

SMART GUARDIAN
Down Prevention & Flood Detection Monitoring System

Project ID: 19-099

Requirement Design Document
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Bachelor of Science Special (Honors) in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

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Author:

Gamage M.K.I

The supervisor/s should certify the proposal report with the following declaration

The above candidates are carrying out research for the undergraduate Dissertation under my supervision

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INTRODUCTION

1.1. Purpose

The predominant purpose of this Requirements Design Document (RDD) is to supply a detailed description of the functionalities of the system 'Arduino based mostly Smart Guardian'. Therefore, this document can cover every of the system's meant options, furthermore as supply a preliminary glimpse of constraints and their effects to the system. The document can additionally cover hardware, software, and varied different technical dependencies.

The main motive of this document is to acknowledge the behavior and also the implementation of the wearable device with the flood detection and coordination generation. As one of the main components of the system the Underwater communication between the wearable and floating devices is of utmost importance in ending the remainder of the system functions. Therefore, the reference to every part is totally explained. Special options to be else and conclusion created at the top of the literature survey that led to the requirement of the options is mentioned. furthermore, the technological aspects to be lined and also the deliverables to be distributed at the top of the implementation are presented diagrammatically and thoroughly.

1.2. Scope

This is one of the most elements of the analysis and there are two main objectives to be achieved through this element. Those 2 needs are,

- The technique of causing and receiving the message below the water
- Error management schemes

To achieve these two goals, many processes have to be compelled to be followed and people are going to be discussed through this document and a number of other hardware elements have to be compelled to be used such as sonar transceiver (Rx & Sx), Nano amplifier and etc.

As well, the practicableness of the wearable device conjointly is going to be handled by this element as a result of it is one amongst the most demand of the user. All these things are mentioned throughout this style document and it'll be a lot of helpful to know the employment and also the operating processes.

1.3. Overview

The main expectations of the planning document area unit to produce a transparent description of the “Underwater Communication between wearable and floating devices” analysis part. Through this document all the useful and non-functional needs and style of the planned product area unit mentioned in detailed.

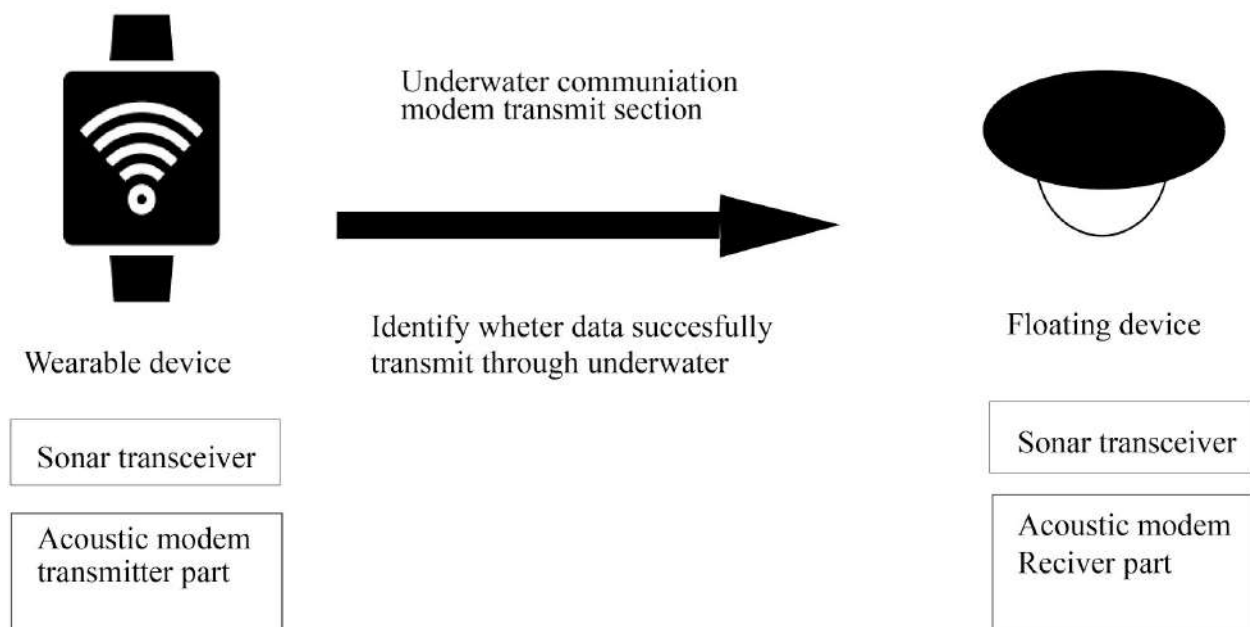
Clear description for the analysis part is going to be supplied with the primary a part of this document and within the second section of the document provides the system to perform details like user interfaces, product perspective, use cases, and also the focusing user characteristics.

