**ECE 4012 Final Project Summary**

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| **Project Title** | Measured Accumulative Underlying Real-time ImpaCt Endo-skeleton “MAURICE” |
| **Team Members** (names and majors) | Aaron Thurston, Computer Engineering |
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| Kevin Webb, Computer Engineering |
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| **Advisor / Section** | Dr. Linda Milor |
| **Semester** | Year/Semester: **2018/Spring**  Circle: Intermediate (ECE4011**)** or **Final (ECE4012)** |
| **Project Abstract** (250-300 words) | MAURICE is a concussion and injury monitoring system specifically geared towards athletes. Concussions have been a topic of great concern in football. Our monitoring system addresses this issue by placing sensors under the pads and within the helmet of the player’s uniform, with the purpose of collecting statistics such as acceleration, torsion, and velocity to calculate the amount of force a player has endured in different areas of the body.  Currently, the NFL uses the Microsoft Surface Pro on the sideline to call plays during the game. Our team would create an app compatible with this device that stores data on the amount of force that a player withstood on the last play. This app will also log the total amount of force taken over the course of the game providing a touch screen compatible, 3D physiological image that is color coded to represent varying levels of impact. The interface will be written in html/CSS, while the back-end & embedded software will be written in Python. The data collected from the sensors will be uploaded to a cloud server, which will process the data for displaying the severity of the hits being sustained by players. The NFL's Surface Pro devices currently use the Verizon network to provide the teams with internet connectivity. The Surface Pro's the team uses will replicate this by using a standalone, mobile hotspot to broadcast Wi-fi, providing the Surface with the internet access it would need to request data from the cloud.    We will attempt to make this system low cost, within the constraints of our budget ($500-$600) while making safety a high priority, since it will be a wearable device in a turbulent athletic environment. A particularly important constraint is providing protection for the sensitive components attached to the suit (microcontroller, heartrate sensors, thin wires etc.) |

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| List **codes** and **standards** that significantly affect your project. Briefly describe how they influenced your design. | 1. FCC regulations (for custom PCB communication and sensor boards) listed in Title 47 of the Federal Code of Regulations. 2. I2C – for communication from microcontroller to Accelerometer 3. SPI – for communication from microcontroller to ADC and Load Cells 4. IEEE 802.11 – for wireless communications between suit and base station as well as base station and router. |
| List at least two significant **realistic design constraints** that applied to your project. Briefly describe how they affected your design. | 1. Connectivity range & Latency: Long connectivity range is necessary since the distance between the suit and mobile hotspot will vary. Upload speed and processing overhead to display on web GUI must be as minimal as possible to report accurate, play-by-play results. 2. Power: The entire suit requires long lasting power since multiple sensors will be used to track multiple parts of the body. Safety concerns (Heat, Power Surge) must be adressed as well. 3. Size of microcontroller / Placement on suit: Due to the nature of the product, it will be necessary to prevent the microcontroller and accompanying from directly experiencing any heavy force. We will need to carefully asses the best position to minimize the risk of damage to this component, as well as encasing to protect from contact. |
| Briefly explain two **significant trade-offs** considered in your design, including options considered and the solution chosen. | 1. Including numerous sensors will greatly improve the accuracy of our product. We would be able to report impacts in finer detail (for instance, more sensors could account for different body parts, or report the angle in which force was applied). However, this would a require a larger battery, for each sensor and the microcontroller will draw more current. CPU performance is also an issue, as each sensor must run concurrently, and must not be interrupted (which would cause a loss of data). 2. During data communication, but it is limited to connecting only two devices. On the other hand, Wi-Fi helps with managing or communicating to the network while being able to send and receive any amount of data. However, with a significant number of players using our product at once, connection bandwidth will become an issue once players send data simultaneously to the cloud layer. |
| Briefly describe the **computing aspects** of your projects, specifically identifying **hardware-software** tradeoffs, interfaces, and/or interactions.  *Complete if applicable; required if team includes CmpE majors.* | 1. Programming Microcontroller to compute values of force. We need to constantly monitor values from our sensors (Flex sensor, Gyroscope, Accelerometer etc.) 2. Sending data from device to sideline/server (Networking). 3. Since the device must be able to communicate over wireless communication, there is a chance of lag being introduced. If this is the case, we will need to scale down the amount of data being streamed from the player to the base unit, or compress the data for easier sending. (Data compression) |