



# ENSC820: Project Report

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### Team: ANC

**TITLE:** ANC HELMETS

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## **INTRODUCTION:**

Bikes and cycles have always been associated with helmets since it is a means of safety. Helmet is the most common motor vehicle equipment in the most populous countries. Paper [1] said the enforcement of road safety regulations to drive the motorcycle helmets market to US\$ 3,516.5 Million by 2027. Paper [1] also said that smart helmet will play an important role in the future. At present the helmet market are not able to fulfil the needs of riders, most of the helmets available in market are just a shell to protect user in case of an accident and helmets with advance features are too expensive to buy, some of the smart helmets cost more than half the price of motorbike. People are still searching for helmets which are smart, simple to operate and fits in their budget. Our proposed ANC device is built to fulfil those needs.

On the other hand, cars are equipped with endless features. Our agenda is to bring some features to the bike world and make their lives a bit easier. Our idea is to invent a small device that works as a patch with an in-built Bluetooth speakers and microphone that could be fitted inside helmets. This device will connect with a mobile application with features that would make sure their every ride is pleasant, safe, efficient and joyful. Our main motto is to make riding experience advance yet simple.

We will further discuss about the various aspects of the projects in the later sections. The report contains the motivation of the project, a brief introduction of the overall working of the project under project summary and details of all the technical aspects of the project under project details.

## **MOTIVATION**

With growing population, the traffic on roads is increasing rapidly and people are leaning towards using two wheelers for daily commute, there are other benefits to it like they are cheaper than cars, do not take much parking space and reaching to places of work takes less than half the time as compared to four wheelers specially in crowded cities and peak office hours, which is an issue in most parts of the world now. One issues with bikes is that you cannot multitask, using maps for navigation needs you to stop the bike open your phone and then remember the route for your destination unlike people with cars who can see as well as listen to navigations, but what if we make it easier just say a command and you can hear navigation till you reaches to your destination from your helmet, no need to check your mobile multiple times and remember the route.

In case your home is far away from your office and it takes you an hour ride to home, now being a productive individual, you would like to listen to podcasts or audio books while you ride, or maybe you had a bad day in office and you want to uplift your mood before getting home to your family in that case what's better than listening to Beate's on your way back home? But wait you are still stuck with your boring helmet which do not facilitates any of these features. Now you are searching for another helmet which gives you this feature, but they are not for all people, they have quite a lot of unnecessary features which you don't need and they are very expensive, smart helmets are almost half the price of the motor bikes, so you cannot afford it.

According to the National Highway Safety Transportation Administration (NHTSA), distracted driving motor accident crashes killed 2,841 people in 2018. And the top 3 reasons are:

1. Using a cellphone for calls, emails, texts, and other phone-related activities.
2. Adjusting a radio station or entertainment system.
3. Looking at electronic devices, such as Global Positioning System (GPS).

We urgently need a plan to release our hands and let us focus more on the road and safemore lives, not only rider but also the pedestrian.

One may ask why not use airpods or other Bluetooth earplug-ins? Firstly, airpods and other Bluetooth earphones costs a lot and in-case of an accident these may break inside the ear and cause harm to the user. Our usage of a patch makes the device much safer and is a cheaper option as compared to those devices. One more disadvantage of having cameras on helmet is that you are carrying it every time you go out so they get scratches and dirt filled in small opening and with the complicated design you cannot just wash it with water and why carry the extra weight when you do not require it? Smart helmet became a complicated device and our main motto for making helmets advance, simple and cheaper.

These helmets can also be modified to be used by construction site workers or people working in tunnels or mines, we can install an additional flashlight maybe in future. Communication with the help of helmets can be lifesaving in these risky jobs, it can be used for efficiently communicating with other to increase the work efficiency as well.

## TIMELINE

### Milestones

Project Proposal Requirement Market Analysis Benefit Cost Ratio Software design Hardware design Order Materials Code(Prototype) Hardware(Prototype) Integration Testing Prototype Documentation Project Presentation Project Report ..

