SMART GUARDIAN

Project ID: 19-099

Project Proposal Report

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ABSTRACT

The Internet of Things, or IOT, refers to the billions of physical devices around the world that are now connected to the internet, collecting and sharing data. When it comes to our environment, this concept can be applied incorporated to make it smarter, safer and automated. This IOT project focuses on building a **'Smart Guardian'** which comprise with two IOT devices.

”The worst thing is watching someone drown and not being able to rescue”, to prevent aforementioned conception we come up with **'Smart Guardian’.** This project support for children or teenagers to survive from the threats which is caused by water such as drowning and also this is may help for people to survive from the natural disaster like flooding. These are the major problems we are addressing through our project.

Projects have ranged from; 1) wearable device; a device that straps to your wrist that has seemingly intended to keep you safe in the water. Estimate the depth of water in a river, lake or sea using the particular sensor to detect the insecure areas. Measure your heart rate via pulse sensor when you are in a critical situation. 2) Floating device; an emergency flotation device for swimmers, its features and the purposes for detect the flooding. Locate the all floating devices using algorithm and it act as intermediate source for water communication. 3) Underwater communication; a technique of sending and receiving messages below water. Analog-to-digital conversion to transmit data. 4) server handling; enhance the security to prevent interference from the third party analyses the signal data to determine the affected user condition and flood detection through algorithm to trigger the alerts. All the alerts will be gone to android Mobile Application which can be acknowledged an incident directly from the notification.

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1 INTRODUCTION

1.1 Background & Literature Survey

1.1.1 Background

One of the most important factors is keep safety while we are enjoying in water. Hence, through our project we elected the specific area, which is water. This area all about accidents happened due to water. Initially as a team, we discussed to focus on accidents. Accidents can be happened in several ways therefore we elect few types of accidents. It was car accident, natural adversity, drown and gas leak injuries. We were figured several product developed for car accidents and for the gas leak injuries as well. Drowning is the second leading cause of accidental deaths in the world, next to road accidents. Even WHO highlighted drowning, as a major cause of death in the Global Report on Drowning (2014). However, there is not a specific product to prevent people drowning from the aquatic body. Especially for the drowning from the ocean or a lake or a river. Most of them are children, teenagers and female. A child drowns every minute in the world, and drowning is the main cause of death from accidents in children under five.

If we analyze the causes of a number of deaths reported daily, the root cause for them is negligence. Those certain accidents can be avoided if the person is really mindful, but it will not behave as we expect. Ocean looks so calm that it seems fascinating, but at times, it is so rough and threatens to bring death to a few lives.

Here what we analyzed from the inaugural Drowning prevention Report for Sri Lanka Published in December 2014

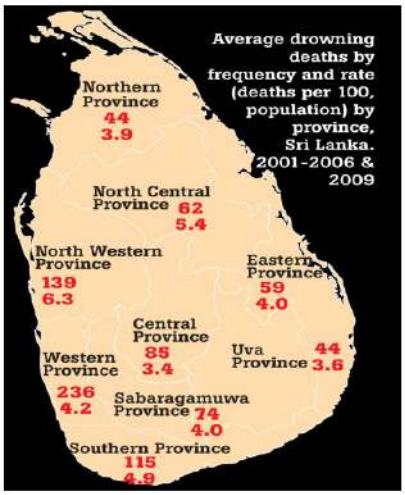

Figure 1.1: Average drowning death

Drowning is generally considered to be a ‘silent death’ for a person who is about to drown is unable to shout for help because he tries to save all his energy and the decreasing amount of oxygen in the lungs to keep his head above water. Drowning is designated the human life into danger. Therefore, we conducted a survey to identify both necessity of this proposal and the key areas to be considered in this project. The survey has been published publicly and several important information was gathered for the necessity of a SmartGuardian.

Those were as follows:

We were elect a specific area for this project. This product is basically focused on children and teenagers. From the survey, we have noticed 69.4% of the people who have responded is teenagers.

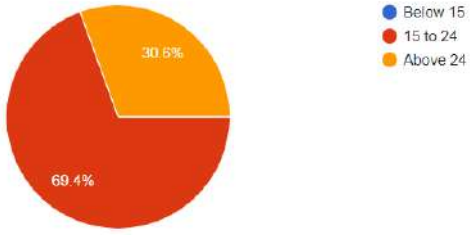

Figure 1.2: Age gap of who have responded to the survey

We require to analyze how many of people able to swim through this survey. Therefore eighty-nine people have been submitted answers and 30.6% out of them have given their response as “No”.

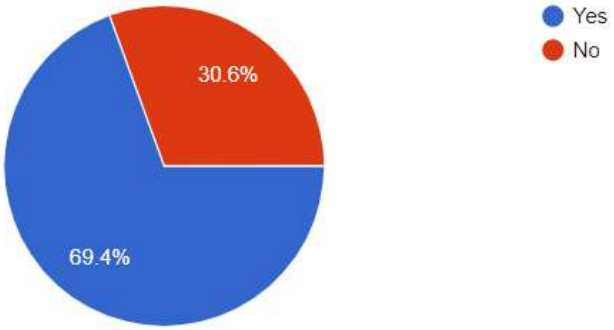

Figure 1.3: Do you know how to swim?

Most of the people can swim. However, unintentionally swim can be lead to death. People might be mindful about their own safety but death can be happened in few seconds. Even though they might not be known how will it be happened?

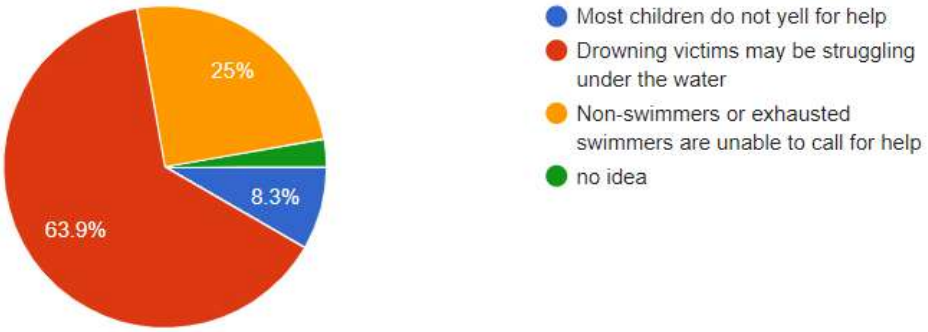

Figure 1.4: Why people cannot shout for help?

Out of all those responses 63.9% people are agreed that victims are struggling under water to survive themselves. When water enters person's air passage, person cannot shout anyway. In other hand, second most percentage has for non-swimmers or exhausted swimmers are unable to call help. It because they are struggling to save their energy but decreasing the amount of oxygen in lungs to keep his head above water.

