Smart Tabletop

Divide and Conquer 1.0
Senior Design
Summer 2019 (Group 10)

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1. Motivation & Statement

When it comes to Tabletop games, one thing that keeps people from trying out this genre of gaming is they want to play with a group they are familiar with. Another would be that one or more people would like to join into an ongoing session, but they are in faraway locations. Also, most people would want to have a tangible feeling to their game and do not like to use a virtual tabletop. This project could provide a solution to a variety of people with different needs. In this case, the game that we are featuring is Dungeons and Dragons, a fantasy role-playing game based on medieval myth. In a regular game, it will include game pieces, dice, paper and pencil. However, this project will reduce to only game pieces and dice. The goal of this project is the following: to be able to move the game pieces using magnetic sensors and obtain statistics such as health and armor via a web application accurately.

2. Description

The initial discussion about this project is to ensure the appropriate size of the board. So far, the size of the board is the most critical step of this project since it will lead a to an x number of magnetic sensors. The size will be reasonably big so that the game pieces can move freely and make the game interesting. Next, an XY plotter will be built and it will be used to move the game pieces around the board underneath the table.

2.1. The Web application and Server

HTML and JavaScript will be utilized to create a web application that can communicate to the Device Controller. Various API's such as Node JS or a MVC framework will be used to access a server such as MySQL or MongoDB database. This application will allow the participant to click on the screen and it sends the data to the XY plotter controller to move a game piece physically on the board. It also continuously monitors all the game objects on the board by referencing their positional data on the server. On the application, it will display a login Username, Health points, Armor class, Speed, and a feature that can send an attack to the enemy. Also, the enemy will send the attack to the participant which can deplete the Health level. On the server, the information stored contain all the unique ID's of the game objects that are currently populating the tabletop device.

2.2. Controller

The controller communicates with the web server and receives information for any game object actions. It also communicates with the XY plotter for moving the game objects around the board. One feature that will be implemented is an edit mode combined with a magnetic pen that can be used to design structures of castles, trees, etc. to create an atmosphere to the game. These designs will be utilized to create obstacles in the grid. Let's say the participant would like to move his or her game piece across a wall in which the XY plotter will not move the game piece through that wall. However, the XY plotter can find another path to move the game piece around the wall. In other words, the XY plotter can find its nearest and most efficient path for the game piece to move to its designated location. If there is no valid path to navigate the game piece to its destination or if the distance is greater than the speed value, then the board will notify to the application that the piece can't move and there will be a visible indication on the board that the game piece can't move. Manual movement of game pieces on the board will be monitored by the sensors and the controller picks up this action. When an object is removed, the controller references what object was in that position and when that object is placed on a new position on the board, the controller updates that object's positional data on the server. This game objects position is updated on the web application due to its monitoring capabilities.

3. Requirements & Constraints

3.1. Requirements

1. Web application Requirements
   1.1. The user interface will display the current state of the board on the physical device.
   1.2. The application will maintain a constant feed from the server for any updates from the device.
   1.3. When using the user interface and moving a game object from one position to another, the app will update the server with the unique object's new coordinates.
   1.4. The application will read from the server if an attempted coordinate update is successful.
   1.5. If the move action is successful, the user interface display board will update with the new object's position.
2. Controller Requirements
   2.1. The controller will monitor game objects on the board and execute the proper functionality.
   2.2. When an object's coordinate position is updated, the controller will create an accurate path from the original object's position to the updated position.
   2.3. If there is no viable path to the new coordinates, the controller will not move the object and will update the server that the move action is unsuccessful due to distance or the obstacle.
3. Sensor Requirements
   3.1. The sensors will be magnetic.
   3.2. They will be magnetic to be able to connect with the XY plotter that will also have a magnet.
   3.3. The sensors are needed to place the game pieces where the user chooses them to be with the help of the XY plotter.
4. XY Plotter Requirements
   4.1. The XY plotter will need to hold a magnet to move the game pieces around, the original function of the XY plotter is to hold a pencil to draw.
   4.2. It will move the game pieces where ever the user chooses the game pieces to go.