### Gantt Chart for ANC

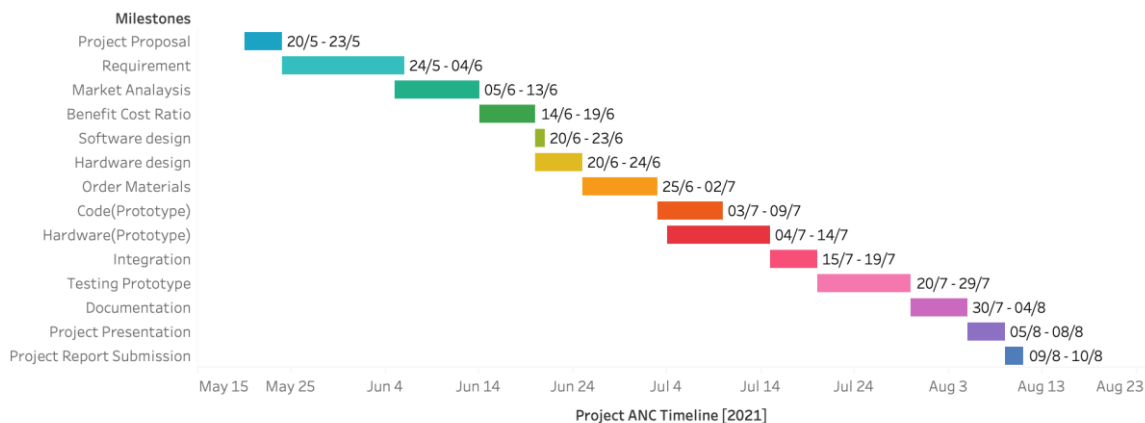


Figure 1 Gantt Chart

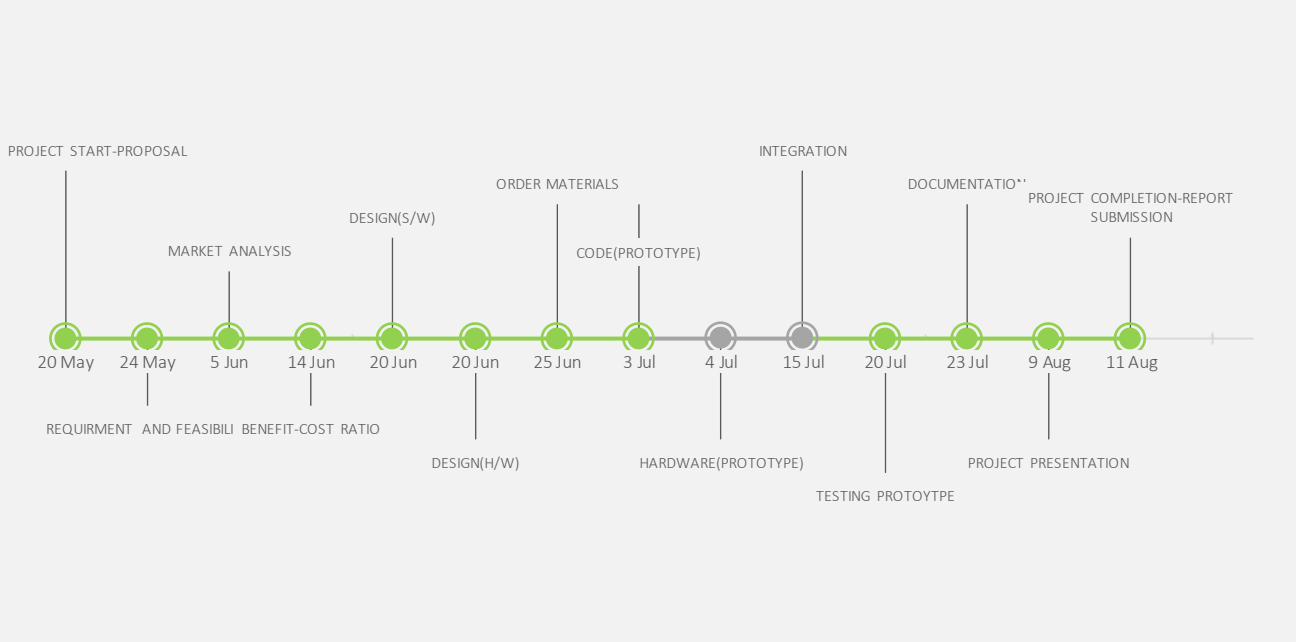


Figure 2 Timeline

With the timeline, we were able to have an organized schedule and finish our prototype on time. We also conducted a survey to understand the needs and wants of our potential clients. The survey gave us a broader outlook on how people feel about our project and got a positive feedback that made us motivated to finish the project and start working with the product in a real-world scenario.

**REQUIREMENT BREAKDOWN STRUCTURE**

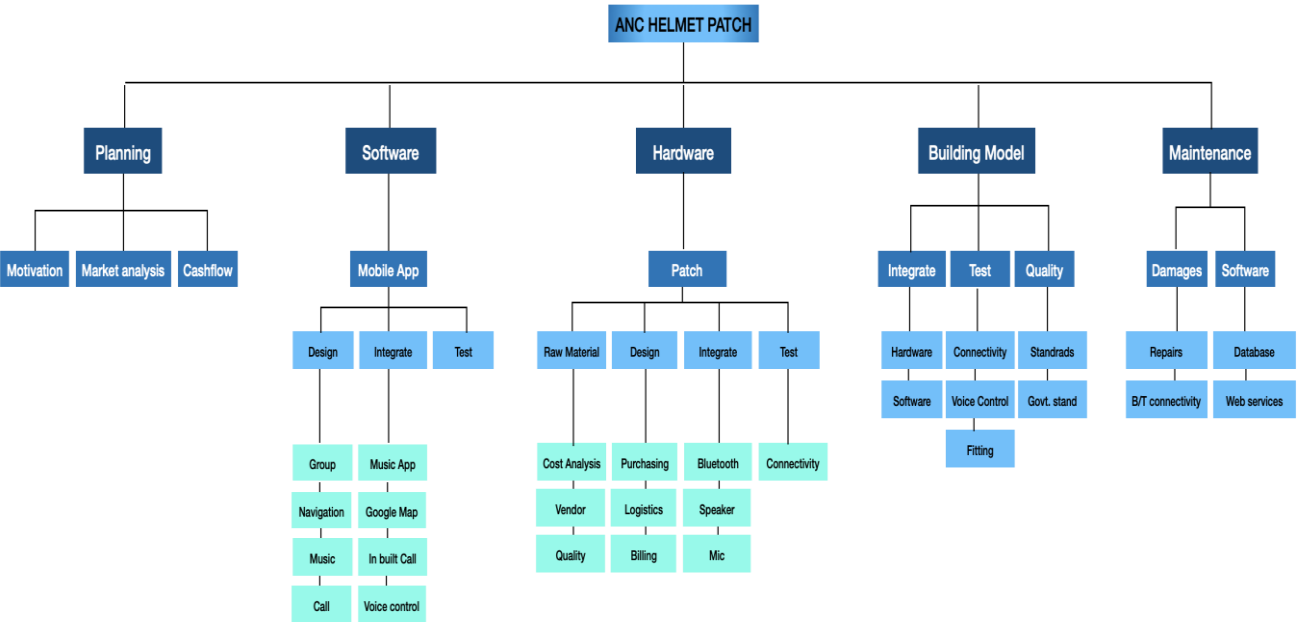


Figure 3 Requirement breakdown structure

Our project focuses on building a working prototype before the submission. This requires an organized approach towards the project, working on the software and hardware in-depth. We had to do a great amount of market research and study the cashflow because our idea belongs to the existing market category. To make our project stand out, we needed to find better features and work around the existing models. Market re-search, a motivation and the cashflow analysis was done under the project planning and took ample time to build a strong foundation. The next steps were software and hardware prototypes, building and coding. These processes are individual tasks that were done parallelly. The software includes the design, code and testing of all the features integrated within the mobile application. The mobile application is further divided into 4 categories, namely, call, navigation, group synch and music. The hardware requirements mainly include the patch formation. A Bluetooth device along with a mic and speaker need to be connected and stitched into the patch. After the completion of the prototype, integration of the separate parts in the software and hardware needs to be done. The maintenance is a future requirement when the product starts selling.

## **CRITICAL PATH**

*Table 1 Critical Path Analysis*

Activities	Code	Immediate Predecessor	Duration (Days)
Project Proposal	A	-	4
Requirement and Feasibility	B	A	11
Market analysis	C	A, B	9
Budget cost ratio	D	C	6
Design / software	E	B	14
Design / hardware	F	B	5
Order material	G	F	10
Code / prototype	H	E	12
Hardware / prototype	I	F, G	11
Integrate device with app	J	H, I	5
Testing prototype	K	J	3
Documenting	L	D, K	3
Presentation	M	L	6
Project completion and submission	N	M	1

*Table 2 Free float and Total float*

	Duration	Total Float	Free Float
2-7	9	19	0
2-5	5	3	0
7-10	6	19	19
5-6	10	3	0
6-8	8	3	3

