UCF SENIOR DESIGN 1

ELECTRONIC CHESS TRAINER BOARD

Initial Project Document and Group Identification

Divide and Conquer

Group 7

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PROJECT DESCRIPTION

Chess players know that there is no replacement for the tactile feeling and weight of moving a chess piece and analyzing a physical 64 square chess board. With the invention and advancement of the smartphone, the chess board has moved to the digital screen and has brought artificial intelligence to the game. Smartphones allow you to play chess against an AI and even players from all around the world.

Many people find the game of chess to be extremely complicated and daunting to learn. A digital chess board also allows beginning chess players to pick up the rules of chess intuitively. By tapping a chess piece on the screen, possible moves for that chess piece are highlighted and the player gets a visual understanding of how each piece moves.

While chess smartphone applications offer numerous advantages for casual players, advanced chess players and chess enthusiasts lose the physical aspect of playing chess. Thus, the motivation for this project was to find a way to intuitively teach how chess is played on a physical board and to create an engaging experience. The advantages of chess played on a smartphone will be applied to a physical chess board. Users will able to see how pieces can move based on available spaces for a piece. Also, a game mode selector will be included so that a player can choose to play against an AI or play against another player.

There are a few smart chess boards that have been made already. Square Off is Kickstarter funded project whose main feature is a two-axis robotic arm underneath the board which is used to move the pieces automatically. A smart chess board was also designed by a senior design team at the Milwaukee School of Engineering in 2014. Their chess board design allows a player to play against an advanced AI. Their board uses LEDs to signal where the computer wants to move as well as indicating where a piece can be moved when it is picked up.

The goal for this project is to design a low cost and lightweight smart chess board that is able to help players learn how to play chess. The smart chess board will also be compact and portable so that the board can be carried around while maintaining a minimalist aesthetic design. The main learning objective for this project is to understand and implement an embedded system with various sensors and to write software to incorporate all the hardware together.

A variety of features will be included in the design of the board. The smart chess board will run on a rechargeable battery and have an efficient battery life to last multiple games. A mode selector will be implemented so that the user can choose to play against an AI or another

human player. An embedded microprocessor will be used to implement a simple chess engine. A LED array will be included underneath the board to indicate a variety of information. To prevent illegal moves, the LED where the illegal move was made will blink several times. Different LED colors will be used to differentiate between two players. The AI will also have a unique LED color to indicate that the user is playing against the computer. The LEDs will also be used to indicate where the AI wants to play so that the user can move the chess piece.

REQUIREMENT SPECIFICATIONS

- Chessboard shall have a teaching program and AI opponent embedded into the microcontroller.
- Chessboard shall be made from a material that's sufficiently aesthetic to create a slick design.
- Two different LED colors shall be implemented in each of the 64 quadrants of the chessboard.
- Chess piece identifier shall be able distinguish between different type of units.
- Microcontroller shall have at least 1GB of SDRAM for the neural network of the artificial intelligence and teaching program.
- Power supply shall maintain at least 5 full games.
- The microcontroller shall have Bluetooth compatibility for communication with smartphone.
- The display shall be on a smartphone application which is easy and simple to use.

HOUSE OF QUALITY

Using the House of Quality design tool, it was possible to create a relationship between the pros and cons of marketing targets and engineering specifications. To meet these targets, a set of needs must be met to incite the customer to purchase the product. Most valuable need for most products include the end cost that the individual will have to pay for the product. Reducing this as much as possible is desirable. The second marketing target is the visual aesthetic of the chessboard. Improving the visual design could include adding features such as LEDs. The User-Interface will also be of significant interest since the customer will be operating the chessboard through this display. Creating a simple and user-friendly interface will be the cornerstone for creating a product that people want to

buy. All successful businesses utilize simplicity in their design. The final marketing target is the performance of the AI opponent. Designing a neural network that adjusts playing style depending on the actions of the user and provides a level of difficulty for experienced chess players or an aspect of teaching for new chess players is the bulk part of the design that will be patented.