Nearly teenagers or children died because of they are surging. If the crease of ocean or speed of the water flow in river is high, it can be the most probably reason for drowning

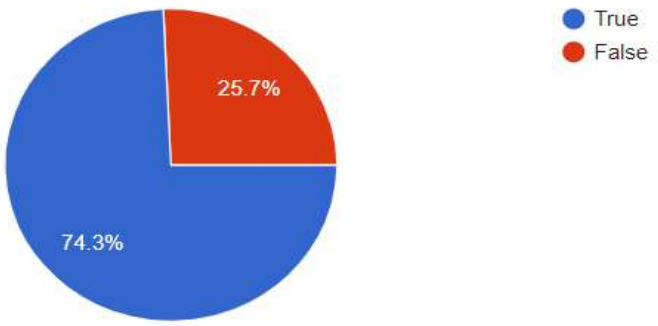

Figure 1.5: Most child or teenager drowning and near drowning occur in the ocean or river because the current is too strong?

From all those responses 74.3%, people out of them have submitted as 'Yes'. Swimmers and non-swimmers could not able to help themselves. Because of the higher crease or higher water flow speed in river.

Our product is based on teenagers and children. Therefore we require information even though child able to swim or learned to swim in the water can they survive without adult supervision.

Out of all those responses 33.3% people submitted as ‘No’ and 47.2% people submitted as ‘May be’. Therefore, it describes without under adult supervision children can be nearly lead to their own death.
Even Though adult keep their eye on children without their acknowledgment children can be drowning.

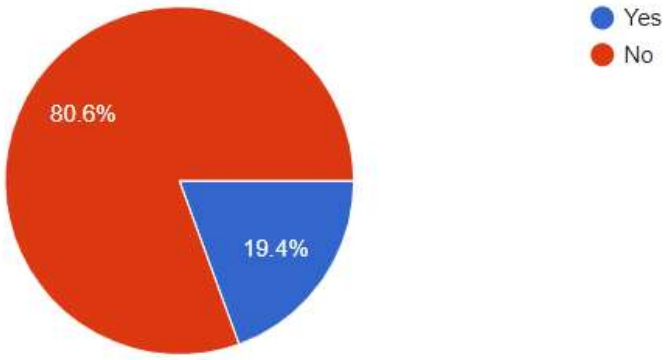

Figure 1.6: Would you get into the water without knowing the depth of the water?

Without knowing the depth of the water, people might not be able to get in to the water. Therefore, out of eighty-nine of people 80.6% people have submitted that they are not willing to take risk for their life without knowing the depth of the water.

Another feature of this product is flood prediction. Floods are common natural disasters that can affect millions of people around the world. They are often caused by rivers, but overflowing lakes and seas can also cause flooding. At least once a year the plains around large rivers are flooded. This is due to the amount of water that rivers bring with them, because of heavy rainfall Thunderstorms can cause flash floods, in which small rivers can swell quickly and carry up to ten times the normal amount of water.
Therefore, we try to predict the flood to acknowledge by the user. Through this survey, we acquire that people need a tool for flood prediction.

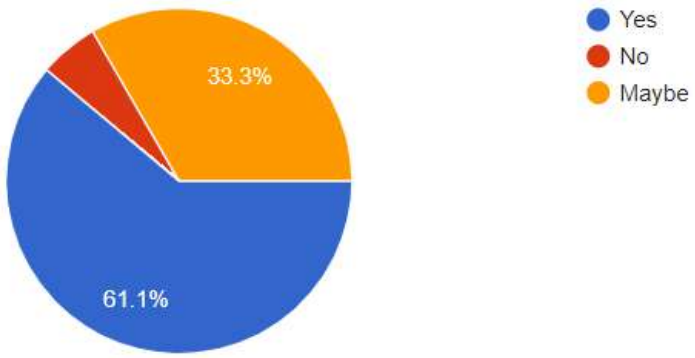

Figure 1.7: Do you think flood prediction is helpful to yourself?

Out of all of the responses 61.1% people is submitted that flood prediction is helpful for them.

By referring all those charts, the necessity of a SmartGuardian with novel features has been clearly proved. Therefore, a SmartGuardian was proposed to develop as our final research because it would be a community work that will help to improve the well-being of human lives.

SmartGuardian is consist with two devices, which are wearable device and the flood device. Wearable device is capable of detect the user condition while the user is in water, measure the depth of water and floating device is capable of flood detection. SmartGuardian is notify the user about all this alert through our mobile application.

1.1.2 Literature Review

Drowning generally happens mutely, with solely a number of folks ready to wave their hands or call for help. To understand why it's therefore necessary to place confidence in safety once in or around the water, one would like solely look into drowning statistics. In 2015, Associate an estimated 360 000 people died from drowning, creating drowning a serious public unhealthiest worldwide. Drowning accounts for 75% of deaths overflowing disasters. Flood disasters are getting additional frequent and this trend is predicted to continue.

Once somebody starts to drown, the end result is often fatal. not like different injuries, survival
is determined virtually completely at the scene of the incident but there are many actions to prevent drowning and as well as the flooding. In here we are introducing a product which can help to survive from drowning and flooding.

Internet of things dramatically improves our world in many ways. Higher output and increased productivity have been two of the biggest reasons in justifying the use of IOT. it has been used in many studies of various research. Therefore, many analysis papers and articles were based associated with our analysis product. Despite the fact that most of the options are completely different whereas comparison with the projected product, much vital data is gathered through those papers because the main focus is the same.

We first reviewed the information in the 2013 iSwimband. This has been developed by Paul Chu [1].This is a waterproof device is known as the iSwimband. It sits around the head of a child and has a Bluetooth-enabled sensor at the front. When the device detects the kid has fallen into water, it sends associate in nursing alert right away to the parent so that they will come back and rescue them. For the interactive features, such as sensor is paired with a compatible Bluetooth-enabled smart device running the free iSwimband app. It has a battery life of hundreds of hours of active monitoring [1]. Include features

in our proposed product such as Estimating the depth of water using Sonar Signals and Gyro and Accelerometer Sensors, Underwater Communication Modem using a Sonar Signals, Flood Detection and Floating Device to collect data transmitted from Wearable and Send data to server which is mobile app is connected, Collect pulse rate of the user and water level and water flow from sensors and predict User condition and Potential Flood using Machine Learning algorithm.

