<table>
<thead>
<tr>
<th>Title</th>
<th>Projection Door Authoring Tools: Illuminating Automatic Doors with Situated Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub Title</td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>陳, 坤浩 (Chan, Terence Kwan Ho)</td>
</tr>
<tr>
<td></td>
<td>奥出, 直人 (Okude, Naohito)</td>
</tr>
<tr>
<td>Publisher</td>
<td>慶應義塾大学大学院メディアデザイン研究科</td>
</tr>
<tr>
<td>Publication year</td>
<td>2015</td>
</tr>
<tr>
<td>Jtitle</td>
<td>修士論文 (2015. 9)</td>
</tr>
<tr>
<td>Abstract</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>Genre</td>
<td>Thesis or Dissertation</td>
</tr>
</tbody>
</table>
Master’s Thesis
Academic Year 2015

Projection Door Authoring Tools:
Illuminating Automatic Doors with Situated Experiences

Graduate School of Media Design,
Keio University

Terence Kwan Ho Chan
A Master’s Thesis
submitted to Graduate School of Media Design, Keio University
in partial fulfillment of the requirements for the degree of
MASTER of Media Design

Terence Kwan Ho Chan

Thesis Committee:
Professor Naohito Okude (Supervisor)
Professor Masa Inakage (Co-supervisor)
Associate Professor Nanako Ishido (Member)
Abstract of Master’s Thesis of Academic Year 2015

Projection Door Authoring Tools:
Illuminating Automatic Doors with Situated Experiences

Category: Design

Summary

Practitioners of Media Architecture are becoming increasingly aware of the difficulties that arise when attempting to engage with the built environment. One of them are the lack of prototyping tools, while the other consists in the need to align the interests of multiple stakeholders. This research which is conducted in collaboration with a Japanese Automatic Door producer is capable of investigating these issues through designing the Projection Door, a modified Automatic Door that can be illuminated with an assortment of experiences. The Projection Door Authoring Tool created as part of this research, is a complementary software tool that enables citizen creatives to develop interactive contents that will be published onto Automatic Doors. In order to bring forth the Projection Door Experience, three guest creatives, consisting of an animator, a creative coder and an installation artist was invited to attempt creating contents for this new medium using the tools that we developed. 12 original Door-contents were curated to potential stakeholders of the Projection Door. This paper describes the process that led up to the conception and making of the authoring tool, and discusses how it may initiate collaborative opportunities for Automatic Door producers to begin re-engineering the urban landscape.

Keywords:
Automatic Door, Media Architecture, Software Tools, Situated Experiences, Radical Collaboration

Graduate School of Media Design, Keio University

Terence Kwan Ho Chan
Acknowledgements

The guidance of Professor Naohito Okude has left me with impressions that were a pleasure to contemplate on. Being supervised by him, I have gradually come to an understanding of how academia pivots itself in relation to society. I hereby thank Professor Masa Inakage, for overseeing the progress of my thesis, equalizing it whenever necessary. Our brief consultations have always resulted in episodes of clarity. I would also like to thank Associate Professor Nanako Ishido for taking the time to act as a member of the committee.

First and foremost, this research would not have been conceivable without the generous support powered by Nabtesco Corporation. It was truly an honor to have worked alongside the unified members of the Nabco Team. I shall never forget the warm kindness received from them. In particular, I wish show my appreciation for Kagotani-san and Kanki-san who enabled us to develop rapport with the Automatic Door.

The Tokimeki Automatic Door Project has defined my KMD experience. I express my deepest gratitude to Project Assistant Professors Daisuke Uriu and Chihiro Sato, who have raised and ushered the project on with their attitude of strategic determination. Periodically plunging me into the depths of uncertainty, they have sharpened me in many aspects. I am grateful for all the advice and criticism given in these two challenging years. I feel very happy to have engineered for Gen Kawaguchi as my senpai, for he has demonstrated to me, intensity. To the Okelanas, the Knives and the Wilburs. For aligning the brutalist with what he ought to be, I am indebted to y’all Russian Style. Arima-san, welcome!

As Keiko-Sensei announced early on, acquaintances at KMD are a pre-requisite for sustained output, I am glad I found myself a few of those. I thank Mieharu Suzuki, for always gently introducing to me wonderful scenarios of Japan since the early days of the Crash Course. Shouki Zhong Yi, the Authoring Tool mentioned in this Thesis would not have been created without you introducing to me openFrameworks in the first place. Kiron Tsang, I thank you for putting up with my naive questionings concerning topics on programming that may have been a
bore for you to compute. I thank Tetsuya Hayashi for inspiring me with kind prose. Makoto Sunayama and Yoshiki Hiraba, to have experienced the process of completing a Master’s Thesis with you two, takes radical collaboration. Lastly, to my Family, Grandmother in particular, the heaviest of bows.
# Table of Contents

**Acknowledgements**  

1 Introduction  
1.1 Tokimeki Automatic Door Project  
1.2 Enabling Infrastructures  
1.3 Evolving opportunities for Creators  
1.4 A Shift in Context  
1.5 Structure of this Paper  
Notes  

2 Related Works  
2.1 Media Architecture  
  Sniff  
  SMSlingshot  
  Soundful AdaptivePassage  
2.2 Content Development Platforms  
  LightSet  
  The Media Facade Toolkit  
  Framed*2.0  
2.3 Research on Automatic Doors  
  Toward Intelligent Automatic Door Systems  
  Automatic Door Gestures  
2.4 Contributions  
Notes  

3 Design Process  
3.1 Concept  
3.2 Developing Rapport with Nabco  
  Initial Prototyping  

iv
Obtaining Resources ........................................... 27
3.3 Reflections from the Wild .................................. 31
  Konan Shock .................................................. 31
  Content Development Framework ........................... 34
  A Proposal .................................................... 38
3.4 Collaborative Development ................................. 40
  openFrameworks Addon ..................................... 40
  Video Arrangement Tool .................................... 43
3.5 From Control-Maintenance to Authoring Tools ......... 48
Notes .................................................................. 50

4 Door-Content Curation .......................................... 51
  4.1 Animator ..................................................... 51
  4.2 Creative Coder ............................................. 60
  4.3 Installation Artist ......................................... 70
  4.4 The Projection Door Experience ......................... 74
    Impressions from Nabtesco ................................ 74
    Impressions from Urban Sectors ......................... 76
Notes .................................................................. 79

5 Conclusion ......................................................... 80
  5.1 3 Links ....................................................... 80
  5.2 Limitations and Improvements ......................... 81
  5.3 A New Paradigm .......................................... 82

References ................................................................ 83
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>A Nabco Automatic Door</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Manga Themed Decorative Automatic Door Seals</td>
<td>4</td>
</tr>
<tr>
<td>1.3</td>
<td>Digitally Ornamented Entrances</td>
<td>5</td>
</tr>
<tr>
<td>2.1</td>
<td>Soundful AdaptivePassage Concept Image</td>
<td>15</td>
</tr>
<tr>
<td>3.1</td>
<td>Matchup Door Prototype</td>
<td>26</td>
</tr>
<tr>
<td>3.2</td>
<td>Time Door Prototype</td>
<td>26</td>
</tr>
<tr>
<td>3.3</td>
<td>Story Door Prototype</td>
<td>26</td>
</tr>
<tr>
<td>3.4</td>
<td>Anpanman Door Prototype</td>
<td>28</td>
</tr>
<tr>
<td>3.5</td>
<td>Grateful Door Prototype</td>
<td>28</td>
</tr>
<tr>
<td>3.6</td>
<td>Demonstration of the Projection Door Concept</td>
<td>30</td>
</tr>
<tr>
<td>3.7</td>
<td>Manual Projections on Real-Scale Doors</td>
<td>32</td>
</tr>
<tr>
<td>3.8</td>
<td>Mini Logo Door: Closed</td>
<td>33</td>
</tr>
<tr>
<td>3.9</td>
<td>Mini Logo Door: Opening</td>
<td>33</td>
</tr>
<tr>
<td>3.10</td>
<td>Large Logo Door: Closed</td>
<td>33</td>
</tr>
<tr>
<td>3.11</td>
<td>Large Logo Door: Opening</td>
<td>33</td>
</tr>
<tr>
<td>3.12</td>
<td>Initial System Sketches</td>
<td>35</td>
</tr>
<tr>
<td>3.13</td>
<td>The Three Components</td>
<td>37</td>
</tr>
<tr>
<td>3.14</td>
<td>The Two Modes</td>
<td>37</td>
</tr>
<tr>
<td>3.15</td>
<td>A View of the Proposed Developing Environment</td>
<td>38</td>
</tr>
<tr>
<td>3.16</td>
<td>Demonstration of the Content Development Platform Concept</td>
<td>39</td>
</tr>
<tr>
<td>3.17</td>
<td>Three Guest Creatives</td>
<td>40</td>
</tr>
<tr>
<td>3.18</td>
<td>A Virtual Door Opened with the Sensor Simulator</td>
<td>42</td>
</tr>
<tr>
<td>3.19</td>
<td>Developing the Take Home Simulator</td>
<td>44</td>
</tr>
<tr>
<td>3.20</td>
<td>Appearance of the Hayakawa Tool</td>
<td>46</td>
</tr>
<tr>
<td>3.21</td>
<td>Interrupt State of the Hayakawa Tool</td>
<td>47</td>
</tr>
<tr>
<td>3.22</td>
<td>The Projection Door System Map circa March 2015</td>
<td>49</td>
</tr>
<tr>
<td>4.1</td>
<td>The Researcher Introducing the Software Tools to Hayakawa-san</td>
<td>52</td>
</tr>
</tbody>
</table>
4.2 Examining Contents on the Mini and Real-Scale Projection Door 53
4.3 Hayakawa-san Arranging his Door-Contents 54
4.4 Future Parade (Closed, Opening, Closing) 56
4.5 曼荼羅色相環 (Closed, Opening, Closing) 57
4.6 出雲の風景 (Closed, Opening, Closing) 58
4.7 四種盛稲 (Closed, Opening var. 1, Opening var. 2) 59
4.8 Tadokoro-san Meeting the Projection Door 60
4.9 BitBucket Commit History 61
4.10 The Researcher Testing Out Tadokoro-San’s Content in Real Mode 62
4.11 市松格子 (Closed, Opening, Fully Opened) 64
4.12 Colorful Rounds (Closed, Fully Opened) 65
4.13 Yellow Swirl (Closed, Opening, Fully Opened) 66
4.14 Firewall (Closed, Fully Opened, Closing) 67
4.15 Logowave KMD Version (Closed, Opening, Fully Opened) 68
4.16 Logowave NTS Version (Closed, Opening) 69
4.17 Fujimoto-san Testing the Parameters of the Physics Engine 71
4.18 Ball Drop (Closed, Opening) 73
4.19 Nabtesco Members Experiencing the Projection Door 75
4.20 Demonstration to the Imaging and Electronics Company 77
4.21 Demonstration to the Shopping Mall Producer 78
4.22 Demonstration to the Printing Company 78
Chapter 1
Introduction

1.1 Tokimeki Automatic Door Project

For the past two years, the researcher has partaken in the Tokimeki Automatic Door Project, a collaboration initiated between Keio Media Design and the Japanese maker Nabtesco Corporation\(^1\). In the course of the project, both parties worked together to discover approaches that would effectively bolster the presence of Nabtesco’s Nabco brand\(^2\) that specialize in producing Automatic Doors. To this day, Nabco holds high acclaim within their trade in terms of quality, market share
and historical relevance. Though well known amongst businesses, the public has only a faint impression of the brand unless further prompted with cues. As Nabco’s Automatic Doors become increasingly efficient and intelligent, the brand itself innocently dissolves into the backdrop of the city, becoming anonymous to those who traverse these machines on a daily basis. In the summer of 2014, this concern was playfully addressed to the public by means of a television advertisement.

