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PROPOSALS FOR IMPROVING SEATING IN MOVIE THEATERS

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by

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ABSTRACT

PROPOSALS FOR IMPROVING

SEATING IN MOVIE

THEATERS

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This project explores the nature of seating arrangements in movie theaters, and the ways that the theater seating experience could be improved. Currently, movie theaters are built with long rows of seats. In a large, nearly-full theater, seating can be impossible to find. This effectively reduces the seating capacity of a theater. Movie theater patrons moving in and out of their seats can also disturb a lot of other clients.

This project includes a brief survey of the history of the theater and the current methods of seating currently employed. Improvements to the system include proposing an optimal number of seats in a row, displays at the end of a row showing how many empty seats it has, and maps of the theater showing the location of empty seats. It also includes a description of our Engineering Senior Project, and android application that helps seat patrons in movie theaters.

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CHAPTER 1

THE FIRST MOVIE THEATERS

1.1 The Nickel Parlors and Nickelodeons

The first movie theaters, called nickel parlors, were little more than rooms where patrons paid a nickel to watch moving pictures through the viewing slot of a kinetoscope. They required only standing room and a collection of kinetoscopes. An invention attributed to Thomas Edison, the kinetoscope featured a synchronized phonograph in a box that was watched through a peephole at the top of the box. It wasn't until 1895 that Robert Paul successfully developed the kinetoscope into a projection apparatus. Today's word, 'cinema', comes from Cinematographie, the title later used by Auguste and Louis Lumiere when they patented their version of a moving picture projector. A similar apparatus, called the Theatrograph was introduced by Robert Paul at Olympia, making Olympia "the first independent picture showplace in England" [1].

In the United States, the kinetoscope was also turned into a projector by Thomas Armant. This improvement was called the Vitascope and projected the pictures from the kinetoscope onto canvas. It was demonstrated on the 23rd of April 1896 at a music hall in Herald Square, Broadway, to great acclaim. The movie showings at Leicester Square and Herald Square propelled both places to fame as part of the coming movie industry. The second movie theaters, then, were the Empire Music Hall in Leicester Square and the old Alhambra. They were the buildings whereby future interpretations of movie theaters took their inspiration.

Before the movie theaters that we know today, however, there were the nickelodeons (penny gaffes in England). Due to the popularity of motion pictures, any businessman who could find a projector, a screen, and a suitable venue could charge viewers a nickel to view motion pictures in his 'theater'. Among all these, however, there were those who sought to provide permanent venues exclusively for motion picture performances. Some venues even boasted of being sophisticated in order to draw in the upper classes and distance themselves from the cheap nickelodeons. Steadily, the number of movie theaters rose as the industry grew into what we have today [1].

A mere look is enough to ascertain that seating in movie theaters has not changed very much since the advent of the movie theater. Pictures of movie theaters now and through the ages can be found in *Theaters,* by Craig Morrison [2], *Cinema Architecture*, by Chris van Uffelen [3], and *Left in the Dark* by McBride and Lindow [4]. Usually, rows and rows of seats are arranged in front of a screen and patrons pay to occupy one of those seats. Seats might be reserved beforehand or chosen when the patron arrives at the theater. The problems with this arrangement are numerous and will be explored in the next chapter.

CHAPTER 2

MOVIE THEATERS TODAY

2.1 The Problems

Today's movie theaters are very different from those at the beginning of the movie industry. The technology is different. The movies are seen in color and heard in surround sound. Lately movies can be seen in rich 3D giving them a depth that the movie goers of the late 19th and early 20th century could scarcely have imagined. Yet a brief picture survey reveals that for viewers, the mechanics remain the same. There is seating in a large room, possibly with balconies, and there is a screen. The seats might all be on the same level or on different levels like an auditorium, and there might be anything from a few dozen to a thousand seats. Several problems are evident with this method, of course.