3.2. Constraints

1. Web Application Constraints

    4.3. It will take time to develop and test the connectivity from the application to the device.

    4.4. Fixing any bugs that may come up while programming the web interface.

    4.5. The time it will take to program the application programming interface that is needed for the web application.

5. Controller Constraints

    5.1. Time needed to program it to work correctly.

    5.2. Flash memory size in order store data coordinates and statistics in the game.

    5.3. Choosing the right type of controller.

6. Sensor Constraints

    6.1. Depending on how big the board will need to be, that will determine the number of sensors that are needed.

    6.2. They need to be magnetic, so we can move the game pieces, that way it's able to connect with the XY plotter that will also have a magnet to move the game pieces.

7. XY Plotter Constraints

    7.1. The XY plotter needs to be configured accurately so that the controller can send data coordinates.

    7.2. It needs to change its functionality from drawing to moving the game pieces using a magnetic sensor.

    7.3. The time is critical when ordering the parts to assemble it.

Time Required	Action
4 weeks	Assemble the magnetic XY plotter
5 weeks	Coding/Configuring Web Application and Server
12 weeks	Assemble the project altogether

4. Project Budget and Financing

Unit	Quantity	Cost
XY Plotter	1	$150-$400
Sensors	256	$150
Controller	1	$40-$70
Server	1	$100
Power Source	1	$80
Magnet	Variable	$2-$20
Total		$820

5. Milestones for project

Senior Design 1 Milestone

Week	Date	Activity
2	May 21st	Project for senior design chosen
3	May 28th	Begin of research, analyze all components and task required to accomplish project
5	June 15th	Begin writing design document
8	July 2th	Check-up, at least 50% of paper complete
11	July 25th	Complete final design document
12	August 1st	Submit final design paper, order parts to begin assembling project

Senior Design 2 Milestone

Week	Date	Activity
1	August 27th	Start assembling project
3	September 10th	Begin testing components in project, start prototype
6	October 1st	Finish prototype, have at least one function fully running
9	October 22nd	Finish project, test all functions
13	November 18th	Prepare project for presentation, multiple tryouts
14	November 28th	Showcase final project presentation

