# ***Post Mortem for a Bicycle Smart Helmet***

| | |
|---|---|
| Project Team | Chakaveh Ahmadizadeh<br>Arta Ahrabi<br>Ibrahim Appiah<br>Wael Jendli<br>Ahmed Medhioub |
| Contact Person | Ahmed Medhioub<br>amedhiou@sfu.ca |
| Submitted to | Dr. Andrew Rawicz - ENSC 440<br>Steve Whitmore - ENSC 305<br>School of Engineering Science<br>Simon Fraser University |
| Issued Date | April 25, 2014 |
| Revision | 1.1 |

# Table of Content

**1. Introduction & Background** ..... 3

**2. System Overview and Features** ..... 3

**3. Budget** ..... 5

**4. Schedule** ..... 6

**5. Challenges** ..... 6

**6. Group Dynamics** ..... 7

**7. Work load distribution & Reflections** ..... 7

Wael Jendli--CEO ..... 8

Chakaveh Ahmadizadeh—CTO ..... 9

Ibrahim Appiah –CIO ..... 10

Ahmed Medhioub—CFO ..... 11

Arta Ahrabi—CTO ..... 12

**8. Conclusion and future work** ..... 13

# 1. Introduction & Background

At Cycle Bright Solutions we aim to create a Smart helmet, which will replace the conventional hand signal that has been described in an article as inadequate and downright dangerous. It require the cyclist to remove one hand from the handle bar to perform hand motions that can throw them off balance and even then, they may be not even be feasible at times due to variety of factors such as grade or conditions of the road. Therefore, the smart helmet will increase the safety of riders by making it easier for cars and cyclists to communicate with each other especially in low light condition such as at night time.

The Smart Helmet by Cycle Bright Solutions features an RGB LED panel at the back of the helmet illuminates left and right signals as well as a brake signal to warn other driver of any sudden stops. This will aid the rider in signalling their intention without restricting them control of their bike.

The Cycle Bright Solutions offers an exclusive and unique product that will provide several useful features to outdoor-sport enthusiasts such as signalling, Bluetooth capabilities and potentially geo location services. The design solutions for this Smart Helmet, as proposed by the Cycle Bright Solutions, are described in this Design specification.

# 2. System Overview and Features

In the following section, the main functionality of our product is introduced. To start with, the below block diagram is a summary of the different modules that define our system.

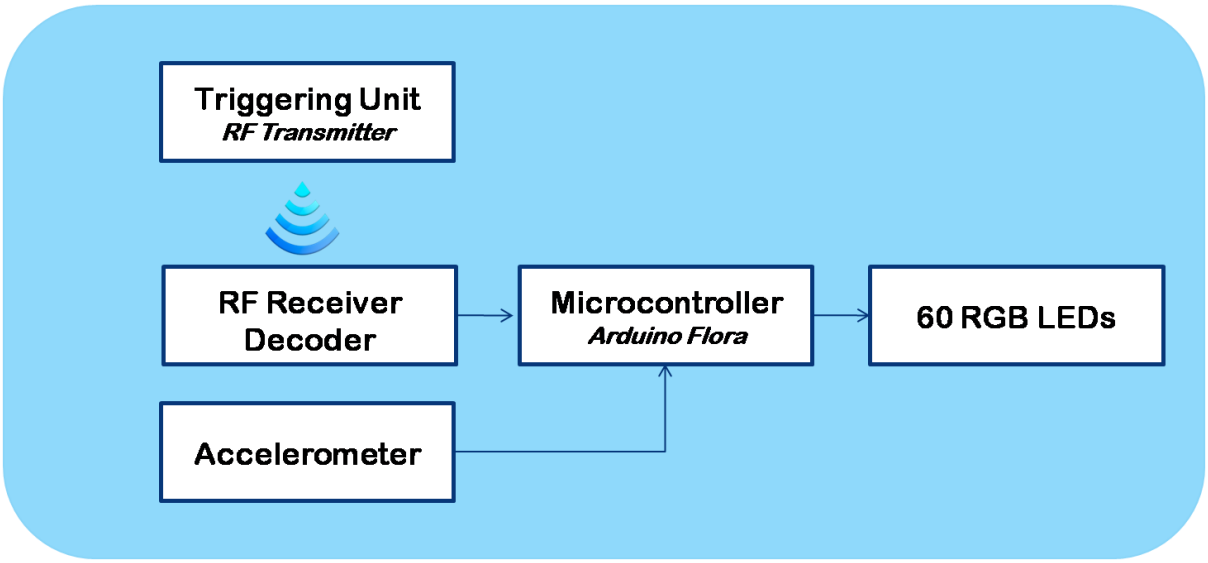


Figure 1: High Level System Block Diagram

The smart helmet is a means of safety and comfort for bicycle riders. What makes our Helmet unique is the set of features that it offers.