2.1.1 Finding Seating is a Problem

Imagine that you walk into a sold-out (or nearly sold-out) movie theater, and need to find a seat. In a comparably small theater, seating is usually not assigned, so you are left to take the first empty unreserved seat you can find. In a reasonably full theater, this will be difficult. In a sold out theater, this will be impossible. For this reason, theaters that do not offer assigned seating have to sell fewer tickets than the theater can hold, or expect less patrons than ticket-holders in order to ensure that every movie-goer will have a seat.

Even in a nearly empty theater, finding seating can still be a problem if movie goers concentrate themselves in one section of the theater. In fact, research shows that

movie patrons tend to choose seats toward the right of the theater when there is a large section of seats from which to choose [5]. A June 2014 article described a plan by Cineplex Entertainment to begin charging more for seats in the middle rows of a movie theater [6]. This is obviously due to the fact - as anyone who has been in a theater knows - that seats in the middle of a movie theater are more likely to be occupied. Whether the section in question is the middle or right of the theater, a patron who needs a seat in a heavily occupied section could find it difficult to get seated.

Assigned seating solves the problem of looking for a seat, but in a large enough theater, there is likely going to be someone sitting in the wrong seat. In that case, you must either find an usher to reseat the errant individual, or find another seat. Either way, someone will be looking for seating.

2.1.2 Getting into a Seat is a Problem

Imagine instead, that you found your seat empty and with little trouble. However, this seat is in the middle of a row of fifteen seats, most of which are occupied. The way to get to your seat is to get past the other customers, who are engrossed in the pre-movie shows (or the actual movie if you are late enough) saying appropriately “please excuse me,” “thank you,” and “sorry,” when you likely step on someone’s shoes. After all that, it is only to be hoped that you will find your seat actually empty, and not occupied by someone’s bag. A paper by Susan Meacock titled “Are you Sitting Comfortably?” while only tangentially related to the topic, does a good job of pointing out the seriousness of the problem [7].

This is a problem that assigned seating will not solve. The problem of distracting other patrons can also hardly be avoided short of finding a system that seats patrons in the

correct order, and ensures that no one leaves for the restroom in the middle of the movie. However, there is no reason that stepping on toes cannot be remedied with the correct planning. A patron also should not have to get past all those obstacles to find that the seat is already occupied, albeit by a small object or a patron who is on a bathroom break.

2.1.3 Keeping a Seat is a Problem

Theaters management advice patrons who need to talk or use their cell phones to go into the lobby. However, a seat left empty is in danger of being taken by someone else. Knowing this, theater patrons often reserve seats with bags, coats, and by asking other patrons to watch over the seats.

Of all the problems identified, that of finding a seat is undoubtedly the most pressing. The next chapter will explore the solution presented in this project and discuss its implementation.

CHAPTER 3

THE EMPTY SEAT NAVIGATOR

A partial solution to these problems, called the Theater Seat Guidance System has been proposed. The system consists of a series of hardware and software components that together provide a better solution to the problems of locating and keeping a seat than merely reserving a seat.

3.1 How It Works

A patron who walks into the movie theater can reserve a seat at one or more Nexus 7 tablets stationed in front of the theater. These tablets contain a pictorial representation of the theater showing empty, occupied, and reserved seats. The patron selects the number of seats he wishes to reserve and clicks the ‘reserve’ button. Those seats are marked as reserved and the patron is assigned a color. Walking into the theater, the patron simply has to find the seats illuminated by his assigned color and sit down. When this happens, the lights illuminating the seats are turned off and the seat is marked as occupied. Subsequent patrons will not be able to reserve that seat on the Nexus 7 tablet. In the case that the patron does not occupy the reserved seats, the seats are automatically marked as free after a few minutes and can be reserved by new patrons.

If a patron leaves a seat after occupying it, the seat is automatically marked as reserved. This happens whether or not the seat was previously reserved. The seat is illuminated with the ‘reserved’ color, and does not count as one of the empty seats in the theater, leaving the patron free to leave the movie for one of the restrooms or concession

stands. Seats must be reoccupied within a long but definite amount of time or they will be considered empty. The length of time for which a seat can remain reserved but unoccupied can be decided by the management.