“存在感が薄いの…気づいて欲しいの...” sings the twin protagonists named Nabco-chan, as an introductory plea for acknowledgement. Broadcasts may be effective as a temporary surfacing; though bottom-up, fundamental changes to the way they provide value to customers should be considered. Since their Doors are already widely deployed across Japan, maintenance and safety concerns have taken over as a key activity. In order to remedy this double edged situation, our team set out conceiving a completely new approach to the use of these automated machines that will re-position the Nabco brand as a producer of experiences for entrance spaces.

We envisioned Automatic Doors as interactive canvas-doors that would illuminate public entrances with an assortment of experiences designed by citizen creatives. To realize this, we commenced the prototyping of the Projection Door, an extended Automatic Door with interchangeable contents on its panels that transform according to the Door’s movement. By the end of 2014, we managed to assemble a working prototype by mounting projectors and speakers onto an Automatic Door unit while pasting transparent rear projection films onto its door panels made of hardened glass. The projector and speaker sources its input from a computer embedded into the unit which is responsible for the generating and substituting of contents. This set-up overlaying a digitally malleable affordance prepares conventional Automatic Doors for a new role to be played at entrances of buildings.

The Projection Door is characterized by its door-specific ability to open and close, rendering it closer to “a canvas that occasionally splits” than a regular planar surface, and thus may not be generalized as a candidate for conventional media facades, an emerging form of urban intervention. Its extended ability to accommodate images may make it look deceivingly similar to a mere display, but with its functionalities inherited from regular Automatic Doors, the etiquette to support a pedestrian’s safe and comfortable transition between one place and another remains hard-wired into its role as a public facility. This calls for the development of specialized tools that takes into account of the unique qualities
and situatedness of the Projection Door.

At this point, the only ones that were able to develop contents for the Projection Door were the researchers themselves. There was no formalized process that enabled others to participate in the development process hence the effectiveness of the Door in delivering interchangeable experiences could not be adequately demonstrated. Under close collaboration with Nabtesco’s engineers, the researcher has developed an authoring framework supporting the creation of contents specific to the Projection Door. This is the interface through which creatives such as animators, creative coders and installation artists can create works publishable onto the Projection Door. Creatives in the city would be given the means to experiment with the contemporary practice of urban prototyping, and more importantly to realize works that would be implemented by members of other urban sectors as part of their services.

This paper argues that in order for the Projection Door to evolve into a key infrastructural component capable of re-engineering the urban landscape, specialized tools that takes into account the unique qualities and situatedness of the Projection Door are needed. In addition to ongoing services, by owning the Projection Door and its companion Authoring Tools, Nabtesco as a maker can extend their ability to facilitate society on another level by producing experiences for entrance spaces.

1.2 Enabling Infrastructures

The potential for infrastructure in performing the additional task of shaping urban landscapes remain largely unexplored. Automatic Doors as an infrastructure that governs the daily influx of the population occupies a decisive post in the make up of the city. Perhaps the ability to provide a safe and comfortable access forms only the foundation for a lot more unfolding activities to come.

In our field observations on the streets of Tokyo we spotted many occasions where shop owners took the initiative to better situate themselves in various ways amongst the environment and the needs of their customers. Recurring practices include decorative seals pasted on Automatic Doors that ranged from abstract patterns to depictions of particular scenes in well-known manga. In our project we have discussed with event holders about the process involved when applying and removing the seals, they revealed to us that it was a costly process that required the assistance of professionals. Nevertheless, owners continue to appropriate their
Automatic Doors, the continuous effort made on the side of the owners to keep their building fronts in presentable condition, shows the importance of the door as a medium of communication.

Some of the more elaborate storefronts such as the Biglo store located in Shinjuku had a pair of interactive displays accompanying each of their entrances. See figure 1.3. The usage of embedded technologies are emerging as a way for owners to manage the experience of their spaces, however many of these installations have used the screen format as their approach. Screen-based media may not be the most effective way for owners to communicate to their target audience in spaces where people are constantly on the move, this is especially true for entrances which could be described as a non-place which only momentarily serve pedestrians in reaching their next destination. Display Blindness also happens when contents and the placement of the signage are at odds with the expectations of approaching walkers.

Chihiro Sato’s research on shopping experiences has revealed that malls in Japan have been keen on re-furnishing their spaces with new experiences, and the inability to do so will result in growing disinterest amongst customers who sense stagnation in the repetitive copy and pasting design of malls. Despite their willingness to initiate change, there are underlying difficulties that discourage full-scale renovations such as having to pace their gradual plans for renewal in accordance to the various contract lengths of a whole list of tenants, limiting the flexibility of their renovations. Her in-depth look into the needs of a shopping mall...
can be attributed to the closely knitted collaboration with actual owners while carrying out designs and tests in the “wild”\(^\text{13}\) where the activity of shoppers are archived and evaluated. In the wild studies is an approach where prototyping and user tests are done in the setting in which deployment is intended. In this way, unforeseeable events may be confronted and integrated as a part of the design process whereby real life use cases and scenarios can be taken to account of.

Similarly, our project intends to design for real life scenarios and wish not to conclude results confined to the lab. We have been negotiating with potential owners such as shopping mall producers, event planners and showroom owners, describing to them our intention to develop and deploy the Projection Door and gained their opinion on the matter. Each of these parties consider the Door to be useful in their own contexts and for different reasons.

The Shopping Mall producer is interested in how the multiple tenants housed within the facility can be able to take advantage of the Projection Door to attract customers while providing fresh encounters for shoppers each time they plan to visit the mall, they also mentioned the need for contents that would attract children’s curiosity so that the families may decide to frequent the mall. The Event Planner hosting a conference in a convention center suggested that the Projection Door may be included in the event as a special feature that would turn the conference’s entrances into a platform whereby multiple works from creators can be exhibited to visitors of the event. The brand and identity of event sponsors may also be communicated in an alternative way processed through the works of creators. The showroom owner who is currently participating in an urban redevelopment project of a certain semi-rural district is also considering implementing
the Projection Door into their building with hopes of contributing to the renewal of the district. Through close discussions with these potential stakeholders, we have come to understand that apart from the continual duty of providing safe and comfortable entrances, there is in fact many other areas in which Nabtesco can support their clients by building upon the space already occupied by widely deployed Automatic Doors.

When the Projection Door is provided to building owners, it enables them to regularly exchange the experience of their entrance spaces without the need for extensive renovations that may be costly or cumbersome to execute. The Door can be implemented for its ability to tailor spatial trajectories for shoppers and customers alike, adapting to the complexities of needs that populate these front lines of everyday transactions. Rather than having to go through the process of designing seals and hiring professionals to remove and apply new variants, the Projection Door only has to be installed once.

The question is, what exactly will these owners re-furnish their entrances with? Also, which contents can be considered appropriate for the context they are to be fitted in? These questions remain unanswered since the Projection Door is still a newly developed medium. This is where works by creators would prove to be an important source of inspiration for building owners.

1.3 Evolving opportunities for Creators

In this thesis, creators are defined as a group of people who either works professionally as a developer of contents or possess the know-how in crafting out experiences through analog or digital means that would deliver different affects to audiences.

The nature of content developing tools greatly influences how creators approach their works and is a decisive factor in determining where their works can been published. Macromedia’s Flash was a defining piece of software developed in the 90’s that enabled hobbyists and professional animators to begin creating contents publishable onto the world wide web, which was the emerging platform at the time. Web portals was a common platform for the works of creators to be showcased, played and evaluated by the public, attracting a community of regular audiences. Professional content creators would host websites welcoming visitors with their own catalog of works created by Flash, an example would be web content designer Yugo Nakamura’s site yugop.com\textsuperscript{14} which continues to archive
interactive works that date back to the late 90’s. The ActionScript component encouraged creators to evolve their illustrations into new formats which eventually became interactive contents and games.

Programming languages such as Processing\textsuperscript{15} which was based on an earlier project named Design by Numbers\textsuperscript{16} has really steered the stereotypically technical practice of coding and made it accessible to creators who were more graphical in their thinking, encouraging them to adopt computational methods in creating their pieces. A chain of emerging open source platforms developed in the past decade has really increased the literacy of hobbyists equipping them with the know how to become home brewed creators. This group of people continually produce works that discovers new ways of reaching audiences while expanding the medium’s potential to communicate.

A successfully kickstarted product/platform named Framed*2.0\textsuperscript{17} is an example exploring the importance of seeing the works of creators as key resources. The product in the form of a hangable signage takes the digital works of creators out of the desktop, breaks the limitation of accessing works only through galleries and ports them into the homes of users. Not only can users experience created works in a whole new environment, creators can now create contents for a whole new context. This product/platform is conceived by the earlier mentioned Yugo Nakamura and his partner William Lai.

On the other hand, there are emerging collectives and communities that strive to engage with the built environment, they have been taking advantage of exhibitions and events to negotiate access to urban surfaces as a medium of their creation. Though acts of graffiti and urban misuse comes to mind, if we look at it in another perspective as Glenda et al\textsuperscript{18} did through analyzing DIY cultures in their different forms, we are able to see that their real purpose lies not in vandalism, but in enabling the city to bring about participatory experiences. Convincing examples include recent urban events such as SMSlingshot\textsuperscript{19} that has been ported to various cities around the world by a collective of media architects under the name of VR/URBAN\textsuperscript{20}. Another example would be Night Lights\textsuperscript{21} which invited citizens out for a night in which the Auckland Ferry Terminal was besieged with the interactive projections of dance moves, planned out by a band of interactive specialists\textsuperscript{22}.

The Projection Door is a highly situated piece of architecture that possesses a very different character to regular urban surfaces. Without the aid of custom built software tools that takes into account of the Projection Door’s fundamental
qualities as an Automatic Door, content developers will not be able to create effective experiences that fit into the context of this specific piece of architecture.

When the Projection Door Authoring Tools is provided to creators, they will have the opportunity to begin creating contents for a new medium situated in the built environment. This does not mean simply granting permission to project their contents onto the Door, but also providing them with the resources and environment which would support them in creating “Door-Contents”, a format of contents that is made in consideration of the opening and closing movements of doors, which can be experienced either by passing through them or watching others pass through.

1.4 A Shift in Context

This research is an attempt in developing a content creation platform for the Projection Door which would act as a channel managed by Nabtesco to curate door-contents developed by creators to clients in need of interchangeable experiences for their potentially installed Projection Doors. The researcher does this by developing customized Authoring Tools, providing them to professional local creators who will experiment and develop preliminary contents with them, and finally bridging the results back to Nabtesco. This is done in order to demonstrate the potential of the Projection Door in creating collaboration with key partners that may eventually bring about new businesses.