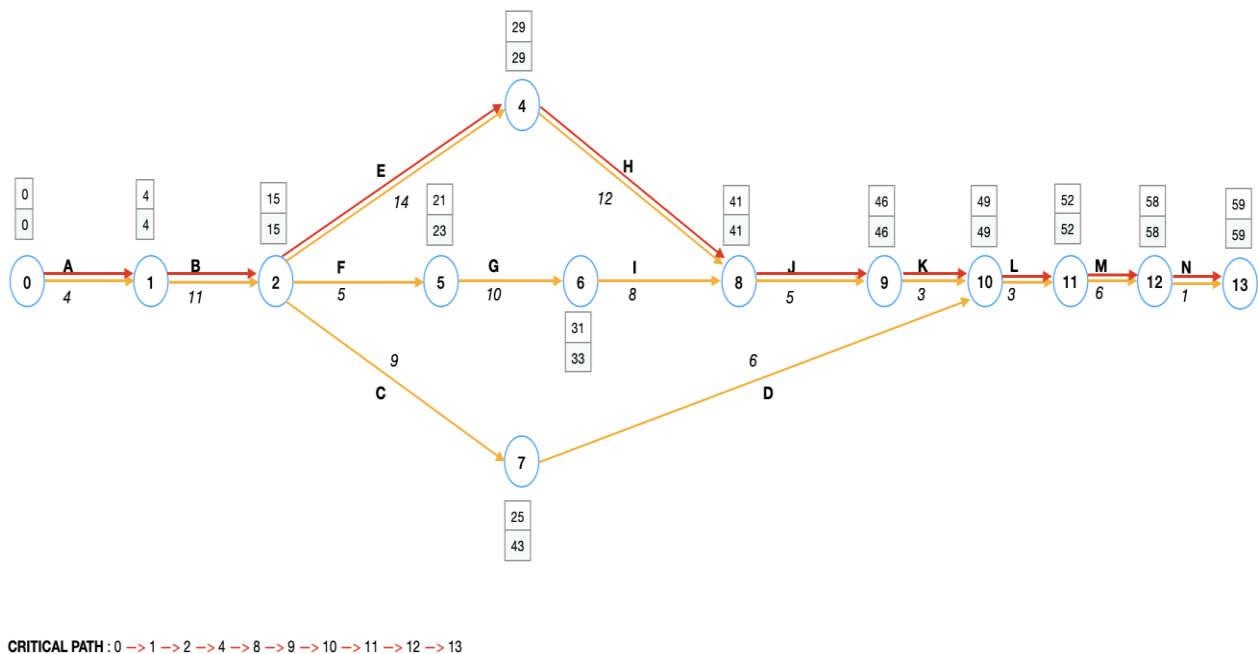


Figure 4 Critical Path Formation

The critical path method is a good tool to use. This allowed us to identify which items are taking longer than expected, which are ahead of schedule, and which tasks are right on track.

We have a span of 2 months for the completion of project and our critical path, being the longest span, ranges to 59 days. This gives a good insight in our project timeline and we were able to coordinate parallel tasks to finish the project on time, regardless of the risks that might have stopped us. We have enough free floats in between to cut down on time and work in parallel with other tasks. Project feasibility, Market analysis and benefit cost ratio is an on-going process and with experience, we concluded that it varies with each step and holds a scope of change. We had amended and enhanced our research of the existing markets of helmets. This gave us a good understanding about the market and how our product could fit in it.

***The critical path achieved, is denoted by red arrows. (0-1-2-4-8-9-10-11-12-13)***

The critical path is associated with the following tasks:

- Project Start -Proposal
- Requirement
- Design(S/W)
- Code (Prototype)
- Hardware (Prototype)
- Integration
- Testing Prototype
- Documentation
- Project Presentation
- Project Report Submission

These tasks are the most time-consuming tasks and will be taking most of the time in the whole project. There are few tasks that will be performed in parallel, like the hardware elements, software elements and documentations. These are highlighted in the figure 4,

where branching of paths signifies the parallel tasks. Since we are three people in the group, we have divided the tasks to better facilitate time management and resource management. Due to the pandemic, we are in different parts of the world and building a proper schedule is a high priority.

## **PRIORITIZING SCOPE TRIANGLE**

Priority Variable	Critical (1)	(2)	(3)	(4)	Flexible (5)
Scope					X
Quality	X				
Time		X			
Cost				X	
Resource Availability			X		

*Table 3 Priority Scope Triangle*

**Scope:** Since our application could have endless features our scope is very flexible but for project purposes, we are including 4 features namely calls, groups, navigation, and music.

**Quality:** Quality needs to be very critical, and we cannot compromise on it as, since it deals with life-or-death situations. We will be taking care precautions while making the patch and ensure it doesn't hinder the protective performance of the helmets.

**Time:** Because of the project deadline we have a timeframe and timeline to hold, and time is very critical in this ever-changing world therefore if we don't bring it first someone else will. During the pandemic, helmets can help people avoid infection and thus, it's a good time to launch our product.

**Cost:** Due to the existing market we are trying to reduce our cost to make our product stand out with its flexible nature and better features. In future, we could set different prices to meet the needs of different markets.

**Resource Availability:** Due to the pandemic its very difficult to say anything about resource availability and our resource requirement is minimal which is readily available in normal circumstances.

## **SURVEY**

There are many topics for which we needed real-time feedback to understand more about the stakeholders' opinions on various sections of our project. We created a google survey to do the SURVEY for our project. This is the link for our survey, we kept it open for people who might still want to provide feedback <https://forms.gle/DQmQbG66wmDbdgYE9> (link is also provided in the reference section). Questions given in the feedback are listed below with a small screen capture containing responses.

Q1. What are the added feature you would like us to integrate apart from in built features (call, navigation, group sync and music).

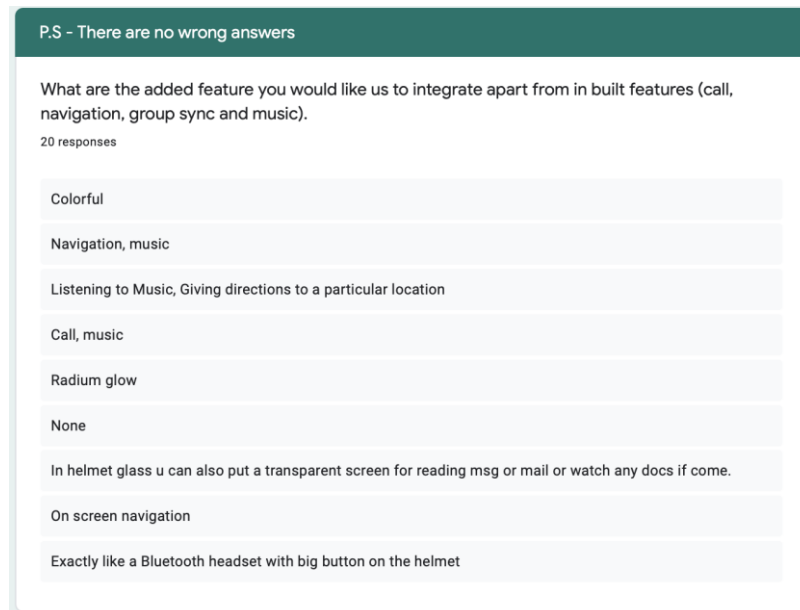


Figure 5 Survey : Question 1

Q2. Please provide us some risk factors which you think can affect our business model ? (pandemics, disasters )

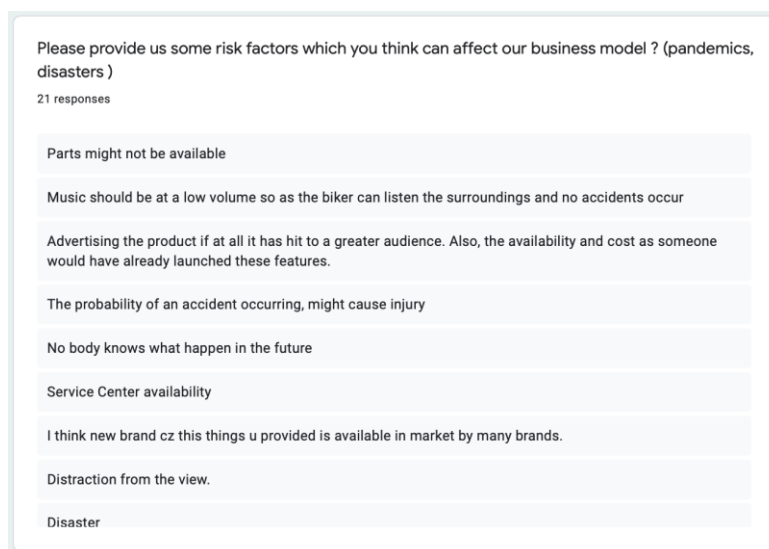


Figure 6 Survey : Question 2

Q3. What should be the cost of the product you expect(USD) ?

