

COMP 4971C REPORT

Project Title:

**Device sharing solution for better utilization
of mobile displays – video storyboard**

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Abstract

This project investigates the question, “How can we better utilize our mobile devices lying around to produce value?”. The report starts with explaining the significance of the topic by addressing the problem of current usage of mobile devices including old unused ones. Then the aim of the project and the tools and methods used to develop the software will be introduced.

The report then shows the parts that I have done in the project, which are User Interface investigation and management of the crowdfunding video production. It will go through the process and difficulties involved in each of the parts.

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1. Introduction

1.1 Project Aim

After laptops, a huge amount of smartphones and tablet PCs have been sold globally. However, whilst each device may work very well on its own, there is a limitation on how users can use their devices' displays. For example, a person cannot share a devices' screen easily with others. If there is a software available that enables this feature, one can simply share his or her screen with a friend to watch a movie together on their own device without having to squint into a small shared screen.

Moreover, old devices are usually left alone and never used again once the person owning the device purchases a new upgraded device. For instance, since popular smartphones such as iPhone or Samsung Galaxy series phones get updated every year, older models like iPhone 4 and Galaxy III models are not being used.

The project aims to provide a software solution for users to better utilize their devices. In particular, it targets the devices' screens, including displays of old devices that is not being used anymore.

1.2 Project Scope

The project's aim is to enable better display utilization among different devices including laptops, Android smartphones, iPhones, and tablet PCs. Therefore, it was necessary to develop a software application for each of the hardware devices available. However, as a group of one professor and 4 students, the resources available was absolutely insufficient. As a result, developing a separate application for each different application and environment was infeasible.

In order to achieve the project's goal with limited resources, a game development

framework called LibGDX¹ and Java language was used. LibGDX enables a single Java code to be compiled for different mobile operating systems including Android and iOS, BlackBerry, as well as general purpose Desktop and HTML5. As it can be seen below in Figure 1, libGDX can produce subprojects for desktop, Android, iOS, and HTML. In the initial setup, developers can choose which platforms they want at the start.



[Figure 1 – Example libGDX initial setup]

¹ <https://libgdx.badlogicgames.com/> [Accessed May 19th, 2016]

² http://williammora.com/assets/libgdx-martianrun-tutorial/project_setup.png
[Accessed May 19th, 2016]

1.3 Features Included

The application developed by the team includes three main features: One-to-Many display, Many-to-One display, and lastly the Meta display with 2 stage development for each 2D Meta display and 3D Meta display.

The One-to-Many display feature enables users to share one screen with many other devices. For example, in a lecture room, the professor may distribute his computer screen with the ppt slides open to his students. This way, students do not have to turn the slides over themselves.

The Many-to-one feature is the opposite of One-to-Many display since it allows one screen to show multiple devices' screens in aggregated form. This can be used in classrooms where the professor can help students by actively seeing how they are doing. It can also be used among friend groups to play a game together. For instance, in a computer science lecture, the professor may let students to run a demo themselves. In addition, with an aggregated view of all the students' device screens, the professor can easily spot students who is struggling with specific tasks. This way, the learning process becomes more interactive and individual-specific even in large-scale university education.

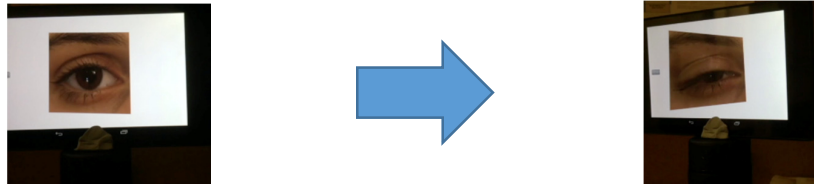


[Figure 2 – Example of Many-to-One display]

The Meta display feature is perhaps the most difficult feature to implement amongst all the features. The idea of Meta display is simple: put together devices in hand

to provide a seamless one larger screen view. For example, if a person has an iPhone and 3 other friends has an iPhone or Android phone or any other device, they can put together their devices physically. Through the Meta display feature, they can use the whole group of phones to see one single view. This can be used to see a picture on a larger scale, or watch a movie in a similar way.