When we begin to conceive of infrastructure as more than specific technical constructs, but as a pivotal element in shaping urban landscapes, engagements should branch out to social and imaginative dimensions as much as engineering, forming an interdisciplinary design effort\textsuperscript{23}. Belanger\textsuperscript{24} argues that the “hardware” of the city has been working too well under the watch of engineers, often to the point of invisibility, obscuring itself from the social and environmental “software” of the city. Does this not sound similar to what Automatic Doors are experiencing now as a dilemma? While makers may perceive this as a hurdle on their part to develop even more advanced machinery and functions that add value to their services, Belanger sees this as a typical example of infrastructure as a closed system designed exclusively on efficiency and economy which resorts to maintenance as a form of self-preservation.

Up till now, Automatic Doors have only been subject to maintenance by qualified engineers. Engineers have developed for themselves the necessary tools to
maintain and preserve the structures that they have built into the city. My approach lies in introducing a slight shift of context to these tools, altering their character from being control-monitoring tools to authoring-collaborative tools, the user’s relationship with these machines would change from one of taming the door to expressing with the door.

Three guest creatives were invited to attempt creating contents with the developed tools, throughout the process, we learned of their individual working styles in which they preferred to craft out their works. As they became familiar with the specific character of the Door, we also collected insights into improving the software tools. With an assortment of door-contents now in our inventory, we presented the Projection Door Experience in its complete but still to-be-refined form back to our partner, Nabtesco, who were curious to see what had become of their familiar product. The prospects of the Projection Door’s commercial implementation prompted discussions with industries who showed interest in materializing the prototype within in an urban context.

This attempt to re-situate the Automatic Door into a potential component for urban re-conditioning aims to foster an environment whereby stakeholders from cross-cutting fields can assemble and discuss their needs in relation to the Projection Door, enriching the diversity in dialogue behind each door-content that is to be published. Content Designers, Automatic Door Providers and Building owners can all take part influencing the process regarding the future of a building and have their interests addressed. Only with such interdisciplinary efforts can this contemporary practice of re-engineering be distributed to the urban surface, no longer exercised within the scope of the maintenance of a single machine.

1.5 Structure of this Paper

In Chapter 2, recent works will be introduced to broaden the scope of the research topic. Similarities and differences will be discussed, deriving insights from a variety of disciplines while positioning my work amongst them.

Chapter 3 will describe the Projection Door Authoring Tools in further detail while revealing the design process that led up to its current prototype.

In Chapter 4, the guest creatives who were invited to develop contents for our Projection Door are introduced. Their voices are brought together along with the feedback received from the Nabtesco team to evaluate the effectiveness of the Authoring Tools.
Finally in Chapter 5, I hope to discuss the potential steps that Nabtesco may take in the future to facilitate society on a whole new paradigm in relation to the findings collected throughout the research.

Notes

1 “Nabtesco Corporation home page” accessed June 2015

2 “Nabtesco Nabco home page” accessed June 2015
https://nabco.nabtesco.com/en/

3 “Nabco-chan CM page” accessed June 2015
https://nabco.nabtesco.com/about/ad/ad2014/


5 “Urban Prototyping home page” accessed June 2015
http://urbanprototyping.org


12 Sato, Chihiro. “Adaptive passage in a shopping mall: calling to drive customers into stores and encourage shopping.” 2013. (Sato 2013)

http://yugop.com

“Processing home page” accessed July 2015
https://www.processing.org


“Framed*2.0 Kickstarter page” accessed July 2015


“Night Lights introduction page” accessed June 2015
http://www.yesyesno.com/night-lights/


Chapter 2
Related Works

This research explores how the role of Automatic Doors in the city can be extended by bringing a slight shift in context to the maintenance-control tools used primarily by qualified engineers, re-modeling them into authoring-collaborative tools operatable by creative citizens who may begin improving the quality of the cityscape through the practice of prototyping contents for the Projection Door.

This literature review will draw upon interventions and studies coming from the fields of Media Architecture, Content Development Platforms and Automatic Door Research to back up my investigation.

In the first section, urban interventions in the form of media architecture initiated by various groups will be introduced, we will look into the ways in which they change the way a city is experienced.

The second section focuses on custom software tools and development platforms that have recently been emerging. We will look into the way they shape the working process of creatives and the way their works are ported into different contexts.

Finally, the third section gives an account of ongoing research concerning Automated Doors, defining main concerns in the field while addressing limitations in this niche that could be expanded upon.

2.1 Media Architecture

As computing take refuge from the desktop and begin to settle in our environments, the urban surface is becoming increasingly populated with digital manifestations\(^1\). In recent years many works conceived by artists, designers and architects have been intersecting in the form of Media Architecture. This section introduces a few artifacts that have been realized.
Sniff

Sniff\textsuperscript{2} is an interactive store front projection conceived by Karolina Sobecka with James George in charge of software development. The installation consists of an animated dog that resides within the window of storefronts. The dog appears to be playful, stimulated by the presence and activity of viewers that pass by in proximity to the shop. Though the movement of the dog is confined to the shop window’s dimension, nevertheless it manages to recognize the audience’s position in relation to itself and is attracted towards its target. The dog engages with the viewer with multiple dynamic gestures changing in accordance to the activity levels and gestures of the audiences. This set up catches the attention of by passers with a simple motif of a CG dog, assuming an alternative window shopping experience for the sidewalk.

This work is made possible by the software combination of OpenFrameworks\textsuperscript{3} and Unity3d\textsuperscript{4}, monitoring the gestures and precise position of the audiences while interpreting their actions as either inviting or threatening. The sensing system of the work makes use of infrared lights and a camera that can discern the levels to deduce position of the audience. The reaction of the dog is one that is involved in a learning process, taking in sensed information and adjusting itself to deliver appropriate reactions referencing to the history of its actions. This is the basis of its life-like quality that sets it apart from the reactive encounters such as an experience of conventional Automatic Doors.

Sniff is an example of artists using technology to conceive of alternate interactions in the context of a city. The context of its deployment brings out the effectiveness of this simple work. Interacting with computer generated images emotively in public where others can observe you performing the act is the crucial public experiment brought up by this work. However, if the creators insist on the work being situated at the context of the store front, one weakness would be the work’s failure to address the fact that a store consists of an inside as well, currently the focus remains on the outbound spectacle.

SMSlingshot

Though most examples of media architectures prefer to retain their ambience within the urban landscape, there are also those that actively seek to engage with the built environment\textsuperscript{5}.

SMSlingshot is an urban intervention in the form of an interactive media facade
developed by the group VR/URBAN\textsuperscript{6}. The project was based on an earlier project in the name of Spread.gun\textsuperscript{7}. The purpose of the intervention was to enable the public to ‘speak up’ and plaster new cultural meaning on to building surfaces in a bi-directional communication that temporarily replaced the uni-directional mode of communication characterizing commercial application of display spaces. The intervention has been re-created in various occasions such as art festivals, indoor exhibitions, conferences and award ceremonies, the creators had to reconfigure the technical setup to adapt to each spatial setting in order to effectively deploy it in multiple instances of the wild.

The user participated by picking up a custom built slingshot with a keypad embedded in its handle, ‘loading’ the slingshot by keying in messages, aiming the sling at the dedicated building and finally releasing the elastic to hurl his message onto the site of the media facade. The result was a projected splatter that held the user-generated message at its kernel. The intervention created a dynamic situation where surrounding spaces constantly mutates in character as people shift in and out of being participants, fostering an environment which the creators call ‘shared encounters’, an urban state that resembles the Situationist’s interpretation of unitary urbanism as “a terrain of participatory games” where architecture, time and space are malleable through the pedestrian’s re-imagination of the city\textsuperscript{8}.

This project was successful in demonstrating how an interactive media facade enables us to appropriate our urban surfaces, observing alternative modes of inter-citizen relations that unravel as a result of it. However the nature of it as an one-off urban performance limits its effectiveness in reaching its long term goal claiming to enable the voice of citizens. Motifs such as the splatter may bring to mind the tactical mindset of the graffiti artist\textsuperscript{9}, but this connotation remains only at the symbolic level. Perhaps the goal of voicing citizen concerns take more than motifs of subversion and text messages.

What does it mean for citizens to impact the way urban landscapes are planned out from a bottom up level? The creators of this work understands the importance of stakeholder relations in undermining the feasibility of the work. However, if citizens are to ‘participate’, they should do it with total recognition of the underlying decisions, and should be made part of the negotiating process that leads up to the realization of a work rather than voluntarily generating “user-generated content” which is easily exploitable as cultural capital these days.
Soundful AdaptivePassage

Visualization of building surfaces is not the only approach to drafting Media Architectures, location-aware computing has enabled the development of spatial auditory experiences to be implanted into public spaces\textsuperscript{10}, we now turn to an example that transplants a multi-dimensional sound system into the innards of buildings.

Soundful AdaptivePassage is the auditorial variation of the AdaptivePassage model put forward by researcher/pianist Chihiro Sato\textsuperscript{11}. Her research overlays an additional layer of phantasmagoric sonic emissions onto the brick-and-mortar of a conventional shopping mall in Japan\textsuperscript{12}. The research aimed to investigate the irrational impulses of shoppers when met with stimulations from the environment. The intervention took place in “Heart Avenue”, a rather reserved portion of the shopping mall that served primarily as a transitional passage. The setup involved embedding custom sensor modules into the mall environment that would recognize the direction in which shoppers were moving and deduce the appropriate timings in which sounds are played to draw in the potential customer.

When customers approached the re-furnished Heart Avenue, they would be ambushed by sounds without knowing where the source was coming from, those
showed interest would be met with the second tier of sounds which gradually led them into the store for further exploration. The project was conducted in collaboration with actual Shopping Mall producers, the researchers were able to gain access to tenants within the mall and undergo analysis along with them concerning the shopping behavior of customers and situation of sales persons.

For Shopping Malls who wished to re-vitalize themselves every once in a while, the Soundful AdaptivePassage provided an alternative to full-scale renovations which may prove to be inefficient. Instead, this intervention has added an additional layer of meaning through sound, which can be easily swapped out for another metaphor with a new set of contents. Unlike media facades which form an outer shell for buildings, by modifying existing infrastructures, this research provides shopping malls with an internal lining, cushioning on healthy shopping atmospheres.

### 2.2 Content Development Platforms

Developing software that enables others does not end at the result of useful tools or platforms, rather it advocates one’s stance in relation to whole ecosystems or users, providers and developers\(^\text{13}\). This section illustrates the various intentions behind each endeavor to code services that would impact the way in which creators conceive of works.

#### LightSet

The creators of LightSet\(^\text{14}\) had in mind to support urban prototyping activities that were in its stage of infancy. Inspired by the array of rapid prototyping machinery available, they decided that media facades too ought to have a set of easily accessible kits that supported preliminary tests, so that early ideas can be communicated to multiple stakeholders. For the Urban Prototyping movement it was important that ideas are distributed and evaluated socially in the wild, even if they are still under construction.