First of all, our Helmet is able to speak the language of cars when it comes to turn signals and brakes. By following the colors and patterns of signalling in cars, the user will be able to use the helmet on the go without any prior knowledge or training.

As residents of British Columbia, WE frequently experience foggy and rainy days. Thus, the Smart Helmet design offers a set of 60 LEDs which are bright enough to be visible in many weather conditions.

Moreover, one of the main goals of this project is the safety of the cyclists and their surroundings. Thus, the Smart Helmet has two safety oriented features which are sudden brake notification: the brake Section of the helmet will turn on whenever a sudden brake is detected; and fall detection and notification via the hazardous lights to ensure that the cyclist is safe as well as other road users.

And to make our Helmet more appealing and environment friendly, we designed it with a rechargeable battery via USB like our phones or any others electronic device. It also has the option of energy saving mode for when the battery is running low, or the user wishes to save on the battery.

The smart helmet comes with a triggering unit as the user interface. User input is encoded and then sent via Radio Frequency (RF) to the control unit, where the data received is decoded and passed on to the Arduino, the brain of our system. Depending on the received data, the Arduino will turn on the appropriate signal. We used an accelerometer to constantly measure the rate of change in acceleration which is used to determine if there are any events that need to be processed.

# 3. Budget

The ISSEF fund run by ESSS was our only source and we got $350. The details are summarized in following table:

Table 1: Budget Breakdown

| Component | Projected cost (Canadian $) | Actual cost (Canadian $) |
|---|---|---|
| Helmet | 100 | 35 |
| Microcontroller | 120 (for 2) | 30 (for 1) |
| Bluetooth | 60 (for 2) | N/A |
| RF transmitter receiver | N/A | 20 |
| LED Strips | 85 | 40 |
| Microphone/Speaker | N/A | 30 |
| Miscellaneous | 200 | 170 |
| Tax + shipping | 124 | 100 |
| Total | 689 | 425 |

Even though our cost is still under the first estimated price, it was more than the received funding. Thus we will be applying to the Wighton fund to cover the extra cost.

# 4. Schedule

As we may all expect, time management is one of the main challenges that every team faces. The difference between the actual and estimated timelines are presented in the below Gantt chart.

Because of unforeseen weather conditions, our parts were delayed for about one week. On top of that implementation, testing and debugging took longer than expected.

But at the end of the day, we have come to the completion of the full project on time