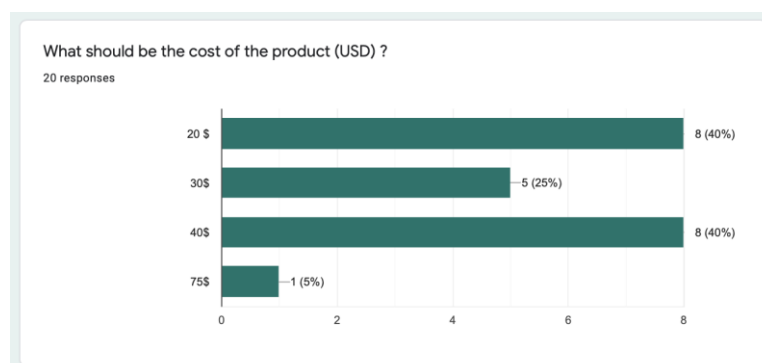


Figure 7 Survey : Question 3



#### Q4. Suggestions for improvement.

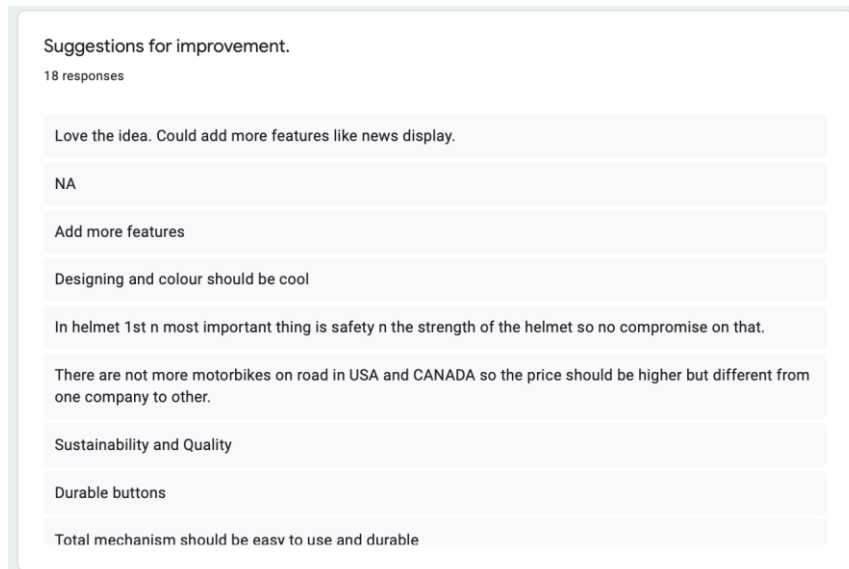


Figure 8 Survey: Question 4

#### Q5. Overall Feedback

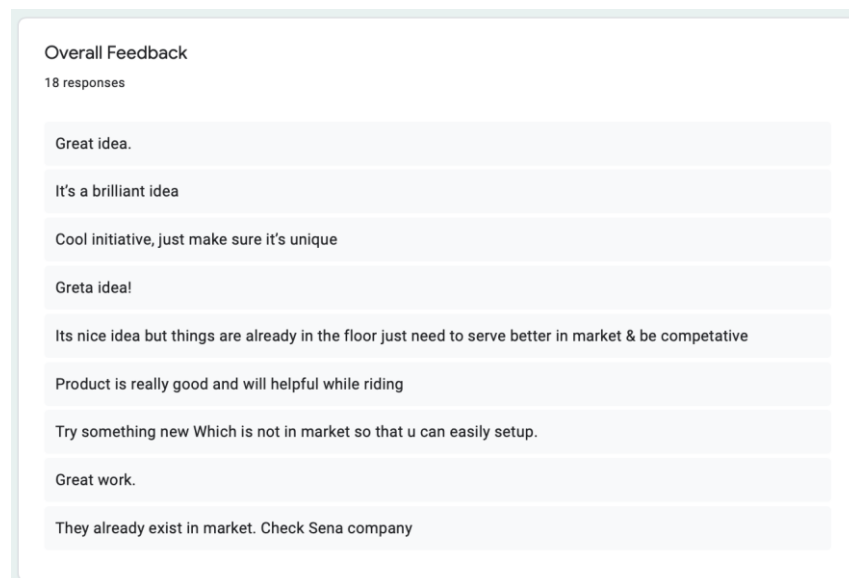


Figure 9 Survey: Question 5

There were five questions provided in the survey. We got an approximate of total 20 responses.

## **Client Wants VS Needs**

With the help of the survey, we got a broad perspective of how people feel about our product. Most people consider the product as a need, especially people living in countries like India, where most of the travel is done using two-wheeler vehicles. A speech guided device that could be fitted in an existing helmet gives it an added advantage over existing smart helmets. Four features that are repeated the greatest number of times are calls, navigation, music and group synchronization which are the basic built-in features for our product. Few other features which are in demand are display screen on visor which is a good option but it's a costly technology and it will increase the cost of the product defeating the main aim of creating a cheaper solution to smart helmets. Another important feature in the wants field was adding color to our product design which is not yet implemented but a very easy alternative. It won't put a dent on our expenditure as we just need to buy the colorful fabric for outer layer and it also motivated us to add stickers to patches related to sports, fashion which are in popular demand. This would be a good marketing strategy and reach the diverse population with these extra features.

There are few factors that distinguish between the client wants and needs. Sometimes the client think they need features integrated into the application, but it is merely a want and not required. For our project we have categorized the wants and needs as given below:

*Table 4 Client wants vs needs*

Features	Client Want	Client Need
Colourful Patch	Y	N
Navigation	Y	Y
Music	Y	Y
Radium Glow	Y	N
Display screen on Visor	Y	N
Control button on Helmet	Y	Y
Calls	Y	Y
Virtual Reality	Y	N
Group Sync	Y	Y
Noise reduction	Y	N

## **RISK MANAGEMENT**

Delivering a project's defined scope on time and under an estimated budget are characteristics of a successful project. However, these factors are extremely hard to achieve, there are external as well as internal requirements associated with the project estimate which can change significantly over time. Risk management deals with such scenarios which may cause delay in project completion. As Murphy's law states "anything that can go wrong will go wrong", so while doing initial project planning risk management is extremely helpful to deal with uninvited delay elements because people tend to spend a lot of money on all kinds of risks, both necessary and unnecessary, if we can correctly evaluate risks then we would be saving a lot of money, keeping track of all the potential risk elements and preparing a backup plan for at least those which have more than half the probability of occurring is a good approach. Risk management is often not considered as a core component of a project development phase rather it is taken as a "nice to have" strategy but we believe it is a core component because analyzing risk and being prepared for it beforehand is an effective way

to deal with any future risk. Preparing a strategy after it happened and wasting time to figuring out what to do will be an expensive trade.