In 2015 a design of Low-Power Acoustic Modem for underwater communication has been developed by Jagdale M.R.1,Puranik V.G [2]. This has been developed mainly by focusing on networks frequently depend upon acoustic communication, which poses some of demanding situations for reliable data transmission. Mainly has several interactive features such as to transmitted Signals in the Ultrasonic Transmitter and received Signals in the Ultrasonic receiver, transforms mechanism for analogue signals into digital signals, software sampling method to interpret signals as the original signals, frequency generators ,amplifiers ,ultrasonic sensors and many methods with sensors have been used in this project. In 2015 another Acoustic Modem for underwater communication has been produced by Slamet Indriyanto, Ian Yosef Matheus Edward [2].This research was based on underwater acoustic modem with ultrasonic frequency using Frequency Shift Keying (FSK) Modulation. The designed system consist of FSK modem, microcontroller, amplifier and transducer. Waterproof ultrasonic sensors JSN-SR04T are used as transducers for designed modems. Some of the features are included in our proposed product as well. As well, another an ultra-Low Power and flexible Acoustic Modem design to develop energy-efficient underwater sensor networks was developed by Pedro Yuste, Angel Perles and Juan José Serrano in 2012 [2]. This is focused on the description of the physical layer of a new acoustic modem called ITACA. The modem architecture includes as a major novelty an ultra-low power asynchronous wake-up system implementation for underwater acoustic transmission that is based on a low-cost off-the-shelf RFID peripheral integrated circuit.

SYN Flood Detection Algorithms has been produced by Matt Beaumont-Gay [3]. He implemented three SYN flood detection algorithms such as SynFinDiff, SynRate, and PCF.SynFinDiff has good detection speed but takes a very long time to return to a non-alert state. SynRate is significantly and negatively affected by attacks that create high variance in the traffic rate, but is faster than SynFinDiff at signaling the end of an attack and PCF performs very well with regards to both detection time and quiescence time. In our proposed product, developing flood detection algorithm by using some of features. Advance Flood Detection and Notification System based on Sensor Technology and Machine Learning Algorithm was developed by Mohammed Khalaf, Abir Jaafar Hussain, Dhiya Al-Jumeily in 2014 [4]. This basically flood detection system designed for immediate notification to the native authorities. It determined the present water level victimisation sensing element network, that provides notification via SMS and internet base public network through GSM electronic equipment. SMS and internet base public network area unit valuable alert communication tools which will distribute the knowledge to the floods victims among specific space. Four machine-learning algorithms were utilized to classify flood knowledge. For our project we applied some of the features such as GSM module, PS module to track the location etc.

Speed of the sound is determined by the by a combination of the mediums rigidity and its density, the more rigid the medium faster the speed of the sound, the speed of the sound in air is low because air is compressible, and because liquids and solids are very rigid it is very difficult to compress, the speed of sound in such area are generally greater than in gases. [5]

In our proposed product, it'll be hoped to specialise in folks that area unit underneath meditation separately. Therefore, the small print that were gathered through this analysis paper can be rather more useful to the progress of our analysis.

1.2 Research Gap

Speaking of safety in aquatic environments, the only step which was taken as a wearable device is the iSwimBand [1]. Which only capable of alerting parents if their children is drowning in the home pool.

But our proposed product, SmartGuardian demands the safety of in aquatic environments like rivers, lakes and oceans where children and elders might know how deep they are going to. So if they cannot swim and if they are reaching towards a deeper area they can take safety precautions before getting drowned.

1.3 Research Problem

Aquatic Safety is a critical matter that people should consider when they enjoy themselves in aquatic environments mostly like rivers, lakes, runnels and oceans. People are advised to swim in the water where visibly perspective to respective person. Because they can rescue the person if happens any accident for some reason. But we hear daily numerous serious injuries and death occurred due to drowning or other accidents which caused by water. The main reason for drowning in water is unaware of the depth of water and communication disabilities while the person in water. When we comes to communication disability, it can be affects to different ways. As a example if a person confront a critical heart condition while person in the water, person might not be able to summon for help or no one will attentive about the person who ever prepared to rescue them. As well with the age, teenager or children are brash. They are not listening their guardians. Hence, they are lead to their own death.

Floods are the most widespread natural disaster. “Nobody is strong enough to stand up under a flood”. Therefore, their damage is so extensive. Flood is responsible for lost of thousands of lives, their wealth, and their home. All of them are pour down to the flood. Flood can be occurred due to heavy rains, broken dams, overflowing rivers likewise it develop by naturally or due to manmade mistake.

To overcome this problem, we proposed Smart Guardian as our 4th-year research project that it will be much helpful for all human beings. Through this project, the respective user will be notified about the affected person if the person is in critical condition in the water and notify the user about the flood to entrench themselves before incur to the flood.

While doing this, several research problems are identified such as,

- How to identify whether related person is in critical condition?
- How to locate the affected person?
- How to identify flood area?

To overcome above issues, several information and details are gathered through so many resources like internet, research papers, articles etc. As well, in the developing process, many numbers of sensors have to be used and we have to develop this project in most feasible manner.

2 OBJECTIVES

2.1 Main Objective

The main objective of proposed product is introducing a full featured smart guardian system comprise with two devices which can be effective for ensure the people protection from aquatic environment. Identify the user condition and the flood prediction

2.2 Specific Objective

- Measure and analyze the depth of the front area of the user when user is in the water and alert if he is going to a deeper are through a vibration in the wearable device.
- Identify the user condition if the user is in critical stage due to accident or some other reason and send an alert to the mobile application.
- Identify the water level and water flow speed, predict the flood of the respective area, and send an alert to the mobile application.
- Identify the location of floating device
- Through underwater communication, data read by the wearable device send to floating device and check whether data is transmitted to the respective floating device.
- Enhance the security of the floating device to prevent interference of third party.

3 METHODOLOGY

3.1 Product Overview

The **'SmartGuardian'** be composed on with wearable device, floating device and mobile application. Four of the most important components are,

- Creating a wearable device for users with particular sensors to detect user condition.
- Underwater communication in between wearable and floating devices.
- Creating a floating device as an intermediary source for water communication with the server.
- Identify the flood and enhance the security of floating devices