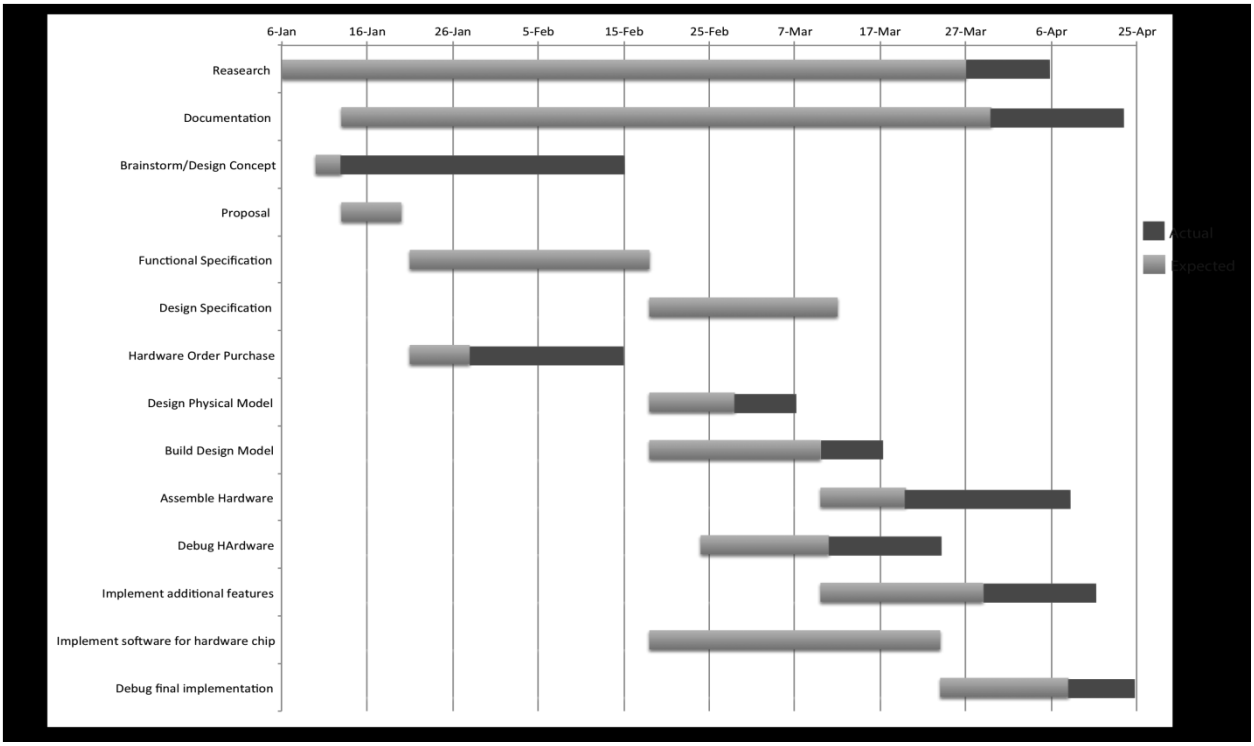


Figure 2: Actual and Estimated project timelines

# 5. Challenges

The main technical challenges that we encountered during the design of the Smart Helmet is power management and packaging. Since we are opting for a portable and lightweight design of the helmet, we had to overcome the challenges of having a battery strong enough to power all LEDs without being too heavy. After some research and deep thoughts we came up to the solution of using rechargeable lithium batteries and a special Arduino that provide more current to the system.

For the packaging, the main difficulty remains in integrating all components, in the helmet without compromising its size, its weight as well as the user's safety. To work around this limitation, we opted

for using spongy materials to package everything, which will provide comfort to the cyclist without endangering their safety.

# 6. Group Dynamics

Our Cycle Bright Solutions team is formed by one systems engineer, one electronics engineer and three computer engineers: Ibrahim Appiah, Arta Ahrabi, Chakaveh Ahmadizadeh, Wael Jendli and Ahmed Medhioub. All of the team members have great industry technical training in various fields such as embedded software development, firmware engineering, web and app development, hardware and communication protocols. Thus for the technical distribution of roles, each member took on both development and testing tasks. There were no conflicts during the semester for this project, and main reason for that was having good communication, dedication and work ethics among all team members. Meeting minutes were taken regularly, and other communications such as email, or Skype meetings, etc took place almost daily.

# 7. Work load distribution & Reflections

Overall, the load was more a less equally distributed among all team members in accordance with the individual experiences and interests.

The following table summarizes the workload distribution:

| Tasks | Wael | Chakaveh | Ibrahim | Ahmed | Arta |
|---|---|---|---|---|---|
| **Documentation** | xxx | xx | xx | xx | xxx |
| **Software Development** | xxx | xxx | xx | xx | x |
| **Software Debugging** | xxx | xxx | xx | xx | x |
| **Assembling and Soldering** | xxx | xxx | xxx | x | x |
| **Final Packaging** | xx | xx | xxx | xx | x |
| **SolidWorks** | x | x | x | xx | xxx |
| **Testing** | xxx | xxx | xxx | xxx | xx |
| **Videos** | x | x | x | xxx | x |
| **Team management** | xxx | xx | xx | x | x |
| **Meeting Minutes** | x | x | x | x | xxx |
| **Administrative Tasks** | xx | x | xx | xxx | xxx |

## Wael Jendli--CEO

The capstone project course was an important course in my undergraduate degree since it is the only course without direct management. In other words we are responsible of defining our own project scope, our own design and specification as well as our own test plan. That way, we got exposure to entrepreneurship experience and we experienced all stages of a product development. It was amazing to see our project growing through its different stages from brain storming to the actual implementation and testing of the helmet. This project changed the way I looked at product management and the different challenges that a team may encounter. Indeed, this project was an opportunity to learn how important is good planning for the success of a project as well as designing with remediation in mind if something goes wrong. While writing these few words, a lot of joy is expressed due to the completion of an intensive term of documentation, designing, testing and documenting every aspect of the project. However, meanwhile a lot of regret is put within these lines because it's the end such a great experience and such an awesome group that I had to work with. This project made me realize that even if you are the most talented person on earth, you are not worth anything without the support of your team members and their trust. In fact, this project was the best thing that happened to me. Beside the technical experience, the taste of achievement and accomplishment; I gained more valuable friendships primarily with my team members as well as other groups. Seeing everyone working hard, going above and beyond their capabilities to deliver high quality projects make me want to be an engineer even more.

On the technical side of the project, I had a great exposure of how to manage a team, take decisions and drive the design of a product from a drawing to an actual product. In addition, I provided support on every single aspect of the project including software and hardware design, debugging and testing. That way, I applied mostly all what I have been learning for the past 4 years of university courses and school. On top of that, I gained more experience using Arduinos and implementing different algorithms to achieve different goals.