The Meta display feature can be further classified into two functionalities: 2D and 3D. While the 2D Meta display is for devices to connect their screens as in a flat 2D surface, the 3D Meta display is much more advanced in that it allows devices to show their screen according to its orientation in 3D. For example, even if a phone that is standing vertically on a rotating table rotates, to a static user in front of the phone will only see the device rotating, while the display stays the same.



[Figure 3 - Example of 3D Meta Display. Although the device has rotated, the screen orientation stays the same for the user. Note that since the image is a demo of an initial version of the software, it is not perfect and the image used is in gif format.]

In fact, Samsung's Group-Play³ feature and a software called "Groupix"⁴

³ <http://www.androidauthority.com/samsung-group-play-195312/> [Accessed May 22nd, 2016]

⁴ https://play.google.com/store/apps/details?id=at.fhooe.mc.multiplemobiles_onedisplay&hl=en [Accessed May 22nd, 2016]

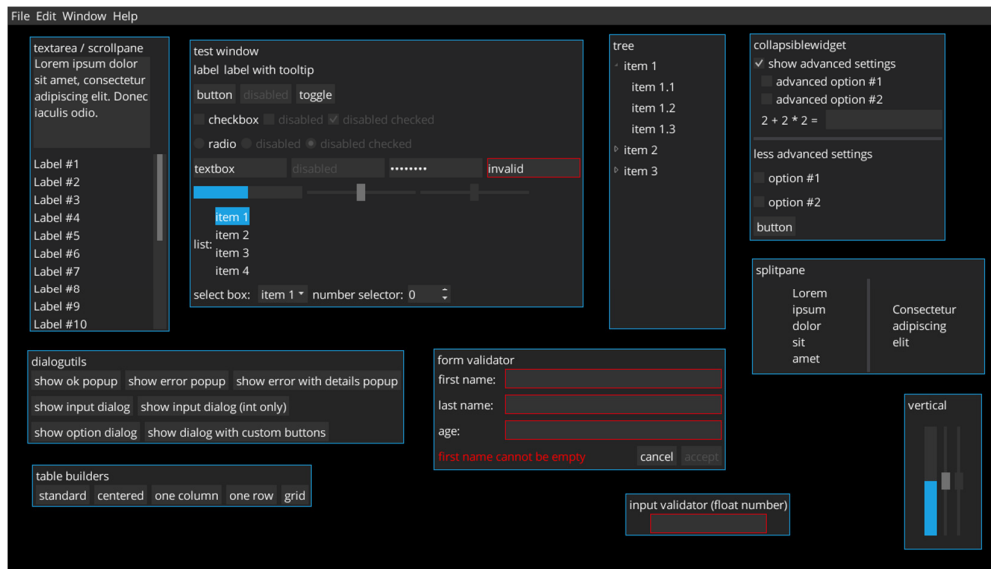
already implemented this feature. However, the limitation to Samsung's software is that it only allows it to be run on Galaxy Phones, and it does not support old devices. Also for Groupix, it only allows Android smartphones to be connected, so it cannot be run on iOS or other devices. Above all, they do not support the 3 dimensional display view that this project is aiming to develop.

2. User Interface and Crowdfunding

2.1 LibGDX: User Interface

As in most software applications, this project also needed a UI built on top of all its useful functionalities. In order to achieve this, VisUI, a tool made for creating UI for the libGDX development framework, was suggested. With VisEditor, it is possible to just simply drag and drop UI elements into cross platform 2D scenes.

However, as the features were not developed and with insufficient experience with the libGDX framework in general, a fully functional User Interface was not yet developed for this project. It is proposed that the UI is built after any feature is developed first, or after a successful funding of the project in order to debug in multiple devices during the implementation process.