From the third section of the document, user specifications, risks of the hardware components, architectural design details are described and maintainability, security and the references area unit provided at the bottom section of the document.

OVERALL DESCRIPTIONS

The system which consists of two Acoustic modems and communicate through these two modems. The system has the capability of getting connected to remote floating devices and getting signal who wear the wearable device via the physical board. The floating devices will be providing the correct signal message to the server with and interface to engage in the app.

This section can offer a summary of the total system. The system is going to be explained in its context to show however the system interacts with other systems/devices and introduce the fundamental practicality of it. it'll conjointly describe what sort of stakeholders that may use the system and what practicality is offered for every type. At last, the constraints and assumptions for the system are going to be bestowed.



2.1. Product perspective

This section describes the entire summary of the communication underwater. Here describe existing systems and the way they move with this element. This the section explains what kind of neutral use this method and the way they operate this method.

Referring to this document, developers, and users will simply perceive, however, this element goes on. This section describes offered constraints, assumptions and the way this element communicates with alternative elements, etc.

The following paragraph describes an actual study mentioned the novel features in brief by comparing with the latest Acoustic Modem for Underwater Communication which have developed in 2015[1] and 2012 [2].

In 2015 a style of Low-Power modem for underwater communication has been developed by Jagdale M.R.1, Puranik V.G [1]. This has been developed primarily by specializing in networks of times rely upon acoustic communication, that poses a number of disputes for reliable information transmission. primarily has many interactive options like to transmitted Signals within the ultrasonic Transmitter and received Signals within the ultrasonic receiver transforms the mechanism for analog signals into digital signals, code sampling methodology to interpret signals because of the original signals, frequency generators, amplifiers, ultrasonic sensors and lots of methods with sensors are employed in this project.

In 2015 another modem for underwater communication has been made by Slamet Indriyanto, Ian Yosef Matheus Edward [2]. This analysis was supported underwater modem with ultrasonic frequency victimization Frequency Shift Keying (FSK) Modulation. The designed system includes FSK electronic equipment, microcontroller, electronic equipment, and electrical device. Waterproof ultrasonic sensors JSN-SR04T area unit used as transducers for designed modems. a number of the options area unit enclosed in our projected product in addition.

2.1.1 System interfaces

“SmartGuardian”, the application is going to be run only on the Android platform. Because the android studio is going to be used for developing the applying. Some details can be gathered from the internet by applying. Also, the Arduino platform goes to be used to develop the hardware elements.

2.1.2 User interfaces

All user interfaces of the SmartGuardian are created exploitation android mobile development platform. These interfaces are accessed to all or any functions.