The Capstone project was a valuable opportunity to practice self-learning as well as interacting with different people exchanging ideas, design visualizations and engineering techniques.

## Chakaveh Ahmadizadeh—CTO

Since the beginning of this course, we as a group have taken various phases to design, implement, and test the Smart Helmet Project. These phases were carried out linearly. We started by deciding on the project through a few team meetings. This decision was based on both team member qualifications and the qualities that the final product would provide its users. Then we started gathering user requirements and documenting them in the Design Specs and Functional Specs documents. The phase requiring most time, effort, and planning was implementation which was carried out in different steps. Last, we tested the product. Testing was done both on units during implementation; and after integration of all units.

In this project I contributed to the programming of Arduino, using accelerometer data for detecting free fall and brakes, and connecting components together. When I started this course I had never used Arduinos. During the project I learned what features they have, when to use each, their limitations, and how to program them. We used an accelerometer to detect situations needing hazardous signals or brake signals. I learned to use the ADXL345 library for Arduino. I learned about algorithms used for free fall detection and sudden movement detection. Using RF for transmitting signals from the triggering unit to control unit, I learned about the RF transmitter and receiver that we were using.  I also improved my skills using lab instrument throughout this project.

I learned that spending more time on research saves much more time in implementation. I learned the importance of proper planning and setting time lines in smooth operation. I improved my team work skills and learned from my teammates. Most importantly, I learned that no matter how simple tasks might seem in theory, they need effort and knowledge to be performed.

Overall, this course provided me with a valuable hands-on experience simulating real world engineering projects. I wish the course was dedicated more credit by having it over more than one semester or having it have more credit units so that fourth year engineering students would have it as their main concern for a longer time rather than having it alongside other courses and having to compromise one for another. That way, this course would provide a much more valuable experience.

## Ibrahim Appiah –CIO

Let me begin by saying that ENSC 440 is one of those classes that can easily be taken for granted. The reason I say this is the fact that everything is independent; there is no weekly assignments or weekly readings. You have one idea, one project in mind and you conduct research and build on it as the semester goes, it can easily be forgotten if there is no weekly meeting to discuss the progress of the project. Moreover, working on our smart helmet was interesting, because at first we had a lot of ideas that we wanted to incorporate into the helmet as additional features but as the semester went on and the deadlines were getting closer and closer a lot of the features couldn't be included due to the time constraints. However, we managed our time wisely; we worked on the things that could be accomplished, and learned about our parts before receiving them. We worked this way so that when our components arrived it was easy to just jump in and start integrating things and putting them together.

Our team had a good group dynamic, all the documentation was evenly distributed throughout each team member. I like that about our group because it kept everyone active throughout the whole project. Also, if someone happened to get sick someone else was able to take over their part of the project and continue working it wouldn't slow us down. I've learned a lot with this project, my duties were to take care of the design aspect of the project. I was in charge of packaging, and ascetic of the helmet, I research a lot about the product to make that's we had the user in mind while designing the helmet.

This project was tough to put together, there was tough time where things did work. We spent time and time trying figure out the bugs especially when you dealing with a lot of components. However, we did a lot with what we had every time with the user in mind so we had to go back to the drawing board and make the changes accordingly. I've learned a lot from this project, learn a lot with time management, how to work in a team and do assigned work and still being aware of what others are doing if things go wrong. I learned how to work with arduinos, because if it wasn't for this project I wouldn't have probably worked with them at all, so this was all new to me. Also I learned how to integrate accelerometer with other components by implementing certain algorithms to justify their usage.

This was a fun project; if I were to do another project I would defiantly do it all over again with the same group. I really enjoyed working with them, Ahmed, chakaveh, Arta, and Wael these are a good bunch of people to work with.

## Ahmed Medhioub—CFO

After a long struggle that lasted something over three months, the time has come to take a step back and revisit this journey. Some people say that ENSC 440 is the course that raises you from being an engineering student to an engineer, others believe that it is nothing but your usual documentation intensive course and it is never about the project. Either way, this course meant something different to each of us, every single one of us experienced it in his own personal way and in the following few paragraphs I will be illustrating my reflection on this experience. I only ask you to just excuse any slips this page may have as I am writing it after being awake for a continuous twenty nine hours.

Reaching your fourth year of engineering is nothing if not a trophy for winning a three or more years long struggle against exams, assignments and labs for the sole goal to develop and nurture the engineer you have inside of you. You learn the theory behind the subjects in the lectures, you then apply them in a lab or a tutorial so that comes an assignment or a test you will know what to do where to look and how to think about solving it. All in a simple step by step method using cook book like instructions, holding your hands and guiding you to pass. And if all of latter did not do the job then the curve should do it. Then comes this 440 beast which from the first contact the first lecture, grabs you from thought, slams you against the wall, lifts you up until your legs can't touch the ground and just when you think it's over he takes his hand, reaches deep into your core and pulls out every bit of genius, wisdom and creativity you have inside. So if you asking me what have I learned from this course, well it is a mixer of all three.

