Personal Accomplishments for semester 2:

- Researched and selected components for project
- Analyzed and designed hardware/circuitry
- Built/wired components/hardware
- Developed code for microcontroller to receive sensor data and convert values into G's
- Collaborated with Ali for Battery Analysis and implementation
- Implemented Trello into team workflow for project management and task tracking

Journal 2:

2/21 - 2/27

- Team Evaluation with Professor Stallard & Team Meeting (2/25)
    - Had team evaluation and went through GitHub repo to evaluate our progress and see what documents we were missing from the repository
    - Advised that we add our team minutes, individual journal and referenced work to repository before end of next Sunday
    - Updated team on what I've accomplished for the knee pad, assigning work
    - Assigned work to be done for whoever is available to update documentation (such as Project proposal writeup, technical requirements paper etc.) for our latest project
    - Assigned Dallas to research how to write data onto SD card and plot data after I complete code for microcontroller-sensor interaction
- Labwork (2/24):
    - Went to GoCreate and then Electronics lab from 11a.m. to 11p.m. in order to work on the knee pad.
    - Soldered leads onto microcontroller and sensors
    - Designed circuitry of kneepad and assembled/wired the components together for preliminary testing
    - Searched for sample code to test whether the sensor data could be read
    - Calibrated MPU6050 for better accuracy
    - Ali came later at night to help with battery analysis

- Team Meeting with Professor Stallard (2/22):
    - Arranged meeting with Professor Stallard for teammates to ask questions about the knee pad and also for Professor Stallard to understand our team's issues.
    - Proposed idea of using knee pad to detect and measure walking imbalances between each leg
    - Received feedback that we should focus on getting the data onto something like an SD card to be able to read data and plot it.

- Lead meeting on Monday:
    - Assigned tasks and received updates from members to be tracked in Trello

- Revised plan to pivot projects from helmet to knee pad. Introduced potential hardware that could be used for the project (as I bought different components for the "best" one to be selected)
- Set up a meeting between Professor Stallard and the whole team so everyone can clear doubts with the Professor while also letting him have a better understanding of our team's issues.
- Tasked Dallas with uploading documents for Team evaluation and TPR before Friday

Technical Work:

- Review, research and purchased variety of components to be used for knee pad project (microcontrollers and sensors)
- Researched and designed circuitry to be used for knee pad
- Learned and soldered components to be used in knee pad
- Assembled and wired microcontroller and sensor
- Calibrated sensor for better accuracy
- Retrieved sample code to test sensor/microcontroller
- Work on code to be used for our use case
- Review power supply options for mobility

2/14 - 2/20

- Lead meeting on Friday (Virtually):
  - Brought up the idea of kneepad project to the team and asked whether any of the members had new ideas that could be implemented with our current work. The team was onboard with the idea but I told them to take the weekend to reflect and brainstorm any other ideas.
  - Discussed about the TPR package. Read up on the IEEE format and started distributing and breaking down the rubric with the team in order to get a better understanding of the format.
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- Met with Professor Stallard (2/16):
  - 1-on-1 about potentially pivoting the project with Professor Stallard and explained our situation
  - Professor recommended pivoting to a project that used a similar concept of measuring acceleration/impact but on a smaller scale such as a knee pad
  - Discussed and talked about components (microcontrollers and sensors) that could be used for the project

- Lead meeting on Monday to assign work and receive updates from other members:
  - Plans to pivot from helmet project as it required sensor that could detect g force higher than 100g's which seriously limited the choices of accelerometer we had

- ADXL377 could not be calibrated and online forums have expressed similar issues with no solutio.