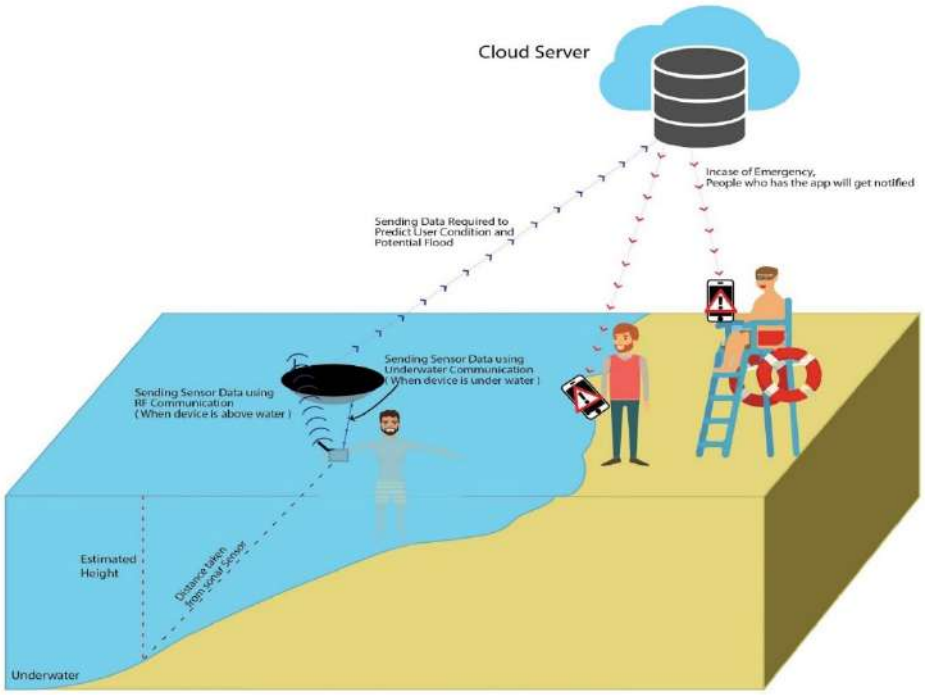

Figure 3.1: Overview of SmartGuardian

3.2 The Functionality of the Project

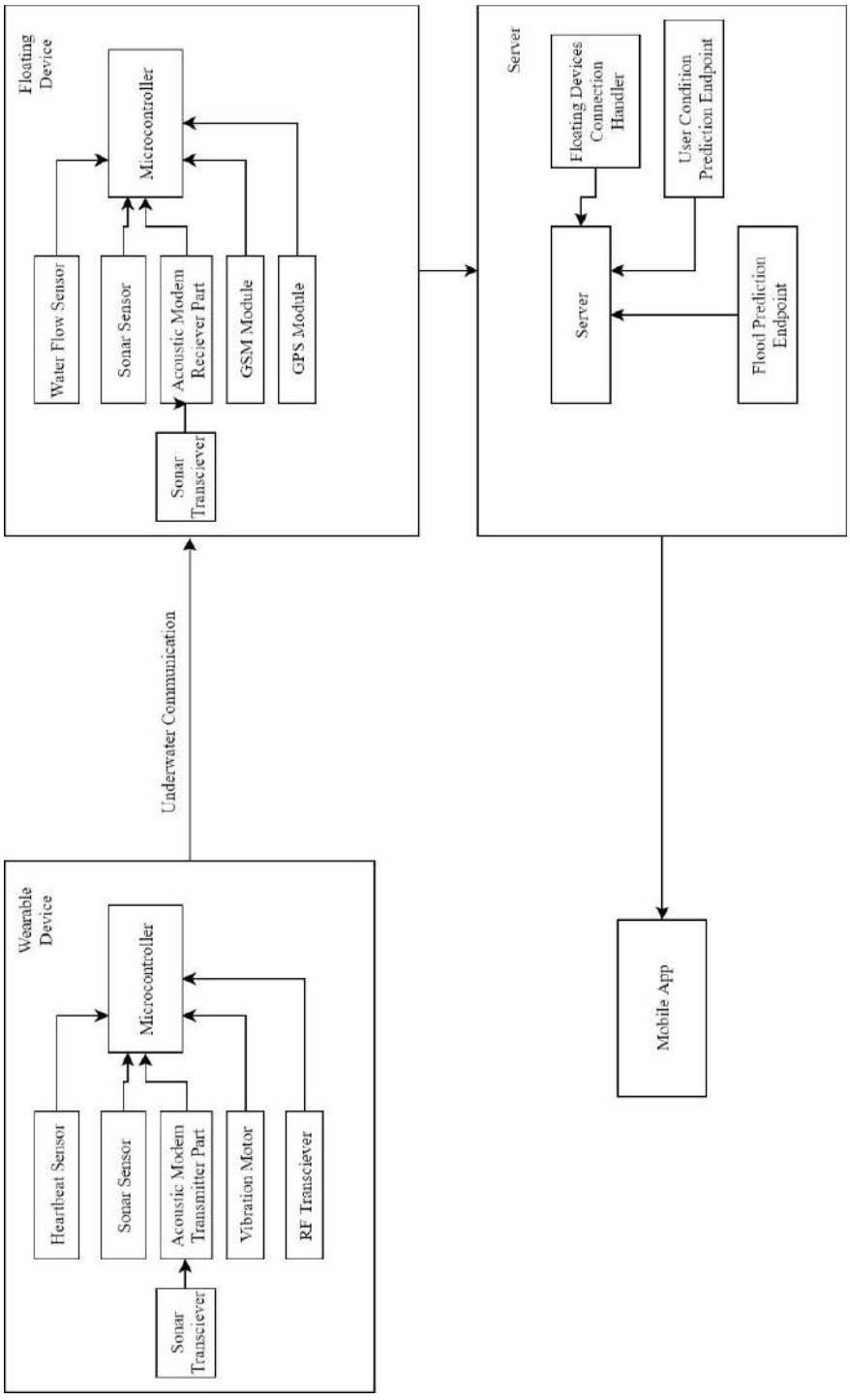

Figure 3.2: System Architecture of Smart Guardian

3.2.1 Creating a wearable device for users with particular sensors to detect user condition

3.2.1.1 Estimating the depth of water

People are basically unaware about the depth of the water where they are stands. Hence, this could be have a higher probability of drowning. The wearable device is capable of measure the depth of the water. If the user is going through deeper area, it will trigger an alert through vibration of the device. This wearable device is waterproof and it feasible to use any user.

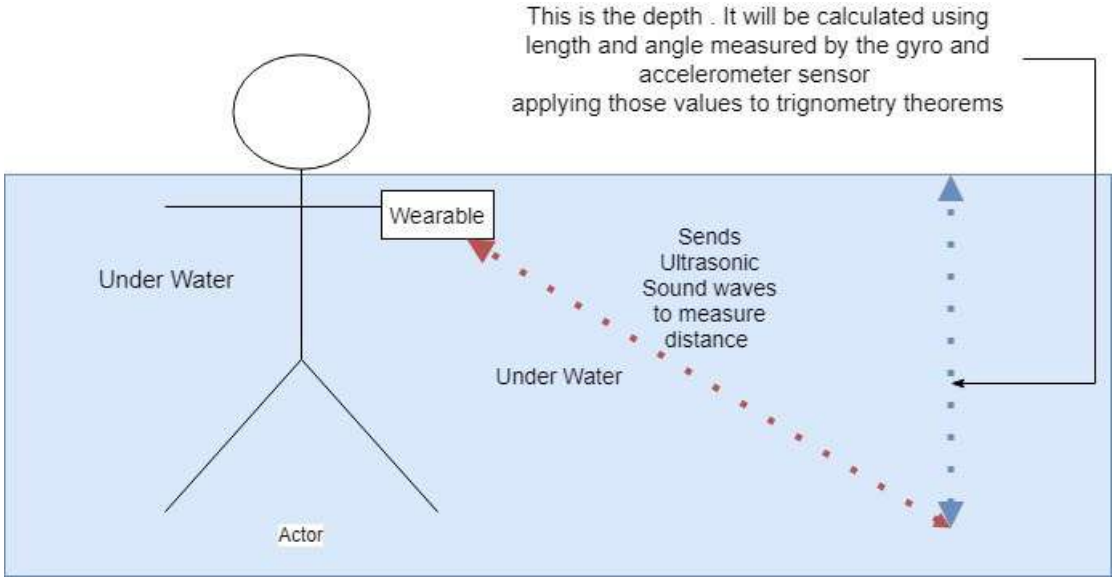

Figure 3.3: Estimating the depth of water

Sonar sensor is used to measure the distance from the wearable device and the bottom of the water body (riverbed, ocean floor and lakebed) assume that distance as x.