Right from the first week we were put in situations on which we had little control. From phone application development to cutting and bending Plexiglas, anything can and will be thrown at you. But perhaps the most interesting experience of all is trust. Everyone of your team mate has his role, you may not be able to comprehend, help or catch up with the progress he or she made. All you can and have to do is, first to get your part working as agreed, and then pray so that your team mates would do the same. Throughout this project I have seen friendships form, different project types groups collaborate some even spent nights debugging code that was not theirs. Not only this course teaches you how to rely on yourself when faced with a totally new problem but also restores you faith in humanity.

## Arta Ahrabi—CTO

During last semester I have changed the way I look at engineering. ENSC 440 was by far the most practical and different course I have ever taken at SFU. Now I have a better understanding of what I have learned during the past 5 years. By taking this course, I had a chance to practically apply most of the theoretical knowledge I have learned from my various courses, and ENSC 305 has taught me the importance of documentation. Having finished these two courses, I feel much more confident in myself facing new challenges and my future career goals. Also I learned, in order to find a solution for a problem, you need to approach it from different point of views and consider all the facts.

One of the most important qualities I learned from these courses is the importance of teamwork. When I started working in this group, I thought we will have difficulty working with different backgrounds, ideas and interests but I must say I am pretty pleased with dedication & work ethics of my team.

From the technical point of view, I was working on Solidworks, testing RF, as well as testing whole system. Our team worked closely as a group to achieve our goals and we all helped each other find solutions to problems when needed and collaboratively worked on certain areas together.

In order to do this project, we had to learn how to find and choose different devices available in the market. After we finished research, ordered our parts and started working on the system, we understood how little we knew about the product we had chosen and we ended up buying new components and make few changes to our original design. I believe with more experience and information about the devices available in the market, we could be more efficient and productive. By doing this project we increased our knowledge about different Arduino boards, microcontrollers, etc. and their functionality.

# 8. Conclusion and future work

We were able to deliver a high quality product that meets the safety concerns presented and that is built to be portable and easier to use. There could be a possibility of following up with this project further in order to tune the brake and fall algorithms for better accuracy before seeking financial help in order to be able to launch the product in the market.

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: final to do list
Date: April 12th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Smart Helmet | Reviewed development stages I & II and discussed final steps of the project | To do list:<br>• Make sure turn left & right and brake signal is working with the new setup and hazardous<br>• Test bottom to stop hazardous lights<br>• Fall notification should work when we are throwing the helmet<br>• Add the coin cell battery to the receiver<br>• IMPORTANT : don't forget to add the resistors<br>• For voltage divider , make sure to respect current rating (maybe 220 Ω)<br>• Pick the braking algorithm that best works (with changes? Without changes?)<br>• Test brakes on a bicycle<br>• Merge braking with signals<br>• Potentiometer? | April 25th |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Functional specification
Date: Feb 5th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed

Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Functional specification | Development stage I & II , general , electrical and physical requirements | N/A | Feb 17 |
| Development stages | The smart Helmet consists of two main subsystems which can be designed, implemented and tested separately then further integrated. | Due to the time and budget constraints, the proof-of-concept will be built through two development stages. | N/A |
| Development stage I | The main goal of the Smart Helmet is to replace the hand signals by turn signals that can be easily triggered by the user. Thus, the first stage of the development will focus solely in delivering such functionality. In other words, this phase will be dedicated to the design and implementation of the triggering circuit and its synchronization with the microcontroller which will be responsible for turning on & switching off the LED signals as per the user request. | • Buy self-explanatory control box<br>• the signals from the control box should be sent wirelessly via radio frequency (RF) which has a limited range of 1-10 meters compared to the wider range of 30 meters for Wifi and Bluetooth.<br>• After decoding the signal, the corresponding LED signal should be on with the possibility of being turned off as per the user request. | N/A |
| Development stage II | After designing the main functionality of the helmet, this development stage will focus on adding the break trigger, the fall notification system and the Bluetooth speaker.<br>The break trigger should be integrated with the previous triggering circuit with minimal wiring to insure the portability | Research | N/A |

