POST MORTEM FOR THE PLANTAR FOOT PRESSURE ANALYSIS SYSTEM BY PRESTRACK

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1. Introduction

Plantar Fasciitis is a condition of the foot characterized by intense pain and discomfort surrounding the heel of the foot, in addition to decreased quality of life, as this discomfort prevents the sufferer to enjoy day to day activities. As treatment for this condition can cause much emotional, physical, and economical stress, addressing key risk factors for plantar fasciitis would aid in the treatment, but more effectively the early risk assessment and prevention of plantar fasciitis.

This Plantar Foot Pressure Analysis System is a system that quantifies the kinematics of the foot during walking. Although risks factors due to foot kinematics are limitless, this system has focussed on six foot features kinematics:

- Frequency of pronation
- Rate of pronation
- Angle of flexion
- Distribution of pressures on the bottom of the foot
- Impact force of the heel during walking
- Pattern of toe off

These measurements of foot mechanics will utilize Force Sensitive Resistors (to measure the pattern of toe off, heel impact force, and distribution of pressures), accelerometers (to measures the angle of flexion), and a gyroscope (to measure the frequency and rate of pronation).

The measurement device includes green, yellow, and red LEDs as feedback mechanisms to let the user know when system calibration, data collections, or system error is taking place. The user will also be able to control the measurement device using a switch that will connect the microcontroller to power, as well as begin the data measurement procedure.

The Plantar Foot Pressure Analysis System includes the following features:

- Portable
- Data logging for a continuous hour
- Compatible computer program to analyze and display findings in an easy to understand format

2. Finances

Components	Estimated Original Cost	Final Cost
Electronics - Sensors	$300	
FSR sensors		$20
Gyroscope		$19.85
Accelerometer		$112.3
Electronics – Miscellaneous	$160	

LED		$4.93
Solder		$3.99
Header Kit & bolts		$27.90
Sandisk		$42.50
Silver Paint		$52.64
Batteries		$4.45
Heat shrink		$2.70
Switches		$2.3
Breadboard		$3.50
Fabric		
Ankel wrap fabric		$7.37
Electronics	$324	
Arduino Uno		$36.76
Datalogger uno		$24.51
Bareboard & 25 Pin D-SUB		$17.3
Prototyping shield		$11.90
MUX		$7.00
Hardware		
Enclosure	$100	$7.10
Casing – support		$11.19
Miscellaneous	$100	$73.06
Taxes		
Total	$984	$495

Table 1: PresTrack Financials

The original estimated cost of our project was $984, however, the final cost of our project is $495. With a given budget of $500 form the ESSEF, we are thrilled to have cut significant costs in our system while maintaining the required design specifications. The significant reduction is cost is due to the replacement of the chosen sensors which reduced the cost of the project by $300. We had set aside a contingency cost for $100, which we had to utilise as a few of the components purchased were not working and had to eventually switch to a more expensive option. Keeping this contingency cost helped keep our project under budget. Hence, our system was under budget.