The set of tools comprised of hardware and software elements. The hardware component included LED strands that were easily malleable into assuming any form, with a controller to feed in signals to the LEDs, while the software component consisted of a Java powered control unit with a built in graphic user interface(GUI). To begin prototyping, the user would mould the bendable LED
mesh into his preferred shape, usually in relation to a model or an actual construct as the researchers themselves did in their evaluation tests. Once the shape of the LED strands are prepared, the user starts up the software and uses a paint tool to highlight the area in which LEDs are to be activated and made controllable.

To test out the effectiveness of LightSet, the researchers organized a workshop in which students participated to create custom contents for the entrance of a certain building. The researchers emphasize that no knowledge of coding is required in order to use the software, it is intended to be a barrier-free platform. For this purpose three interfaces are provided. A Gesture Painter, a Visual Turntable and an Interactive Lighter. These three interfaces are linked up with the software to trigger corresponding changes in RGB values in the LED modules. As a result, participants were able to improvise contents with body movements while using familiar tools.

The participants reacted with both positive and negative comments. Some reveal that after an initial period of exploration the content quickly becomes saturated. However the researchers report a strong demand by the participants to create individual content, save it and share it with others. This results from this research was carried on by another project under the name of Orkestra which combined rapid prototyping tools and techniques described in LightSet to create hybrid mock ups of potential media architecture that Nakanishi et al\textsuperscript{15} also advocated with his CityCompiler prototyping tool for space design.

The Media Facade Toolkit

The Media Facade Toolkit\textsuperscript{16} is another attempt at streamlining the strenuous process of prototyping and implementing media facades in both virtual and physical environments. Unlike the LightSet which aims to provide novices a barrier-free environment, this toolkit targeted at existing professionals is made with the intent of becoming a universal design tool in the media facade community. Drawing from the 8 challenges encountered in designing media facades put forward by Dalsgaard\textsuperscript{17}, the developers aimed to address as much of the 8 concerns as possible through providing detailed calculations that accounts for possible environmental factors derived from the scenery, remedying the content accordingly through using appropriate shaders.

The software contains 7 main modules, each of them having a unique function that can be attached or removed. The Interaction module is in charge of intaking
inputs and distributing it to application modules. The Application module contain the visual contents that are loaded into the program. The Media Facade module transforms the visual output of the application modules into specified dimensions. The visual appearance of the output will be mapped onto the media facade as a texture, which means that 2D images can take on the qualities and perspectives and exist in the form of 3D. The Model application is a 3D model of the building concerned, where the user can define portions of the 3D model as potential media facades which will hold application modules. The 3D representation can include the scenery and surrounding of the building as well so obstructions can be taken to account of. The Rendering module always exist and form the main loop of the program, assigning applications to media facade buffers while invoking listeners that take in input and carry out the simulation. Lastly there is the User Interface module where users can easily add applications and inputs while seeing a visual representation of their current model.

Developers and Professionals were invited to create content with the Toolkit, they reported positive comments about the ease of use of the application module which enabled users to quickly try out multiple contents without having to reconfigure their original media files. Others liked the ability to model the surrounding of the building that simulated multiple scenarios.

**Framed*2.0**

Apart from contributions from academia, businessmen have also partnered up with content creators to cultivate an approach to the understanding of digital arts. Electric Objects\textsuperscript{18} is an interior device that allows digital pieces of art works to exist under home environments in an ambient manner. The creators of the device believe that digital works that are only available on the internet should be made available for appreciation at home, and should be a device that takes on an existence that resides in the backdrop of your home as a piece of calm technology\textsuperscript{19} that has found its way into the home, not being overly obnoxious but allowing the user to attend to it when they feel the need to. This platform provides a new way for the works of graphical artists to be experienced by users.

Framed*2.0\textsuperscript{20} conceived by Yugo Nakamura, a creator of interactive web contents, with his partner William Lai is a similar product in the same form as an interior device though having a different conception. Framed*2.0 hopes not only to create a device for enjoying art at home but spent their efforts in conceiving a
new platform in which digital art works can be made, circulated, interacted with and collected. This is a new format in which creators of digital pieces of interactive works can be indulging in. The Framed*2.0 platform supports digital media of many different formats as well including gif, movie files, animations, flash, processing, open frameworks and more. This is an important factor allowing creators with differing skill sets to be able to create contents for the platform.

This new framework reminds us of the period in the 90’s when Flash Creators were a community of prolific content creators that were fascinated with the potential of the world wide web. Nowadays where the basic literacy of creative coding has been picked up by increasing number of hobbyists, this platform would be a unique venture where the source of excitement won’t be focused on features of the platform, rather the fascination of creators themselves in experimenting with a new way of dealing with digital art, will be fueling our excitement.

2.3 Research on Automatic Doors

However similar it looks to a flat transparent surface, the Automatic Door is not to be confused as a mere screen. It possesses the distinctive quality in being capable of performing the dual movements of opening and closing, the ability to do so places it in the category of Doors. Unlike screens and walls which can be defined at will, Automatic Doors are heavily situated facilities that exist primarily at entrances. They are the membranes that define the territorial boundaries between two separate places, and are assigned a certain etiquette that permits everyday events to proceed more easily. To design for such site specific pieces of equipment poses a specialized challenge in design. The anywhere-anything approach which characterizes a lot of the projection mapping initiatives nowadays does no justice to the context and results only in illuminated projectiles of extinguished meaning. Greenfield has emphasized that when harnessing the abilities of ubiquitous computing, there are consequences that one may not have intended in the first place. Therefore, it is important that we first understand the character of this screen-like structure and its ongoing challenges in the field of engineering and design before we proceed to exploit it as just another prey for the all-devouring glare of the projector.
Toward Intelligent Automatic Door Systems

The Automatic Door’s mechanism is constantly being updated by engineers who work behind the scenes to ensure that its seamless operation provides a safe yet convenient access for users. Recent research on Automatic Doors has been putting emphasis on developing customized sensors complementing the Door to make it increasingly intelligent. Tomizawa et al’s Intelligent Autonomous Door using SOKUIKI sensor\(^2\) is an example. The research seeks to minimize the unnecessary triggering of door openings in order to further enhance energy saving purposes, while calibrating the timing of the door’s opening to the speed and direction of the approaching user to avoid contact and collisions.

Nabtesco’s Intelligent Eco Automatic Door\(^3\) took a similar approach and configured the sliding speed, opening width and triggering timing of the Automatic Door to the walker’s approaching velocity. This strand of research develops novel hardware that provide additional sensing capabilities to conventional Automatic Door sensors while coming up with algorithms that are used specifically with the sensors. A key element to these algorithms are its capability to recognize more than presence, but also predict the intention of the walker as well.

Researchers in the engineering field see conventional sensors as something to be eventually replaced. When these sensors are finally applied for commercial use, they are marketed as eco-friendly solutions that further save costs for the building owner. However, we believe that this is not the only solution and if Automatic Door research is to be broadened, contributions from other disciplines may help to bring in new perspectives.

Automatic Door Gestures

Interaction designers have made a move. They show interest in the simple movements of the Automatic Door mechanism and set out to investigate how minor configurations to the automated act of opening and closing doors can be perceived as a gesturing action to bypassing and incoming pedestrians\(^2\). Without access to an Automatic Door system, they implemented field tests and simulated automated door-gestures using Wizard of Oz techniques. Their interest lie in testing the effectiveness of implicit modes of interactions\(^5\) without reliance on the use of explicit modes of deliverance such as speech or text based informative displays.

Ju uses the doorman is an example of how simple gestures such as eye contact, or the gripping of the door handle combined with a slight friendly smile can implic-
itly suggest a welcoming gesture. In addition to the affordance of the door handle of the entrance, the doorman communicates this potential action of entering to the potential customer through subtle gestures. This type of interaction that encourages joint actions reap important insights for situations in the city where the pedestrian in constant motion has only a brief span of time to catch fleeting cues from the environment saturated with explicit means of communication.

This study shows that the combination of simple movements to form door-trajectories has the capability to communicate a wide range of emotional reactions ranging from a sense of approachability, recognition, frustration and admiration. This brings to mind the initial awe that struck the observers of Heron’s Temple Doors created over two thousand years ago, when the steam powered Doors of a temple spread open to the priest’s ritualistic action of torching up the altar of worship. This study reminded us that phenomenon of automation itself can be interpreted with meanings depending on its context, the door’s opening and closing movements when fine tuned, can put a very different impression on us.

2.4 Contributions

This research contributes to the field of Automatic Doors by bringing in a new approach. Instead of treating the Automatic Door as a machine to be regularly controlled and monitored, an authoring environment can be built upon its existing infrastructure, enabling the Automatic Door to take on a new role in the city as an interface for shaping the built environment, a way in which our encounters with everyday spaces will take on new meanings. We insist on treating Automatic Doors not as another opportunity to project on screens, but as a transition node between places. McCullough mentions the importance of a place-centered approach when we intend to apply digital technologies onto architecture. This research contributes by developing a new format of content to be implemented on Projection Doors that recognizes the essential qualities of the Automatic Door.

Our project’s approach hopes to synthesize the interests of the Projection Door’s multiple stakeholders, facilitating them in developing new conditions for each other. The process involved in establishing these conditions will be valuable experiences that contribute to others who may wish to initiate similar collaborations touching upon the alteration of the built environment.

To materialize these contributions, a series of actions was taken by the researcher as a participant of the Tokimeki Automatic Door Project during the
period between October 2013 and March 2015. The next chapter will provide an explanation of the process.

Notes


8 Internationale Situationniste 3 (December 1959)


12 “iias Tsukuba home page” accessed June 2015 http://tsukuba.iias.jp


18 “Electric Objects home page” accessed June 2015
https://www.electricobjects.com


20 “Framed*2.0 home page” accessed June 2015
http://frm.fm/jp/


23 “Intelligent Eco Automatic Door product page” accessed June 2015
https://nabco.nabtesco.com/nabco-select/eco-door/


Chapter 3
Design Process

3.1 Concept

The researcher has developed an authoring tool for creators to develop contents for Projection Doors. The tool is a complementary software tool to the Projection Door system that enables the user to create “Door-Contents”. Door-Contents differ from conventional screen-based graphical contents in its capability to transform its shape in accordance to the opening and closing movements of the Automatic Door. They are also state sensitive, that is, the software recognizes the Projection Door’s current status as either: Fully Closed, Closed, Stopped, Opening, Fully Opened or Interrupted.

Since the authoring tool was developed based upon the foundation of Nabco’s motion-control technology, with the appropriate Projection Door hardware in place, the authoring tool is readily compatible with Nabco produced Automatic Doors, though at the moment only LOSCA models are supported.

Conventional Automatic Doors have infrared sensors installed either into the ceiling or protruding from its engine case, these sensors track the presence of approachers with a specific algorithm enabling it to identify precise locations that are being occupied by walkers. The user will be able to harness the ability of these sensors, one on each side of the door, to devise interactive experiences for the Projection Door.

The authoring tool is able to take on multiple variations to cater to the different skill sets that the user may possess. Two variations are used in this research, namely, ofxProjectionDoor and Hayakawa. ofxProjectionDoor is an openFrameworks(OF) library that can be used by users working under the OF environment. It is made for users who have a background in coding in the style of Processing’s setup-draw structure. Hayakawa, on the other hand is created for users who create their own video files and would like to see them loaded onto the door in the form...
of door-contents.