Project risk management is divided into four major process groups which are risk identification, risk assessment, risk mitigation and risk monitoring and control. Let us look into all of these one by one, risk identification is the first step in which we try to identify all the types of risks that can happen in a project. Risk identification is subdivided into four categories which are technical risks, project management risks, organizational risks and external risks. To monitor and control the risks, we create a database which logs all the risks occurrences along with a risk ID number, description, who worked on it and what are the steps taken to prevent the risk with all the other details which will help in future to avoid any similar type of risk.

We have combined risk assessment in the same table to make it easier to understand:

**All the events in green region are less probable and do not incur high loss and hence can be ignored, yellow events are the one which do not require instant response, but management should consider these as potential risks and make plans to fix them in future. Red region is the dangerous one, all the events falling under red are highly probable and have high loss component attached to them.**

## Technological Risks:

Table 5 Technological Risks

Risk Category	Scope Triangle	Event#	Event	Y/N	Probability	Priority(H/L/M)
Technology	Scope	TS1	Hardware might not connect with future devices	Y	30%	M
		TS2	Present web services might stop its services	Y	5%	H
		TS3	Device not syncing with group of mobiles(BT capacity is 7 peoples)	Y	50%	M
		TS4	Hardware availability or change of vendor	Y	60%	H
	Cost	TC1	Unexpected need to acquire hardware	Y	20%	H
		TC2	Unexpected need to acquire software	Y	10%	H
		TC3	Cost of Web services might increase	Y	90%	L
	Time	TT1	Service disruptions by vendors	Y	15%	H
		TT2	Software integrated API's updates might cause delay	Y	20%	L
	Quality	TQ1	Cotton patch might come off	Y	10%	H
		TQ2	Patch might not be properly stitch	Y	10%	M

It is observed that our project has the greatest number of risk events in technology category, there are multiple risk involved with various scope triangle features. We have TS1 – TS4 defining events under the category of technology and which comes under scope part, TS1 is related to hardware issues which may be caused by advanced devices that are launched in near future, probability associated with event TS1 is 30% and has a low priority risk associated with it because with the advancement in technology, our product will advance too and we will make it connect easily with multiple future devices. Event TS2 is related to vendors providing web services for our application with a minimal chance of 5% as there are always alternative to this option. Hardware availability might be an issue especially when we have high demands for the product, therefore it is a high priority task with a probability occurrence of 60%. Another likely event is TC3 “cost of web services might go up” which is easy to mitigate and hence have a low priority. In time category for the matrix, we have two main events which are “service disruption by vendors” and “software integration API update delays”, both events are not highly probable and unfortunately cannot be mitigated at the time of occurrence, we might plan for a backup but during initial phase of the business model it can be costly. Red region is the dangerous one, all the events falling under red are highly probable and have high loss component attached to them. In our case TS4 in technology category is an event which is highly probable with 60% chances of occurrence and have high losses associated with it, hence this event can be categorized as take actions event.

### Project Management Risks:

Risk Category	Scope Triangle	Event#	Event	Y/N	Probability	Priority(H/L/M)
Project Management	Quality	PQ1	In-case of accidents the device might break and cause injury	Y	2%	H
		PQ2	Inaccurate budget assumptions	Y	30%	M
	Scope	PS1	Existing market coming up with better solutions	Y	28%	M
		PS2	Unavailability of internet	Y	15%	L
	Resource	PR1	Delivery of raw material	Y	10%	M
		PR2	Return/replace damaged materials	Y	15%	M
	Time	PT1	Task duration estimate too optimistic	Y	15%	L
		PT2	Difficulty scheduling meeting	Y	5%	L
	Cost	PC1	Less demand but high production	Y	20%	L

Table 6 Project Management Risks

This category also has some significant events associated with it, there are two events in quality part of project management which deals with accidents of bike riders and inaccuracy in budget planning. Event PQ1 is related to accidents and it's not something which we can control so no mitigation plan but there is mitigation available for budget accuracies in form of extra funds or savings in case we get out of budget in between the project or in any future stage. There are other risks such as better or cheaper product in market and internet unavailability, looking into current business market these are not very likely events and hence assigned a probability of 28% and 15% respectively. Another scope triangle component affected by project management risk is resource which we have introduced in project management category. PR1 is delivery of raw material and PR2 is return of damaged goods, both are very less probable and are assigned a probability of medium. PT1 and PT2 is under time category and states risk associated with time duration estimate and problems with meeting schedules both are easy to mitigate and unlikely to happen. Internet unavailability is not very likely events from the cloud part, all the cloud guarantee five nines service, which means only 5.26 mins for one year our apps will lose connection. Most of internet unavailability happens on the client side for a variety of reasons, such as the phone being too far away from the signal tower or the phone automatically connecting to an invalid wifi. One last scope triangle feature is related to cost which is having a less demand of product but higher production, this also has another name which is creating more products than the order but this is a necessary step and can be easily controlled under good supervision and quality client management. For the risk assessment analysis, most of the risks in this category fall under low or medium risk which presents itself as a positive factor for our project.

### Organizational Risks:

Risk Category	Scope Triangle	Event#	Event	Y/N	Probability	Priority(H/L/M)
Organizational	Cost	OC1	Deliverable rejected at last minute	Y	5%	H
		OC2	Unable to payoff the loan amount	Y	25%	H
	Scope	OS1	Hired employee left before completing the task	Y	30%	M
	Time	OT1	Slow knowledge transfer	Y	5%	L
		OT2	Excessive number of leaves	Y	5%	L

Table 7 Organizational Risks

We considered all the risk that might affect our working conditions in this category. Working conditions are important in all projects because it holds all the different elements together. There are various aspects to the risks that might become an organizational hazard like, Deliverables being rejected at the last moment, the loan is high to pay off, an employee leaves at the last moment or perhaps a slow knowledge transfer. After identifying such risks, it becomes easier to find a solution to lessen its impact. Having back-up with employees and making a plan to the number of leaves each employee takes cuts-off most of the potential risks. Loans and deliverables are a matter of instant reaction which should be dealt before-hand to reduce it before it piles up and causes risks. Since, paying off loan could be a potential risk but if planned properly, bankruptcy could be avoided and thus would pose a 25% risk

factor with a high priority. Another high risk in this category is the employee leaving the organization before the completion of task. This could delay our project but with a back-up plan in hand, we could easily by-pass such a situation therefore even though the risk will be 30% but the priority would be medium. This category is a combination of medium and low risks.