1. Login Page

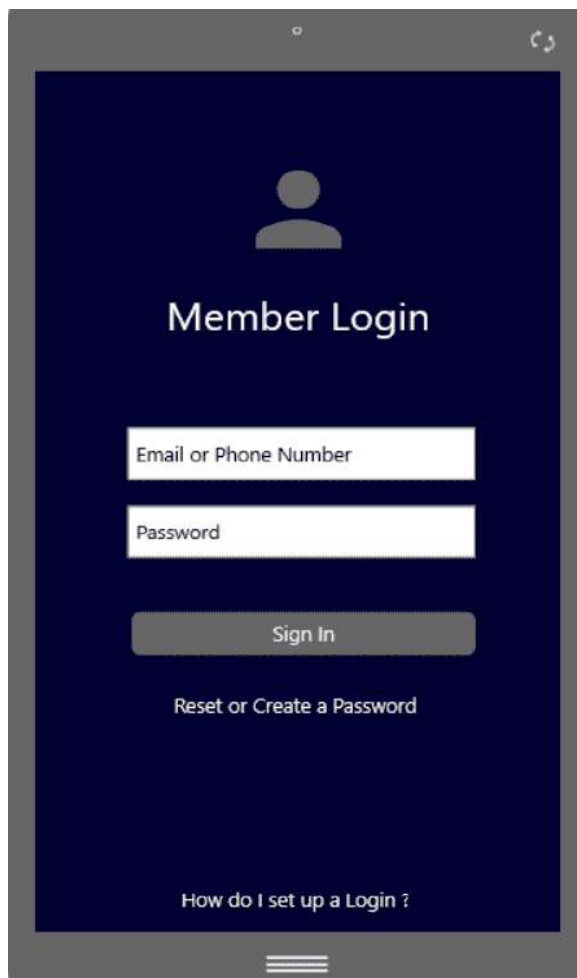
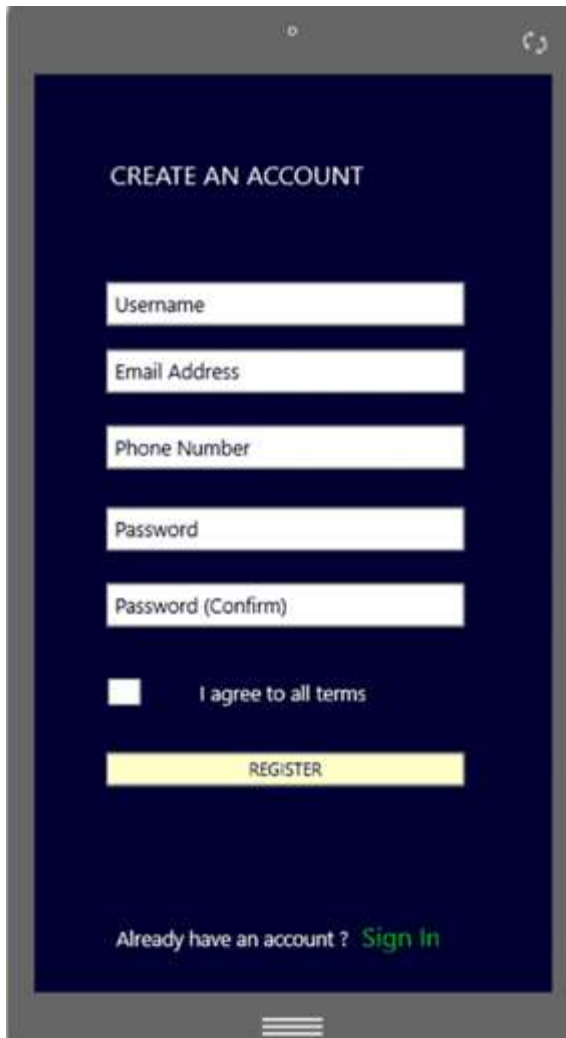


Figure 1 : User Interface - Login Page

2. Create an Account Page



A mobile application interface for creating a new account. The screen has a dark blue background with white text and input fields. At the top, the title "CREATE AN ACCOUNT" is centered. Below it are five white input fields stacked vertically, labeled "Username", "Email Address", "Phone Number", "Password", and "Password (Confirm)". Below the input fields is a white checkbox followed by the text "I agree to all terms". Underneath that is a yellow rectangular button with the word "REGISTER" in black capital letters. At the bottom of the form area, the text "Already have an account ?" is followed by a green link that says "Sign In". The entire interface is framed by a grey border representing a mobile device, with a small status bar at the top and a hamburger menu icon at the bottom.

CREATE AN ACCOUNT

Username

Email Address

Phone Number

Password

Password (Confirm)

☐ I agree to all terms

REGISTER

Already have an account ? [Sign In](#)