For those patrons who choose not to use the Nexus 7 tablet, simply walking into the theater and choosing a seat is an option. Seven segment displays located at the end of the rows of seats display the number of available seats in each row. This makes it easier to find empty seats. Seats are also illuminated with a different color depending on whether they are reserved or open, reducing the risk of the confusion that ensues when one patron takes another's seat.

3.2 Hardware Components of the System

The system uses an Arduino Yun, a seven-segment display, a Nexus 7 tablet, switches, colored LEDs, and wiring to implement its functionality.

3.2.1 The Arduino Yun

Figure 3.1: A Picture of an Arduino Yun

The Arduino Yun, a microcontroller, is responsible for collecting information from the switches to determine if a seat is occupied. It sends this information to the Nexus 7 tablet. It receives information from the tablet when a seat is reserved, sets the

colors of the LEDs illuminating the seats, and turns the LEDs on and off. It controls the timer to keep a seat reserved when a patron temporarily rises from the seat. It is the main means of communication between the seats and the tablet.

3.2.2 The Nexus 7 Tablet

Figure 3.2: A picture of a Nexus 7 Tablet

Theoretically, this can be replaced by any tablet or smartphone. A Nexus 7 was simply the tablet used for implementing the project. It runs the software that allows patrons to select and reserve seats, as well as view a map of the theater and the location of available seats. It is the main communication interface between the user and the system.

3.2.3 The LEDS

Figure 3.3: LEDs [8]

The LEDs are an important part of the system. They can be replaced with any form of lighting that is sufficiently unobtrusive. They perform the important job of signaling to a theater patron that a seat is available or reserved (whether by themselves or by another). This is important for reserving seats and communicating availability to patrons.

3.2.4 The Seven Segment Displays

Figure 3.4: A Seven Segment Display in Use [9]

These are another important part of the interface. By doing the relatively simple task of displaying the number of empty seats in a row, they save patrons the burden of straining their necks looking into each and every row they walk past to make sure that there is no empty seat there – or find out if there are enough seats for everyone in their group.

3.2.5 The Switches

Figure 3.5: A Tilt Switch

The switches are simple mechanisms that detect if a seat is occupied or unoccupied by checking the tilt of the seat. An upright seat is unoccupied, while a lowered one is occupied. They can be replace with some other technology like weight or pressure sensors whenever appropriate.

3.3 Software Components of the System

While the hardware components of the system convey information between the environment, the software, and the user; the software components of the system are responsible for its workings. They process all the data received by the system and produce the expected output. The Software is made up of several divisions: the User Interface (UI) Layer, the Logic Layer, and the Map layer. While I contributed to the early design decisions, the Map layer is the portion of the project to which I contributed the most. It is made up of the Data Storage Module, and the Communication Module.