[Figure 4 – The VisUI interface⁵]

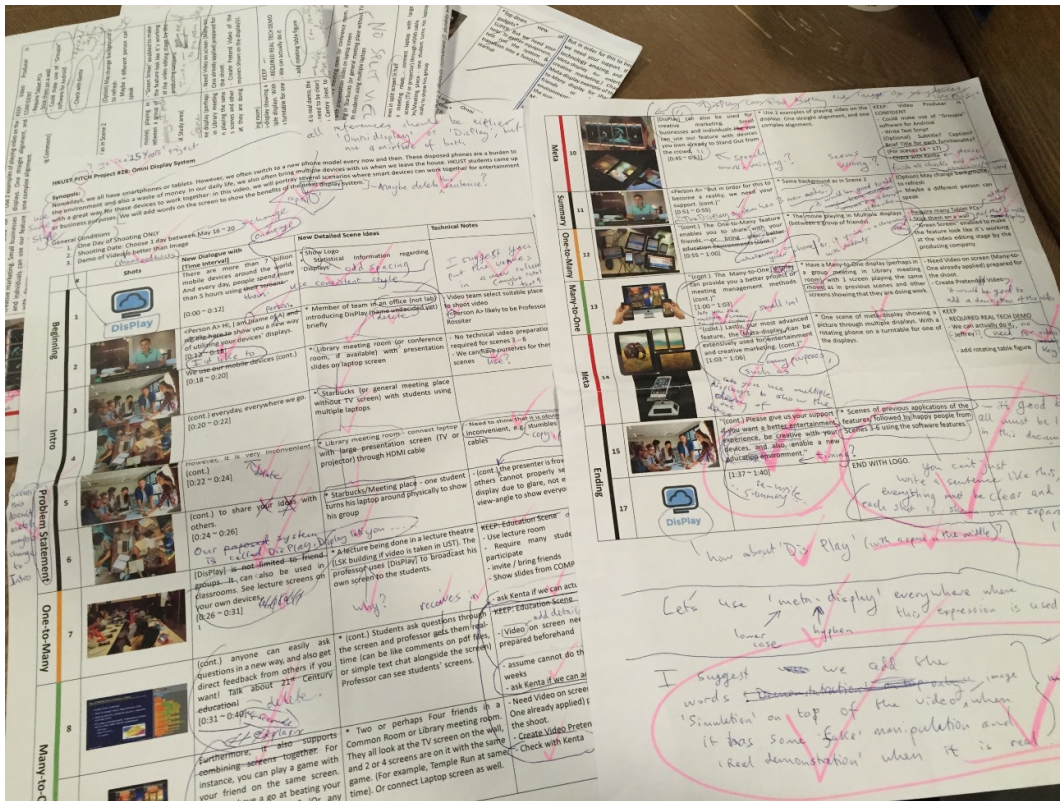
⁵ <http://kotcrab.com/images/projects/visui.png> [Accessed May 22nd, 2016]

2.2 Crowdfunding Video Production

Another main part of the project is funding. As one of the 25 year projects of HKUST, it was allowed the opportunity to work with a private video production company to produce a crowdfunding promotional video. The process of the video production for the team's part was more than a month long. This includes writing and editing of the video script, producing pretend videos of the software functionalities, and communicating with the video production company.

The first video script was provided by the company. However, after numerous editing processes, the final video script became completely different from the initial version. During the process, other successful and unsuccessful crowdfunding videos from crowdfunding sites like Kickstarter was referenced. This helped to get an idea of the general template of the overall sequence and content of the video for crowdfunding purposes.

For each edit of the script, the person in charge of the video, Zi Won KIM, had to discuss and evaluate the script with the professor, David ROSSITER. In the beginning stage of the editing process, the sequence of the video did not change much since the original file was provided by the company. So the editing process only involved adding scenes and details including scripts, detailed scene description with background, and technical details. This resulted in a bulky and large amount of scenes. Figure 5 below partially shows how the editing process was done.



[Figure 5 – Part of the Video Script Editing Process]










However, in the end after an offline meeting with the company, it was decided that it is best to customize the overall sequence of the video ourselves. As a result, we were able to reduce the scale of the whole video, and we were better prepared for the final shooting day, which took place on May 12th, 2016 with the company and the video shooting crew. Figure 6 below shows the final edition of the video script.