### External Risks:

Risk Category	Scope Triangle	Event#	Event	Y/N	Probability	Priority(H/L/M)
External	Resources	ER1	Unavailability of hardware raw material (pandemic/disaster)	Y	4%	H
	Cost	EC1	Inflation due to pandemic	Y	4%	M
	Time	ET1	Employee availability due to pandemics/disasters	Y	5%	H
		ET2	Natural disasters might delay the production and sales	Y	10%	M
	Scope	ES1	Pandemic might reduce the product usage	Y	5%	H
	Quality	EQ1	Weather conditions might affect the internet connectivity	Y	15%	M

Table 8 External Risks

There are a lot of external, uncontrollable factors that pose a high risk to our project. While natural disasters might hinder our sale but a pandemic situation might dissolve our project completely. If a pandemic situation occurs, like the covid outbreak, nobody would be using bikes and hence, no helmets. This is a risk, to not only the sale, but also the production since the raw materials might reduce its manufacturing and thus, a hike in prices. On the other hand, there is a fair chance that people will avoid contact with other people during the pandemic, so people might avoid taking buses, subways, or taxis. Riding a motorcycle is a good option to lessen the effects of COVID 19, so pandemic is a double-edged sword, it depends on how we use it. We need to have a back-up plan and prepare ourselves for such a situation. Since natural disasters are a rare occurrence, these external factors have a low probability overall. The natural disasters will destroy all user data, losing user information is catastrophic for any company, to avoid this, our cloud service system will back up all data from the database in three different data centres that are in three different zones or even, three different countries.

## **BENEFIT COST RATIO**

Benefit cost ratio is a project profitability indicator used in cost benefit analysis to determine the viability of cash flow in a project. It is the ratio between the present benefit generated from the model with the present cost involved in it. A benefit cost ratio value higher than 1 indicates that the project is expected to generate a profitable income while a value less than 1 is a loss scenario. Mathematically benefit cost ratio is given as below.

$$\text{Benefit cost ratio} = \frac{\text{present worth benefit}}{\text{present worth cost}} \geq 1$$

Present worth benefits and cost is given by the equation below.

$$\text{Benefit} = A \left[ \frac{(1+i)^n - 1}{i(1+i)^n} \right]$$

$$\text{Cost} = F[(1+i)^n]$$

Where,

$A$  = Future value of a lump sum

$i$  = interest rate per period

$F$  = Principal value or present value

$n$  = number of periods

Benefit cost ratio values interpretation,

$\frac{B}{C} > 1$  : Business is projected to make profit

$\frac{B}{C} = 1$  : Breakeven situation, money invested = money earned

$\frac{B}{C} < 1$  : Business is projected to make loss

In terms of our project, to calculate the benefit cost ratio we need to first figure out the total cost and estimate the benefit of our project. Let's look into the cost analysis for our prototype in figure 9, with an overview of manufacturing and operations cost for products in the figure. Manufacturing cost of products comprises of the cost of various raw materials used in manufacturing such as Mic, Bluetooth and other materials while on the right-hand side of the figure ratio of operating costs which is required to smooth functioning of our project is given, it is clear that cloud services is taking a big chunk of pie out of operating cost which can be reduced using cheaper alternatives in future.

## Cost Analysis:

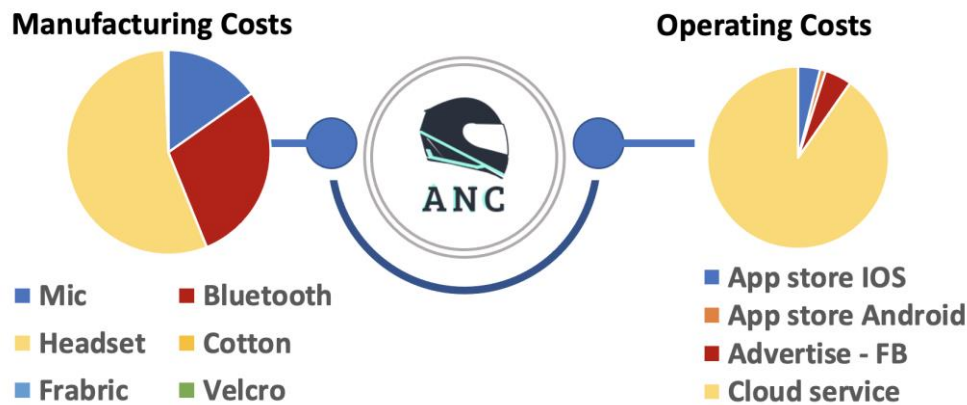


Figure 10 Cost Distribution Chart

We need to list out the cost involved for each individual raw material per product to find out the total cost involved in overall project; table 8, below shows the cost breakdown of manufacturing as well as operational requirements. Internal assemble of microphone, Bluetooth and headset costs 1.7, 3.2 and 6.2 dollars respectively while outer padding consist of cotton, fabric and Velcro which costs a total of 0.07 dollars per piece. There are no raw materials involved for software as we can use our normal laptop for programming and maintenance, but we do need to list out our application in IOS and android store which can cost a total of 124 dollars. We have included a very basic Facebook advertising scheme involving an investment of 10\$ per month which makes it 120 dollars annually. Cloud services for hosting out environment and supporting database and other application required services will cost around 2268 dollar. Total 2512 dollars are invested in operations costs annually.

Manufacturing	Price (In dollars)
Microphone	1.7
Bluetooth	3.2
Headset	6.2
Cotton	0.02
Fabric	0.03
Velcro	0.02
<b>Total cost</b>	<b>11.17</b>
Operations	Price (In dollars)
IOS store	99
Android store	25
Advertising - FB	120
Cloud services	2268
<b>Total cost</b>	<b>2512</b>

Table 9 Cost Analysis

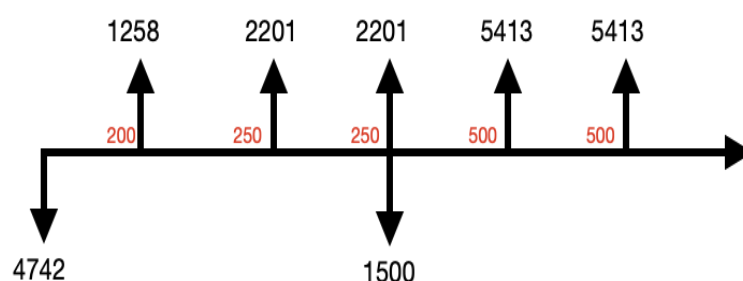


Sales estimate is the main part for deciding the benefit cost ratio over the upcoming years so table9, below shows the items manufacturing estimate along with the cost involved and the cost price along with the return amount on the overall investment with profit figure separate. We will start the project with manufacturing 200 product for the first year which will require a manufacturing cost of 2234 dollars with 11.17 dollars per piece. Extra cost evaluated for first year which will be our operational cost and will amount to 2512 dollars annually. So total input by the end of first year will be 4742 dollars. Now let's look into the selling aspect, considering a margin for sustaining our business model and generating money for our risk mitigation as well as research part we kept the selling price for each product as 30 dollars. If we manage to sell all 200 products by the end of the year, we will have a profit of 1258 dollar in our first year which is a good figure.

