Final Project Proposal

Year: 2022 Semester: Fall Team: 12 Project: R.A.C.H.E.L.

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Team Members (#1 is Team Leader):

Member 1: Bartosz Stoppel Email: bstoppel@purdue.edu

Member 2: Jack Myers Email: myers395@purdue.edu

Member 3: Micah Morefield Email: mmorefie@purdue.edu

Member 4: James Hubbard Email: hubbar31@purdue.edu

1.0 Project Description:

Project R.A.C.H.E.L. is an enhancement to the original game of table tennis. Through real-time feedback to the user directly on the table. Information about the game is collected using data from two sources: a microphone array, and a camera, and displayed using a projector mounted overhead. The user will interact with the table through a simple button panel, and crucial data such as game score will be presented. But, project R.A.C.H.E.L. truly excels as a platform: a space for enthusiasts to reinvent table tennis, and create unique and engaging experiences that take place all within our product.

2.0 Roles and Responsibilities:

Bartosz Stoppel has had experience with designing, ordering, and soldering PCBs in two different projects. He was a part of EPICS, and is familiar with large-scale, early-stage projects. He had a leadership position in his EPICS project that will translate well to his leadership in this senior design project.

He will be helping with constructing and ordering the PCB, as he has the most experience with it. In software, Bartosz will be working on computer vision for ball tracking.

Micah Morefield has worked with a variety of microcontrollers, as a teaching assistant in a microcontrollers course at Purdue University, as a researcher for SPARCLab (affiliated with Purdue University), and as a product developer for Garmin. He enjoyed his work in an ASIC design course in creating block diagrams, and will use that knowledge as this project’s system engineer.

He will handle a majority of the embedded programming for this project, as well as the microcontroller integration with other subsystems, such as custom hardware, sensors, and the Raspberry Pi.

James Hubbard has a thorough understanding of signal processing and generation through his ECE 362 project where he created a polyphonic synthesizer. He was able to add features to his project that weren’t originally planned, such as pitch bending, as he is very passionate about the subject. He also has exposure to image processing, through development of a kinetic sandbox, using an Xbox Kinect.

James will be responsible for most of the signals processed from the contact microphones to track ball bounces and the computer vision because of his experience. He will focus on circuit and PCB design, because he likes it.

Jack Myers has experience prototyping, building, and testing software systems. He took a leadership position in VIP, developing an automatic grading system for ECE 264. He has experience with software development strategies, having used an agile system to create a web stack for a portable station. He is working towards a minor in art and design, and has interest in UI design.

Jack will be working on handling the user experience of the senior design project. He will handle the game logic - tracking and displaying the score, reading and completing requests from user input, and designing our projector’s display system.

2.1 Homework Assignment Responsibilities

Homework responsibilities are detailed in figure 1, below.

| *Design Component Homework* | | *Professional Component Homework* | |
| --- | --- | --- | --- |
| A3-Software Overview | BS | A9-Legal Analysis | JH |
| A4-Electrical Overview | MM | A10-Reliability and Safety Analysis | BS |
| A6-Mechanical Overview | JM | A11-Ethical/Environmental Analysis | MM |
| A8-Software Formalization | JH | A12-User Manual | JM |

Figure 1. Assignment Responsibilities

3.0 Estimated Budget

In Figure 2 below, our estimated budget, green text indicates that this object (these objects) have already been purchased.

| **Table Tennis** | **Estimated Cost** |
| --- | --- |
| Table | $40 |
| Balls | included with table |
| Paddles | included with table |
| **Peripherals** |  |
| Projector | $0 - borrowed from ECE shop |
| Camera | $0 - borrowed from ECE 477 Lab |
| Contact Sensors | $10 |
| **PCB Costs** |  |
| SMT Parts | $10 |
| PCB | $20 |
| Shipping | $50 |
| **FPGA/MCU/MPU** |  |
| Raspberry Pi 4 B | $0 - already owned |
| SMT32F091RCT6 | $0 - borrowed from ECE 477 Lab |
| **Total Cost** | $130 |

**Figure 2. Estimated Budget**

4.0 Project Specific Success Criteria

Hardware

1. An ability to convert voltages through a buck converter of our design.
2. An ability to handle 2-way communication between 2 microcontrollers through UART.
3. An ability to read key presses from a 4x4 keypad matrix.
4. An ability to amplify analog signals from contact microphones.
5. An ability to clean analog signals through a hardware filter of our design.