3. Timeline

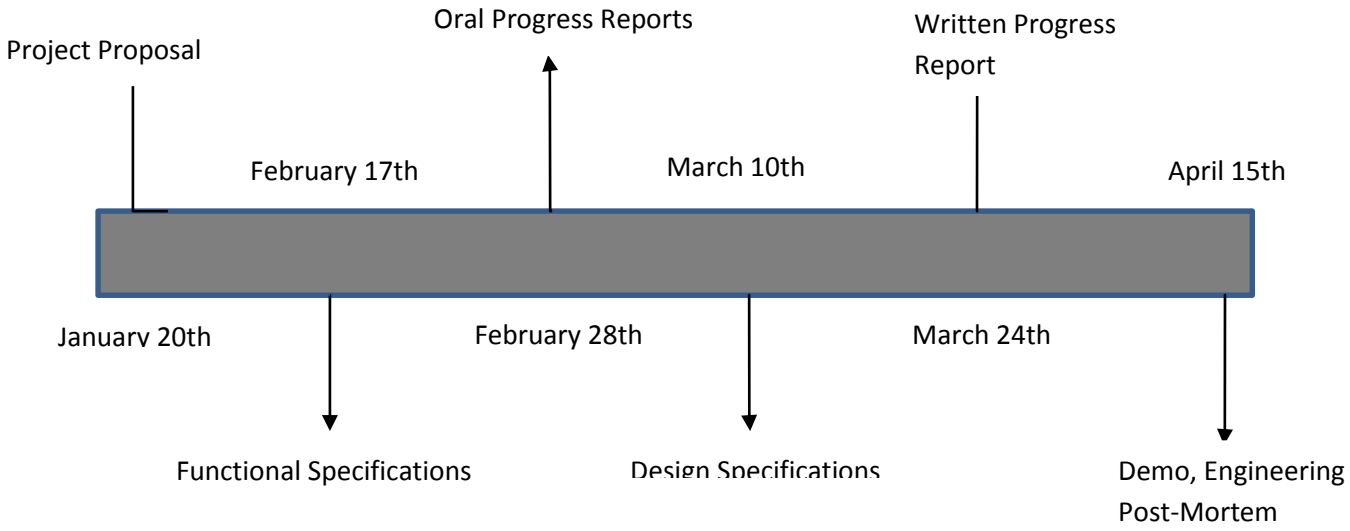

Figure 1: Major Milestones

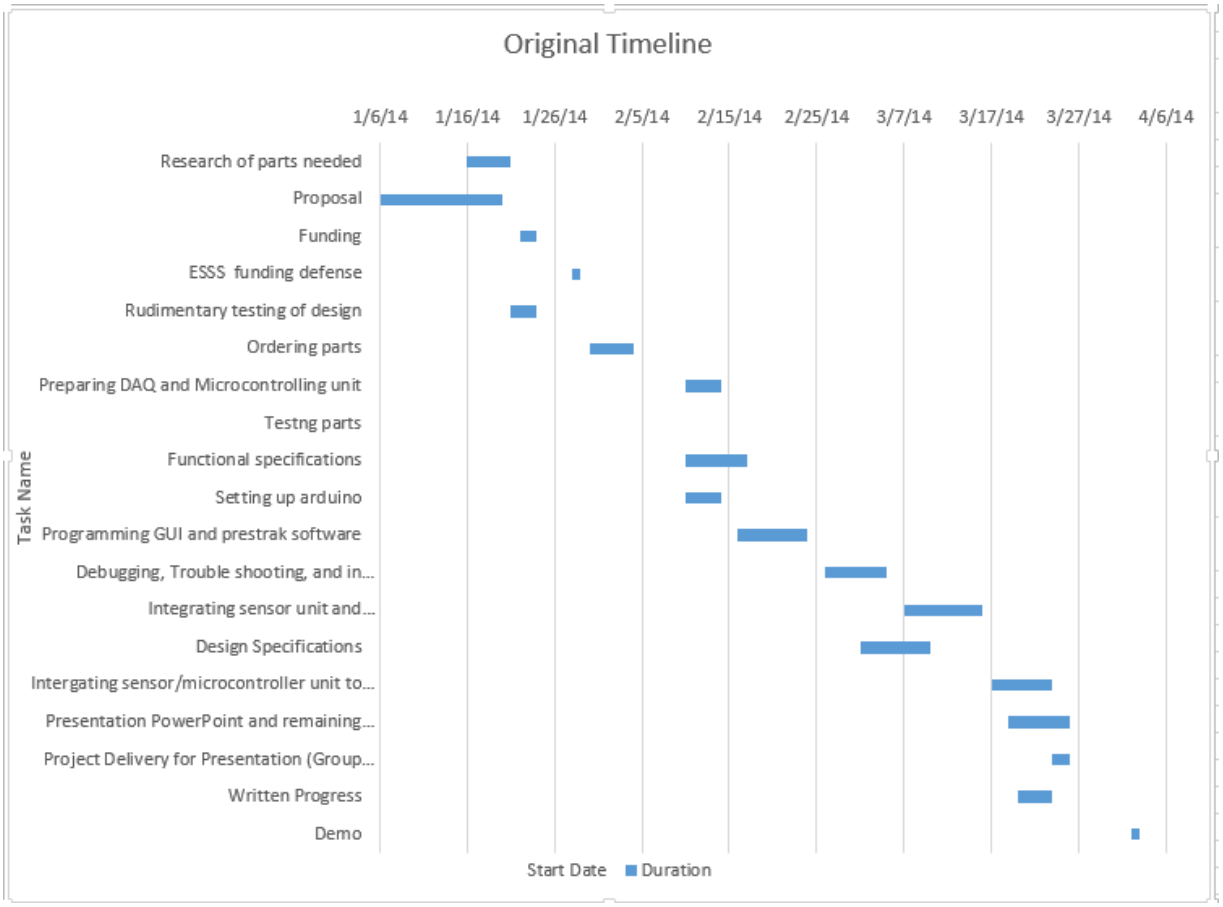

Figure 2: Original Timeline

ID	Task Name	Start	Finish	Duration
1	Research of parts needed	01/01/2014	21/01/2014	15d
2	Funding	01/01/2014	20/01/2014	14d
3	proposal	06/01/2014	23/01/2014	14d
4	Ordering parts	30/01/2014	30/01/2014	1d
5	Rudimentary testing of design	14/02/2014	17/02/2014	2d
6	Testing parts	14/02/2014	17/02/2014	2d
7	Setting up and coding Arduino	14/02/2014	20/02/2014	5d
8	Preparing Daatalogger and Microcontroller Unit	20/02/2014	28/02/2014	7d
9	Debugging, Trouble shooting, and in general buffer time	26/02/2014	04/03/2014	5d
10	Integrating sensor unit and microcontroller unit	28/02/2014	14/03/2014	11d
11	Integrating sensor/microcontroller unit to gui and software	28/02/2014	01/04/2014	23d
12	Enclosure and ankle wrap	20/03/2014	11/04/2014	17d
13	Presentation PowerPoint and remaining documents to be completed	07/04/2014	11/04/2014	5d
14	Programming GUI	10/03/2014	11/04/2014	25d

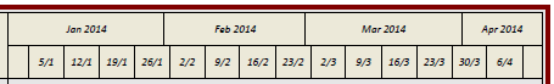

Figure3: A timeline of our project starting from Jan 2014 to April 2014

As seen from the original to actual timeline, most of the tasks took longer time than anticipated. The buffer time which we left at the end of March was sufficient to accommodate the changes in our timeline.