Technical Work:

- Analyzed and researched components to ensure compatibility
- Purchased selected components in order to reach deadlines in the event that the team agrees to the new project
- Read and researched about the MPU6050 sensor and related documentation for better understanding of the sensor

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Journal 1:

2/7 - 2/13

- Lead the meeting on Monday to assign work and get an update from other members
- Purchased BNO055 Sensor as backup/temporary solution as we were having troubles with the ADXL377

Technical Work:

- Assigned EE members to test battery for the helmet, found that the 3.7V 500 mAh battery took around 20 minutes to fully charge and according to online searches will last around 6 months to 1 year of “regular use”. Further testing required.
- Ran code to try and calibrate the ADXL377 but ultimately failed. We tried resoldering the pins on the Microcontroller to see if it was a connection issue but were still not able to fix it. Bought another sensor to progress temporarily
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1/31- 2/6

- Team had trouble keeping track of tasks and distributing tasks. I created a Trello Board that we would use every meeting to assign, update, and track tasks so we can view our progress and delegate tasks accordingly.
- I created Teams and linked a google doc that would contain all our Team Minutes for ease of access
- Worked on the Meeting Minutes to be submitted for the past 2 weeks

Technical Work:

- Created Trello Board for project management and tracking
- Looked into alternatives to LoRaWAN, could potentially use a host PC on the field that would connect to the helmets and upload data through internet connection with the Host PC
- Looked into how to calibrate the sensor and find resources and code online to do it

1/17 - 1/23

- Met with the Team after the first class and talked about work that carried over from the last semester

- Work that carried over were calibrating the sensor, moving the components to a larger helmet, where to secure the components to, how to implement code with lorawan
- Arranged with team to meet on Mondays at 4.00 PM to mainly distribute work to be updated on Friday

FIRST SEMESTER JOURNAL

Personal Product Reflection

I feel that our product (Collision Detection Helmet) can assist youth athletes in detection and treatment of concussions. As youth football games usually lack the appropriate amount of medical staff or staff that are knowledgeable with regards to concussions. Youth athletes can suffer concussions that go unnoticed. By having an alert system that can alert staff through the phones or devices they already carry, we can relieve burden from the medical staff that could potentially miss a collision due to a lapse in attention and allocate their efforts to property diagnose and treat high risk youth athletes.

However, I do have concerns regarding our product and the level of success it can achieve. The first is cost. With football helmets already ranging from $100 to $200, the addition of specialized equipment and support could increase the cost beyond the budget of youth league teams or parents of youth athletes. With our calculations, we estimate that the cost would need to be around $100 more than the helmet in order to breakeven/cover cost including time spent developing the product. This would make our potential margins very thin as any further increase in price would deter most of our targeted audience.

Second concern that I have is acceptance and reluctance of implantation by coaching staff. Coaching staff might be reluctant to make accommodations or allocate staff to pay attention to alerts sent out by the program. The deployment of the helmets would need an initial setup and personalization of the helmet to the wearer which also might deter coaching staff from implantation as they might feel that it would be “too tedious”.

From a technical perspective, the maintenance of applications might be a problem in the future. If the alert via application route is taken, the application needs to be updated and maintained to ensure proper functionality with the devices current operating system and software. A lapse in this might cause the program to not function as intended and not alert the appropriate staff. Another concern is how we can accurately detect and compare waveforms of the collisions, as our team currently lacks experience with Machine learning/Artificial Intelligence, we cannot currently deploy a program that can analyze waveforms and learn to detect patterns and similarities. This would result in us needing to hardcode parameters and thresholds which might not be as accurate as concussions can occur in varying conditions with varying factors. AI solution would be a long term solution if the initial setup is completed appropriately.

Week 1 (9/5/2021)

Project Selection:

- Initially we had the idea of building a “Smart Board” that would enable students in a lecture to mirror or stream content on the smart board on their personal devices. This would let them take notes on their device or select out important parts of the lecture.

- After feedback from the class, we felt that it was hard for us to not only build our product, but also beat out preexisting similar smart boards that are already out on the market.

- We have since decided against doing that project and set up a meeting with Coach Allen and Professor Stallard to potentially do a LoRaWan Project.

Role Delegation:

- We delegated roles to the team members to decide on what portion of the projects each member would take up. Andrew, Ali and Isuru would work on the hardware and electrical components of the project while Dallas and I (Julian) will focus on the software/Programming section of the project.

Week 2 (9/12/2021)

Project Selection:

- After meeting up with Coach Allen and Professor Stallard, we’ve decided on working on a LoRaWan Project. The project involves a helmet that detects whether enough trauma has been dealt to the head for a concussion to occur.

- The helmet would potentially detect acceleration, impact, angle of impact etc. These variables would then be passed into software where parameters would be set up to decide whether the hit could cause a concussion.

