Portable Battleship Display

Design Document
Group #80
Jonathan Rakushin, Elizabeth Roels, Colin Lu
TA: John Capozzo

1. Introduction

Objective

Originating in the 1930s as a rudimentary pen-and-pencil game[1], the game Battleship has grown into what is known as one of the most popular and prolific board games the general public enjoys. It has spawned countless spin-offs, including video games, movies, and electronic reimaginations. However, throughout all these various forms, there is a main issue Battleship failed to address: the idea of portability. The current standard design of Battleship includes two large plastic boards, 84 white “miss” pegs, 42 “hit” pegs, and five ship pieces[2]. As a result, Battleship is a hassle to take out, set up, and play. Furthermore, many pieces get everywhere, leading to a mess where the pieces are prone to get lost. The tedium of taking Battleship off the shelves, setting up the game board, and marking coordinates with pegs each turn has made it near impossible to play on the go, an important aspect of a game the public values greatly in an era where mobile apps and handheld games are an arm’s reach away.

Our goal for this project is to bring back the fun of Battleship through a fun new medium: a portable wireless display. In order to do so, we will create a battery operated digital display, complete with visual and audio elements that will be simultaneously controlled by a microprocessor. We will implement a chip into each device as well so they can wirelessly interface with each other, removing the need for wires or any other interconnection. We hope that with the completion of this project, we could reignite the joy of Battleship in people of all ages while minimizing the hassle its setup has become associated with.
Background

It can be difficult to keep people, especially children, occupied on the go. It is why handheld and mobile games are so widespread and prevalent -- the convenience of having a portable distraction to entertain themselves while traveling or waiting around has led to the public spending increasing amounts of their income on mobile apps or video games[3]. However, both of these forms of entertainment have certain drawbacks associated with them. For mobile games, many require internet access or a mobile carrier, two things people may not have or want access to. Furthermore there are relatively few mobile apps which support multiplayer functionality. On the other hand, video games do not from these same problems, but instead from having a complicated set of controls. The user interface for handheld video games frequently include a wide variety of controls. Although this leads to varied gameplay, it can be difficult for the public, especially younger children, to learn. Furthermore, small features like buttons or stylis are prone to get damaged or lost.

In order to address these issues in our project, we plan on implementing a sleek, simple user interface that is easy to understand yet engaging. We will also include multiplayer support because we believe that including a social aspect to a game is key to making it enjoyable and memorable. We hope that our device will be able to be enjoyed anywhere, at any time, for audiences of all ages.

High-level Requirements

The three main goals we aim to meet for this project are:

1. The game is aesthetically pleasing
   a. The included audio elements are interesting and meaningful.
   b. The included visual elements are similarly interesting and meaningful.
   c. Good simple interface design.
2. The game is light and portable
   a. Devices can interact wirelessly through implementation of chips.
   b. The physical design minimizes extra bulk, allowing the product to be carried easily in a travel bag.
   c. No additional pieces needed, everything is included within the display.
3. The game engages audiences of all ages
   a. Adding a handicap for younger children.
   b. Adding a CPU for an audience who cannot play against others
The main component of the design will be a centered microcontroller. This microcontroller will handle all of the inputs and outputs made by both players throughout the game. Each player will need their own handheld device, and the two devices will communicate wirelessly. The device will be powered by a lithium ion battery, which should have a battery life of at least 8 hours when playing the game. The microcontroller will also be connected to, and powering a microphone, speaker, button array, wireless module and LED display. The microphone will be used for the game's voice commands. Since the old method of playing Battleship involves saying your move to the other player, we’d like to keep this in place but update it with voice recognition. The player will state his/her command and the game will get confirmation, and when approved, will “fire” at the opposing player’s board, detecting a hit or not. The connected speaker will play sounds associated with the firing, including hit, miss and sunk noises. The button array and LED display will be the game board in the player’s eyes. The player will place their pieces on the board using the button array at the beginning of the game, and from then on the board will show the opposing player’s shots taken.
2. Module Description

1. User Interface

   For the user interface, we needed to decide how to control our device. Initially we wanted to incorporate a button array in order to control the gameplay. This will add an interesting layer of complexity to our project as well as simplifying the design process.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Verifications</th>
</tr>
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<tbody>
<tr>
<td>1. Simple, easy to control user</td>
<td>1. Player and enemy's display updates almost instantaneously after a button press with low latency.</td>
</tr>
<tr>
<td>interface.</td>
<td>2. Player's display updates pieces when buttons are pressed.</td>
</tr>
<tr>
<td>2. No additional pieces required.</td>
<td>3. Able to switch modes via button press.</td>
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</tbody>
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2. Speakers