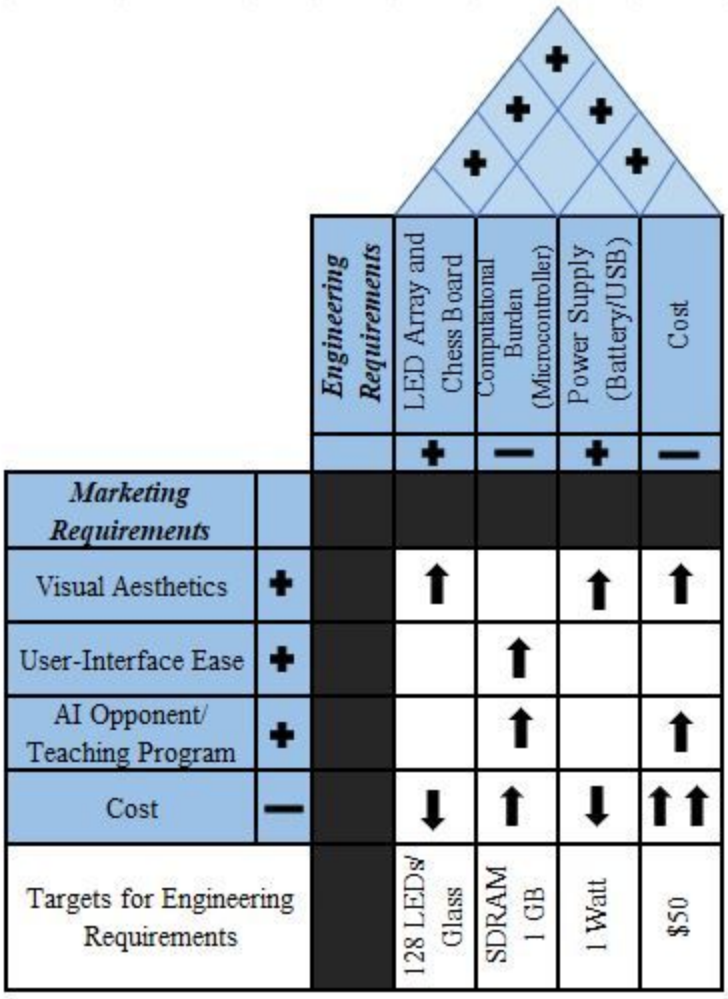
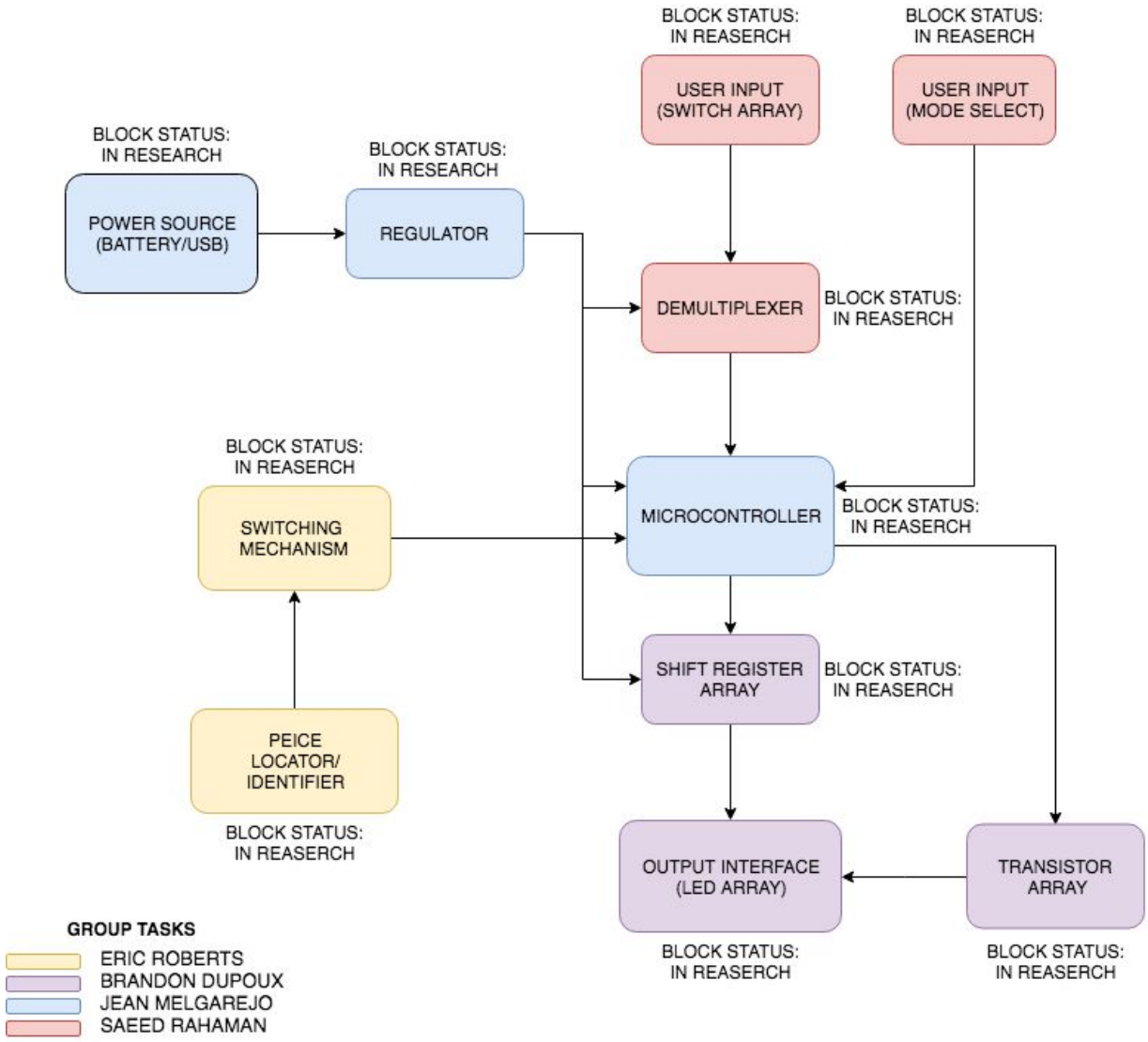