	Products	Cost	Extra cost	Per product cost	Input	Return	Profit
<b>1st Year</b>	200	11.17	2512	30	4742	6000	1258
<b>2nd Year</b>	250	11.17	2512	30	5299	7500	2201
<b>3rd Year</b>	250	11.17	2512	30	5299	7500	2201
<b>Money</b>							
<b>4th Year</b>	500	11.17	2512 + 1500	30	9587	15000	5413
<b>5th Year</b>	500	11.17	2512 + 1500	30	9587	15000	5413
<b>Benefit</b>	15280						
<b>Cost</b>	5976						
<b>BC ratio</b>	2.55						

Table 10 Benefit Cost Ration

Looking into the second and third year, the profit gained in first year we will be increasing our manufacturing quantity to 250 products. With the same logistics in place, we will be projecting a profit of 2201 during these years. After third year we are planning to go for a business loan at the standard rate of 4.5%. Loan amount will be of 1500 dollars and we will be using this money to invest in doing our patch assembly and stitching work. This should increase our production from 250 to 500. This would also require assistance for making the products in mass, therefore we have considered an over-all 1500 dollars that will be spent on labour. With the loan in the model, we still are having a profit of 5413 with which we can easily clear up the loan amount in a year. A benefit cost ration chart shown below will be easy to visualize the projection of our project.



Downward arrows show the money invested into the business while upward arrows shows the profit generated each year. 4742 is the initial investment and 1258 is the profit after completing first year. 1500 downward shows the loan taken and arrow just after the loan shows that consecutive year the projection for profit will be 5413 dollars.

With all the cost details are analyzed and final projection is also decided, next step is to calculate the benefit cost ratio using the formula before.

$$\text{Benefit cost ratio} = \frac{15280}{5976} = 2.55$$

Above calculation tells us that we have a benefit cost ratio after five years projection of input and sales will be 2.55, which means that for each dollar invested into the project we will receive a benefit of 2.55 dollars. It is easy to interpret now that the higher the ratio goes the more profitable business it became. Incorrect cashflow prediction may lead to a flawed benefit cost ratio and it can lead to a very bad situation. Therefore benefit cost ratio is a useful measure to determine the project feasibility and check if the project will generate profit over the upcoming years or not. One of the main advantages of benefit cost ratio is that it is very easy to calculate, it does not involve any complex mathematical calculations for which one need a computer or MATLAB skills. Anyone can do the BCR projection with the help of a simple calculator.

### **Best- and Worst-Case Scenarios**

A very important aspect to be considered while creating a benefit cost ratio is that it is based on assumptions and we cannot rely completely on the projected estimates, there are scenarios which can affect these and change the benefit cost ratio. For example, in case another company launched a product which is cheaper or equal in price as our product then it may reduce the sales and we may not be able to sell all our products which can affect the BCR ratio. Another example will be a software related issue, maybe transaction or payment gateway not working or server crashes, which may cause us to lose revenue. We tackle these unwanted situations with adding probability in benefit cost ratio. We multiple the benefit generated with the probability of getting the benefit value as expected and we do the same with the denominator. Overall formula changes a little bit as shown below.

$$\text{Benefit cost ratio with probability} = \frac{\text{Benefit} * \text{Probability of getting that benefit}}{\text{Cost} * \text{Probability of getting that cost}}$$

In our project we have taken two scenarios to get a benefit cost ratio with probability in both the cases, first case is an optimistic approach where we are considering a 85% probability of getting the same benefit as expected and 90% probability that the cost of project will be the same as expected. After calculations as shown in table below, we got a benefit cost ratio of 2.415 which is almost same as our initial projection which was 2.55. Let us now take the worst-case situation where we have taken a benefit likeliness of 60% whereas the cost will remain the same, this gave us a benefit cost ratio of 1.53 approximately which is a dollar less than our initial projection and it's not a good scenario but risks are inevitable part of any business and we must consider the worst-case scenarios to be on the safer side. One good point about both the worst and the best case is we were able to make profit in both the situations, even

though we reduced our benefit from 100-60 percent we are still on the positive end of the benefit cost ratio, which implies that this project is a good choice and it will be able to sustain even the high risks associated with it.

Normal projection		Best case scenario		Worst case scenario	
Benefit ( 100% )	15280	Benefit ( 85% )	12988	Benefit ( 60% )	9168
Cost ( 100% )	5976	Cost ( 90% )	5378	Cost ( 100% )	5976
BC ratio	2.55	BC ratio	2.415	BC ratio	1.53

Table 11 Best Case and Worst Case Scenario for Benefit-Cost Ratio

## **PROJECT SUMMARY**

Winston Churchill once said “Victory is the beautiful, bright-colored flower. Transport is the stem without which it could never have blossomed.” We hope your path to victory is safe and sound. ANC gadget makes a normal helmet to an advanced hand free tool, not only for the safety concerns but also adding a bonus to ordinary life. Necessary features like navigation routing, calling, listening music or podcasts, making group phone call with friends, and synchronizing everyone’s location, are now integrated and you need to do enjoy your bike ride and leave all tasks above to our mobile application via voice control.

To achieve this vision, we are working on two fronts, our ANC tool and mobile application. Equipment for communication like speaker and mic is installed with safe padding within the patch to protect any injuries to rider in case of any unwanted event and it will not reduce the helmets safety measures. For mobile application, we implement voice control, translate speech to text, song storage and account registration/authentication through SDK on the cloud service to save more local space.

## **PROJECT DETAILS**

The project is a combination of 2 elements:

1. Helmet Patch ( Hardware element ):

**Patch Dimensions:** Our smart helmet path fitted inside the helmet with 3 x 9.3 x 1.5 cm and 140 Grams weight.

**Feature:** one mic and Bluetooth chip in the front and two speakers circuit near to user’s ears from two side.

**User manual:** The path installation is easy and no need for expert assistance, nylon buckle on the patch will stick the helmet and patch together. User won’t feel any discomfort with the patch. Every time user wears the helmet, they only need to press the wake-up button and our patch will automatically connect it to the phone via Bluetooth. Users have all the functions through manual control or voice control, giving them multiple options to work it to make their driver experience easy.

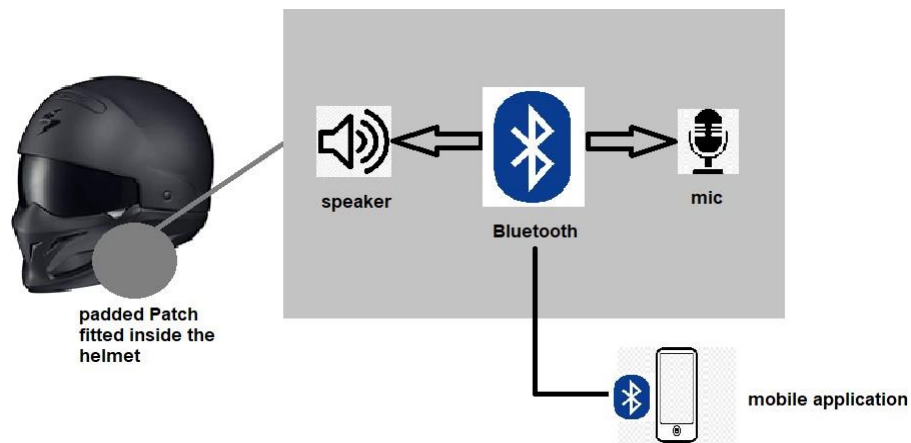


Figure 11 Architecture

2. Mobile application ( Software element ) : An IOS application performs as an interface to implement functions include phone call, destination routing, podcast, music and a group navigation app.