- The data and signal can utilize LoRaWan to send the signals or notification if a potential concussion occurs.

Personal Research:

- Conducted research and reading on LoRaWan. Looked up other implementations of LoRaWan on the LoRa Alliance website to see if there could be other ways for us to implement LoRaWan on the project.
- Searched up whether our idea of a concussion detecting helmet has been done and whether any of their resources are open source. Learned how other helmets' approach to detecting concussions. **Week 3 (9/20/2021)**

Project Planning:

- Sat down with the team to plan out the project and delegate writing the project planning paper.
- We discussed about our teams' skills, ana analysis of legal and ethical aspects of our project and whether it violated any Intellectual Property laws, milestones and metrics.

- Dallas and I discussed about software development model and what model suited our project the best. We settled on the waterfall method as we were only a 2-man team, and the software aspect compliments the hardware instead of being a standalone product. Organizing the software in phases would keep the process organized and straightforward.

Week 4(9/27/2021)

Midterm Presentation Planning:

- Sat down with the team to discuss about the midterm presentation. We distributed the work and delegated tasks to each member

- I was tasked to do the part on concussion hit detection, how will we detect a concussion and how the basic math would work for the helmet

Meeting with Coach:

- Went to GoCreate and talked to Coach about our project. He talked to us about equipment and expectations. He suggested some microcontrollers for us to use such as the Adafruit M0 feather.
- He also talked about the LoRaWAN GitHub repo that we need to have our code in when we start coding.

Week 5 (10/4/2021)

Midterm Presentation Rehearsal:

- Met up at John Bardo Center to practice our presentation and look through slide. I made the google slides for everyone to upload their slides to and made/tweaked the slides of other members for basic things like font, size, and formatting to be consistent through out the presentation (except for Dallas's, his slides were neat).

Personal Research:

- Researched about concussion impact force among youth athlete's vs high school athletes and the minimum/average force of impact that resulted in a concussion.

- Learned the basic math behind how we can calculate the magnitude of acceleration and how that relates to concussion detection

Week 6 (10/11/2021)

Skills Assessment Revision:

- Revised on topics related to OOP, Data Structures and Algorithms, Networking, and Discrete Structures to better prepare for the Skills Assessment.

Technical Requirements Paper Discussion:

- Discussed with the team about how we should prepare to finish the technical requirements paper due in around the end of week 7.

Week 7 (10/17/2021 – 10/23/2021)

Skills Assessment:

- Completed Skills Assessment for Computer Science in Week 6

Technical Requirements Paper Discussion:

- Divided work among the EE and CS members

- Analyzed the software development process of the helmet

- Elaborated on software design, components, limitations and constraints, alternatives, and regulations.

Week 8 (10/24/2021 – 10/31/2021)

Block Diagram:

- Developed the block diagram that describes how our software/hardware interacts between components

Personal Research:

- Researched about sensors and microcontrollers and decided to instead go with the Adafruit feather M0

- Look into visualizing the data of different impacts on different materials and how we can capture that in a graph after receiving the sensor data from the accelerometer.

Week 9 (10/31/2021 – 11/6/2021)

Electrical Components:

- Met up with team to agree upon components and purchase said components

- Purchase the ADAFRUIT Feather M0 with LoRa compatibility for the microcontroller and the SparkFun Triple Axis Accelerometer ADXL 355 for the accelerometer of choice.

Data Graphing:

- Discussed with Dallas about possible ways we can visualize the data obtained from the sensor.

- Agreed that we need to find out how the sensor outputs the data to consider if we can temporarily use a rudimentary method like excel to graph out the data.

Week 9 (10/31/2021 – 11/6/2021)

Helmet Assembly:

- Came together with the team and tasked EE members to assemble the electrical components so that we can attach it to the helmet to begin testing

- EE members assembled the sensor and microcontroller and passed it to the CS members to set up the environment and software

Arduino IDE Set-Up

- Set up the Arduino IDE on a PC to see if we could run test code to see if the ADAFRUIT feather M0 could be detected with Dallas

- Troubleshoot the issue of PC not detecting the microcontroller when plugged in and discovered it was a cable issue.