The following sections describe in detail the events and actions taken that led up to the completion of an alphaware of the authoring tools.

### 3.2 Developing Rapport with Nabco

In the beginning of the project, the researcher’s knowledge of Automatic Doors could be comparable to the average citizen. Without knowing how the mechanism actually worked, it was hard to draft out our ideas into working prototypes. This section explains how we employed iterative prototyping to develop rapport with both Nabco and their Automatic Doors, gradually understanding what it meant to be working with Automatic Doors.

#### Initial Prototyping

To kick off discussions we prototyped several Doors demonstrating our various approaches. These resulted in the Match up Door, Time Door and the Story Door.

- **The Match up Door.** See figure 3.1. aimed to convey the experience of using the Automatic Door as a gaming interface for people on both sides of the door. A simple game was proposed where the presence of users on each side of the door was represented by a circle that increased in size as they got closer to the door. When the two circles are matching in size, the circles would vibrate as if a certain chemical reaction was taking place which eventually triggered the opening of the door. If the two circles were not matched up properly, the door would not open for the user. This proposes an alternative use to conventional doors which is really more reactive that interactive.

- **The Time Door.** See figure 3.2. suggested a portal like experience where the walker felt transported from one time frame to another as they passed through the door. This was demonstrated by projecting an historic video of the exact location on the Automatic Door. As the Door opened the historic image/video vanishes, what remains is in view is the unchanged present.

- **The Story Door.** See figure 3.3. explored the capability of Automatic Doors acting as carriers of metaphorical entrances that was capable of hosting a range of themes. We designed several scenarios each having a simple sequence that triggered the animation to run whenever an approaching user was present.
Figure 3.1: Matchup Door Prototype

Figure 3.2: Time Door Prototype

Figure 3.3: Story Door Prototype
The common feature between these three prototypes was that they all made use of a projector to project images onto the door panels. It wasn’t long until we were confronted with a critical problem. Whenever the Door opened the image would be separated into two portions and the middle portion would disappear, due to the absence of surface in the opening gap.

We realized that this was a key characteristic of the Automatic Door that we would eventually have to work around. At this point, either an additional member was employed, manually controlling the opening and closing of the Door to match with the movement of the projected images, or we attempted to adjust the timing of the contents to move in coordination to the opening of the door. However the sliding movement of the door did not occur in a steady velocity. An initial acceleration, and a cushioning tailing that followed characterized its typical movement, therefore it was difficult to achieve perfect cohesion between the two. Although we managed to demonstrate our ideas to the Nabtesco team, it took a while for them to figure out what was going on due to the fragmented experience.

**Obtaining Resources**

To breach this challenge, it was necessary for us to consult the Nabtesco team for viable solutions. It turned out that they have custom built bluetooth modules in their inventory of tools that enabled them to monitor the position and states of the door. The door position data values obtained from the door represented the width of the opening gap, while the door state data values informed us whether the door was in a fully closed, closing, opening, or a fully open state. They granted us access to these information by lending us the aforementioned bluetooth module to aid us in our experiments.

With the availability of these data, collected through bluetooth and parsed into the computer into usable values, it enabled flexibility in the calibration of our images to the movement of the Automatic Door. However more importantly the process of parsing data coming from the bluetooth module enabled us to gain insight into the way Automatic Door engineers work with their machines through understanding the terminology and data they use to communicate amongst each other.

We integrated off the shelf technology along with the door values provided from Nabtesco to form a framework for these projection based works to operate upon. This consisted of 3 main modules. The main module was a Processing
Figure 3.4: Anpanman Door Prototype

Figure 3.5: Grateful Door Prototype
sketch that received and parsed serial data incoming from the bluetooth module, the second component was an Arduino Uno board that read in signals coming from an ultrasonic distance sensor and serially communicated it to the processing module. The Arduino was also in charge of sending triggers to the Automatic Door input terminal in order to respectively open, close or stop the door. The last and optional module was a Flash/ActionScript applet that enabled other members in the project to prototype contents for the door. The Processing sketch provides Flash/ActionScript with the door values, so that they can be used to shift the position of the image as well.

As a result, we were able to begin another round of prototyping which gave birth to two additional doors, the Anpanman Door. See figure 3.4. and the Grateful Door. See figure 3.5. These two prototypes explored how external interfaces and interactions along with projected images can be integrated into the experience of the Automatic Door. The Anpanman Door was another attempt at creating a game like experience, where a certain narrative was built into its sequence of actions. Based on the popular Japanese animation Anpanman, the Anpanman Door wished to let users take on the role of the main protagonist Anpanman where his main goal was to punch the trouble maker Baikinman and Dokinchan who are preventing the user from passing through the door.

The Grateful Door on the other hand had a “Saisenbako”\(^1\) attached to the Automatic Door, it encouraged the user to make donations that would trigger varied opening experiences. Depending on the amount of coins you donate through the Saisenbako, the projected image that depicted stained glasses, normally found in catholic churches, will alter its intensity in color before opening for the user.

In the final demonstration of the 2013 annual project year, we presented 4 working prototypes to the Nabtesco team. One of them was the Kumamon Door. See figure 3.6. Our team intended for the Kumamon Door to be a summarized statement of our trials and errors concerning the projection experiments. Its purpose was to demonstrate that by integrating the bluetooth module into our system, the projected images were finally able to glide along with the movement of the Automatic Door in cohesion, which enabled us to create contents for it that put forward simple metaphors such as a welcoming atmosphere provided by the motif of the joyful bear. The result was understood and Nabtesco saw that their technologies could be put to use in a different way. This framework marked the beginning of the Projection Door.

In conclusion, a first link was created by developing rapport with the Auto-
Figure 3.6: Demonstration of the Projection Door Concept
matic Door through prototyping iterations. With an understanding of what we wanted to achieve and by communicating these concerns to the engineers, they realize that their holding technologies can be put to use under a very different context. This initial inheritance of holding technologies formed an important milestone.

3.3 Reflections from the Wild

We intend for the Projection Door to be deployed in actual settings in the city. It is not an experiment that ends within the confines of the laboratory. This section will detail our attempts to move our results into the field, which meant to put the Projection Door under the inquisition of wild.

Konan Shock

Our prototyping was largely done with a mini-door provided to us by Nabtesco who use them for Automatic Door maintenance examinations. It is a stand alone machine that proves useful for sketching up quick ideas, though it is not capable of emulating a real environment.

In the summer of 2014, the researcher was given the opportunity to participate in a two week internship that took place in Nabtesco’s Konan Plant (甲南工場). The point of this internship was to carry out some initial trials in the context of a real-scale environment. We were assigned to an Automatic Door located at the entrance to the factory’s office section that was fitted with rear projection films on its door panels. We were set to carry out our tests on it on the second week of our stay.

As we set the ultra short throw projector in position, immediately we realized that this was not going to be a smooth transplant. Rather we had to devise a completely different projector setup in order to cover the whole door with projected images See figure 3.7. Due to the constraints in the environment, we were not able to use a single projector, instead we had to utilize two projectors, each covering one side of the door. Although we managed to find a fitting position for the projectors, we had to clear up the projectors as the day ended due to possibility of accidents. This made it difficult for us re re-create the set-up each day.
Prior to the internship, the researcher created a rough content that was given the name of “Logo Door”. It consisted of multiple Nabco logos that were shimmering while the door remained closed. When some one approached, the arrow shaped logos would rush to the side while increasing in size. When the door once again started to close, the logos returned to place, while decreasing in size, eventually settling to a subtle glow. The Logo Door was intended as a test sketch that would be implemented in the real-scale doors. The second issue appeared.

It became apparent to us that the software we have developed so far was suited only in the lab setting, we spent a lot of time struggling to calibrate our software to the unexpected change of projector setups, the intensity of the sunlight also prevented us from being able to clearly monitor the contents on the door. However the issue of most importance was that there was no formalized way of developing contents for the door, we could not easily adapt to the change in dimension of the door, especially since real Automatic Doors have the additional two panels which are called the Door Fixes occupying the spaces at each side of the Door, which was non existent in the mini-door environment. Secondly, it was difficult for more than one person to create contents for the door because the code was too specialized for the researcher himself.

As a summary to the trials at the internship, we got together in a meeting to discuss the issues that arisen out of our field test at the factory. Nabtesco’s
engineers put extensive focus on safety concerns and hardware limitations of the Projection Door such as the opacity of the rear projection screens causing potential collisions, and the tendency for the Projectors to blind the incoming user, causing uncomfortable entry. While, on the other hand, the researcher believes that the more apparent problem lies in the software and content development process. Even though an animator colleague was present with the researcher during the internship, she was not able to utilize her abilities to create contents on the spot. This motivated the researcher to begin thinking about questions such as: Who would develop contents for the Projection Door, and how exactly would they go about doing so.

Figure 3.8: Mini Logo Door: Closed

Figure 3.9: Mini Logo Door: Opening

Figure 3.10: Large Logo Door: Closed

Figure 3.11: Large Logo Door: Opening
Content Development Framework

The experience of developing contents at the internship felt like a bricolage where multiple elements were put together so that we would see immediate results. The researcher made a retreat and defined a vision to create an Authoring Tool that would enable multiple creators to be part of the content development process. They should be able take up a basic set of language that was specific to developing door-contents. The experience should be one where they could think in a first-person perspective from the door instead of imagining the door in third person as a canvas. Creators should be able to become the door.

The purpose was to create well defined variables and functions for the user so that they can understand how to orient the surface of the door while understanding its activity in relation to the environment.

The Three Classes

The re-construction of the software began by identifying the key elements of the Projection Door, the researcher categorized them into three components, the Door, the Sensor and the Screen. See figure 3.12. The researcher decided to create a class for each of these components so that data parsed in from the bluetooth module would be understandable in the context of the Projection Door.

The Door Class has data such as door position and door states encapsulated in it. It also included functions such as open(), close() and stop() which enables the user to control the door’s movements and decide when the door ought to make certain movements.

Nabtesco’s infrared sensors has the ability to locate exact position of approaching walkers within its sensing range in the form of a matrix grid, this data is also obtainable through the bluetooth module provided to us.Parsed data is allotted to the Sensor Class in the form of a two dimensional array which stores and updates the sensor grid in 100ms intervals. The class includes a function named checkSensorGrid(), which users can input arguments to check for presence in exact spots of the sensing area that is returned in the form of boolean values. The researcher has also abstracted the sensor values into three states of presences, which informs the user whether people are here, there or not present.

The Screen Class is an important class that is specific to the Projection Door. Its main purpose lies in orienting the user to different portions of the Projection Door’s surface, taking into account of individual sections such as the left fix, right
Figure 3.12: Initial System Sketches
fix, left door panel and right door panel. The user has to initialize the screen object with arguments that set up the shape of the door and its dimensions, also by inserting the width:height ratio of the door before the variables are calculated accordingly. The researcher has abstracted door position values into specialized variables such as screenposL and screenposR which are positions values that take into account of the moving door panels.