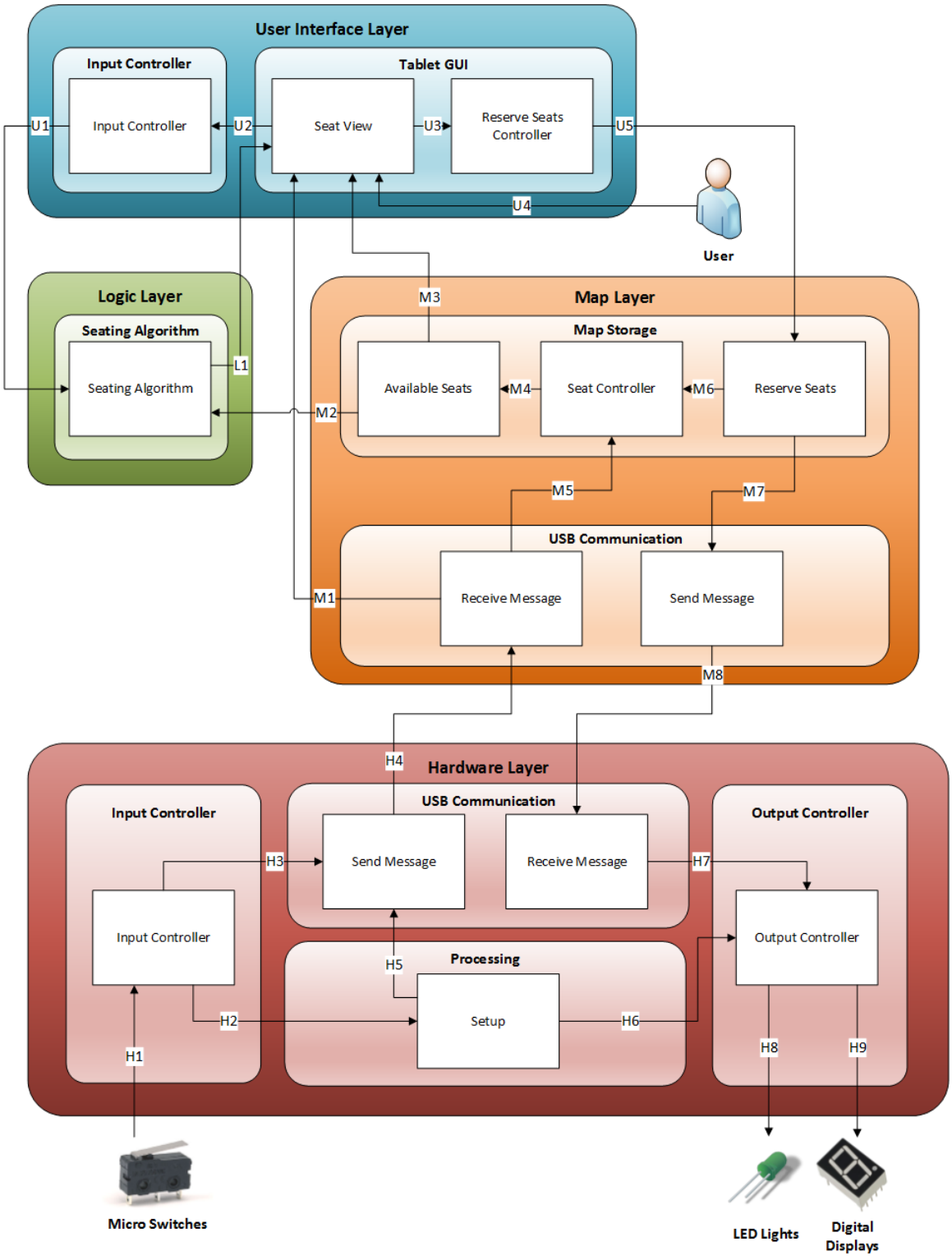

Figure 3.6: Graphical Overview of the Theater Seat Guidance System

3.3.1 The User Interface (UI) Layer

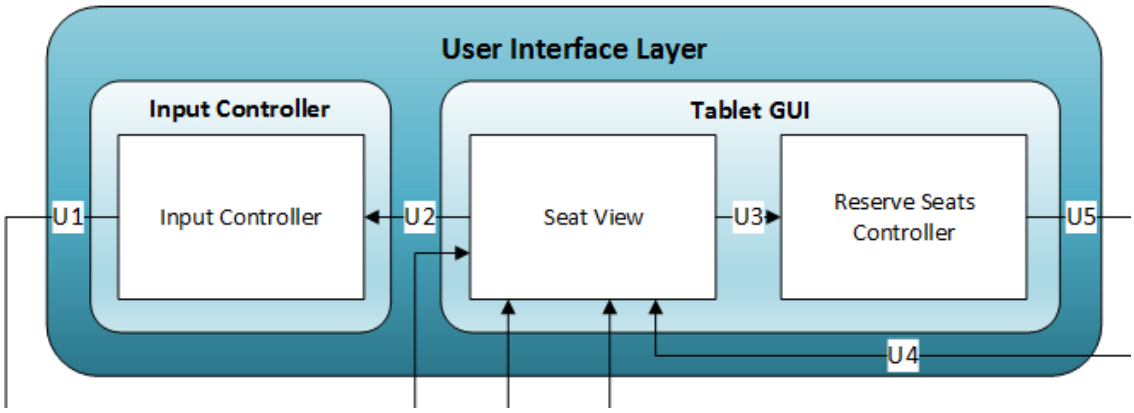

Figure 3.7: Graphical Overview of the User Interface Layer

The User Interface layer is the portion of the system with which the user directly interacts. It consists of a graphical user interface, and an input controller. The graphical user interface (GUI) consists of the input and output screens, and the menus and buttons with which the user interacts with the system via the Nexus 7 tablet. It displays a map of the theater showing all seats and their status. It is also responsible for taking a user's request to reserve a seat and sending it to the Map Layer for fulfillment. The portion of the UI layer that fulfills that functionality is the Reserve Seats Controller.

The other component of the UI is the Input Controller. Like the Reserve Seats Controller, it receives input from the GUI; but in the form of a request to find available seats of a type. A user selects a group size and a seating preference, i.e. front, back, or middle of the theater and the information is sent to the Logic Layer through the Input Controller for fulfillment.