4. Current State of the Device

4.1.System Overview

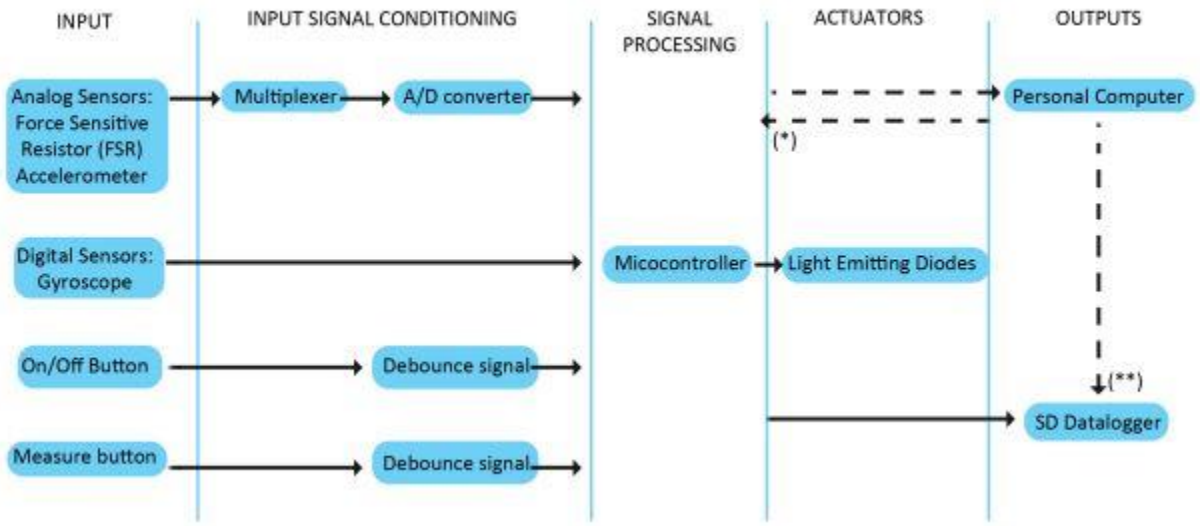

Figure 4: High level system design

Our system is divided into components of input, output, signal conditioning and processing as depicted in the figure above. Inputs include buttons that turn the device on as well as begin data collection and analog and digital sensors. The gyroscope and accelerometer sensors are on breakout boards with built in circuitry to intrinsically manage any filtration necessary. Analog input will be relayed via an analog multiplexer, and conditioned through an A/D converter on the microcontroller for further processing and data logging. This data is then inputted into the GUI which then processes the data to present the data in a way that is easy for interpretation. The LEDs are used to give feedback to the user with the system status, so that the user can collect the data knowing exactly when the system is read to process it. All processing takes place in the microcontroller which also logs data to an SD card.

4.2.Components

4.2.1. Accelerometers

We will be placing three accelerometers (3-axis), which are sensors that measure acceleration, on the foot to aid in angle measurements if pronation and flexion. These accelerometers are already sown into foot brace that will be worn by the user.

4.2.2. Gyroscope

The gyroscope is also placed in position on our foot brace, and it will measure angular speed in x,y, and z directions. The gyroscope combined with the accelerometers

4.2.3. Force Sensitive Resistors (FSR)

As mentioned in the design spec, we were limited by the number of analog pins that were available for use on the Arduino Uno microcontroller platform. Hence, we have strategically embedded seven force sensitive resistors on the insole as depicted in the figure below. These force sensors will provide information about the pressure distribution over the sole of the foot, and is one of the essential components to diagnose symptoms of plantar fasciitis.

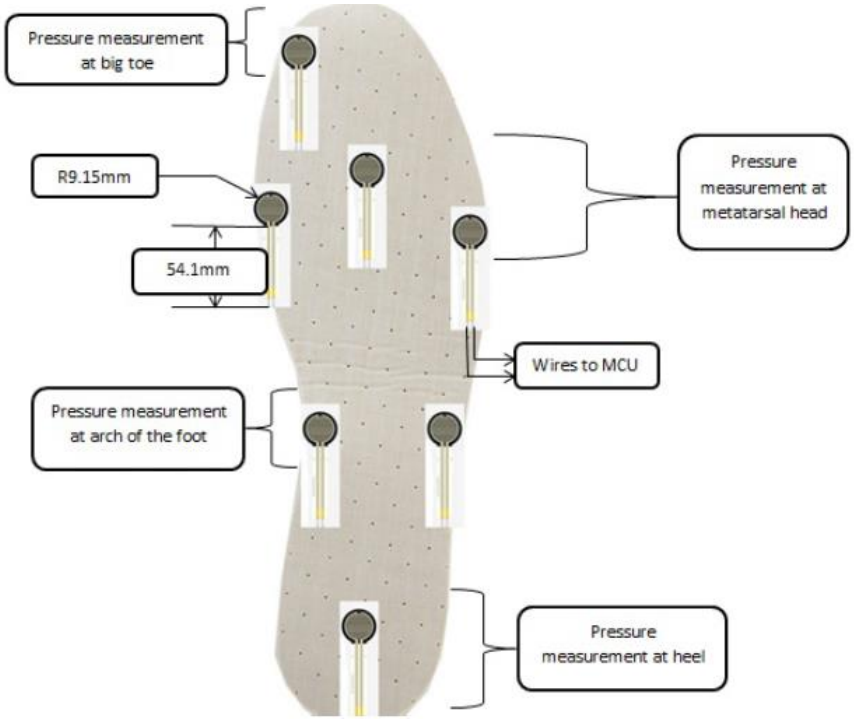

Figure 5: Shoe insole image depicting placement of Force Sensitive Resistors

4.2.4. Multiplexers (MUX)

We have three 8 - channel multiplexers that will select the FSRs and the x, y, and z axes of the accelerometer one by one using the selection lines at a set frequency. These multiplexers are soldered onto our Arduino prototype board.

4.2.5. Arduino UNO

The Arduino UNO is the microcontroller platform we are using to drive the data collection in our system. This board is set-up for PresTrack's system, and we have also coded the supporting software needed on the Arduino platform.

4.2.6. Datalogger

The data logger is an external shield (layer) attachment that fits over the Arduino board. This allows us to log our sampled data onto an SD card. Currently this shield is programmed and mounted onto the Arduino board for data collection. We have collected data on this SD Card for testing purposes and successfully extracted it on the PC for further analysis in MATLAB.

4.2.7. GUI

The Graphical User Interface (GUI) is designed as a convenient software interface in MATLAB for the user so that they can simply use the SD card that has the data logged onto it and receive the analyzed the data by following the simple steps instructed on the GUI.