| | | | |
|---|---|---|---|
| | of the system. When the user breaks, the breaks' LED signal should turn on & automatically turn off, when the break is released. The main constraint with this part of the triggering is that the breaks are a mechanical action of the bike that needs to be detected and then wirelessly sent to the microcontroller without any significant modification to the bike.<br>In addition, the fall detection sensor is to be implemented and integrated during this phase of the development. The sensor should detect free falls when the user falls from their bike due to incident.<br>This event must result in a flashing state of the LEDs simulating the hazardous lights available on other vehicles. The difficulty with this part is the ability to detect fall events with reliability and avoid any false negative triggering of the flashing state.<br>Finally, the speaker and microphone unit should be added to the helmet taking into consideration the perfect emplacement and measures to avoid noise interference. Choosing an already made module with Bluetooth capabilities might be the ultimate solution due to the incompatibility of the microcontroller with audio devices. | | |

| | | | |
|---|---|---|---|
| General Requirements | • must be compatible and adapted to any bike<br>• replace the hand signals with a safer turn signal mounted on the helmet<br>• be able to trigger the turn signal simply with a touch of a finger<br>• user input shall be wirelessly transferred to the MCU to switch on the turn signals<br>• shall not interfere with other devices or other vehicle | Think/ research about:<br>• Price?<br>• Weight?<br>• Shape?<br>• Size?<br>• Material? | N/A |
| Electrical requirements | • The power provided should be sufficient to power up all the components of the helmet<br>• The power supply must last for a usual day of cycling<br>• The power supply must be eco-friendly and rechargeable<br>• On-bike recharging unit might be adopted for further revisions of the SBH<br>• All components of the helmet must have an operating point of 3-12V | | N/A |
| Physical requirements | • The Helmet shall be of adjustable size to fit almost every user<br>• The helmet shall be fully compact and look appealing to a broad range of users<br>• The helmet shall have an ear-cover to suppress neighbouring noise<br>• The Helmet shall be | | N/A |

| | | | |
|---|---|---|---|
| | comfortable, fits securely and provide ample ventilation<br>• The triggering circuit should be portable and with a size not exceeding 5x5x3 (cm3) | | |
| Other requirements | • Environmental?<br>• Sustainability and Safety<br>• Reliability and Durability<br>• Usability Requirements<br>• Standards | To do:<br>Research about these requirements and be ready to discuss them in next meeting | N/A |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Functional specification
Date: Feb 11th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Functional specification | System overview | N/A | Feb 17 |
| Trigger circuit | Easiest way is to use RF signal which will be connected to Arduino board and use it for<br>• Lights and have 4 stages (left, right, brake, off)<br>• Test plan for LEDs instead of Bluetooth because it is cheaper! | • BUY L4 latch type<br>• LED feedback need to be present | N/A |
| Brake | Pressing one/both brakes which will turn the brake on without turning the turn light off | N/A | N/A |
| LEDs | • Need to be seen in difficult | Research | N/A |

| | | | |
|---|---|---|---|
| | environments ie. Fog, rain<br>• User friendly<br>• Water proof?<br>• Either orange or red colors (orange for turn right/left and red for brake) | | |
| Standards and laws and regulations | • Lights in transportation<br>• Cannot be yellow/blue<br>• No music allowed<br>• Speaker in one side only | research | N/A |
| Microcontroller | • Control unit/GPS for Bluetooth of Arduino<br>• Speaker? Cant user Arduino (since it doesn't support it)<br>• Regulations by law says one speaker only | Think about "speaker into ear caps"? | N/A |
| Powers | • LED ➔ power friendly?<br>• Microcontroller ➔ box? Lightweight? Waterproof? Arduinos?? | Research | N/A |
| Bluetooth | • Standards for production and low energy concept<br>• Any Bluetooth connectivity resistant for wind? Noise? Sound proofing? | Research | N/A |
| Sensors | • Distance sensors?<br>• Approximately detector<br>• All cars should stay away within 1 meters from the cyclists | THIS IDEA IS NOT HAPPENING! | N/A |
| Fall detection | When the person falls the whole helmet will flash | research | N/A |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Introduction ~ project ideas
Date: January 14th, 2014

Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Introduction | Each member introduces her/himself to the rest of the group | Ask everyone to fill their availability online | N/A |
| Project ideas | Share ideas and features of each topic | Select project : smart helmet | N/A |
| *Smart Helmets* | Choose company name | Need to do a company logo | N/A |
| | Discussed the possible features of the product:<br>• Turn right/left<br>• Brake signal<br>• Navigation?<br>• Approximately sensor signal<br>• Gloves?<br>• Jackets? | Research | N/A |
| | Select officers of our team | CTO ➔ Arta<br>COO ➔ Chakaveh<br>CEO ➔ Wael<br>CFO ➔ Ahmed<br>CIO ➔ Ibrahim | N/A |
| | Proposal | Ask everyone to do research in different areas & select a date for Skype meeting in order to discuss the proposal progress | January 17th |
| | Proposal | Final edit of proposal | January 20th |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Functional Specification
Date: January 25th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed

Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Functional Spec. | Discussed functionality of the proposed product | N/A | Feb 17th |
| Technical process | Discuss different options to use:<br>Option1: a self contained box consisting of another battery pack + MCU+ Bluetooth buttons for each direction. Can also feature a pressure sensor that will turn the RGB panel red similar to car brake lights<br><br>Option 2: use smart phone: featuring our own custom app to communicate with the helmet. Can also be used to implement more advanced features such as automatic turn signal activation using GPS tracking on a pre-determined path. The phone's accelerometer can be used to activate the brake lights!<br><br>Option 3: MORE RESEARCH TO DO<br><br>Things to keep in mind:<br>• Waterproof?<br>• Lightweight<br>• One sided Bluetooth speaker<br>• Navigation maybe?<br>• Power | More research | N/A |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Oral process
Date: March 4th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Oral Process meeting | Discussed schedule/progress/remediation/financial | N/A | March 6 |
| Schedule | • Ordered everything<br>• Getting familiar with new components & how to use them (reading data sheets)<br>• One week behind schedule – due to snow shipping got delayed<br>• Were supposed to do integrating this week but now we are taking slow steps | Spend more time on tasks to get back on schedule | N/A |
| Progress | Planning: 2 phases<br>• Phase 1 plan: designing and implementation<br>• Phase 2 plan: add extra features | N/A | N/A |
| research | Mostly done during last one and half months on topics such as:<br>• Type of LEDs?<br>• Can we connect them to Arduino?<br>• How to integrate them all together?<br>• Power?<br>• How to address the LEDs?<br>• etc | Do more research | N/A |
| User meetings: | All of us use bicycles and have a motorcyclists among us | N/A | N/A |
| Experimentation: | Team members who are not familiar with Arduino , are reading datasheets and getting familiar | Reading datasheets and running sample codes | N/A |
| Tests/measurements | For Fabrication, Ahmed is experimenting the placements of brakes without having to replace | N/A | N/A |

| | | | |
|---|---|---|---|
| And fabrication | the original brakes | | |
| Remediation | ❖ Have plan A and plan B for every step<br>❖ Human resources:<br>• Splitting every task among members and working together<br>• So during sickness/exams/etc , other person will continue to work and we will continue to work and stay on schedule<br>Such as:<br>Arta+Ahmed ➔ solidworks<br>Chakaveh+ Ibrahim ➔ Arduino<br>Ibrahim + Ahmed ➔ LED's<br>Wael + chakaveh ➔ Algorithms<br>Wael + Arta ➔ testing RF<br>❖ Issues with brakes: easy portable design?<br>❖ Issues for testing:<br>• Key pad with 4 bottoms<br>• Plan A: make everything integrate<br>• Plan B: have a backup plan so if they are not integrating get another RF circuit and for the switches just use the original 4 bottoms available on the keypad | | |
| Financial | Mention source? How much we asked for? How much we got? etc | | |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Design Specification
Date: March 9th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Design specification | Discussed LED and triggering units | N/A | March 13 |

| | | | |
|---|---|---|---|
| LED | It will provide visual feedback to the pedestrians and other motorists by illuminating LED's to the right side on helmet for right/left signals | • Using WS2812b LEDs (orange color) for left and right signals, which is a combination of RGB LED 5050<br>• Assemble LED's in strip to do the turn signal without using multiple pins of microcontroller<br>• LED strip enclosed in a silicon sleeve with IP65 and its waterproof, flexible and robust | N/A |
| Power | Power of average and full brightness of LED's were discussed | N/A | N/A |
| Triggering unit | • An RF transmitter to transmit the user commands to the RF receiver<br>• An RF receiver to receive the user commands and interface with the microcontroller to turn the corresponding LED signal light.<br>• Signals buttons that can be activated and deactivated to turn on or off the corresponding signal with some visual feedback to the user | The RF transmitter we got is 315MHz 4 button key fob RF transmitter based on PT2262 by Princeton Technology. Each button is connected to one channel to of transmission. Therefore, button presses can be encoded and then sent via the 315MHz wave. The 315 MHz frequency is categorized as an ultrahigh frequency which has a wavelength (distance of transmission) of 10cm-1m , which is conform of the functional specifications. In addition, the RF transmitter uses 2 coin cell batteries with an operating voltage of 4-10Volts | N/A |
| RF receiver | what type of RF receiver are we using? | A corresponding 4 channel 315Mhz RF receiver should be used in order to receive and then decode the data transmitted by the transmitter. Thus, for better compatibility the PT2672 by Princeton Technology | N/A |
| User interface | To meet the requirements of the functional specification regarding the use of self-explanatory buttons | Use Solidworks to draw the design | N/A |