Imagine a triangle as in figure 3, the slant of the triangle will be x. therefore, to find the estimated depth (h) in the front area, we have to use trigonometry.

Degree of angle (m) is calculated by the Gyro and Accelerometer Sensor (MPU-6050).

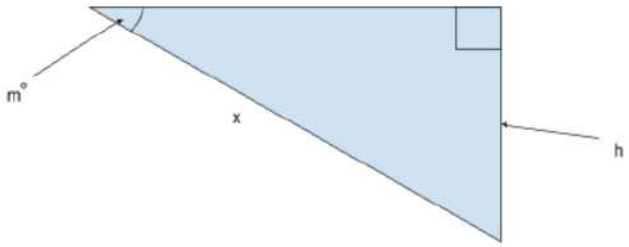

Figure 3.4: How to estimate the depth

Since we acquire the degree of angle and the slant (hypotenuse) using the respective sensors we can estimate the depth of the water (side opposite) according to trigonometry using below formula.

$$Sin(m) = h/x$$

$$Hence, \quad h = x.Sin(m)$$

Wearable device should be turned on while it in the water and for more accurate estimation device should be positioned as it in the Figure 3.5.

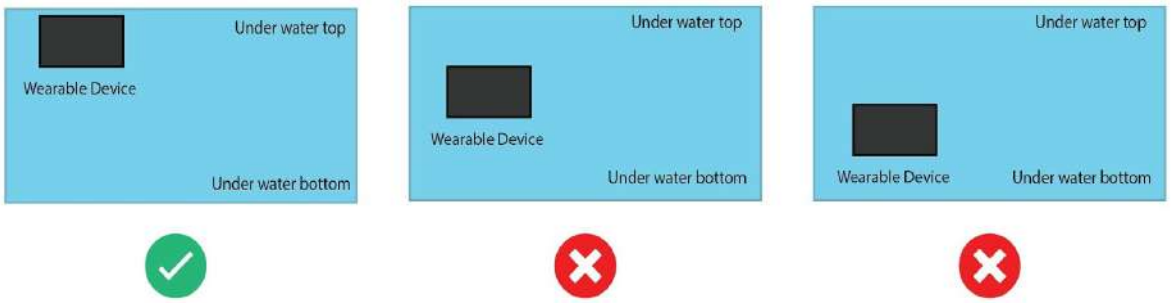

Figure 3.5: How to place the wearable device

Wearable device has a small screen to display the depth of the water and once the device identify the depth as dangerous it will vibrate the device according to the alert

3.2.1.2 Detect the user condition

Wearable device is capable of predict the user condition once the user confront to an accident while user is in the water. Wearable device has a component to measure the pulse of the user. It is called pulse sensor. This device is worn on the wrist to acquire the pulse rate. Once it is acquired and transmitted to the floating device, which is prepared to communicate with the server and the underwater. Transmitted data set will run through the user prediction algorithm.

Usually average person heart rate is lower when person is swimming. When comes to the data, it estimate the average pulse rate of the respective person and identify the when the person has an irregular heart rate pattern beyond the average rate, algorithm detect the change of the heart rate in determine whether it is normal level or critical level condition.

Once it is determine, as critical person who has already connected with the device will notify that affected person is in critical stage. Each wearable device has a unique ID. This id should be input in the mobile application before going to the water. Therefore, guardians can alert about the respective user condition through mobile application.

3.2.2 Underwater communication between wearable and floating devices

The water communication the purpose is to transmit information from under the water to above water because we need to collect allow information under the water.This is something very difficult to implement because even though sound travels well in water, our vocal cords are not designed to generate underwater sound.

Due to the large attenuation and absorption electromagnetic signal does not propagation well in the water. There for we use acoustic signals. Acoustic waves are a type of longitudinal wave that propagate by means of adiabatic compression and decompression. Acoustic waves travel with the speed of sound depends on the medium they are passing through.

Underwater communication is a technique of sending and receiving messages below water. Underwater communication is difficult due to factors such as multipath propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges.

Radio wave's propagation underwater at extremely low frequencies (30Hz-300Hz) and require large antenna and high transmission power. Optical wave do not suffer much attenuation but are affected by scattering. Acoustic waves are the signal best solution for communicating underwater.

Basic Acoustic communication model,

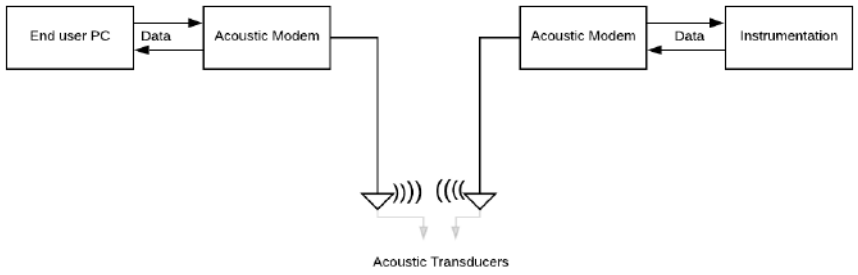

Figure 3.6: Underwater Communication Modem

Acoustic Modem; Basically this responsible for translating bit streams into the form of signals that can be transmitted. This consists of three major components as transmitted signals in the Ultrasonic Transmitter received signals in the Ultrasonic receiver and ultrasonic sensors. Transducer; is a component in-order to translate an electrical signal (sending side) into an acoustic signal and translate back to acoustic signal into electricity (receiving end). Ultrasonic sensor; transmits these amplified signals. 200 kHz transceivers can be used as both transmitter and receiver.

Thus, the advantage is preferred using with low-powered and have the capability of digital-analogue data communication.

3.2.3 Creating a floating device as an intermediary source for water communication with the server

Floating device is literally act as an intermediary source for the underwater communication and it float top of the water. We implement this device because the server could not able to communicate with the devices, which are in the water. The floating device in comprise with set of sensors for each task. To determine the depth of the water it has a sensor called depth-sensing sonar sensor and to determine the speed of the water flow it has a sensor called water flow sensor. Floating device capture the data, which are receives from the wearable device at the same time sends the all data to the server.

This is not the only purpose of this device, which is capable of doing. If someone drowning, we trigger the alert to our mobile application. However, we need to locate the affected person. Therefore keeping track of a person in the underwater is an essential part of this process. To achieve this we follows a process as below that how we tackle this problem.

