Final Project Proposal

Year: 2021 Semester: Fall Project Name: RevEx

Creation Date: August 25, 2021 Last Modified: August 26, 2021

Team Members (#1 is Team Leader):

Member 1: Matthew Rumple Email: rumple0@purdue.edu

Member 2: Isaac Hagedorn Email: ihagedo@purdue.edu

Member 3: Zach Ghera Email: zghera@purdue.edu

Member 4: Swagat Bhattacharyya Email: bhatta21@purdue.edu

1.0 Project Description:

RevEx is a non-optical virtual reality (VR) input device with haptic feedback that creates a more immersive VR experience. This system will contain a low-power wearable device that collects sensor data and applies haptic feedback as well as a host computer running a dynamic VR simulation. The wearable also utilizes regenerative braking in conjunction with the haptic feedback to increase the battery life.

2.0 Roles and Responsibilities:

**Team Leader**

Matthew Rumple is a jack of all trades with ample experience in CAD design, embedded systems, PCB design, and VR programming who will serve the team well in a position that allows him to apply his broad knowledge to all levels of the project. Additionally, he has prior leadership experience within his EPICS team organizing resources and collaborative tasks within his team. He will be responsible for assisting in all levels of the design including the mechanical design.

**Mixed-Signal Systems Engineer**

Swagat Bhattacharyya is a seasoned, mixed-signal designer with six years of experience in ultra low-power design at the Computational Electronics Systems Lab at West Virginia University. He has also developed hardware for biomedical systems including an implantable gastric monitor, an exoskeletal elbow joint, and a wearable seizure monitor. As the electrical engineer he will be responsible for hardware design and testing as well as coordinating PCB designs within the team.

**Embedded Software & Communications Engineer**

Isaac Hagedorn is a well rounded embedded systems and software designer with experience in microcontroller design for low powered devices and ASIC design and test verification. He has experience in networking algorithms and embedded software design with applications specific to electronic locks and satellites. As the systems engineer Isaac will be responsible for standing-up the different microcontroller peripherals and low power optimization. In addition, he should assist in the sensor fusion of the IMU and Bluetooth low energy protocol.

**Host Software & Sensor Engineer**

Zach Ghera has ample experience in software engineering for a variety of applications. He has completed 4 software engineering internships across Google and Tesla primarily focusing on performance and system development. He is also the technical lead for Autonomous Motorsports Purdue’s software team. He will be focusing on the host-side software including sensor data processing, VR simulation, and haptic feedback response.

2.1 Homework Assignment Responsibilities

|  |  |  |  |
| --- | --- | --- | --- |
| *Design Component Homework* | | *Professional Component Homework* | |
| 3-Software Overview | Zach | 9-Legal Analysis | Swagat |
| 5-Electrical Overview | Swagat | 10-Reliability and Safety Analysis | Matthew |
| 7-Mechanical Overview | Matthew | 11-Ethical/Environmental Analysis | Zach |
| 8-Software Formalization | Isaac | 12-User Manual | Isaac |

3.0 Estimated Budget

|  |  |
| --- | --- |
| **Item** | **Estimated Price** |
| ***Mechanical*** |  |
| Stepper Motor With Gearbox | $50.00 |
| Screws | $10.00 |
| PLA Filament | $25.00 |
| Adhesives | $20.00 |
| Bands/Velcro | $20.00 |
| ***Electrical*** |  |
| Amplifiers (Operational & Instrumentation) | $30.00 |
| Switching Elements (FETs, BJTs, Relays) | $20.00 |
| Passive Components (Resistors, Capacitors, Crystals, Diodes) | $20.00 |
| Power Conditioning (Battery, Regulators) | $30.00 |
| Wireless Communications Modules | $50.00 |
| Misc. Components (Microcontroller, IMU, Level Shifters, Logic Gates) | $50.00 |
| ***Services*** |  |
| PCB Fabrication | $50.00 |
| Shipping | $50.00 |
| **Total:** | **$425.00** |

Given the current budget estimate, it is not expected that team members would need to provide any additional money out-of-pocket. However, if the need arises, any costs exceeding the $425 budget allocated by the course staff would be shared equally amongst team members.

Mechanical components are components related to the mounting of RevEx electronics onto the user’s arm. This section also includes electromechanical components such as the generator. Electrical components are components related to sensor signal acquisition, processing, and transmission as well as power conditioning and haptic feedback. The “service” section contains a list of services integral to product development.

4.0 Project Specific Success Criteria

1. Ability to read accelerometer and gyroscope data from an inertial measurement unit (IMU).
2. Ability to read elbow joint angle from an analog potentiometer.
3. Ability to transceive raw sensor data and haptic feedback information from/to wearable devices to the host computer.
4. Ability to provide passive haptic feedback on an elbow joint.
5. Ability to transform raw sensor data into arm position in a VR simulation.

5.0 Sources Cited:

No external sources were used in completing this proposal.