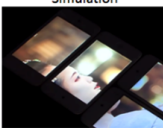

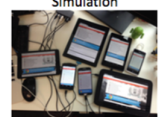





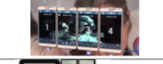




HKUST 25 Years Project #28: Omni Display System

Synopsis:

Nowadays, we all have smartphones or tablets. However, we often switch to a new phone model every now and then. These disposed phones are a burden to the environment and also a waste of money. In our daily life, we also often bring multiple devices with us when we leave the house. HKUST students came up with a great way for these devices to work together: in this video, we will portray several scenarios where smart devices can work together for entertainment or business purposes.

The video shooting will be done in one day only. The shooting date is suggested to take place on May 10, but is still under confirmation from the production company. Also, for all demonstrations of the system shown on devices within the scenes, it is suggested that we use videos rather than images.

| | # | Shots | New Dialogue with [Time Interval] | New Detailed Scene Ideas with [Venue] | Technical Notes |
|-------------|---|---|--|--|---|
| Beginning | 1 |  | There are more than 7 billion mobile devices around the world. And every day, people spend more than 5 hours using them on average. [0:00 ~ 0:12] | * Show Logo * Statistical Information regarding 'Displays' | |
| | 2 |  | <Person A> "Hi, I am <Person A> and today, I'd like to show you a new way of utilizing your devices' displays. [0:12 ~ 0:18] | * Member of team introducing Dis Play briefly. [Venue: Office] | - Video team select suitable place to shoot video - <Person A> likely to be Professor Rossiter |
| Intro | 3 |  | We use our mobile devices (cont.) [0:18 ~ 0:20] | * Students with presentation slides on laptop screen [Venue: Library meeting room (or conference room)] | - No technical video preparation required for scenes 3 – 6 - We can use ourselves for these scenes |
| | 4 |  | (cont.) everyday, everywhere we go. [0:20 ~ 0:22] | * Students using multiple laptops during a meeting. [Venue: Starbucks (or general meeting place without TV screen)] | |
| | 5 |  | However, it is inconvenient (cont.) [0:22 ~ 0:24] | * Connect laptop with large presentation screen (TV or projector) through HDMI cable. [Venue: Library meeting room] | - Need to show that it is obviously inconvenient, e.g. stumbles with cables - HDMI Cable available |
| | 6 |  | (cont.) to share with others. [0:24 ~ 0:26] | * One student turns his laptop around physically to show his group. [Venue Starbucks/Meeting place] | - (cont.) Need to show that it is obviously inconvenient, e.g. the presenter is frowning, others cannot properly see the display due to glare, not enough view-angle to show everyone |
| One-to-Many | 7 | Simulation  | Our system is called "Dis Play". [Dis Play] let's you use your devices' displays beyond boundaries through software. [Dis Play] can be used in classrooms. See lecture screens on your own devices, [0:26 ~ 0:31] | * The professor uses [Dis Play] to broadcast his own screen to the students. [Venue: LSK Lecture theatre – because it looks more decent than other buildings] | KEEP: Education Scene - Use lecture room - Require many students to participate - invite / bring friends - Show slides from COMP 1021 - Real demo possible but performance is slow. - Cannot bring many phones. Planning to use 4 phones. |
| Many-to-One | 8 | Simulation  | (cont.) anyone can easily ask questions in a new way, and also get direct feedback from others if you want! [0:31 ~ 0:35] | * (cont.) Students ask questions through the screen and professor receives them in real-time (can be like comments on pdf files, or simple text chat alongside the screen) Professor can see students' screens. [Venue: LSK Lecture theatre] | - Video on screen needs to be prepared beforehand - Create Pretend Video |
| | 9 | Simulation  | Also, you can play a game with your friend on the same screen. Why not have a go at beating your friend on Deemo? [0:35 ~ 0:40] | * Two or perhaps Four friends in a Common Room or Library meeting room. They all look at the TV screen on the wall, and 2 or 4 screens are on it with the same game. (For example, Temple Run at same time). Or connect Laptop screen as well. [Venue: Common Room or Library meeting room] | - Need Video on screen (Many-to-One already applied) prepared for the shoot. - Can use 2 phones and a monitor with no image content - Achieve scene through video editing |