Three Components

The software included 3 main components. See figure 3.13. The first component is the User Sketch Class that was inspired by Processing’s Setup-Draw structure which provided an easy entry for the creator. The Door, Sensor and Screen Class are all included in the User Sketch, therefore the user can make use of all the functions and variables inside those classes. This sketch is where users initialize, declare and call functions that draw onto the screen and subsequently the Projection Door. The second component was the mini graphical interface where the user can keep track of the door’s current state and position as well as be informed of whether there are people around the door by visualizing the sensor grid values obtained from the door. The third component was the projection monitor which was displayed to the user on the computer screen, letting him know of what is being projected on the door at this moment. This component was made in order to address the difficulty where creators had to shift their bodies to the front of the door to check whether the Projection was correctly in position.

Two Modes

The software had 2 modes. See figure 3.14. “Real Mode” is used when the user is working with a physical Automatic Door, it automatically boots into this mode when there are serial values incoming from Nabco’s bluetooth module. When there are no serial values incoming from the bluetooth module, the software boots in “Virtual Mode”. In Real Mode, the Automatic Door’s movement is calibrated with the depicted canvas on the monitor, while in Virtual mode the user will also see a door-canvas depicted on his screen, he can hit input into the keyboard to trigger a simulation of the door’s opening and closing movements. This feature enables creators who have no access to Automatic Door units to be able to virtually simulate their contents, while those who had access to an Automatic Door unit could open and close the physical doors with the same keyboard inputs.
Figure 3.13: The Three Components

Figure 3.14: The Two Modes
Using Video as material

The researcher addressed the concern of video creators not being able to publish their contents by creating a simple solution that required users to create a video file for each state: Fully Closed, Closing, Opening, Fully Opened. Then split each file in the middle so that it became 2 separate files where one represented the left door panel, while the other represented the right panel. When a complete set was placed in the data folder of the application and named according to a specific manner as shown in figure., The content could be activated by typing in the folder name in which the segmented files are contained. The Hawk Door, was an example that was created with this method, it was only later that the researcher noticed the disabling element of this method and created an improved version based on the error which would be explained in the next section.

A Proposal

The subsection above gave a brief explanation to the components and elements that made up the authoring tool’s basic framework. The purpose of assembling a drafted framework was to initiate a proposal for developing a platform that extended the development process to members outside of the project. In order
to demonstrate the potential impact of the Projection Door Experience, having
the hardware prepared was not enough, the software component was equally as
important.

We built upon the resources granted to us in the first link and through actual
field tests, we recognized how these information should be re-modelled to be able
to fit in to the needs in the context of a creator developing contents for a door.
The second link is established by digesting the resources granted to us, grounding
it in the context of the Projection Door and presenting it back to the Nabtesco
team as authoring tools. See figure 3.16. so as to allow a new group of people
who are familiar with creative coding to take part in the process of developing
contents.

Technically, it demonstrated how Automatic Doors integrated with projected
images can be calibrated, controlled and modified through using personal comput-
ers. Though strategically, by owning this tool, Nabtesco can begin to deal with a
new group of stakeholders: Creators, who can be the suppliers of Door Contents
if they are provided with the appropriate tools.

Figure 3.16: Demonstration of the Content Development Platform Concept
3.4 Collaborative Development

With the basic framework of the authoring tools drafted out in pre-alpha, we had the means to invite actual creators to participate in a period of collaborative development that spanned a month's time. The researcher needed to look into how real creators outside of the lab environment created their works and whether the current framework was actually of valid use. This period was crucial for the transition of the framework into an actual tool that will be used to create contents.

Since the creators joined in, the development branched into two paths. One path pursued was targeted at creators who had background in coding graphical works and were familiar with the openFrameworks environment. While the other path was targeted at creators who were not familiar with coding practices but possess other skills such as video editing and post production techniques. This section will detail the features developed in each of the branches.

openFrameworks Addon

The first path, targeted at creators who had coding background, headed toward the goal of creating an openFrameworks Addon, which would enable the user to easily include the Authoring Tool into their application. It also lets the user to create Door-contents with the aid of other libraries and Addons which makes it a flexible format. The researcher was given helpful comments on how to improve the Authoring Tool by the creators who examined and used the code under Virtual Mode and eventually finished off in Real Mode.
**Realistic Simulations**

The creators expressed concern about the lack of realistic movements of the simulated door movement under Virtual Mode. The researcher responded to this by sampling positional values from the physical door into a .txt file. Two files were sampled. One of them for the opening motion, and the other for the closing motion. By including these files into the application and reading them in whenever the creators triggered the opening and closing of the door enabled an improved simulation of the door’s movement which made it easier for creators to imagine the contents as if it was being projected on a real door.

The researcher also included a simulated version of the door’s infrared sensor. The purpose of this feature was to give the creator a feeling for how potential users would approach the door, and how their presence in particular spots would affect the change in content displayed on the door. The researcher made use of a two dimensional array represented by squares which constantly compared the area they occupied with the coordinates of the mouse. Whenever the mouse’s position is detected to be matching or being rolled over, the square would disappear and return a boolean value that will be stored in another two dimensional array which is reference able by a function called checkSensorGrid(). In case of the Virtual Mode it will reference the mock two dimensional array controlled by the mouse. In case of the Real Mode, it will reference another two dimensional array formed by values collected through the bluetooth module.

**ofLerp Smoothing**

The creators recognized in the Real Mode that there appears to be a noticeable latency as the graphical door panel tries to keep up with the physical door panel. In the Virtual Mode it appears as a rough sliding motion. The researcher initially thought that it could be related to the fact that the bluetooth serial values were first parsed in by a Processing application before sending the parsed values through to openFrameworks by the OSC Protocol. However through the process of elimination, the researcher realized that the fundamental problem lies in the fact that the bluetooth module was transmitting data values in 100ms intervals. This equates to a maximum support of 10 frames per second(fps), while the creators preferred to work under conditions of 60fps.

Since the solution could not be provided to us from the hardware side of the module, the researcher made use of the function ofLerp from the ofMath library
Figure 3.18: A Virtual Door Opened with the Sensor Simulator
included in openFrameworks to carry out the process of fitting in 5 mock values between each value pair that was received through the module. Every time a value was received, the program would check the interval between the previous value. Depending on the size of the interval the program would deduce 5 incrementing values and append it onto the current value. This is done in a frequency of 60fps. The result was smoothing effect as the door opened and closed. Though less appearing to stutter less, there remained a noticeable latency.

**Video Arrangement Tool**

The second path targeted at creators who did not have a background in coding, and aimed to provide an application where the creator could create his contents under his own comfortable software environment and use the video output of those works as components that could be mixed, arranged and juxtaposed to create Door-contents in this way.

**Take Home Software**

The researcher designed a light weight take home software programmed by Processing that served the purpose of introducing to the creator the concept of a Door-content. The software took in video files slicing them into four portions that represented the left fix, left door panel, right door panel and right fix respectively. When the user pressed the assigned open key on the keyboard the left door panel and the right door panel will slide apart. When the user pressed the assigned close key on the keyboard, they would slide back in place to the middle. The user would prepare 4 video files named according to the state in which they wished for the video to be displayed. Eg. closed.mov, closing.mov, opening.mov and opened.mov. The program automatically exchanged the videos to perform the slicing function on, and displayed the video file that corresponded to the current state. Specific aspect ratios and formats are standardized after having measured the dimensions of the physical Automatic Door in our lab.

**Hayakawa**

While the aforementioned Take Home Software served as a light weight sketch, the researcher developed a similar application under the openFrameworks environment. This was necessary since the Processing environment did not perform
particular well when dealing with video files. The openFrameworks environment though did not have the same PImage class included in its library, therefore it required the researcher to re-write the function under a relatively lower level context. This involved reading the pixels as a linear sequence, slicing the portions out at the pixel level instead of defining a rectangular area which was possible under the Processing environment. However, after accomplishing this feat, the performance of video playback and exchange was drastically increased.

Similarly the user would prepare 4 videos each named according to the state in which they wished for it to be played according to a standardized aspect ratio and format and stored them into a directory under a name that the user decides to name his content with. This directory would be referred to as a content set. The user would then load up the openFrameworks application and run the code. A simple console based interface asked the user which content he would like to display onto the door. As the user accumulates multiple content sets, he can store them all into the bin folder of the application. When the user entered the content name, the program will search the database for the directory of the same name and start running the Door-content on the door. This application was named after the creator it was tailored for. A detailed account of our exchange will be provided in the next chapter.
Interrupts and Roulettes

In order to provide additional expressions to the limited four video format which formed the basis of the Video Arrangement Tool, the researcher attempted to create new conditions for the creator to extend out of the four states. The “interrupt” state was added as an additional 5th state in which the creator can make videos for. This state referred to the moment when the Automatic Door is trying to come to a close but is met with an incoming presence which causes it to re-open once again. Although not listed as one of the official states in the Automatic Door engineer’s vocabulary, it is nevertheless a common phenomenon in everyday usage. Therefore the researcher decided that it should be included as a usable state.

Apart from devising additional states, a second way to extend the possibility of the Hayakawa Tool was to introduce indeterminacy to it. Instead of having a fixed set of contents, the roulettes feature enabled the user to include multiple content sets each containing the four essential video files. The program could access different content sets each time the door was opened so that in situations where there are revisiting walkers, they will not experience the same sequence of Door-contents over and over again. The condition to switch between content sets can be further programmed to suit the creator’s requests.
Figure 3.20: Appearance of the Hayakawa Tool
Interrupt State

Triggers when Door is caused to Open while it is in the middle of closing.

Figure 3.21: Interrupt State of the Hayakawa Tool
3.5 From Control-Maintenance to Authoring Tools

We have come a long way since the first parsing of data incoming from the Automatic Door. We were given access to information that was originally intended for control-maintenance purposes. Through the process of prototyping, surveying and collaborating we have re-situated these values into a different context of use. This process documents the actions and events that transformed the “door position”, “door state”, “sensor area information” into key components that make up and drive Door-Contents.

It was interesting to see how the nature of engineering tools differ from the reference of graphical creators. A clear example would be the offLerp Smoothing reconfiguration that the researcher had to attempt, another example would be the “interrupt” state developed as a means to develop expression methods for the Hayakawa tool. Engineers have equipped themselves with vital tools to carry out their everyday missions, what type of tools do we need to re-engineer urban landscapes, is the question. Through the process of developing Authoring Tools, we are just beginning to find out. The conditions are prepared. What remains is to develop actual contents with the tool.
Figure 3.22: The Projection Door System Map circa March 2015
Notes

1 A religious item found in Buddhist temples and Shinto Shrines in the shape of a box, used to collect offerings. A grated design is applied for the prevention of cases of theft, though as a bonus affect, a pleasant wooden sound accompanies each offering as the coin tumbles down.
Chapter 4
Door-Content Curation

The preceding chapter detailed how we established the conditions for our three guest creatives to participate in the Projection Door’s content development process though a series of actions. This chapter recounts the researcher’s facilitation of each creator toward the completion of select door-contents, and how our team managed to bridge their works to other stakeholders of the Projection Door.