Figure 2 : User Interface - Create an account page

3. Geolocation Map

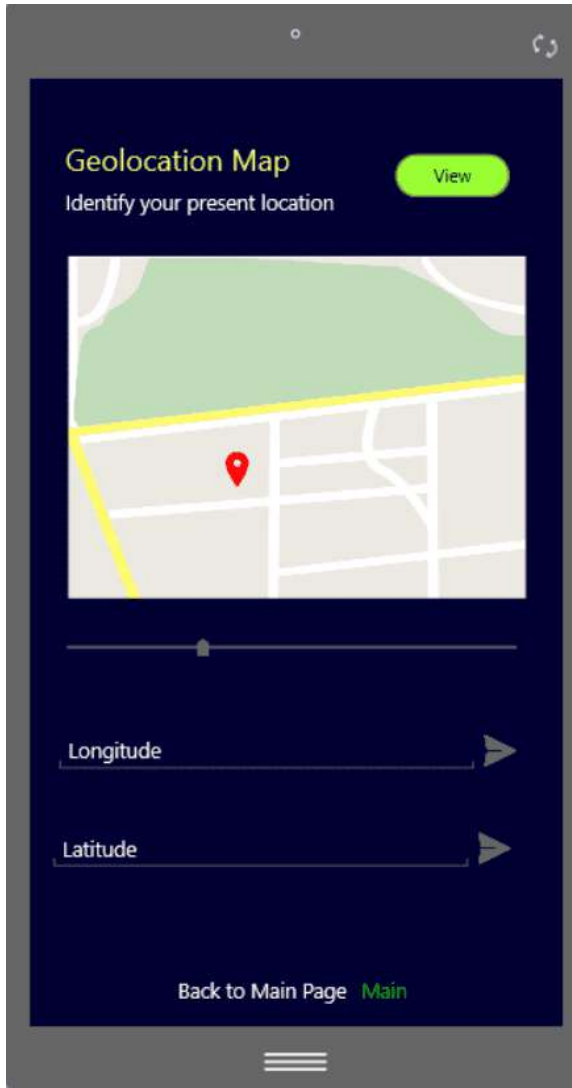


Figure 3 : User Interface – View Geo Location

2.1.3 Hardware interfaces

Following are the Hardware used for Acoustic Underwater Communication System In between wearable and floating devices.

Arduino Uno board

The Arduino Uno board could be a microcontroller supported the ATmega328. It's fourteen digital input/output pins during which 6 is used as PWM outputs, a sixteen megacycle per second ceramic resonator, associate degree ICSP header, a USB affiliation, 6 analog inputs, an influence jack and a push button.



Ultrasonic transducers

Ultrasonic transducers or ultrasonic detectors area unit a sort of acoustic sensor divided into 3 broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals into ultrasound, receivers convert ultrasound into electrical signals, and transceivers will each transmit and receive ultrasound.



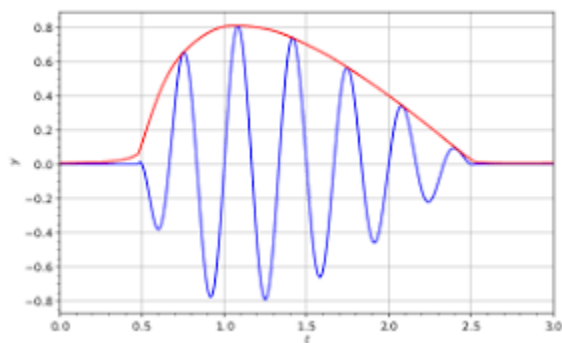
Electret Microphone Amplifier

The ultrasonic sensing element receives the transmitted signals and sends them to the electronic equipment. as a result of the received signals area unit a moment signal, to method them within the next step, they have to be amplified.



Envelope detector

An envelope detector is associate degree electronic circuit that takes a (relatively) high frequency amplitude modulated signal as input and provides an output that is that the envelope of the first signal.



2.1.4 Software interfaces

Following are the Software used for Acoustic Underwater Communication System In between wearable and floating devices.

Android Studio	Developing Android Mobile Application
Arduino	Hardware configuration purposes
Mongo DB	NoSQL database management

2.1.5 Communication interfaces

Following communication, interfaces are required to communicate between the Wearable device and the Floating devices.

- Automatic Repeat Request (ARQ)
- Communication between the wearable and floating devices and packet formatting required.