   For the speakers, we wanted to go with a lightweight, cheap part that is simple to incorporate into our design. We opted for a 50mm 3W speaker unit due to its flexibility and ease of use.
### Control System

#### 3. Microcontroller

<table>
<thead>
<tr>
<th>Requirements</th>
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</thead>
<tbody>
<tr>
<td>1. Device must be able to communicate and interface with each other component.</td>
<td>1. Properly interfaces with each module in order to output the correct display info and audio.</td>
</tr>
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</table>

#### 4. Bluetooth Chip

In order to wirelessly interface the two devices together we would need to include bluetooth chips in each device. We opted to go with HC-06 Bluetooth chips, due to the its lightness and great range of communication.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Able to transmit information between devices at least 30 ft apart.</td>
<td>1. Operate at a voltage range no greater than 3.3V.</td>
</tr>
<tr>
<td>2. Low latency, data travels between devices quickly.</td>
<td>2. Device will interface properly 30 ft apart.</td>
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### Power Supply

#### 5. Battery

We wanted to select a cheap, potentially rechargeable battery with a good operating range for our device, which both a lithium-ion and lithium-polymer battery provides. Ultimately we went with the lithium-ion battery due to it being more affordable and maintaining the same potential voltage ranges as the latter. [4] We plan to wire these batteries in series in case one battery does not supply enough power to our device. In order to use these batteries we need to maintain the proper operating voltage range and temperature.

<table>
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<tr>
<td>1. Sustain stable voltage, within operating range of device.</td>
<td>1. Maintain a 3.7V voltage output.</td>
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<tr>
<td></td>
<td>2. Temperature does not exceed</td>
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</table>
2. Operates within safe temperature range. 100°C.

5. Physical Display
We would like to create a light, concise display with durable material. The display should be large enough to contain all the circuitry.

<table>
<thead>
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</table>
| 1. Relatively light display.  
2. Visual elements sync with gameplay, is engaging and interesting. | 1. Design doesn’t exceed 10 Lb.  
2. Light changes demonstrate game mechanics. |

3. Tolerance Analysis

**Speakers** should be clear and at a controlled voltage.
1. Speakers may have a higher voltage.  
2. Speaker may have background noise which maybe hard to diminish

**Power supply** will satisfy the circuit’s modules to act appropriately
1. Could get damaged by too high heat if connected incorrectly, may damage other devices if overheat.  
2. With the number components to power, Voltage level may exceed.  
3. May set the circuit too high, damaging devices.  
   \[ 3.7V(\text{Power Supply}) > (\text{Bluetooth Chip}) + (\text{Speaker}) + (\text{interface}) \]

User interface is simple and engaging
1. The buttons could overheat if not powered correctly

Control System simplifies the communication between the modules within a single board
1. If not coded correctly, may lead to more miscommunication.  
2. If modules exceed the physical tolerances of the microcontroller board, the board can be damaged and lead to more miscommunication

Bluetooth Chip for communicating between boards
1. If powered too high, could break the device  
2. May be complicated for the players to keep up with the game if the two players are meditating on the boundary of the bluetooth chip(30ft)

Physical Display to display progression in the game against opponent
1. Not designed correctly, could lead to the giveaway of the opponents layout.  
2. The game may lose information on game ‘score’ if the two players are meditating on the boundary of the bluetooth chip(30ft)
4. Ethics and Safety

One of our constraints for this project is to make the project portable, so we figured to go forward with the Lithium Ion battery which is large enough in energy for portability. We have been accepted to use Li Ion batteries. For testing, we will use the bench initially if we can avoid the battery, but for testing the power circuit we will test with the battery. When we are done with the batteries, we will place the batteries in the battery bag and ammo box before storing in the yellow locker. We did look at certain safety conditions and procedures in the case of a fire or burning for Li Ion batteries[5].

We will be sure no one will be electrocuted by changing the circuit only when the power of the circuit is off. We will use the soldering station. The team will make sure the station stays nice and clean. If there seems to be something wrong with the station’s equipment, we will notify the TA for help. For any case, we do know where and how to use the Fire Aid Stations, Spill Kit and Fire Box.

What was listed so far does follow the IEEE Code of Ethics(1) and (9)[6]. To obtain complexity, our project may develop more by certification from our TA to make changes as well as getting advice and/or approval on materials to help make the changes necessary. This statement does show our respect and understanding of the IEEE Code of Ethics (3),(5) and (6)[6]. The team will be sure to be honest about the safety of the product for public use. When it comes down to the public, we will follow the IEEE Code of Ethics (1),(3),(7) and (8)[6]. If the occasion related to the IEEE Code of Ethics (2) and (4,) we will abide the code[6].

5. References