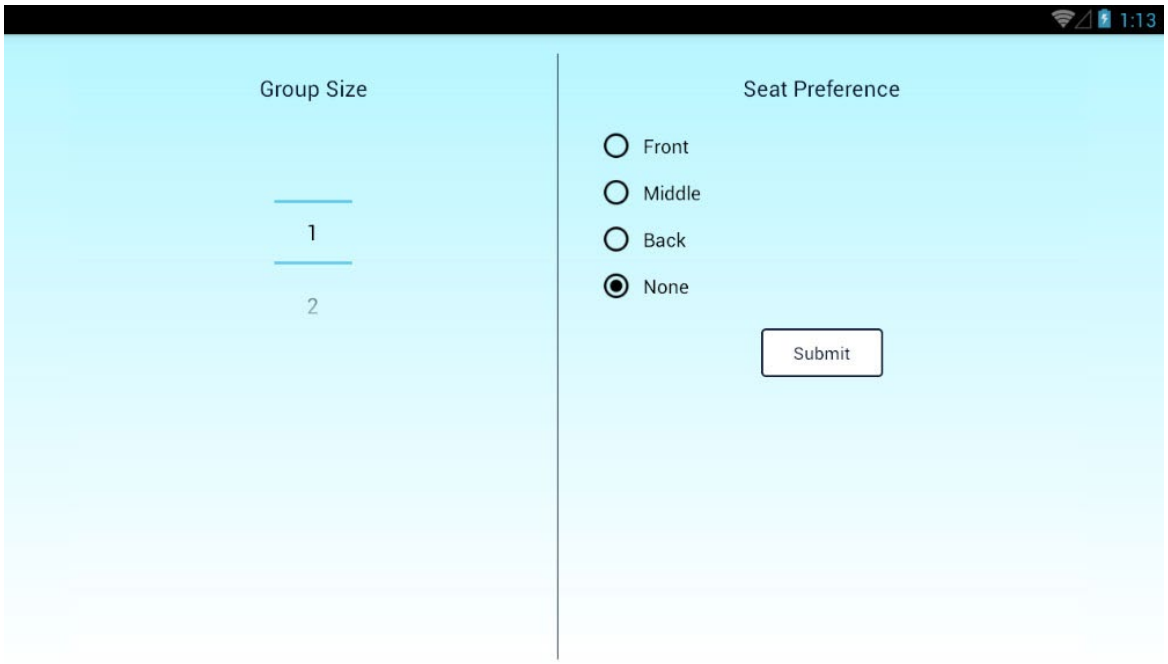

Figure 3.8: Seat Selection

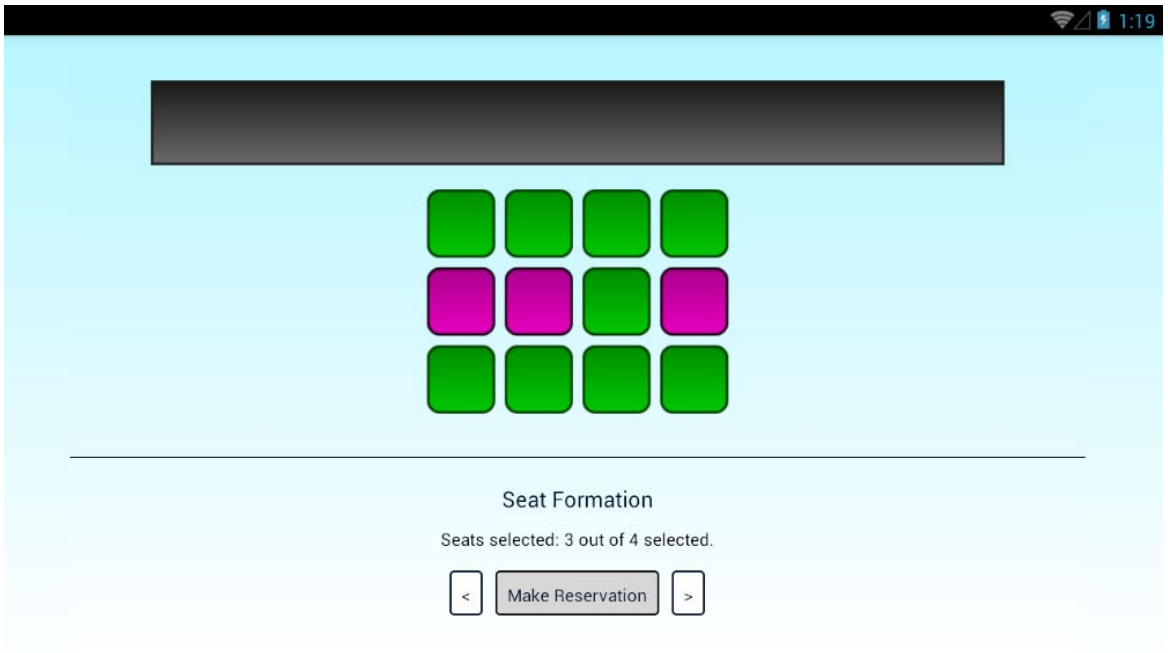

Figure 3.9: Map of Small Theater Showing Seats

3.3.2 The Logic Layer

The logic layer is responsible for fulfilling the request to find seats of a specific type. A user is visiting the movie theater with a friend and wishes to seat at the back of the theater selects this information from the User Interface, and it is sent to the Logic Layer. The Logic Layer then checks all the available seats to find two consecutive seats that fit the requirement. All such seats are returned to the UI Layer for the user's choice. If seats fitting the user's preference cannot be found, other empty seats are returned.

The algorithm for selecting the seats is the most important part of the logic layer, and is a simple one. It begins from the section requested by the user (front, middle, or back of the theater) and searches for seats in that section. If such seats cannot be found, it moves outwards towards the other sections until seats are found or there are not more seats to be examined. All seats found are returned to the UI Layer.

The Logic Layer depends heavily on the Map Layer, which will be discussed in the next section.

