as adversaries fighting for a piece of the digital media pie, media professionals and creators of user-generated content can work together to create content in which all the participants play an active role.

Entirely made up of videos shot by fans around the world using webcams, the music video for “Hibi no Neiro” (Tone of Everyday) is an example of how artists, working on shoestring budgets, can not only produce music for their fans but also make the fan-base part of their creative work. Band members as well as their fans were spread out all over the world. Utilizing social networking platforms, over eighty fans participated in the making of the video. Meticulously choreographed scenes and actions between and amongst the globally co-located fans were filmed on Skype via each person’s webcam.
engaging the crowd, Sour was able to create a truly collaborative and unique moving visual montage of their music.

The 2011 documentary “Life in A Day”\textsuperscript{107} serves as an example of industry and audience can come together to tell a multi-faceted story of what is means to be human. The documentary is comprised of user-generated content from hundreds of people around the world giving a glimpse into one day (July 24th, 2010) of their lives. The professional production team of producer headed by Ridley Scott sifted through and curated almost 4500 hours of videos submitted by thousands of people from around the world into a 95-minute feature film.

Ridley Scott’s production team once again worked with ordinary people in the construction of the 2012 documentary “Japan in A Day”\textsuperscript{108}. The 92-minute documentary is a collection of crowdsourced clips shot by hundreds of contributors on March 11, 2012 - one year to the date after the Great East Japan Earthquake and Tsunami. Through the lenses of the various contributors, one can see the daily lives of those affected by earthquake and tsunami either directly and indirectly. Directors Philip Martin and Gaku Narita were tasked with selecting and carefully juxtaposing over 8000 submitted clips and over 300 hours of video into the vessel of a feature-length commercial documentary. Both examples of large-scale communal filmmaking illustrate not only the challenges of collaborative content creation on a professional level, but also demonstrate the untested potential that collaboration can bring to visual media production in an environment where people are becoming “incredibly visually sophisticated”\textsuperscript{109}
5.2. Tools to Support Collaboration

The need for more collaborative content creation and framework for the production of collectively produced digital video media is made clear by the recent release of two multi-platform smartphone applications. *Vyclone*\(^{110}\) and *MixBit*\(^{111}\) are applications, released by different companies at separate times, that share similar functionality. Multiple users can share the videos they shot at a particular location together and stitch different angles together, through the use of algorithms. Without much effort, a simple and shaky smartphone video becomes one with multiple shaky shots from various angles. These two applications are limited in the control that users have over the cuts and transitions between different angles and user videos, but are an important step in the future of technology-assisted collaborative visual media.

On a platform level, *Blend.io*\(^{112}\) is a web service that allows musicians to collaborate via a web-based interface. The website enables collaborators to remotely work together on projects in real-time and share their work with other users of the site for more possible collaboration. The service overcomes previous obstacles to collaboration such as software compatibility, the choice of file and data sharing services, and slow communication. Although the *Belnd.io* is a music/audio based collaborative service, the simple-to-use interface and real-time collaboration, rendering and remixing features reflect some of the essential components necessary in collaborative video production environments.

The technology giant Sony’s recent public beta release of its interactive cloud-based creative collaboration platform *Ci*\(^{113}\) by its Media Cloud Services subsidiary adds validity to the argument that there exists a need for tools and
services that can assist in creators of user-generated content to work together. Ci allows remote collaborators to simultaneously work on a project. Similar to the research conducted on real-time content collaboration presented in this paper, the cloud service enables users to remotely generate rough cuts of visual media productions that can then be imported into video editing software. Ci corroborates the theme of this research that collaborative content creation is an important field of study that requires attention, structure and a framework to support it.

5.3. Social Impact

The current situation, in terms of access to technology, provides the ideal context for further exploration into collaborative content creation. The paucity and challenges associated with digital resources, to promote creative work that was prevalent in past are no longer insurmountable obstacles that prevent people from participating in the production of visual media. There is a variety of hardware and software that can meet peoples financial needs and technological skill levels.

5.3.1. Changing the Game

The implementation of collaborative content creation into mainstream media industries such as film and television can open up the field of opportunity for creators and contributors who may not be able to get their foot in the door otherwise. While new practices and technologies are constantly being introduced and adapted in the film and television industries, legacy production techniques, workflows and hierarchical models dominate the way in which content is developed, produced and distributed.
By engaging creators of user-generated content and embracing collaborative community content. Major studios and networks can tap into a new and diverse talent pool of viewers who not only consume, but also create visual media content. From a business perspective, major media conglomerates who have been struggling to increase revenues in times of greater production costs, can reach out to the crowd and have them actively participate in the production process. The distribution of work could have an effect in managing costs as well as qualitative results in the form of new and innovative content.

5.3.2. The Big Picture

The digital divide, the resource chasm that separates people, communities, regions and countries in their access to acquiring and contributing to information is gradually getting smaller. Collaborative content creation can have a significant impact in narrowing the global digital divide through breaking down and, hopefully, removing barriers of entry that prevent people around the world from connecting to one another to create new and unique visual narratives that, just a few years ago would not have been possible otherwise. Communities of people who on the surface may have little in common or almost no previous interaction can learn from one another and teach others through the distribution and sharing of their collaborative stories. Creative visual narratives that once could only be produced by major broadcast media players can be done at negligible fractions of the cost by individuals who, in some cases, may not have even had access to mainstream media.

Collaborative content creation has the potential to influence other, non-visual media disciplines and fields as well. In education collaborative content creation techniques can play an integral role in the way in which people learn from and
teach one another. More emphasis can be placed on peer learning to help people both inside and outside the traditional classroom setting. Distance based eduction can shift from a VOIP interaction to the actual production of educational contents by learners for themselves as well as for the future. A deeper sense of intimacy and personal relationships can be formed through remote learning that does not feel distant. Most of all, the ability to share, in real-time and afterwards the challenges, progress and achievements gives learners a sense of pride and empowerment.

5.4. Summary

The research presented in this dissertation offered a detailed account of collaborative content creation in the production of visual media through an action research approach. Three models of collaborative visual media production - curation of crowdsourced assets, remote co-location using large touchscreens, and real-time content creation to generate cooperative rough cuts - and the research that accompanied them were explored and discussed. A review of research in similar fields and disciplines provided valuable knowledge the traits and attributes that are associated with collaborative content creation. An analysis of the findings of the three collaborative techniques identified the constituent parts behind the collective production of visual media. Motivations and requirements for collaboration were extrapolated, collaborative strategies proposed, and limitations were taken into consideration.

Due to the scope and focus of the research this paper does not cover topics which may be relevant to other researchers, practitioners, media professionals and producers of user-generated content. Some of the topics and themes that
can be undertaken and studied include: the extent to which collaboration is feasible with respect to technology and networking infrastructure; the limits of creative control that major media entities are willing to forgo in order to tap into the crowd of user-generated content producers; and the human breaking point, numerically and psychologically, at which taking collaborative endeavors in content creation is worse than not having collaborated at all.

Collaborative content creation in visual media production is an emerging field that is undergoing identity-building and garnering attention through continued awareness. The contribution of the research presented in this dissertation is to establish collaborative content creation as an interdisciplinary field of study and research for the scholarly community as well as provide content creators, both existing and new, with the tools and knowledge to work with other individuals in the pursuit of collective visual storytelling. Advancements in technology and communication networks will not make this study obsolete as the core elements of collaborative content creation, the components of visual media collaboration, have a long shelf life and can serve as a repository of knowledge for future research.
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Endnotes


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