4.2.8 PCB

Part of the future work we want done on the system is to move to away from open source components to ones that are specific for PresTrack. One way to do is to design a printed circuit board (PCB)

specifically designed for our system. The drawing below is the first attempt at doing this. The PCB is modelled after the Arduino Uno which was at the core of our system, it uses the same microcontroller the ATMEGA328. The board below however is not quite ready to be taken for printing, largely because it is only optimized by 88.5%. The major issue is the spacing between components, as components can only be so close and at a specific angle in relation to each other. Given more time, we would manually route these components in order to deal with this problem.

4.2.8.1 Include EAGLE Schematic

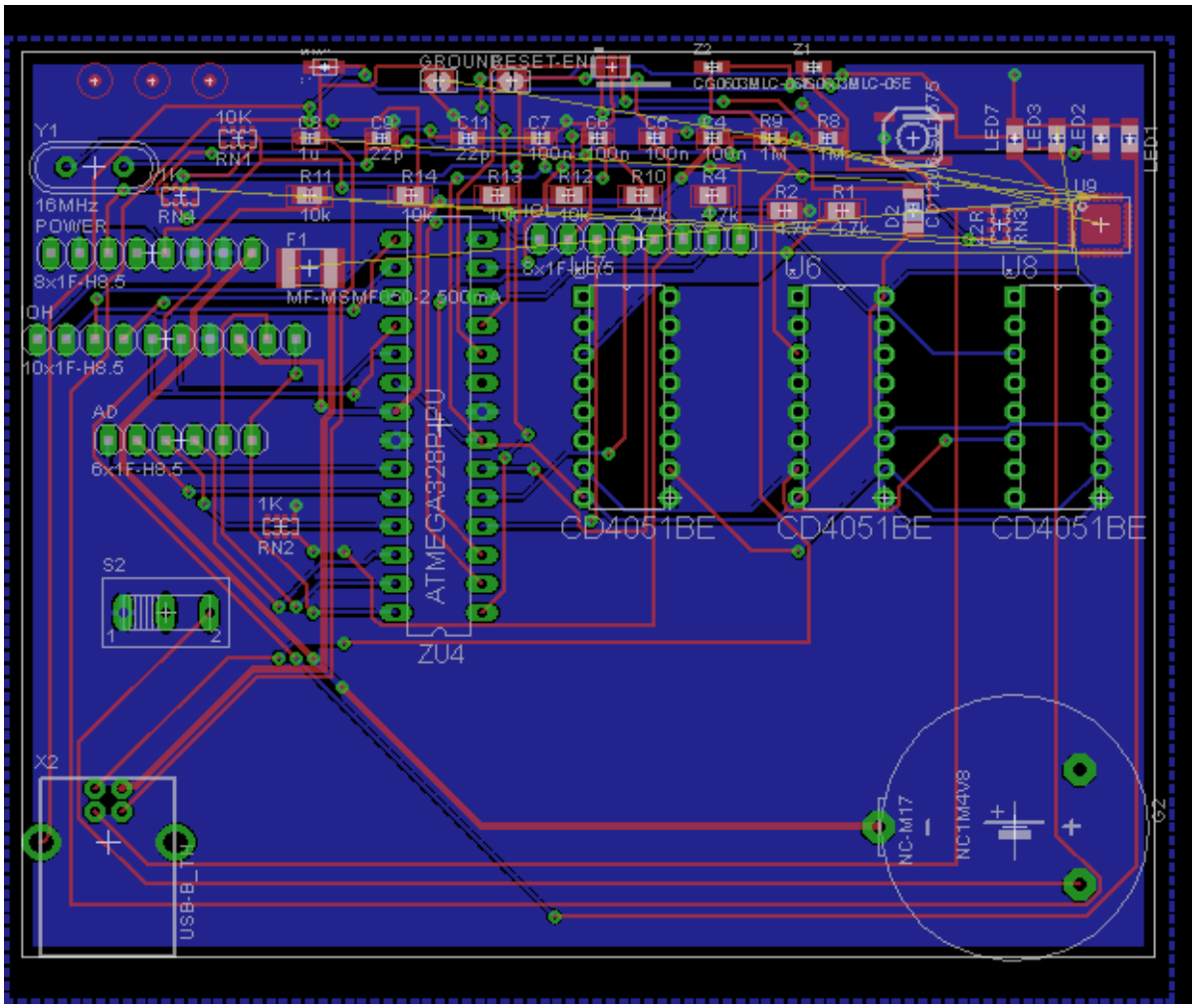

Figure 6: PCB Layout

4.2.9 Picture of Final Product

Figure 7: Final Design

5. Problems & Challenges

5.1. Multiplexers

Initially, the multiplexers we were using were not functioning as expected due to some internal fault in the MUX itself. The eight channel MUX has three selection lines that can make eight unique 3-bit combinations (2^3) to choose each of the channels for data. This selection process seemed to not work, and as a result we tested both the software coding and the circuitry for errors. When this did not work, we were able to get a replacement MUX from the manufacturer, and this resolved our problem.

5.2. Datalogger

The data logger had an issue similar to the one described above. We were unable to get the data to store on the SD card. Upon some speculation, we concluded that the device may be a defective one, and were able to get it fully replaced by the manufacturer.

5.3. Placement

We also had some challenges with regards to how to fit all the force sensors into the insole without the user feeling discomfort. After some group discussions as well as consultation with the TA, we decided to sandwich the sensors – as previously planned – in between the insole. That is, we have cut the insole into halves and then placed the sensors in between the layers.

6. Deviations from Original Design

6.1.Pressure Resolution (FSR Count)

In our original proposed design, we were planning on using 10 FSR sensors since the competing product on the market, the F-Scan, had a high resolution on pressure on the feet. However, due to the limitation of analog pins available for connection on the Arduino, as well as the size of our sensors, we had to reduce the number to 7 FSR sensors as depicted in the figure below.