- A GPS tracker in the floating device so we'll know the exact location of each floating device.
- When a user data gets sent to the floating device a timestamp will also be included in the data file
- After receiving the data file, the timestamp will be converted to local time and compare with the time received and calculate how much time did it take the data to arrive.
- With this result, we are going to calculate an approximate value and show it in a radius respective to a floating device.

As mentioned earlier, the floating device has two communication modules to communicate with the wearable device, which is the underwater communication and RF communication to capture the data from the sensors in wearable device to send data to the server.

3.2.4 Identify the flood and enhance the security of floating devices

- **Flood detection**

Flood can happen in multitude ways. Most commonly happens when rivers or streams overflow their banks. Excessive rain, a ruptured dam can be caused for this and overwhelm a river and send it spreading over the adjacent land.

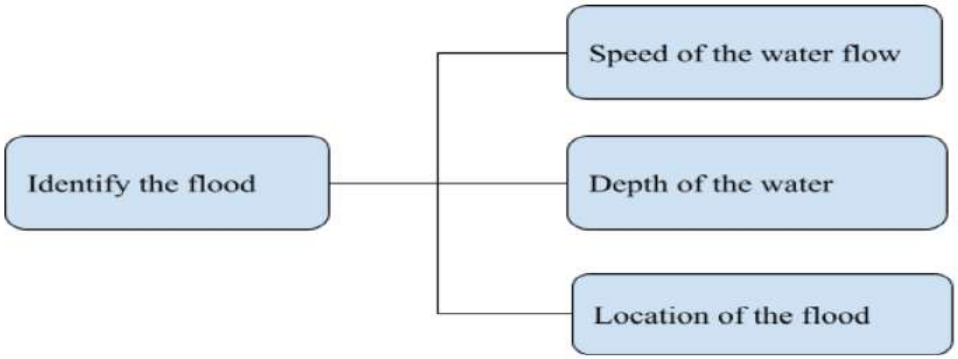

Figure 3.7: Parameters for Identifying the Flood

In this component need to detect the flood to notify the user which it will be helpful for them to entrench themselves before incur it. In order to do that as displayed in Figure 13 should collect the set of data that are acquired from sensors in floating device.
When comes to the data, water flow rate calculate using data acquired from the water flow sensor. It consist three different type of components. Water rotor rolls when the water flows through it and measure the speed of the water flow. Then half effect sensor output the correspond pulse signal. The ultrasonic sensor using for measure the depth of

the water. Sensor head emits an ultrasonic wave and receives the wave reflected back from riverbed/lakebed/ocean floor

Depth of the water estimate by the using sonar sensor. It provide us the distance in between floating device and the water floor.

By considering all those parameters and input into flood algorithm to determine whether is there any probability to flood at respective area.

Location of the floating device track down from the GPS tracker it provide us the location where the floating device is at and we can determine where the flood will occur.

- **Enhance the security of devices**

New devices are being plugged into the Internet of Things (IoT) at a rapid pace. While IoT is expected to offer many benefits, adding insecure devices to an enterprise network can have serious consequences. Therefore less security can be lead the entire product into failure. The level of security required by IoT devices and their supporting solutions will vary depending on the specific functions they are performing.In order to prevent the interference and to enhance the security, it follows a typical process. secure and centralize the access logs, use encrypted protocol to secure communication, create more effective and password policies likewise there are several procedures to follow.

Sensors have lack strong authentication and access methods. Devices may cease to function as designed, incorrect data from the endpoint may infect the data stored centrally, sensitive data stored at the endpoint may be at risk, and attackers may threaten the device provider's intellectual property. Therefore to ensure only verified software applications are executed within the device, and to secure any critical data such as secret keys.

3.3 The Flow of the Project

3.3.1 Project Development Process

As a team should have a clear vision about the process of the development to implement and manage this research project. In here, addressing the project scope, features, final product and the project duration. We are using iterative model to manage this research.

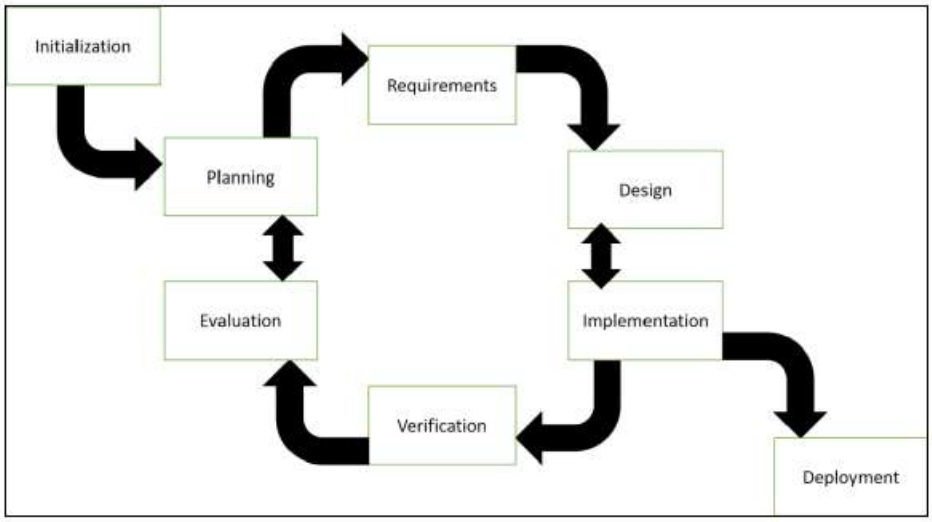

Figure 3.8: Project Development Process

3.3.2 Fesibility Study

After went through several research topics, discussions and problems, we came across a topic called “Smart Guardian”. It comprise with several features and functionalities to reduce the acrimonious incident, which can be happened from water.

As a team, we intend on Arduino and IOT technologies to develop wearable device and floating device into smarter. There are several sets of sensors have that feasible to the feature of all he devices. Hence, this research project is technically feasible.

In the local and foreign market place have the project in a attainable price as well as in the good quality. Hence, this project is economically feasible as well.

3.3.3 Requirement Analysis & Specification

When going through the research papers and other resources, we couldn't find exact the same product as our research product. However, after analyzing almost identical researches and products, gathered most important facts and problems from them.

We come across with the new unique features due to the founded facts.

Under the guidance of the supervisor, we survey a questionnaire form to analyze the more data with several questions to further study the research topic.

3.3.4 Design

According to the converged information, the team distinguished the requirements, which should be included to research project. In this phase, visually convert those requirements into the structure. In our scenario, it divided into two parts,

- **Product design**

In this phase, we fantasize the wearable device and floating devices size, weight and the materials for implementation of the product. As a team we emphatic to design the product with the measurement using AutoCAD. AutoCAD used because it is used for the visually implement converting the 3D objects into the 2D object.

- **System design**

To implement the system we should convert the system visually into easily identified manner. Because of that, we collaborate to draw the UML diagrams for this system to abstract the task.