| | | | | | |
|-------------|---------|--|---|--|---|
| Meta | 10 |  <p>Simulation</p> | <p>[Dis Play] can also be used for creative marketing. Small businesses and individuals can use our feature with devices you own already to Stand Out from the crowd.” [0:40 ~ 0:46]</p> | <p>* Use 2 examples of playing video on the displays. One straight alignment, and one complex alignment. [Venue: Engineering Commons]</p> | <p>KEEP: Video Producer is CONFIDENT - Require Tablet PCs - Stick them on a wall - Make use of “Groupix” software for Android</p> |
| | Summary | 11 |  | <p><Person A> “But in order for this to become a reality, we need your support. The Dis Play system has 3 main modes. (cont.)” [0:46 ~ 0:50]</p> | <p>* Same background as in Scene 2 [Venue: Office]</p> |
| One-to-Many | 12 |  <p>Simulation</p> | <p>“(cont.) The One-to-Many feature enables you to share whatever on your phone with your friends, or, if you’re in a classroom setting, with students. (cont.)” [0:50 ~ 0:56]</p> | <p>* A movie (any movie) playing in Multiple displays (between a group of friends). The image appears at once on all devices. [Venue: Outside – LSK Study area]</p> | <p>- “Green Screen” enabled to make the feature look like it’s working at the video editing stage by the producing company. - Is more technical scene than previous One-to-Many scene. - Create Pretend Video</p> |
| Many-to-One | 13 |  <p>Simulation</p> | <p>“(cont.) The Many-to-One feature lets you see multiple screens on your screen. It can provide you better project or meeting management methods. (cont.)” [0:56 ~ 1:03]</p> | <p>* Have a Many-to-One display (perhaps in a group meeting in Library meeting room), with 1 screen playing the same movie as in previous scenes and other screens showing that they are doing work. [Venue: Library meeting room]</p> | <p>- Need Video on screen (Many-to-One already applied) prepared for the shoot. - Create Pretend Video of the movies shown on the display(s).</p> |
| Meta | 14 |  <p>REAL (or Simulation)</p> | <p>“(cont.) Lastly, our most advanced feature, the meta-display, lets you use multiple displays to show the display of one device. It can be extensively used for many purposes, such as entertainment and creative marketing. (cont.)” [1:03 ~ 1:10]</p> | <p>* One scene of meta-display showing a picture through multiple displays. With a rotating phone on a turntable for one of the displays. [Venue: INSIDE (since it is real demo, the videos on the displays need to be clear) – Visitor Information Centre (next to Souvenir shop)]</p> | <p>KEEP - REQUIRED REAL TECH DEMO - We can actually do it - add rotating table figure - Can really do it - Make use of “Groupix” with another image. - Could be real, but depending on circumstances, may have to use simulated video.</p> |
| | Ending | 15 |  | <p>“(cont.) Please give us your support, (cont.)” [1:10 ~ 1:12]</p> | <p>* Scenes of previous applications of the features, followed by happy people from Scenes 3-6 using the software features. Start with Education Scene.</p> |
| 16 | |  | <p>“(cont.) to provide a new education environment, (cont.)” [1:12 ~ 1:14]</p> | | |
| 17 | |  | <p>“(cont.) a better entertainment experience, (cont.)” [1:14 ~ 1:16]</p> | | |
| 18 | |  | <p>“(cont.) with your family and friends, (cont.)” [1:16 ~ 1:18]</p> | | |
| 19 | |  | <p>“(cont.) and a creative way to use your devices. (cont.)” [1:18 ~ 1:20]</p> | | |
| 20 | |  | <p>“(cont.) every penny helps (cont.)” [1:20 ~ 1:22]</p> | <p>* Same place from scenes 3 & 5, but the presenter is using [Dis Play] to show his/her laptop screen on the TV without a cable, and everyone happy.</p> | |
| 21 | |  | <p>“(cont.) in bringing this system to reality (cont.)” [1:22 ~ 1:24]</p> | <p>* Same place from scenes 4 & 6, but the presenter is using [Dis Play] to show his/her laptop screens on every other’s laptop displays easily, and everyone is happy.</p> | |
| 22 | |  <p>Dis Play</p> | <p>[1:24 ~ 1:26]</p> | <p>END WITH LOGO.</p> | |