Figure 8: Original design for placement of Force Sensitive Resistors (left) and the revised placement (right)

6.2.Number of multiplexers used

The multiplexers are used to accommodate for the limited number of analog pins on the Arduino UNO board. Initially we planned on using 2 multiplexers, however, we had to add an additional one due to our use of analog accelerometers (we were unable to obtain digital ones in time for our planned schedule).

7. Future Improvements to the System

During the fixed time frame of five months, PresTrack has strived to provide a cost-effective, portable system that would aid in quantifying symptoms of plantar fasciitis. Some features we would explore into would be adding Wi-Fi capability to the system, so that the data could be transferred wirelessly. In addition to that, we would also like to significantly reduce the weight of the system by using a printed circuit board to replace our current circuitry; this will allow us to make the device slimmer and more aesthetically pleasing. We would also like to improve battery access, charging methods, as well as efficiency of the system to improve battery life. Finally, we would like to improve the resolution of the pressure map. Currently, we are limited by the size of each pressure sensor, and by looking into implementation of smaller sensors, we hope to provide a better resolution of the pressure distribution across the sole of the foot.

8. Group Dynamics

The PresTrack team went on quiet a journey through the last four months while working on the Plantar Fasciitis Pressure Analysis System. The work was distributed based on the strengths and weaknesses of the team members, which were discussed in the first meeting of our group last November.

The system developed along with supporting requirements through the course required the team to possess the following skills:-

1. Hardware skills for constructing a feasible working enclosure as well as a keen on the user design features
2. Software skills for developing the software to process the data extracted from the sensors as well as to develop a user interface
3. Additionally, an integrated approach with software and hardware is required to connect the Arduino Uno to the remaining electronics and extract the data from the sensors
4. Research of the diagnostics measures of PFPAS system as well as the identification and placement of the sensors in the appropriate location
5. Debugging and testing of the components to ensure the smooth functioning of the system

Most of the work distributed amongst PFPAS team was based on the qualifications of each of the team members. Additionally, not one member took on the sole responsibility of a particular task. Any concerns that we had regarding work ethics was proactively resolved by meeting as a group and also with our 440/305 professors.

Mona played a crucial role in the development of the project, with focus on the interaction of the Arduino board with the Multiplexer and data logger as well as the sensors in our project. With her proficiency in both hardware and software integration, this seemed the ideal placement of her skills. Additionally, she contributed significantly to the documentation especially in the design document due to her technical insight of the project. Her skills were further utilised in the development of the enclosures required for the placement of the sensors across the feet. Her debugging skills were further exercised in the final testing of the prototype. Her expertise in the anatomy of the human body and human kinetics acquired through her previous degree in Kinesiology was an asset without which this project would not have the light of the day.

Riddhi as the CEO of the PRESTRACK team, upheld the task of identifying and outlining the direction of our project and to balance the distribution and work held amongst the team members. Her efforts to accommodate the skill set of the team members and maintain the order and discipline in the team was exemplary. In addition, to the team management skills she played a key role in integrating the Arduino with the electronics as well as the development of the graphical user interface. Amongst her major role she played a part in all aspects of the development of the project due to wide knowledge of expertise.

Navjot contributed as the chief creative officer by setting up the preliminary GUI layout that would make it the most appealing to the end user, and she was also in charge of ensuring that the packaging and final fitting of the enclosure to ensure that all components of the circuitry fit in.

Tenge is the chief technology officer of PresTrack and was co-in charge of the GUI layout as well as ensuring that the packaging and final fitting of the enclosure to ensure that all components of the circuitry fit in. She also created a schematic diagram for our circuit that we can convert to a PCB layout in the future.

Rohini role for the project was adequate and she put effort in initial testing of the components and the calibration of the FSR sensors which would allow justification of the usage of the FSR sensors with the market product- F-scan machine. She played a key role in the analysis of the sensor data, the FSR data which would map the pressure across the feet as well as the Accelerometer and gyroscope data which is to calculate the angle of pronation and supination. So, her primary focus of the project was in software side with the development of the Graphical User interface while simultaneously analysing the sensors data to depict them as a decipherable reading to the user.

A work distribution chart for the group is included below:

Areas of Development	High Level Tasks	RIDDHI BHIDE	MONA LISA DELVA	ROHINI ISHWARIYA	TENGETILE MHLANGA	NAVJOT RANDEV
Management	Administrative tasks	xx				-
	Financial administration			xx		-
	Documentation	xx	xx	xx	x	x
	Compiling and Editing Documents	xx	xx			-
Software	MATLAB GUI Designing	x		x	x	xx
	MATLAB GUI Implementation	x		xx		-
	Arduino Platform Development (Software)		xx			-
Hardware	Sensor testing	xx	xx	x	x	x
	Arduino Platform Development (Hardware)	x	xx			-
	SD card data logger		xx		x	-
	Interfacing sensors with Arduino	xx	xx			x
Packaging	Packaging	x	x		xx	xx
Research	Parts research and sourcing		xx	x	x	xx
	Research of biological data	x		xx		xx
	Research of present technologies	xx		xx	x	xx

9. Conclusion

Prestrack successfully delivered on its goals of delivering a comfortable, safe and easy to use portable device that would measure kinematic indicators of plantar fasciitis. While delivering this product, we were sure to adhere to the timeline as well as the financial budget plan set by Rohini. As mentioned earlier, any team dynamic issues were proactively solved by either meeting as a group and/or with a professor. We believe this is a good prototype that we can further refine and deliver to the market in the coming years.

10. Reflections

10.1. Riddhi Bhide (CEO)

The capstone project semester is one that I have always looked forward to with excitement, and also with a bit of hesitancy as we are given a plethora of choice and freedom to pursue this endeavour. ENSC 440 has been an enthralling experience during which I truly feel that I grew as a leader and an engineer.

