Final Project Proposal

Year: 2023 Semester: Fall Team: 5 Project: Smart Air Hockey Table

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Team Members (#1 is Team Leader):

Member 1: Alan Chung Ma Email: achungma@purdue.edu

Member 2: Benjamin Owen Email: owen67@purdue.edu

Member 3: Trevor Moorman Email: tmoorma@purdue.edu

Member 4: William Dobert Email: wdobert@purdue.edu

1.0 Project Description:

The project at hand involves the development of a smart air hockey table that replicates the functionalities of a traditional arcade air hockey setup with a twist. The notable innovation is the incorporation of a responsive surface beneath a translucent playfield. This reactive surface, comprising strategically positioned lights, sensors, and computational components, reacts in real-time to the movements of the puck, generating visual displays that enhance the gameplay experience.

The dynamic nature of the reactive surface introduces novel game modes that transcend the boundaries of conventional air hockey. Despite its technologically advanced features, the smart air hockey table maintains a compact form factor, making it adaptable to a variety of flat surfaces, from regular tables to other suitable platforms. This convergence of timeless gameplay with modern technological advancements is poised to redefine the enjoyment of air hockey, offering enthusiasts an immersive and unparalleled gaming encounter.

2.0 Team Member Expertise and Team Roles and Responsibilities:

The project's success hinges on the diverse skill set and collaborative efforts of the team members. Each member brings a distinct range of expertise that collectively covers the technical, creative, and organizational aspects required for the development of the smart air hockey table. This section provides an overview of the team's collective skills and the roles and responsibilities each member will undertake throughout the project's lifecycle.

2.1 Team Member Expertise

2.1.1 Team Member: Alan Chung Ma:

Alan Chung Ma brings a wealth of expertise to the team. His involvement as the Software Lead of Autonomous Motorsports Purdue underscores his proficiency in managing and developing large, complex software systems. Additionally, Alan's diverse coursework, including courses such as Compilers and Operating Systems, provides him with a strong foundation to navigate intricate technical challenges and facilitate effective collaboration among team members with varying areas of specialization. His practical experience gained from two internships at Google as a Software Engineering Intern, focusing on infrastructure projects, further highlights his ability to contribute meaningfully to the implementation of the smart air hockey table project.

2.1.2 Team Member: Benjamin Owen:

Ben has lots of experience with embedded electronics and PCB design. As Electrical Lead for Autonomous Motorsports Purdue, he spearheaded the PCB redesign from the ground up, including shifting to a brand new microcontroller platform and integrating many different analog and digital components into the final design. Furthermore, his experience in classwork, including microcontroller and FPGA-focused courses, provides him with lots of experience with low-level embedded microcontrollers. His practical experience as a TA for the Electrical Engineering fundamentals lab and his internship at Milwaukee Tool also supplements his analog electronics background, resulting in a well-rounded individual with lots of knowledge and experience in the world of embedded systems. The smart air hockey table project is a great opportunity to combine these strengths into a completed project.

2.1.3 Team Member: Trevor Moorman:

Trevor Moorman has past professional experience working as a firmware engineer intern at Indesign, LLC, an Indianapolis-based electrical and computer engineering design and consultancy firm. During his internship, he got to work on projects for Indesign clients developing firmware for embedded systems which used the PIC16F15345, PIC18F46K22, and STM32F439ZIT and were programmed in C. During these projects, he gained experience with a variety of tools including MPLAB X IDE, STM32CubeIDE, MCUXpresso IDE, Simulink, and Git. Trevor also worked on an internal project developing an internal tool using JavaScript and the Electron framework. These past professional experiences give him a good technological background to draw from for this project. These experiences also provide him with vital experience working on teams with diverse technical knowledge, which will help the team work at its full potential by playing to each members’ strengths. Trevor's previous coursework includes fields such as ASIC design, computer networking, microcontrollers, and operating systems among others. Trevor’s professional and academic experience has him proficient with C, Java, and Python with knowledge in functional and object-oriented programming paradigms.

2.1.4 Team Member: William Dobert:

Will is well acquainted with designing software for a variety of applications. He has previously completed coursework in embedded systems, compilers, operating systems, and integrated circuit design. This wide variety of technologies will be highly relevant, and can provide valuable insights in designing this project. He recently held a position at Alarm.com as a Device Engineering Intern, responsible for writing firmware in close collaboration with a team of skilled engineers. This experience provided Will with new perspectives on system design for consumer products and the vital role that firmware plays when designing a device. The smart air hockey table project provides the perfect environment for him to work with his team to make valued contributions.

2.2 Team Roles and Responsibilities:

| *Role* | *Team Member* |
| --- | --- |
| Team Leader | Alan Chung Ma |
| Systems Engineer | Trevor Moorman |
| Hardware Engineer | Benjamin Owen |
| Software Engineer | William Dobert |

Figure 1: Team Roles and Responsibility Table

3.0 Homework Assignment Responsibilities

| *Design Component Report* | *Professional Component Report* |
| --- | --- |
| A3-Software Overview | Alan Chung Ma | A9-Legal Analysis | Alan Chung Ma |
| A4-Electrical Overview | Ben Owen | A10-Reliability and Safety Analysis | Ben Owen |
| A6-Mechanical Overview | Trevor Moorman | A11-Ethical/Environmental Analysis | Trevor Moorman |
| A8-Software Formalization | William Dobert | A12-User Manual | William Dobert |

Figure 2: Assignment Responsibilities

4.0 Estimated Budget

Below is a table denoting the estimated budget of the smart air hockey table. Any additional costs that go over the allotted budget to each team will be evenly split between the members.

| ***Mechanical*** | ***Estimated Cost*** |
| --- | --- |
| Puck and Pushers | $20 |
| Air Hockey Table | $90 |
| Blower | $200 |
| ***Electrical*** |  |
| PCBs | $80 |
| Electrical Components | $200 |
| ***Other*** |  |
| Shipping | $50 |
| ***Total cost*** | $680 |

**Figure 3: Estimated Budget**

5.0 Project Specific Design Requirements (PSDRs)

The design and development of the smart air hockey table will adhere to the following focused design requirements to ensure a successful and captivating gameplay experience:

5.1 PSDR List

5.1.1 Light-Up Display Hardware

An ability to control a grid of lights beneath the playing surface to create complex visuals.

5.1.2 Puck Tracking

An ability to accurately track the puck’s position on the playing field in real time.

5.1.3 Software to Control Dynamic Display

An ability to display dynamic light effects on the playing surface based on game state by implementing software that synchronizes visual effects with ongoing gameplay.

5.1.4 Goal Score Detection using Infrared Sensors

An ability to reliably detect goals scored by monitoring the passage of the puck through the goal.

5.1.5 Score Tracking with Display

An ability to internally track the score of ongoing games, which is then displayed with a display.