6. Block Diagram
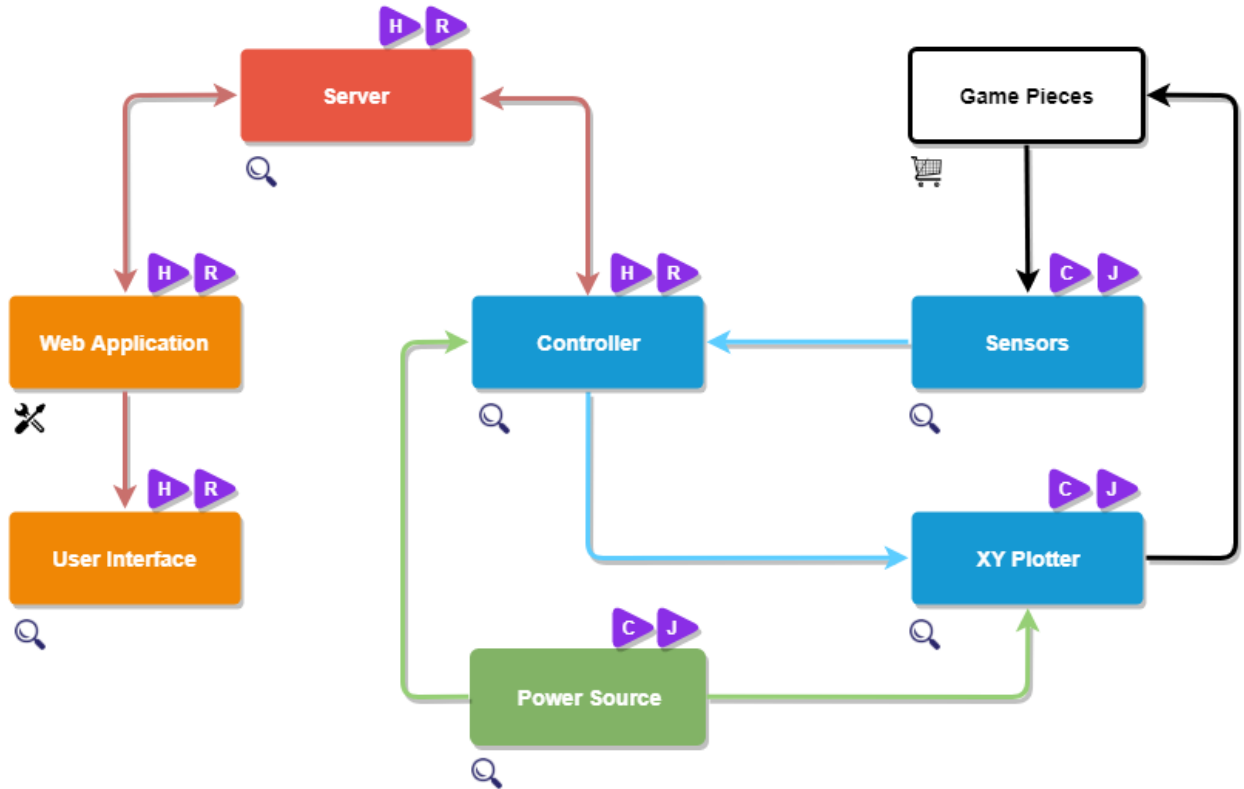
Block Diagram
Smart TableTop

Acquiring
Researching
Designing
Prototyping
Completed

Server Hardware	Comm Line
Control Hardware	Control Line
Power	Power Line
Web Software	Physical Action

R — Richard Almario
C — Coraima Orochena
J — Jose Castano
H — Hubert Barrantes
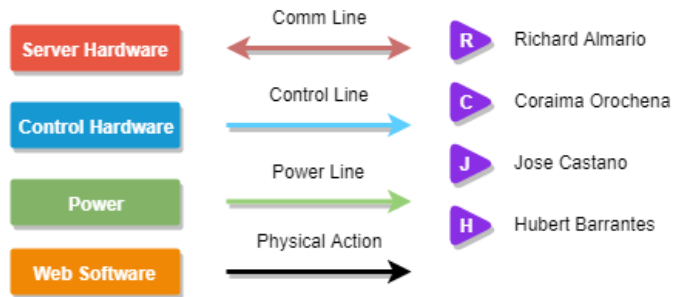
7. Project Prototype
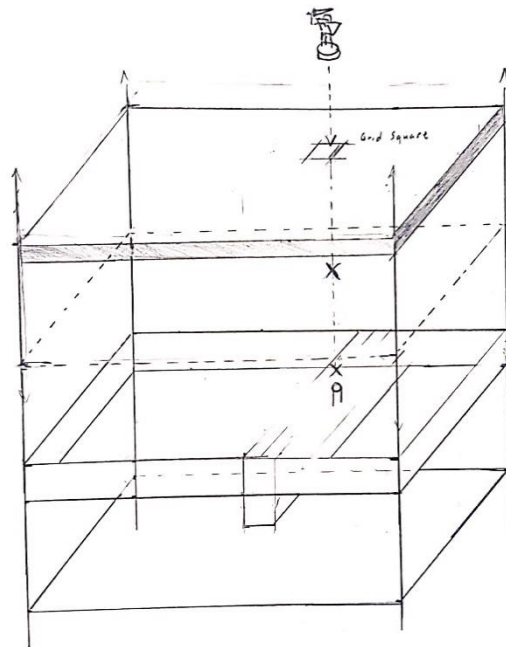
Layer: Game Pieces

1. Layer: Board

2. Layer: Sensor Matrix

Layer: XY plotter

Layer: Controller

Grid Square