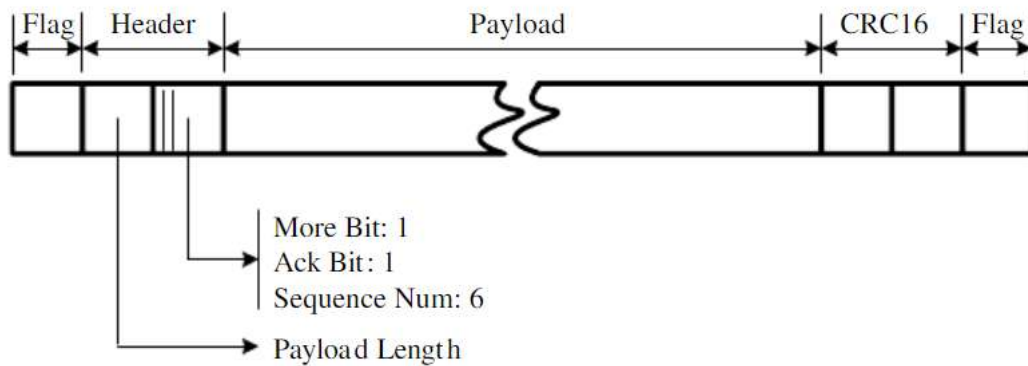


Figure 4 : User Interface: Packet Formatting

2.1.6 Memory constraints

The Android mobile application is required,

- 2GB RAM
- Processor with speed 500MHz
- 250MB Memory space

2.1.7 Operations

The user ought to install the mobile application to use our product. as a result of the user can be notified with the mobile application concerning the user condition or flood notifications. After putting in the mobile application, an account ought to be created by the user because there ought to be AN account for every and each user.

Then the mobile application should be connected to the server and thru the server, it'll connect with the floating devices and the wearable device. mistreatment packet data format communication can happen between these 2 devices. To ensure the information accuracy for the underwater communication can have implement error management theme

2.1.8 Site adaptation requirements

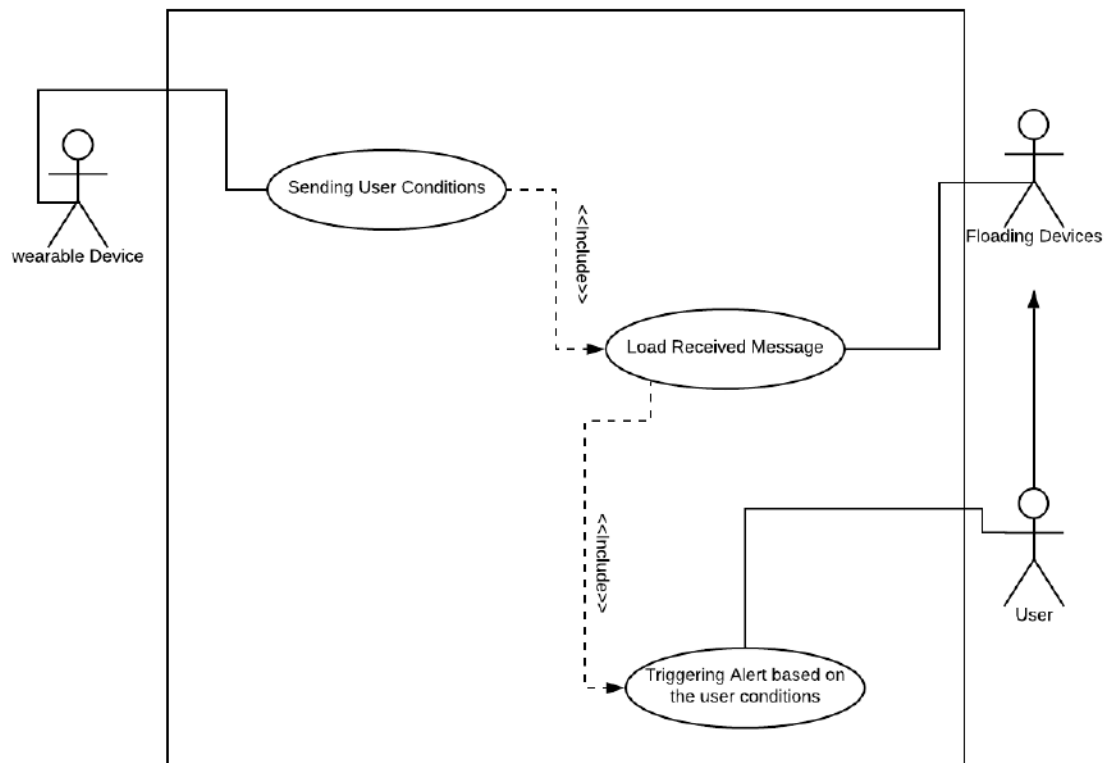
- The database should be created and connected with the smart phone.
- The wearable device and the floating devices should be connected using acoustic modem.
- Active internet connection should be available.
- The English language will be used for displaying mobile app information and other staff.