As the CEO and project leader of our group, my responsibilities were to see our product go through its development cycle, assign tasks throughout the semester while ensuring that keep up with the timeline. I also oversaw all every aspect of the project which allowed me work in key areas such as the initial research, documentation, electronic development and software of the product and its testing. On a project management level, I gained valuable experience in coping with shifting timelines and priorities. Dealing with setbacks such as non-functional parts or longer testing periods required me to reschedule our tasks by consulting with other team members to make certain that the product was ready on time and under budget. I also learned to work with other's work styles and deal with any conflicts that arose during the term.

In the early part of the semester, I learned how to interface an Arduino UNO board with circuitry. I quickly discovered the importance of refining the product development cycle while testing the circuitry, as not all components worked the way we had intended. While working the electronics, I improved a lot of my electronics knowledge from Mona, who took the time to bring me up to speed with her progress with the hardware. During this time, I learned some of the communication protocols that the Arduino UNO utilizes, as well as enhanced my soldering skills. Later on, I had co-worked with another team member to start coding the graphical user interface in MATLAB, which was also a newly acquired skill for me as I had never set-up an interface before. This involved a fair amount of trial and error to ensure that the layout was the easiest for the end user.I found that some of my programming skills in MATLAB as well as C++ came in handy during this process. Finally I also improved my technical writing skills by co-compiling and modifying the documentation for this course.

I feel privileged to have been able to lead our group this semester and to work with some of the brightest minds in engineering! I am extremely proud of all our accomplishments this semester, and will fondly remember this experience.

10.2. Mona Lisa Delva (COO)

I would say that most of what I learned from this project could be divided into three categories: Project Management Skills, Technical Skills, but most importantly how to deal with people. In terms of project management, I found I felt I had the urge to be Riddhi's right hand man, so it was a new experience for me to support the leader of the project without overstepping and disrespecting their authority. Usually, I am the head of whatever project that we're a part of (whether it was engineering related or not), so I definitely learned a lot about myself in being able to trust in the experience and capabilities of my team leader to make sure that we accomplished our goals.

Between Riddhi and I, we coordinated the team and agreed upon assigned tasks to continue forward. So I was in a position to see firsthand how individual team members' self perceived capabilities contrasted with what they were able to accomplish with a given task. Usually in other smaller projects, if workmate couldn't perform I would usually just pick up the slack. However, because this project was so large, I learned how to rework priorities, how to convey biomechanical concepts I am comfortable with from my BPK background to my peers, and how to divide tasks that are more fitting a person's personality and skill. Usually, I am only loose acquaintances with my coursework workmates, and I care more about the project than team dynamics. Outside of PresTrack we are all quite good friends, so this was definitely a learning curve on how to balance friendships and feelings with constructive criticism.

One of my favourite parts of this project was actually learning how to use all the tools available for large scale projects like this that require extensive and large scale documentation, scheduling, updating, and communication. Over the duration of this project I've worked with Gnatt charts, milestone schedules, Google Documents, email, phone calls, skype, google hang outs, and Prezi frequently. The most amazing thing that I learned was that you can create automatic table of contents in Microsoft Word that update themselves based on heading that you insert. It's just ... Magical. The templates that Word has is glorious. Before I used to do everything manually, and if something was shifted, then I had to redo the formatting. Creating a references and placing footnotes, endnotes, or in text citations made me want to eat glass. I would say I only used about 10% of the function of Word... and I feel like now, I have shaved off about 5 hours of formatting work off of any future project I may have. In fact... just now, I learned how to do a page break... Whaaaat!!!!

Outside of the admin stuff, this is the first time I've ever felt like I put my 'engineering skills to use'. Because so much of our coursework is pre-planned and supplied, I've always felt quite removed from the engineering process. I had so much fun research parts, visiting various forums to see what others have done with the same problems I had, and trying to figure out new ways to approach the problem. After visiting the electronics store so many times, I realized how expensive any project could be, how important buying in bulk is, how important proper planning is so that I don't have to make too many unnecessary trips. But seeing every possible component from switches to IC components, to breakers, protoboards, sensors, it was almost like a freedom... like there wasn't anything I couldn't do. It made Engineering a reality, and it doesn't seem like such a daunting thing I could never do any more. The best part was being able to interact more with Fred, Dr. Park, and Dr. Sparrey and tap into their wealth of knowledge.

All in all, it was an awesome experience. Working with the PresTrack team is definitely the most memorable experience of my undergraduate career. So much so, I am looking forward to continuing this project for my honours thesis.

10.3. Rohini Ishwariya (CFO)

The development of this project facilitated my growth as an Engineer, with the emphasis put into cohesively working in a team dynamic and translating technical language onto paper while

accommodating a non-technical user. My documentation skills significantly improved as she was exposed to an environment where design specifications were crucial for the further progress of the project. Additionally, the integration of all the theoretical knowledge acquired through the four years of the degree was overwhelming and tough and the practical expertises are going to be useful to transfer to the industry upon graduation.

As the CFO, my key responsibilities were to keep track of all the financial documentation and ensure that the project stays under the designated budget of $500. My prior expertise from serving as the VP of Finance for the Engineers without Borders (EWB) assisted me considerably in serving my role as the CFO.