4.1 Animator

Hayakawa-san is an Animator/Filmmaker who animates the organic through digital techniques. His distinctive style originates from a delicate hand-crafted approach to delivering abstracted surges of rouge passion. Lately he has been exploring the potential impact of his oeuvre on other fields such as design and education. Having organized creative workshops for high-school children, he brings out the essential joy of “frame-advancing” and shares it with the next generation of creators-to-be. As an animator, not only is he insistent on expressing himself through his works, but places equal importance in advancing his art through social engagement. Between the months of February and March 2015, Hayakawa-san made 6 weekly visits to our laboratory. This section describes our ongoing exchanges leading up to the completion of the door-contents: 出雲の風景, Future Parade, 曼荼羅色相環 and 四種盛稲.

Prior to the first encounter with Hayakawa-san, the researcher focused mainly on developing an environment that targeted creators who had knowledge of coding graphical contents, and only addressed non-coders with an optional function for video files to be used. In order for the images to move along to the Automatic Door’s motions, the user was required to split his videos into left and right portions. Only through discussions with Hayakawa-san did the researcher realize that this extra step was almost incapacitating for the artist who worked with video,
for not only would he have to work with irregular aspect ratios that were not optimized with conventional video editing tools, it also burdened the creator by demanding that he slice up his work into 4 parts that distracted him from the creation of the intended piece.

It was fortunate that the Authoring Tools did not have a determined format during our first encounter. The researcher was able to shift into the perspective of an animator and begin to negotiate ways that would enable Hayakawa-san to step in to the development process. It was clear that the Authoring Tools could not have been effectively developed without the participation of actual users.

What was needed was for Hayakawa-san to understand that creating contents for the door is a feat incomparable with producing content that are intended for conventional screens. On the other hand, the researcher had to come to terms with the capabilities of the creator and enable him to be aware of the medium’s characteristic without inhibiting his ability to express himself. Such a balance had to be established as a pre-requisite for productive discussions.

During Hayakawa-san’s second visit to our lab, he prepared a directory in which he stored an assortment of previous works. Addressing the issues raised in the first meeting, the researcher created a working software draft that performed the action of dissecting a video into four independent sections that referred to the left fix, left panel, right panel and the right fix respectively. The left and right
panel would shift in position corresponding to the door position values received from the Automatic Door’s bluetooth module, making the video resemble the proportions of an automatic door. Secondly, whenever the door’s state is changed, the software looks for a different video file to carry out the dissection. The four basic states: Fully Closed, Closing, Opening and Fully Opened implies that there are at least four videos that the software can alternate from.

Figure 4.2: Examining Contents on the Mini and Real-Scale Projection Door

Hayakawa-san stated which videos he wanted to show in each specific state, then the researcher would combine the four videos as a set and implement the program. The result would be published onto the door and the process was iterated many times to run through different combinations of video files that Hayakawa-san has prepared for the occasion. During this visit, he was surprised at the way the Automatic Door governed a limitation upon his contents by its tendency to break apart and come together again. Though no cohesive contents arisen out of this second encounter, Hayakawa-san seemed to begin to understand how he was going to approach the medium. As a parting note, the researcher installed the software into Hayakawa-san’s computer so he could put together videos at home and simulate door-contents virtually through a custom software that emulated an Automatic Door’s movements. The researcher also established a common understanding with Hayakawa-san concerning the format, aspect ratio, codec and resolution of the video files that are to be used. The specification was provided to him in the form of a document which he took home along with the drafted tool.

By the third encounter Hayakawa-san came to our lab with the video files already categorized into sets. He prepared four door-content sets that are to
be tested with the Automatic Door. This time our discussion involved less talk about the mechanism but moved toward what the creator himself wanted to create. Running through his four door-content sets our team also began to realize that Hayakawa-san had a preference for creating with strong colors especially in red. Though Hayakawa-san tended to create works that are highly detailed marinated with subtle fluctuations, we came to the conclusion that larger movements were more effective at the moment when the door opened, while muted changes could work well when the door was ambiently standing by for potential approachers. We suggested that he try creating a content with the motif of a mandala in mind where visual gravitation concentrated at the center when the door is standing by; expanding to the periphery as the door slid open.

![Figure 4.3: Hayakawa-san Arranging his Door-Contents](image)

In the fourth encounter we began to narrow the number of contents to a selected few to improve upon them. Together we decided to put emphasis on developing the experience of Izumo, Mandala and Future Boys. Izumo illustrated the landscapes of the city of the same name. One felt like it was a heated summer day when looking from afar, though once approached, the door opened with an additional layer of leaves breezing by, adding to the swiftness of the sliding motion. The Mandala felt as if the door was continually charging and accumulat-
ing, changing in patterns as the door reached different states. Future Boys was selected for its simple glittering, increasing in intensity as the door opened and reclined to a rather muted glow as it returned to a closed state. Hayakawa-san was concerned about the transitions and noticeable glitches as one video file was swapped to another, while we were concerned about the selection of colors that may have hindered the effectiveness of some of the contents. By now we could respond to each other’s requests as we gradually understood how the other party carried out their work.

During the fifth encounter, Hayakawa-san was arranging and orchestrating the door-contents by himself. Apart from the 4 videos that referred to each Door state he prepared an option directory that stored video files that he wishes to test out in his visit. The researcher suggested that there are other expressions available as well if he wishes to try it out. 2 additional expressions have been created. The first one is an additional “Interrupt” state which describes the occasion when the Automatic Door is in the process of coming to a close, but is suddenly met with an incoming walker which causes the Door to slide open again. This is a fifth state in which Hayakawa-san can make use of if he wishes. The second expression is the roulette, which enables the user to store 4 sets of door-contents into one application. The Projection Door will have a different set of opening and closing animation sequences each time it is met with an approaching user. This extends the experience to an indeterminate one and is demonstrated in Hayakawa-san’s 四種盛襟.
Figure 4.4: *Future Parade* (Closed, Opening, Closing)
Figure 4.5: 曼荼羅色相環 (Closed, Opening, Closing)
Figure 4.6: 出雲の風景 (Closed, Opening, Closing)
Figure 4.7: 四種盛襟 (Closed, Opening var. 1, Opening var. 2)
4.2 Creative Coder

Tadokoro-san is a prolific Creative Coder who has been contributing to Japan’s Creative Coding community through creating a significant amount of works and consistently unearthing current issues related to the practice of coding. His website www.yoppa.com is a platform where emerging artists can learn about a variety of code-related topics through his resourceful archive of online lectures. His work synthesizes the organic with algorithms to create graphical and auditorial expressions. Through a command of a wide range of programming languages he is able to traverse multiple platforms, tinkering at will within the software sphere. This section describes our ongoing exchanges leading up to the completion of the door-contents: 松格子, Colorful Rounds, Yellow Swirl, Firewall and Logo Waves.

Since the first startup meeting where the researcher introduced the basic framework of the Authoring Tools, collaboration with Tadokoro-san took place primarily through the online hosting service BitBucket which provided a Git revision control system. We created a repository where the code for the initial framework was shared between us. As Tadokoro-san did not begin creating contents immediately after we first met, the researcher had time to address some of the requests made by Tadokoro-san during the first meeting.
The activities BitBucket commenced on the 8th of February and lasted until the 18th of March. Early it consisted of the researcher adding functions that aided Tadokoro-san’s usage of the software in “Virtual Mode” (without physical door). This involved developing a simulation of the Automatic Door sensor with the cursor as an interface to occupy locations within the sensor’s range. Secondly, after having sampled the Automatic Door’s change in position as it opened and closed, these logged values were saved as a reference within the bin directory of the openFrameworks application. This enabled Tadokoro-san to simulate the actual opening and closing movements on his own laptop.

![Figure 4.9: BitBucket Commit History](image)

As these conditions were met, Tadokoro-san also commenced his content development. As he worked on the code the updates are pushed on the repository. During the third week of February, our team was setting up a dedicated computer that acted as the control desk for the Projection Door. The researcher pulls latest updates from Tadokoro-san written in the Virtual Mode environment, and implements it with the physical door under the Real Mode environment. Apart from a few changes that adapted the door ratio from the mini door setting to the real-scale door setting, the program successfully compiled. The researcher then records a video of the contents in action with the real movements of the door, returning the results to Tadokoro-san.

The reference Real Mode videos gave Tadokoro-san an impression of the im-
mense difference between developing in Virtual Mode and Real Mode. In his next visit, he came fully prepared with multiple contents written in the Virtual Mode environment, with the intention of testing them personally through “Real Mode”. Tadokoro-san’s contents made use of the door position values as a dependent variable that demonstrated the dynamics of the Automatic Door movements through extensive use of the Google developed LiquidFun fluid simulator that was appropriated into openFrameworks use by Tadokoro-san himself.

Our team suggested that apart from particles that demonstrated the force of the Automatic Door’s movement, perhaps symbolic signs could be included into the visualization. As a result, Tadokoro-san modified his code to accommodate spherical objects that could contain image files as textures. Our team experimented by providing Tadokoro-san with spherical instances of Keio Media Design’s logo in its multiple official colors. Tadokoro-san’s concept of the fluid-wave was put into a new context as logo-wave, enabling it to take on multiple identities as a general template for door-contents.

While Tadokoro-san continued to create contents, the researcher attempted to
tackle the prevailing defect where the maximum supported frame rate supported by the bluetooth module remained only at 10fps. Although the graphical elements of Tadokoro-san’s contents were not affected by the reduced frame rate, the door panels calibrated to the bluetooth obtained door position values continued to move under a visible latency. Even though the differences are little, it nevertheless affected the smoothness of the physics in simulation, resulting in a stuttering jitter that can be noticed especially when a preview is being displayed on the monitor.

The researcher consulted the engineers in Nabtesco and asked if there could be a bluetooth module supplied to us that would support 20ms cycle transfers which would enable a 50fps resolution. We were informed that it was not feasible, hence the researcher took actions on the software level (see section 3.4 ofLerp smoothing).

Nearing the end of the development process, Tadokoro-san summarized the changes to the basic framework so far and packaged the result into an Addon. This format made it easier for openFrameworks users to include the tool into their application along with other Addons which may be used. The researcher later learnt that this was an important etiquette for openFrameworks users. Giving back to the community what you have developed with the tools that others have provided you also strengthens the philosophy of the openFrameworks platform as a “glue” that encourages wrapping together diverse libraries to make things happen.
Figure 4.11: 市松格子 (Closed, Opening, Fully Opened)
Figure 4.12: *Colorful Rounds* (Closed, Fully Opened)
Figure 4.13: Yellow Swirl (Closed, Opening, Fully Opened)
Figure 4.14: *Firewall* (Closed, Fully Opened, Closing)
Figure 4.15: *Logowave KMD Version* (Closed, Opening, Fully Opened)
Figure 4.16: Logowave NTS Version (Closed, Opening)
4.3 Installation Artist

Fujimoto-san is an interdisciplinary artist operating within the fields of art, physics and engineering. He has once been a programmer of interactive contents and a developer of digital signages. Since 2009, he has been participating in collaborations with other artists in contexts that range from gallery exhibitions, public interactive events and live performances. He has also co-authored books teaching about Arduino and Computer Vision techniques. His recent work *Immersive Shadow* creates an environment that extends the audiences’ limbs into shadows that interact with projected contents. It has been implemented in several situations. This section describes our ongoing exchanges leading up to the completion of the door-content: Ball Drop.