Figure 1 House of Quality

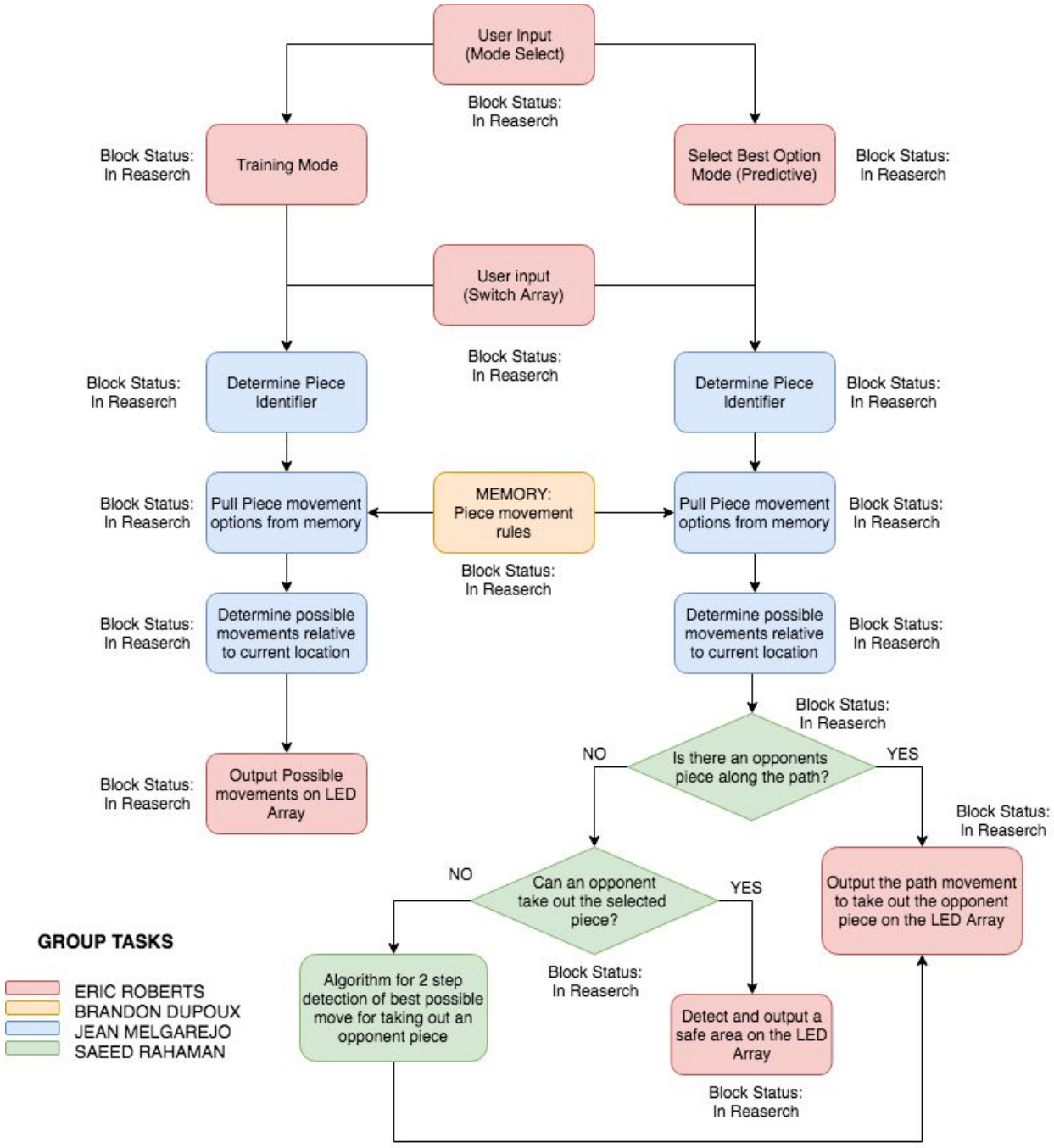
From an engineering perspective, the technical needs differ greatly from the marketing needs. There's more attention required for technical specifications to handle problems such as optimizing computational burden and increasing user simplicity. The overall cost of the product will dictate how sophisticated the technology is. The main objective here would be to have an efficient program that can run a slick user-interface and handle the AI with sufficient time while being cost friendly. Since the chess board is designed to help teach the game to users, the final product will come with a power supply that can be recharged at the leisure of one's own house. The power supply will be the main