| | | | |
|---|---|---|---|
| | or switches with convenient visual feedback. The design is based on a (ON-OFF-ON) Single Pole Double Throw (SPDT) switch. | | |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Design Specification
Date: March 10th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Design specification | Discussed Accelerometer and microcontroller units | N/A | March 13 |
| Accelerometer | The ADXL 345 accelerometer by Analog devices is a 3 axis accelerometer, used to measure changes in accelerations to detect brake movements as well as any sudden shocks to detect falls. Being a lightweight and a low power device, the ADXL345 conforms to the physical requirements of our systems | To do:<br>• Add specification of the ADXL 345 from datasheet to design spec<br>• Flowchart describing the detection of a free fall by the ADXL345<br>• Flowchart describing the detection of a Braking event by the ADXL345 | N/A |
| Microcontroller | an Arduino Uno will be used because of its properties of making prototyping easier and debugging more efficient | The Arduino is a good design solution since it offers a large number of ports as well as a 2KB of RAM. As discussed earlier, 45 LED pixels need about 135 Bytes of free memory which constitutes only 7% of the available RAM. Therefore, there will be no shortage of memory, and the Arduino can comfortably drive other devices and include the needed libraries.<br><br>To do: | N/A |

| | | | |
|---|---|---|---|
| | | • Talk about the Arduino Uno characteristics in the doc. | |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: Test plans
Date: March 11th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Test plans | Discussed different ideas for test plan | N/A | March 13 & 31 |
| BIG picture | Our biggest concern is *safety*. Since any errors or confusions regarding the signals can cause serious accidents as both the helmet user and other road users depend on accurate functionality of the system. In order to ensure high performance of the Smart Helmet and for easier debugging process, unit testing will be conducted, as well as regression testing after adding any modules to the system. | N/A | N/A |
| Triggering Unit Test Plan | • Signal buttons<br>• Brake trigger<br>• RF Transmitter<br>• Integrated Triggering | • For signal buttons, we will use two LEDs: one turned on by flicking switch to right and the other one turned on by moving it to left.<br>• For brake trigger, we will use an LED that will turn on if the brake is used<br>• For RF transmitter, we will use the RF receiver and four LEDs. Each LED is turned on by one | N/A |

| | | | |
|---|---|---|---|
| | | of the four combinations of sent signals<br>• For integrating triggering, once the individual top components are working as described, the whole triggering circuit is assembled. Signal buttons or brake triggers should be successfully sent via the RF transmitter and the corresponding LED should turn on | |
| Others | N/A | To do:<br>• Speaker and microphone unit test plan<br>• Fall notification unit test plan<br>• LED unit test plan<br>• Microcontroller unit test plan<br>• First phase regression testing<br>• 2nd phase regression testing | |

**Meeting minutes**

Group # and name: Group 9 – Cycle Bright Solutions
Purpose of Meeting: written process report
Date: March 19th, 2014
Attendees: Arta, Chakaveh, Wael, Ibrahim, Ahmed
Absent: none

| Topic | Discussion | Action by / Decision | Due date |
|---|---|---|---|
| Oral Process meeting | Discussed schedule/financial/progress/remediation | N/A | March 24 |
| Schedule | Working on implementation and integration of the first development phase functionalities | N/A | N/A |
| Financial | The ISSEF fund run by ESSS was out only source | To do:<br>Have a table with all the amount asked for?<br>Amount received? | |

| | | | |
|---|---|---|---|
| | | Amount spent? Future expenditure? Amount left? | |
| Progress | Planning and research: 2 phases<br>• Phase 1 plan: designing and implementation<br>• Phase 2 plan: add extra features<br><br>Design and user experimentation:<br>The design is based on making the helmet portable and lightweight as well as easy to use.<br><br>Material acquisition and testing:<br>Most of the components are ordered and by the end of this week the totality of the needed material will be at the disposal of the team members.<br><br>Documentation:<br>On time | Continuous research led us to change some of the design choices from using the Arduino Uno provided by ESSS and tow batteries to power the LEDs and the other components, to using one battery and an Arduino Flora board | N/A |
| Remediation | Base on the needed voltage and current rating of both the Arduino Uno and the LEDs used, we had to change to another board called Arduino Flora board which is more compatible with lower voltages. | Ordered the Flora board after purchasing most of our components. This unexpected change didn't delay our progress more than the delay occurred before since it only took one day to receive it. However the amount paid came out of our contingency budget. To avoid schedule slippage, every task is assigned to two team members to assure that the subsystems get delivered on time | |