Since most of the changes to the original framework of the Authoring Tool was already made in the BitBucket exchange with Tadokoro-san, Fujimoto-san was able to use the ofxProjectionDoor openFrameworks Addon to begin creating contents directly with the physical Projection Door. He spent one afternoon creating the content Ball Drop which made use of the mechanism of *Immersive Shadow* to create a door-content version of it. Fujimoto-san was particular about the way his objects were affected by the movements of the door. In combination with ofxProjectionDoor, he glued together other Addons to his openFrameworks application, one of these was the Box2D physics engine\(^3\). He spent time fine-tuning the physics component of his graphical objects. In contrast to the original *Immersive Shadow* the Projection Door version did not make use of the computer vision element that mapped the shadow of the user onto the work. Colorful balls fell from the ceiling and they were launched up into the air when a user approached.

In Fujimoto-san’s case it was a process of transforming his previous work into the format of the door-content, which meant that he also met with the wrath of the “splitting screen”. Hayakawa-san had multiple visits which enabled him to carry out several build-to-think iterations to gradually make sense of the splitting screen and contextualize his animations to the situation. Perhaps Fujimoto-san found some difficulty in transferring a screen-based work into a door-based work. This is insightful to the researcher since it shows fundamental differences between the two approaches. The aesthetic of the door-content should be investigated from bottom up, gathering difficulties faced in order to discover a different mode of thought to developing contents for the Projection Door. The researcher has been aware of this problem since the early stages of the project while he was working on
Figure 4.17: Fujimoto-san Testing the Parameters of the Physics Engine
the “Match-up Door”. Seeing the same challenge being faced by other creators, made it apparent the challenges characterizing the format of the door-content.

The researcher suggested that instead of focusing on the movements of the door, interactions can also be devised through the use of the sensor functions. It seemed as if Fujimoto-san placed importance on the physics of the work. Having little knowledge about the workings of physics engines, through watching spherical objects, the researcher imagines that the inertia of the colored balls could be charged as people are around the door and should appear to be compressing, when people finally get close enough, the charged inertia will cause it to launch out to both sides along with the sliding of the door panels. Through this process, colored balls will get lost beyond the Projection Door’s frame of scope, but it won’t be long before a new batch of colored balls are dispatched from the ceiling again, resembling a sort of imaginary sphere generator that is virtually hidden in the Automatic Door’s engine case. Due to the limited ability of the researcher to speak in coherent Japanese he could not convey the suggestion to Fujimoto-san, though in the end Fujimoto-san understood that he could make use of the sensor’s values to cause a subtle vibration to the spheres implying an eventual launch if one came closer.

Finally Fujimoto-san applied a Max/MSP patch that he created and informed me that the patch was to be booted up every time before running the openFrameworks application that contained the door-content. The Max/MSP patch is linked with the openFrameworks application triggering modulations to the sound contents whenever collisions are detected by the physics engine. This last component wrapped up the improvisational session.
Figure 4.18: Ball Drop (Closed, Opening)
4.4 The Projection Door Experience

With the hardware of the Projection Door assembled, along with an assortment of door-contents in our inventory, our team was prepared to curate the Projection Door Experience. Consulting with the creators, we gave names to the door-contents and sorted them into a menu that determined the order in which we will present each content. Our list totalled 14 door-contents which included the works from Hayakawa-san, Tadokoro-san, Fujimoto-san, and the researcher himself. We presented them to our partner, Nabtesco, and a few other companies, each representing a different urban sector which included a shopping mall producer, an imaging and electronics company and a printing company. The demonstration took place in the university under a lab environment. Our team created a questionnaire that included space for them to note down their thoughts on each door-content, we handed this questionnaire to the participants prior to the demonstration, asking them to fill it in as the demonstration proceeded. We retrieved the questionnaires when the demonstration ended. This section will detail their impressions and opinions in response to the Projection Door Experience.

Impressions from Nabtesco

The feedback we collected from the Nabtesco team was of mixed opinions. Their comments ranged from praises such as “Magical” to the uncertain “Too Abstract”. Generally they were impressed with the new aesthetic that is made possible through the extended capabilities of the Projection Door, and were able to discuss on topics that conventional Automatic Doors would not have incited. For example a member of the team stated that “The calibration of sound with the door’s movement works well”, while another wrote “Though the motif is simple, it does not bore”. The Projection Door’s practicality emphasized by contents such as Tadokoro-san’s Logo Wave was complimented for its versatility in adapting to multiple contexts. The comments from the members differed depending on their taste. While some comments “Not Unified”, others say “Beautiful” regarding the same content. It is interesting how impressions of an Automatic Door shifts from the discussion of utility to one of aesthetic judgements. Of course, as a producer of Automatic Doors, it was inevitable that they also raised questions concerning safety issues touching upon children’s curiosity to touch the sliding doors, and the blinding lights from the projector which may be a cause for accidents.
Figure 4.19: Nabtesco Members Experiencing the Projection Door
Impressions from Urban Sectors

The shopping mall producer looks forward to try implementing the Projection Door to increase sales activity in their malls and sees it as a hopeful means of attracting customers within the vicinity. They were concerned about the managing of contents and how they would alternate throughout the day. The possibility of using it to promote limited events were also considered. The imaging and electronics company mentioned that using Automatic Doors as the subject to project images on is an interesting and unique approach and suggest the possibility of implementing it in one of their new showroom which is currently under construction. As an electronics company that produces projectors as part of their catalog, they were concerned about the hardware setup. They also commented on the potential of developing the authoring tools into a platform based on existing digital signage utilities. The printing company commented on the Projection Door’s current status and consider it ready to begin engaging in field tests, although finding the right places and partners to do so would be an important point of consideration.
Figure 4.20: Demonstration to the Imaging and Electronics Company
Figure 4.21: Demonstration to the Shopping Mall Producer

Figure 4.22: Demonstration to the Printing Company
Notes

   https://github.com/google/liquidfun
   https://github.com/tado/ofxLiquidFun
3. “Box2D page” (accessed July 2015)
   http://box2d.org
   https://cycling74.com/products/max/
Chapter 5
Conclusion

5.1 3 Links

Through the development of the Projection Door and its Authoring Tools, our team aims to coordinate 3 crucial links between the stakeholders which comprises of Nabtesco (Automatic Door Industry), Creators (Citizen Creatives) and Urban Sectors (Potential Owners of Projection Doors).

The first link involves developing rapport with Nabco and their flagship product. Given the opportunity to gain access to their Doors and prototyping with them really allowed us to gradually understand the overall perspective of the Automatic Door Industry and coming up with realizable plans accordingly. Obtaining holding technology as an important resource also contributed to the development of the Projection Door.

The second link takes these resources and processes them, situating them within the context of an authoring environment for the Projection Door. Through collaborative development with creators we have gained practical insight on the transformation of control-maintenance tools into usable authoring tools. The reformed output are presented back to Nabtesco as a determining proposal that attempts to extend the services capable by the Automatic Door into a new infrastructural medium that not only supports the needs of urban sectors in their everyday dealings but also encourages the Automatic Door Industry to take on new pioneering roles that hold a proactive stance towards shaping the city’s urban landscape.

The last link requires us to prove the possibility of this proposal by attempting to facilitate the mediating role that Nabtesco may take in the future if the Projection Door project proceeds. We invite creators to actually use the Authoring Tools to create an assortment of contents, package them into a second proposal that seeks to demonstrate the Projection Door Experience and bridge this news to various Urban Sectors who may well be the Door’s potential owners. While
Nabco provides the Projection Door infrastructure, Urban Sectors hold various territories within the urban landscape that awaits new values to be installed into them.

5.2 Limitations and Improvements

The Tokimeki Automatic Door Project has been proceeding in a hurriedly pace, though we are seeing promising results, the researcher is also aware of the accumulated issues that should eventually be addressed. The Authoring Tools are currently in a beta stage of software development, though its features manage to support our immediate activities in the project, as we gradually move towards engaging with multiple Urban Sectors, the tools will have to prove itself robust enough to operate under real-life occasions.

Up till now, the content creation process has largely taken place inside the lab. Under this environment, there is no place for actual walkers to naturally traverse the door, hence interactions may not be informed by real user affordances. For example we have no way of knowing how walkers actually perceive the contents in a real situation. Secondly we would have to imagine that during a real case scenario, when and where will creators develop the contents? With or without the Door? Perhaps content creation would take place in midnight when the building is closed, similar to Automatic Door maintenances.

The Creative Coder has mentioned early on that in order to develop contents without access to a physical real scale door, he would need more realistic simulations of the Door’s abilities. This is not provided well in the current stage. Although the researcher has managed to address some of the issues such as simulating mock sequences of the Door’s opening and closing and adding a virtual sensor module, it is clear that Creators prefer to work on contents while being able to feel the impact given off by the movements of the Door. Drawing influence from previous works, especially the toolkits that support a 3-D visualization of the scene in question, the researcher can try to provide a similar environment in the form of an applet that enables future creators to be able to imagine and see their contents simulated in a mock environment.

Out of the three creators, only the installation artist has made slight use of the sensors that come with Automatic Doors. Apart from the opening and closing of the doors, the researcher wishes to configure the authoring tool so that the sensors’s simple but powerful ability should be made more accessible to the
creator. In its current form, perhaps the Automatic Door’s reactive nature is too dominating. One possibility is to begin ideating and maybe even redefining how interactions at the entrance can be conceived otherwise.

The next challenge would be to expand the Authoring Tools to not only be compatible with creators who are familiar with the coding environment, but like what was initiated with the Animator, we would have to consider supporting non-coders with intuitive environments and tools that can support them with creating works in other approaches as well. In order to do this, further contact and collaborations would be helpful to gain insight into how other creators work and with what tools and mental models do they find themselves comfortable working with.

5.3 A New Paradigm

The researcher believes that managing and operating the Projection Door is a role fundamentally different with conventional Automatic Doors. There can be discussions with members of the Nabco team in establishing a new position of the “Projection Door 技能士” or what I call the Ubiquitous Doorman. This person should be equipped with the know how in the maintenance of normal Automatic Doors, but also has the ability to manage the Projection Door’s extended system while being able to manage a smooth installation of it into different architectural terrains, leading up to Projection Doors that can be built upon various Nabco door models. This person would need to deal with different creators while keeping close client relationships with existing Door owners. While comprehending the potential needs of building owners, the Ubiquitous Doorman will curate Entrance experiences accordingly.

As the flows of pervasive computing are continually being engineered, Mccullough tells us, “Not all is Flux”. It is a reminder that even computational flows ought to find their place and eventually ground themselves into the architectural elements of the city, it is where context takes over and becomes responsive through the integration of technology. Gradually theses flows will be merged with what we value about the built world, that which has memory, that which is lasting. Otherwise, McCollough also mentions “Everything else just gets in the way”. We should carefully and thoughtfully introduce technology into our environment through the discipline of interaction design, Automatic Doors have taught us one lesson, perhaps elevators and escalators stand next in line?
References


Nichols, J, JO Wobbrock et al. (2002) “Mediator and medium: doors as interruption gateways and aesthetic displays.” DIS.