[Figure 6 – The Final Edition of the Video Script]

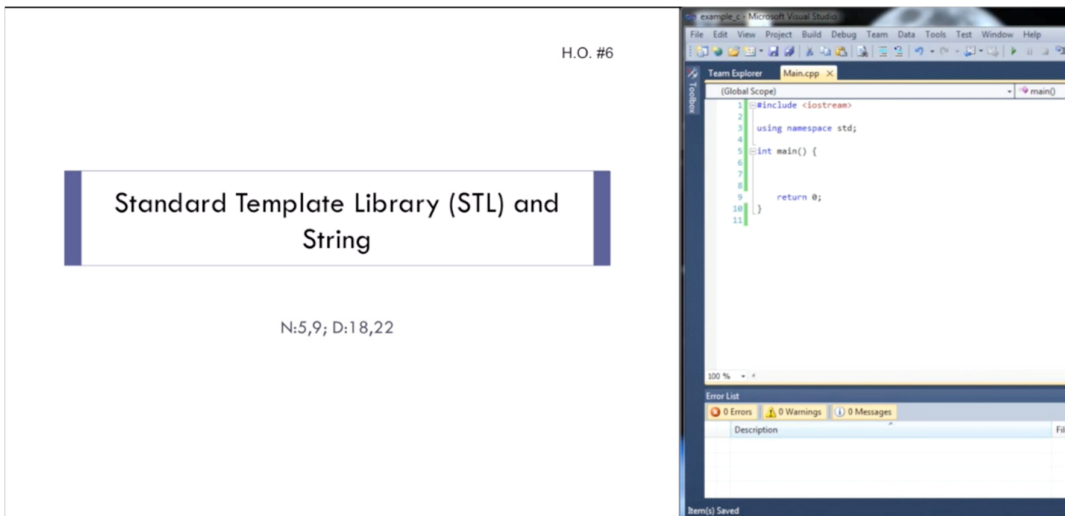
Other than the script, since the purpose of crowdfunding was to receive funding for the development of the software application, a full decent demo for the video was needed but not available. Therefore, we had to produce a pretend video for the promotional crowdfunding video, to let the audience get a fairly good idea of what the project aims for. In the end, advanced video editing tools such as Final Cut Pro X were used to produce videos to be used during the shooting.

As a result, scenes for the Many-to-One feature and One-to-Many feature were produced. Figure 7 and Figure 8 below shows an example of the video scene. Figure 7 illustrates that the Many-to-One feature of the software can be used to aggregate an individual's phone and laptop to show two screens in one bigger screen such as on smart TV. In this case, the user could use his phone to watch a movie and at the same time, play an online game on his laptop and see the two together on a TV screen.

Figure 8 is shown to give an example of how a professor can use the One-to-Many feature to let students get direct access to his screen on their own devices. It shows the lecture ppt slides and a demo running a computer code on Eclipse at the same time. It can be seen that since the computer language code on the Eclipse editor is rather small, with the One-to-Many feature can allow students to see the code more clearly on their device's screen and enhance the learning experience.



[Figure 7 – Video Scene for Many-to-One display feature]



[Figure 8 – Video Scene for One-to-Many display feature]

3. Conclusion & Evaluation

To sum up, the project started to provide mobile users a better way to use their devices' displays. This is proposed to be achieved by developing a software with four main features: One-to-Many, Many-to-One, 2D Meta, and 3D Meta. In order to let all devices work regardless of its operating system, a software development tool LibGDX that can target cross-platform devices was chosen for the development process. VisUI, a UI editor for LibGDX was also considered for the user interface construction of the construction. Furthermore, since funding is necessary to proceed with the project, a video script for crowdfunding was produced.

Overall, the idea of the whole project has been clearly set and the crowdfunding video script has been well prepared. However, creating the user interface of the software is not complete. It would have been better if it was successful in designing the UI of the software and integrate it with actual functional implementation of the feature. This would have resulted in a better software demo for the crowdfunding video as well. It is proposed that the next step of the project to be creating a user interface that can provide an intuitive experience to the user, along with optimizing the Meta display feature and implementing One-to-Many and Many-to-One features.