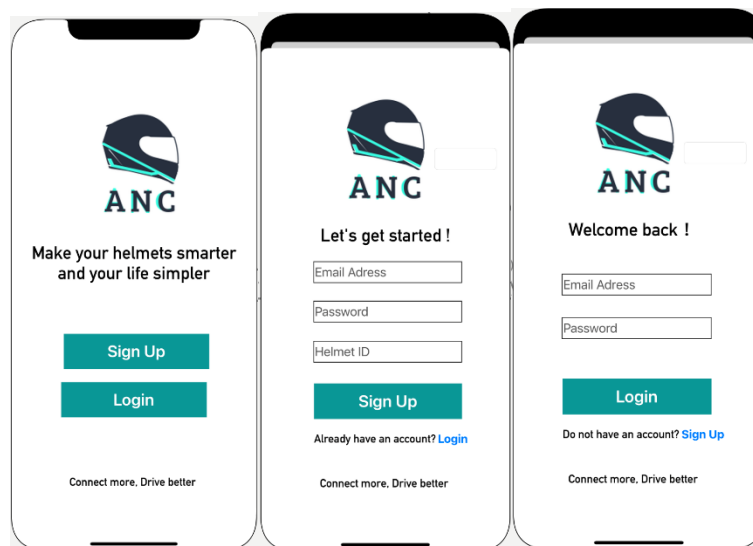


Figure 12 Login and Sign-Up Pages

**Function 1: Verification system** are shown in Figure 12, is the first interface of our app, after user enters the account and password, the app will connect to a virtual machine from the cloud for validation, and for safety reasons, we use Amazon RDS service and backup all the data in three place like HDFS does.

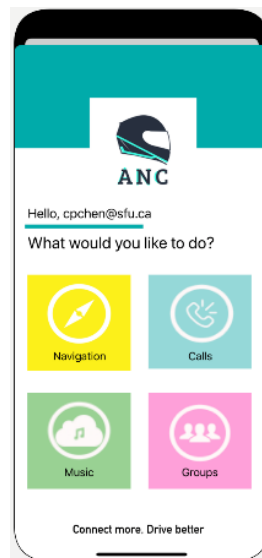


Figure 13 Main dashboard

**Function 2: Main dashboard system** shows all the functions we have, and users are able to manual control or voice control them. For translating the speech to text, it can accurately convert speech into text using an API powered by Google's AI technologies. It is free for first 60mins and charges \$0.006 for each of the translation. We will use our own SDK in the future.

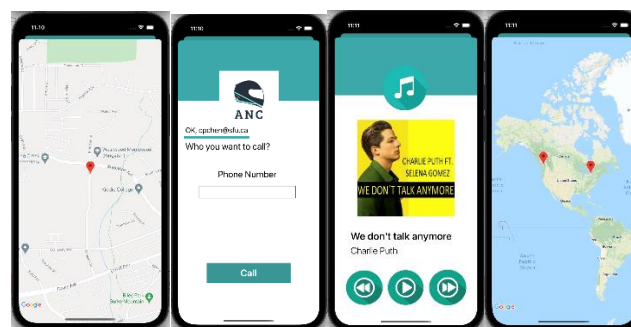


Figure 14 All the function we have with our app

**Function 3: Destination routing, phone call, music and group navigation functions system:**

**Destination routing:** By integrating google maps into the IOS application, the user will be able to navigate easily with the help of speech and listen to the direction without looking at the phone. This would remove the dangers of physically using mobile GPS systems.

**Phone call:** With the help of the mobile application the user will be prompted whenever there is a call and if he wishes to receive it. A hand-free system of making and receiving calls with simple speech/voice recognition gives a comfortable option to the user.

**Music:** Users tend to get tired after riding for a long time. This feature can help relieve fatigue and we don't need to switch back and forth from our app to other music apps.

**Group navigation:** First, add everyone as a group with the unique user ID. Every second the smart helmet sends its ID and coordinates to the database from the cloud. Then the database receives and distributes group information to each of the smart helmets. We could check the location of our friend through our phone app.

## **CONCLUSION**

There are smart helmets available in the market which are expensive, and people are not interested in those helmets because comparing the technology factor of those helmets with normal helmets doesn't justify the use and people are better off with a simple helmet. Making commute simple yet efficient is a major advantage of our patches. These patches are easy to install and can be used with any type of helmets.

Project development and management techniques strengthened our organizational skills and made it easier to build a project by considering risks and clients equally. Gathering requirements and doing a market analysis took an in-depth study and turned out to be fruitful in the overall build of the project. Breaking the tasks and working in parallel saves us time and resources. Prototype building was the most sensitive part of the whole process and required a lot of working to create a product that could be shown as a demo. The survey gave a positive response towards our project that reflected the need for such a smart helmet patch. This makes our product stand out in the existing market and after a market research conducted by the team, we have concluded that the product will indeed be a success due to its less cost and the unique features that distinguishes our product with others. As per the benefit cost ratio, we will not go into loss even in the worst-case scenario, that gives us an edge to move forward with the product. Potential risk includes natural disasters and pandemic situation that could disrupt the business. In case of such an event, the use of bikes would reduce, thereby reducing the usage of helmets. All other risks are mitigated and do not pose a very high risk. Overall, the project was completed on time as per the timeline and the product is working as per the client needs.

## **FUTURE WORK**

Our survey depicted that all participants were in favor of our product and the price range is also very less which makes it a suitable product. People don't need a new helmet rather they can just stick our patch inside their existing helmet. Adding color and stickers for our patch is a future aspect which can be very beneficial, as people showed interest in colorful patches in our survey. One important future work is a survey on a bigger scale. For our future proposal, we will be conducting a survey on a larger scale to have a good idea of a bigger section of population. The survey will include at least 1000 people who are bike riders having a driving license to increase the quality of survey. The feedback would give us a better outlook on our plan, and we would have a better idea about what needs to be done to make our product better.

Patches which are detachable have a very big market in the field of construction workers who wear helmets while working. They use a walkie talkie to communicate with each other with the disadvantage of short range and distortion in signals, people need to stop working while talking on walkie but with our patches all these issues can be resolved, in fact we can use this in any facility where a group of people work together like in the zoo, museum or laboratories. Another important future modification work for these patches will be making it flexible to be installed in hospital beds where patients can use these to send a distress signal to hospital authorities in case of emergencies, it will be a new domain, but we can make it work.

Apart from these future models, to make our current model a success in the market, we would require a lot more advertising and we would be investing for the same to make our product reach a bigger audience. We have also planned to collaborate with helmet companies and bike companies to sell our product with theirs. That would give us a better scope at reaching the right audience. To assure the safety of the public we will be going for a quality certification, and we will also file a patent to solidify our plan.

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***CONTRIBUTIONS:***

ANIMESH: Market analysis, benefit-cost ratio, managing resources.

NIKITA: Design, marketing, and documentation.

CHARLEY: Building of prototype (Hardware and software)

In addition to individual tasks, each team member was a part of the whole process and worked on all components of the project equally.