1. Use case diagram
2. Activity diagram
3. Sequence diagram
4. Class diagram
5. State diagram

3.3.5 Implementation

After the design phase, we should implement the product and the system. In this scenario, implementation of product is done by using a set of Arduino sensors, to program those sensors we are using Arduino software. We must need skills of hardware knowledge, electronic knowledge and the programming knowledge to implement overall project. Initially program the sensors and after that set sensors into appropriate devices with feasibility and efficiency manner.

To store and analyze the set of relatable data we are expecting to use mongo DB as the database. It is given to manage the data without infrastructure so it has the quick data transferring ability.

To manage the server we are hoping to use node js. Because it is fast, efficient and high scalable and provide security benefits as well.

To implement the mobile application we are going to use ionic framework. Because it can be used for any mobile operating system.

3.3.6 Integration & Testing

When comes to the integration part of the devices, It depending on the electronic knowledge and the practical. Integration part of the server and algorithms we used machine learning to make the outcome more efficient Integration part of the mobile application, we don't waste any time for the integrate the outcome since we are using GitLab version control repository. In addition, it is easy and safe to collaborate the project with the team members.

In testing phase of devices, algorithms and mobile application, we are manage to do re analyze input output of the system to make the outcome more accurate. We are expecting to test final product as one with including all the set of sensors. In order to do that, there have three possible testing phases. They are,

1. Unit Testing 2. Integration Testing 3. System Testing

3.3.7 Maintenance

After have gone through all the phases finally comes to the maintenance phase. In here final product including mobile application, we procure the wearable device with sensor to the user and we float the floating device on the river. When using this product by the user there can be some suggestions, so they are maintaining here. To do that, there have three ways. They are,

1. Corrective maintenance
2. Perfective maintenance
3. Adaptive maintenance

3.4 Hardware & Software requirements

3.4.1 Hardware requirements

- Arduino UNO Microcontroller
- Waterproof Sonar Sensor
- Pulse Sensor
- Gyro And Accelerometer Sensor
- RF Transmitter and Receiver
- Water flow Sensor
- GPS Module
- GSM Module

3.4.2 Software requirements

- Arduino IDE
- Auto Cad
- 3DS Max
- VS Code
- GitHub
- Mongo DB
- MS Word
- MS PowerPoint

3.5 Technologies

- **Arduino**

  Arduino is a free and open source software and hardware platform, which is widely used in IOT. Because of its free, open source there is a huge community and it is very easy to get the help. Arduino microcontrollers support both analog and digital sensors. Therefore, there is a vast amount of sensors and other appliances that we can plug into Arduino microcontroller and we can get them maximum output of our project.

- **3D Printing**

  As a part of our project, we need to make the wearable device and the floating devices a robust and waterproof. Which may not harm the circuits, microcontrollers and some sensors, which are highly intolerant for water.

  Therefore, we will be creating a 3D model of our wearable device and floating device and 3D print them.

- **Machine Learning**

  Since we are collecting numerous data and we thought of using them for a predict user condition and We will be using machine learning to predict user condition (pulse rate) and the potential risk of a flood using the data collected data and predict the readings.

3.6 Research Areas

- Data Communication
  - Internet of Things
- Artificial Intelligence
  - Machine Learning