3.3.3 The Map Layer

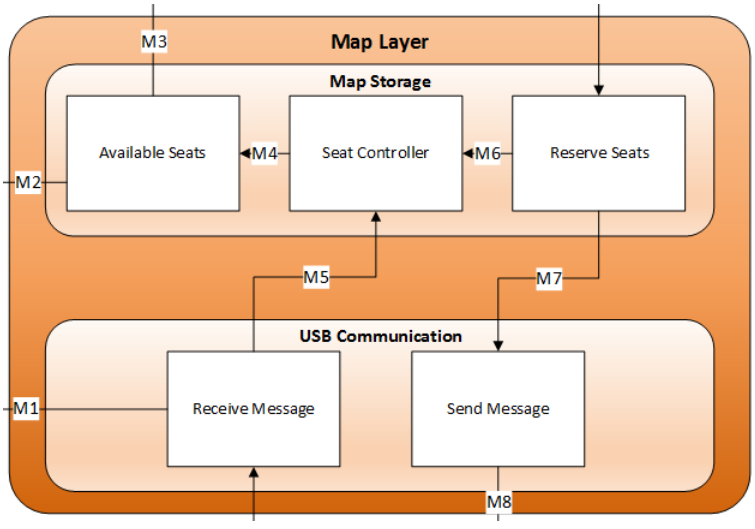

Figure 3.10: Graphical Overview of the Map Layer

The Map Layer is the final component of the system. Its task includes keeping track of the status of all the seats in the theater, and communicating the seats with the hardware components of the system. The communication is necessary to ensure that the LEDs and seven-segment displays correctly keep track of the status of a seat. It would be embarrassing for a patron to find a seat occupied when the LEDs and seven-segment displays considered it empty.

The USB Communication module has only two functions: sending messages to the hardware when the status of a seat changes in the software, and receiving information from the hardware when the status of a seat is changed externally i.e. by a user occupying or vacating a seat.

3.3.3.1 The Seat Class

My section of the system concerned the Map Storage module. In addition to storing the status of all the seats in the theater, it is the only portion of the system with direct access to the seats. As such, it defines an interface for finding available seats, reserving seats, and accessing or modifying the status of the seats. A previous design decision had already been made to regard a theater as an array of seats, but the significant decision about how to represent the seats still remained. It was decided that a Seat class was the most efficient way of depicting a seat. The Seat class consists of several components:

1. A boolean variable to store the status of the seat. This variable would be true when the seat is available, and false if it is reserved or occupied.
2. The row and column of a seat that, together, provide a unique identifier for the seat.

3. The color of the seat. This would be used to identify which patron had reserved a seat. As previously mentioned, a different color is assigned whenever a patron reserves a seat.

The decision to handle seats in such a way puts all the information about each specific seat in one location, ensuring a clearly defined and consistent method of keeping track of the seats.

3.3.3.2 The Database Controller

The database controller class is responsible for controlling access to the seats. The most important decision made in creating this class was to keep its constructor private. On starting the system, an instance of the Database Controller class is created. No other instances are created during the running of the program. The Logic Layer, UI Layer, and Communication module all access the status of the seats using this one object. This decision ensures that only one component of the system can access the seats at any given time. A user cannot reserve a seat while the seat is being changed by the communication module.

The other important components of the Database Controller class are the Reserve Seats, Get Available Seats, and Update Seat methods. The Reserve Seats method changes the status of a seat to ‘reserved’ and notifies the hardware using the Communication module. The Get Available Seats method returns the status of all seats to the caller, and the Update Seats method updates the status of a seat with information received from its caller.

CHAPTER 4

CONCLUSION

4.1. Solutions to Other Problems

While the Seat Guidance System solves the problem of finding and keeping a seat, it does not solve the problem of distracting other patrons when getting into and out of seats. This problem remains for future projects to solve. Two suggestions can be offered. One is to better separate the rows of seats so that a patron getting into a seat has enough room to walk without stepping on toes. Some movie theaters already do this. An auditorium type seating arrangement also helps to ensure that patrons walking between rows do not obstruct the screen. The second suggestion is to reduce the length of rows so that fewer patrons are disturbed by others moving in and out of their seats.

4.2 Benefits and Alternative Uses

Although the focus here is on movie theaters, this project can be used to seat patrons in any large theater or auditorium. It can find use in large lecture halls, opera halls, churches, and anywhere else in which a large number of people need to be seated effectively. It would improve the seating capacity of the venues while providing ease and comfort for patrons. Anyone who has attended a talk at a large venue knows the pain that can be involved in finding a seat. Using this system, ushers can be utilized more effectively.

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BIOGRAPHICAL INFORMATION

Tracy Oguni was born in Nigeria in August 1994 and graduated High School there in June 2010. She then moved to Arlington, Texas, to earn an Honors Bachelor of Science in Software Engineering. She has been accepted into Graduate School at the University of Texas at Arlington and plans to attend there in the fall of 2015. After earning her master's degree, she hopes to continue working in the field of software engineering to develop interesting, innovative, and useful applications to aid humanity. Her interests are numerous, and include computer software development and philosophy.