In terms of technical responsibilities, I was solely in charge of the execution process of the GUI in MATLAB. This was a major component of the project, which allowed me to further enhance my programming and analytical skills. One of the challenges I faced was deciding how to interpret the data most accurately while designing the GUI. With researching for data analysis with regards to human kinetics, I was able to find directions with which we could proceed to meaningfully

10.4. Tengetile Mhlanga (CTO)

On a technical basis, this project has taught me the power capabilities of the Arduino Uno as it is the system we are at the core of our project. It has also taught me how to design Printed Circuit Boards as I had to do this through a program that was new to me: EAGLE. It has also taught me how to do research about things one might not have had prior contact with and find a way to make them work for your application. On a more personal note, it has taught me to try to be more accountable, especially when working in a team environment. When I got busy with other courses, my contribution to the team would decrease, even though it took some time I had to learn to be more accountable and work better with my team members

10.5. Navjot Randev (CCO)

I am really glad that I got a chance to work with the best engineers in my batch. In these four months we just didn't accomplish our goal of making a shoe-insole system to characterise pressure distribution on the plantar surface of the foot during everyday task but also added additional features like measuring angle of dorsiflextion and pronation.

In my team I was mainly responsible for research. I learnt about the various sensors we used, arduino board, I2C protocol, SPI, eagle specs, GUI. I also acquired a thorough understanding of human gait cycle. I also managed to acquire great interpersonal skills from my teammates, especially Mona and Riddhi. These two are the best people I have ever come across. They are very patient, humble, committed, understanding and cooperative. I believe patience is must when it comes to teamwork. In the real world technical skills can be acquired anytime even while at the job but I personally believe that it's the people's skills that takes you a long way. I am glad that I took this course with these people because it was a great learning experience. They not only made me realize my weakness but also showed me the direction to improve it. Making mistakes and learning from it is a part of growing up, I believe I have a grown a little in these four months, credits: My teammates.

11. Meeting Agenda and Minutes

PRESTRACK
MEETING MINUTES
NOVEMBER 7, 2013

Meeting Agenda

1. Check to see if everyone got into 440 and 305 (heard of other groups whose members did not)
2. Discuss project ideas (Mona, Rohini and Riddhi can present their ideas and if anyone has new ideas that are not on Google Docs, feel free to make additions)
3. Narrow down to 2-3 presentable ideas for Dr. Rawicz (get someone to arrange an appointment)
4. See how to start writing a proposal – general format (details will have to be clarified once we meet with Dr. Rawicz)

PRESTRACK
MEETING MINUTES
NOVEMBER 28, 2013

Meeting Agenda

1. Overview of meeting with Andrew Rawicz.

   Dr. Rawicz seemed more critical on pulse oximetry and ECG and they are both experiments previously done. Additionally, the pulse oximetry seemed a project which too doable and not capstone worthy. Glucose measuring device is quite new and not previously done, hence would be very hard and not sure if it can be done.

   - ECG - expand project
     -pulling all data from multiple electrodes
   - Pulse oximetry
     - simple to implement
     - glucose measurement failure highly probable. Hence, worrisome.
     - too many variables to account for.
   - Foot sensor
     -too many variables. Hence, focus the area of the project, specifically fall prevention.

2. Advice from Andrew Rawicz
   - don't be discouraged from his words
   - it is our decision
   - Arduino board unlikely to be in final prototype.

3. Things to do:
   - Lab 1 usage during semester break - **Navjot– Done**
   - Book an appointment with Dr. Sparrey - **Mona -- done**

PRESTRACK
MEETING MINUTES
JANUARY 10, 2014

Meeting Agenda

1. Progress Reports on Parts
2. Locker/Storage space
3. Funding
4. Proposal - Mona and Riddhi
5. Revised time plan (for next 2 weeks)
6. Scheduling (Who comes to what class for 305)
7. Design Standards we need to consider for biomedical devices
8. Talk to TAs

Meeting Minutes

1. Progress Reports on Parts
    a. Tenge:
        i. DAQ Cards are extremely expensive($1000)
        ii. A MCU that can act as a DAQ card ($60) - 12 analog inputs
    b. Rohini:
        i. Fabric is hard
        ii. Nanowires are not possible because they are too expensive
    c. Riddhi
        i. Connector link sent
2. Locker/Storage space-Navjot to get locker for Lab 1
3. Funding - Rohini to document this funding proposal
4. Proposal - Mona and Riddhi (Due Wednesday January 15th, 2014)
5. Revised time plan (for next 2 weeks)
6. Talk to the TAs by Monday (Riddhi to get appointment)
7. Profiles (Due Monday January 13th, 2014)
8. Proposal - Mona and Riddhi (Due Wednesday January 15th, 2014)
9. Sensor: Rohini, Riddhi, Navjot
10. Arduino and resolution: Mona and Tenge
11. ideally we want at least 25 points per square inch
12. Scheduling (Who comes to what class for 305)
13. Design Standards we need to consider for biomedical devices

PRESTRACK
MEETING MINUTES
JANUARY 13, 2014

Meeting Agenda

1. Discussion with TA (Lukas) and Lucky
2. Research

Meeting Minutes

1. Discussion with TA (Lukas) and Lucky
    a. There is still significant research that needs to be done

b. For data - can change arbitrary to meaningful data by measure high and low points of pressure on foot (from heel and ____)

Research/tasks

a. Navjot&Rohini
   I. Capacitors and Inductors
   II. Dielectric Materials (with strong mechanical properties - but also flexible) and general physics and chemistry for it.
   III. How to use capacitive plate? What is Etching?
b. Mona and Riddhi - Proposal, Electronics

PRESTRACK
MEETING MINUTES
JANUARY 19, 2014

Meeting Agenda

1. Proposal - Feedback on what we have done and what needs to be done
   a. Capacitor idea
   b. How many capacitors are we to use,
   c. How many wires,
   d. What dielectric?
2. Electronics – number of microcontrollers to use, casing costs. Set up a meeting with Dr. Parks to advise on the electronics
3. FlexiForce idea - Feasibility?
4. Grant Proposal – Feedback on that. Proposal due date?
5. Modules of the project – perhaps break down the project into modules so we all feel like we have something to do as well as streamline the process
   a. Electronics
   b. Circuitry
   c. Programming
   d. Other
6. AOB