3.7 Work Breakdown Structure

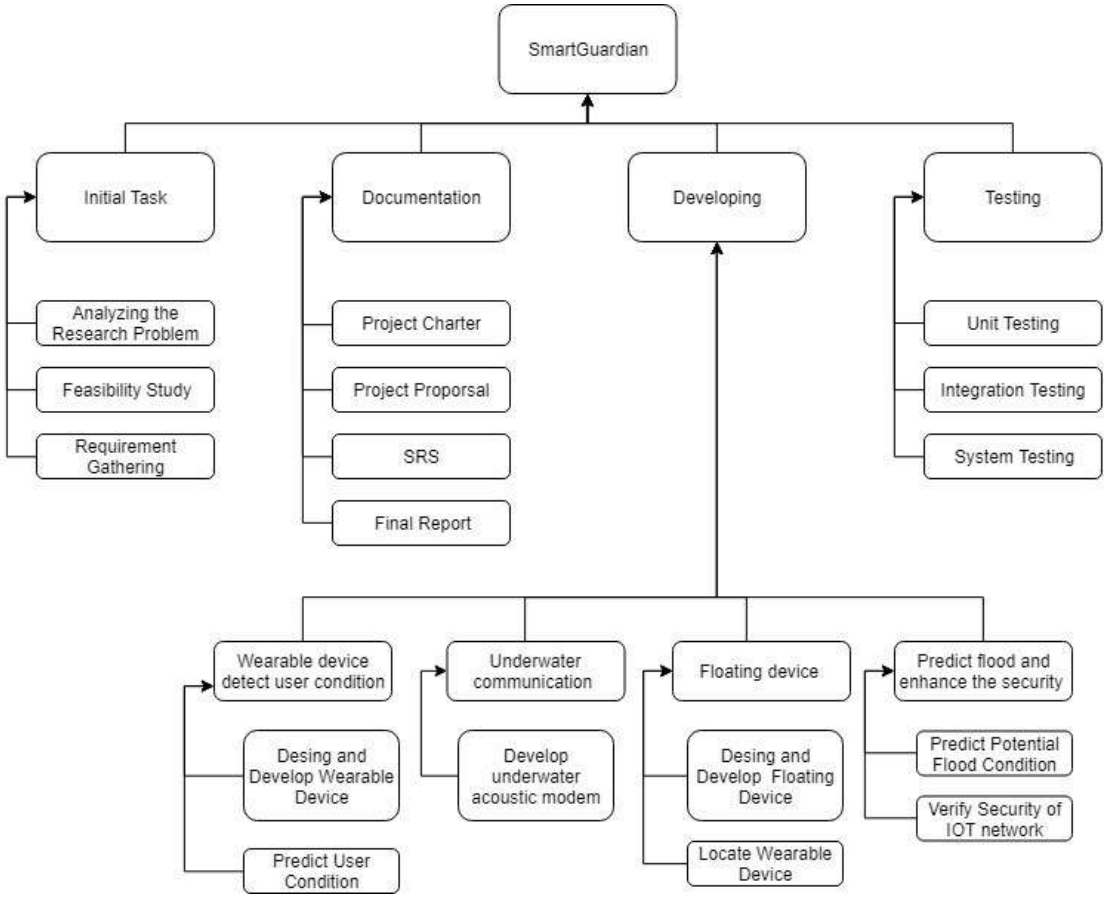

Figure 3.9: Work Breakdown Structure

3.8 Gantt chart

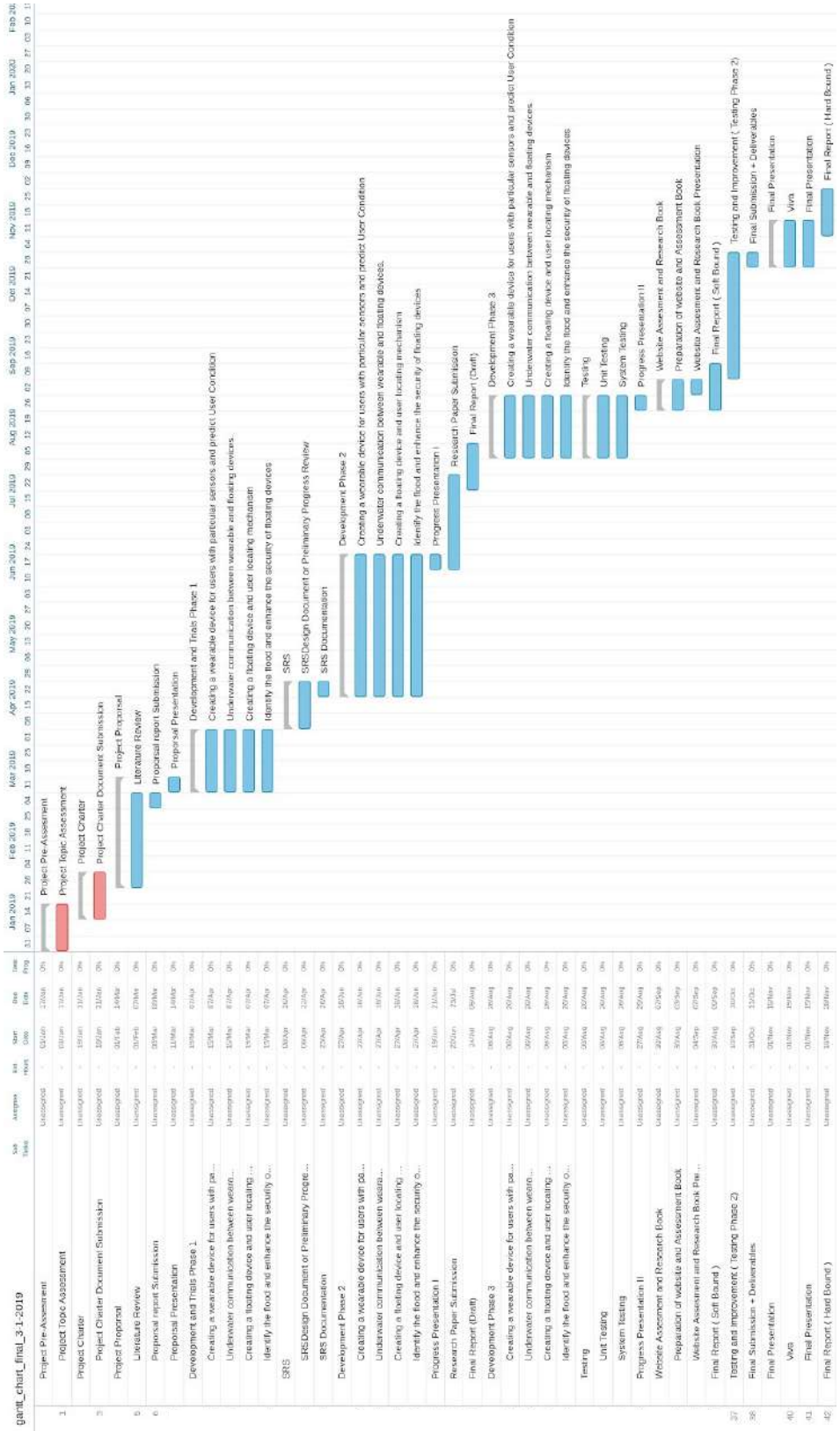

Figure 3.10: Gantt chart of the Project

4 DESCRIPTION OF PERSONAL AND FACILITIES

Table 4.1: Personal and Facilities table

Member	**Component**	**Task**
K.D.Samarasinghe	Creating a wearable device for users with particular sensors to detect user condition	• Design and Development of the waterproof wearable device • Integrating communication modem transmitter part in the device • An algorithm to predict the user condition from sensor readings taken from wearable device.
Gamage M.K.I	Underwater communication between wearable and floating devices	• Design and development of underwater acoustic modem using Sonar Sensors.
P.M.De Silva	Creating a floating device as a intermediary source for water communication with the server	• Design and development of floating device • Integrating the acoustic modem receiver part to the floating device • Estimate the distance from floating device to wearable device to locate the user.
T.U Mudalige	Identify the flood and enhance the security of floating devices	• An algorithm to predict potential flood condition. • Improve IOT Devices Security • Deploy server to collect sensor data and to implement algorithms for both flood and user condition prediction algorithms.

5 COMMERCIALIZATION FOR ENTREPRENEURSHIP

We have identified numerous opportunities that we can commercialize our product.

We can introduce our product to

- Hotels situated around lakes and rivers as well as oceans

  By doing this they can demand the safety of their customer. Not just keeping a Lifeguard standing on the beach or riverbank, they can demand a lifeguard who is monitoring their customers when they are in water.

- Travelers

  We hope to introduce this product to travelers who do waterfall hunting like adventurous activities so they can use our product and ensure their safety.

- Rescue Groups

  Since this product is capable of finding the depth of unclear water also, we can use this product in rescue missions in floods as well as rescue missions.

Since safety in aquatic environments is a critical topic that draws attention and since there are no product or research undergoing which is similar to our product Smart Guardian will gain a higher market value.

Also we did a survey to gather the hopes of potential users of this product. The results is shown below.

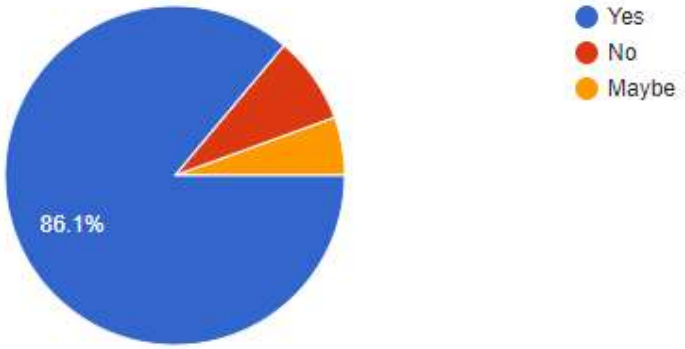

Figure 5.1: Would you like if someone is making a tool to prevent or take precautions for drowning?

6 BUDGET AND BUDGET JUSTIFICATION

Table 6.1: Budget table

Description	Quantity	Price(Rs)
Arduino UNO Rev3	2	2,900.00
0.91 Inch LCD Display	1	795.00
Pulse Sensor	1	500.00
Waterproof Sonar Sensor	3	1,950.00
Silicone Sealant	1	1000
GPS Module	1	1900
GSM / GPRS Module	1	2800
MPU6050 - Triple Axis Accelerometer & Gyro Breakout	1	280
Water flow Sensor	1	650
	Total	**19575**

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