limiting factor for the microcontroller, LED array, and Piece Identifier. Once the appropriate power requirement is calculated, the next step is to identify a microcontroller that can handle the computational burden associated with AI technology. Handling tradeoffs between how sophisticated the Artificial Intelligence is and the computational burden on the microcontroller will be very important. The final engineering requirement is creating a user-friendly interface that anyone can operate. Features would also include "smart options" that teach the user how to handle certain situations and the best play available considering all the positions of the units.

HARDWARE BLOCK DIAGRAM



SOFTWARE BLOCK DIAGRAM



TOTAL COST ESTIMATES

A rough estimate of the budget is provided to show best and worst-case scenarios pricing on parts. These prices are subject to change if certain materials or parts are chosen or changed once implementing the final product. All of the prices were gathered from online research and vendor sites. As of right now, all expenses shall be divided evenly amongst the group members since there is currently no sponsor.

	Part Description	Price Per Part ($)	Quantity	Cost ($)
1	LED's	$0.07-$2	64	$14-$128
2	Power Supply	$35-$100	1	$35-$100
3	Custom PCB	$30-$100	1	$30-$100
4	Microcontroller	$20-$50	1	$20-$50
5	Regulators	$5-$20	2	$10-$40
6	Transistor Array	$0.39	1	$0.39
7	Glass/Acrylic Sheet	$10-$30	1	$10-$30
8	Chess Pieces Set	$15-$50	1	$15-$50
	Total			**$135-$500**

INITIAL MILESTONES

SUMMER 2018		
Description	**Time**	**Dates**
Project Idea	1 week	
Project Division	1 week	May 21 - May 27
Documentation	1 week	May 28 - June 7
Initial Project Documentation		8-Jun
Research on past projects	2 weeks	June 11 - June 24
Individual writing	2 weeks	June 25 - July 5
Initial Draft (60 pages)		6-Jul
Design & Development prototyping	2 weeks	July 9 - July 19
100 Page Submission		20-Jul
Finish documentation	5 days	July 21 - July 25
Documentation Review/Purchase Components	4 days	July 26 - July 29
Final Documentation Submission		30-Jul

FALL 2018		
Description	**Time**	**Dates**
Component Testing	1 week	August 20 - August 26
Build Prototype	8 weeks	August 27 - October 14
Test Prototype	3 weeks	October 15 - November 4
Finalize Project	2 weeks	Nov 5 - Nov 18
Final Documentation and Presentation	2 weeks	Nov 19 - Dec 1