PRESTRACK
MEETING MINUTES
JANUARY 23, 2014

Meeting Minutes

Sensors

- Navjot and Tengetile still working on trying to find the resolution. This is proving difficult however they are still working on it. They are going to present documentation to the group on DUE Sunday 26 January 2014 , 12:00 p.m. Deliverable: a numeric resolution value that we can use as our standard. Please format as a write-up with references (to be sued in functional spec document)
- Also, when Dr. Ash brought up a good point that, say a person weighs 200 pounds, each sensor will not bear 200 pounds of weight!! So we will have to calculate what's the max pressure we

can experience (I'm presuming the heel of the foot) and then get sensors accordingly. (Sunday 26 January 2014)

- They are also going to connect with some profs to get help on this
- Sensor testing to occur tomorrow (24 January 2014) at 1330 hours in Lab 1

DUE Sunday 26 January 2014 , 12:00 p.m.
Worked on: Resistance
What we need to do:Max resistance
What we need to research: resistance to pressure calculation/formula
Deliverable: Can this sensor work (Please provide back-up)

PRESTRACK
MEETING MINUTES
FEBRUARY 4, 2014

Meeting Agenda

1. Scope of Project
2. Funding
3. Design Considerations

Discussions

1. Scope of Project
    a. We defined the scope of our project to be able to accomplish the following by the end of term: a sensing unit, the data collection unit, data analysis program
    b. Sensing Unit
        i. We explained our intentions to test out a capacitive pressure sensitive method as well as a force sensing resistor, however because of time constraints (with the first demos schedule to begin April 2nd) and the uncertainty of the success of the capacitive idea, that it would be in our best interest to pursue the FSR as our main method.
        ii. They agreed.
        iii. They also indicated, that we still need a better definition of the problem. PresTrack was initially under the impression that our goal is to create a product similar to function of the F-Scan by TekScan, for a better cost for wider spread use. However after meeting with Dr. Sparrey& Dr. Park, we came to an agreement that our focus should be on diagnosing Plantar Fasciitis. And for that, a high resolution may not be necessary, but rather focused measurements of area key to the development of plantar fasciitis.
        iv. As such, our goal is to better define the problem, which will dictate the number of sensors we will use
    c. Data Acquisition Unit
        i. We stated that the minimal ability of the project to transmit data will be data logging onto an SD card, although we will aim for wireless capability.
        ii. All were in agreement
    d. Data Analysis Program
        i. Our hope for the project is that the accompanying software will provide a thorough analysis of the incoming in a form that requires no educational background or technical experience.
        ii. Using SD data logging
2. Funding

3. Design Considerations

PRESTRACK
MEETING MINUTES
FEBRUARY 16, 2014

Meeting Agenda

1. Tasks
    a. By March 3rd: Each separate components assemble
        i. MCU
            a. Take Data from FSR and take to FScanTekScan in Surrey and compare measured values and come up with a standard (Here we'll see how each of our eqtns compare to Fscan)
            b. Getting data from each sensors and getting them logged onto SD card
            c. Once all circuits are confirmed, then put all parts together in terms of actual connections (solder, prototype with insoles and headers etc) - lots of time to be spent in lab to get it working and then need to test this circuit again
        ii. FSR: When combined with MUX it gives a reading even if
        iii. Figure out a way to solder/assemble FSR Material + delivering on socks, velcro by March 3rd
        iv. Analyzing Data nn each sensor (what does this data mean???) BIG JOB!!!
            a. FSR - how do we determine the start and stop of a gait cycle from FSR data, taking fsr to surrey and comparing to fscan tekscan
            b. Gyro - how do we get pronation data from this, importance of placements?
            c. Accel - how to integrate 3 separate accelerometer readings to get joint angle.
        v. Developing the GUI - See if MATLAB can control our device (see if MATLAB can access SD Data logger through the Arduino) - Coding interface vs. coding algorithm
            a. Try to get the data from the SD card first (directly)
            b. Download the data from USB of the arduino board (later)
            c. then manipulate V5H 3M7 late and present the data (programming) -
            d. Managing inputs and outputs
            e. IMP: the person responsible for this should come up with the design, layout, and picture and data samples and get feedback from the group BEFORE coding so that we can customize it.
                1. code should be adaptable to matrices of different sizes. We'll have at least 21 columns (10 for FSR, 1 Gyroscope +3*3 accelerometers + 1 time) + 1 header row + 1 row with patient/physician identifiers
                2. what will the person see when they click the prog, when they see the help menu etc. Basically how will the program flow in terms of what the user sees. What kinds of clicks will the user do, how can they select the data they need what will it look like to the physician vs patient. How will the physician interact with the GUI versus patient
2. Updates

FEBRUARY 17, 2014

Meeting Agenda

1. General Update on progress, goals and timeline
   Progress
   a. FSR Sensor Testing
   b. Arduino testing and coding
   c. Integrating FSR sensors with Arduino
   Challenges that we have encountered thus far

PRESTRACK
MEETING MINUTES
MARCH 22, 2014

Meeting Agenda

1. Updates from all team members
2. work to be done (assign)
3. Wi-fi shield
4. Written Progress Report

Meeting Minutes

1. Updates from team members
   a. Rohini
      i. GUI - algorithm written
      ii. Can log in data, but not analyzed
      iii. Will try to finish by Monday, March 26th.
   b. Tenge
      i. Researched on arduinowi-fi shield - expensive ($100)
      ii. Found online how to send info, but still not clear how to work with our data
      iii. EAGLE - Due Wednesday, March 26th, 2014
         a. she will email Lukas and confirm all that needs to be included
         b. Navjot can perhaps join you

   work to be done (assign)

. See the schedule in the progress report document (emailed to entire group)
   Wi-fi shield - We are scraping this idea.
   Written Progress Report

. Email all changes/modification ideas to Rohini and Riddhi