2.2. Product Functions

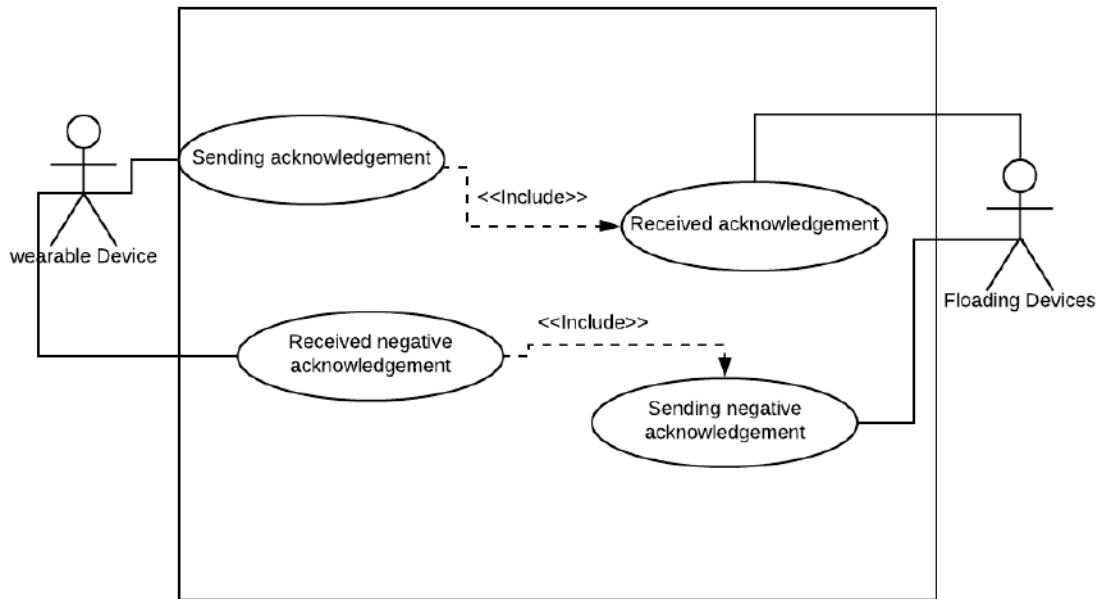
The Drown prevention and user condition monitoring system has active actors. The User, Reader, or Reviewer accesses the online app through the Internet. With the mobile application, the users will be notifying the flooding areas by generating an alert message and estimate the depth of water by triggering alert.

In this component has two main functions,

- i. Technique of sending and receiving message below water.



ii. Error control schemes.



2.3 User characteristics

Drowning is a leading cause of death among children in low and middle-income. For children under age 5, drowning is a leading cause of accidental death.

As a result, this product will be more useful for children and it can be used without any age limitation. Therefore, this system will be more useful for younger people.

2.4 Constraints

- Sender (wearable device) should receive a Ack from the receiver (floating devices). If the only isn't received from the top, causation negative Ack back to the sender
- The system server ought to be up and run 24/7.
- The application and also the devices square measure needed with enough battery life.

- For the communication purpose, the Bluetooth and web property ought to be always enabled.
- Android is going to be accustomed develop the mobile application.
- With the restricted phone memory, the appliance ought to be able to run with none effect on the opposite operations and also the process speed.
- Arduino Uno board is needed to use and a few knowledge goes to be keep in there.

2.5 Assumptions and dependencies

- The user contains a smartphone.
- Always the user uses the wearable device before attending to the swim.
- All info that is provided by the user ought to be correct.

2.6 Apportioning of requirements

Requirements that mention within the demand within the chapter 01 and 02 during this document are referred on primary specifications, those in section three are stated as needs (or functional) specifications. within the event that a demand is expressed among each primary and useful specifications, the appliance is engineered from the useful specification since it's additional elaborate.

In the case that the project is delayed, there are some needs that might be transferred to ensuing version of the appliance. Those needs are to be developed within the future version of the system.

SPECIFICATION REQUIREMENTS

3.1 External interface requirements

3.1.1 User interfaces

Login – Please log in using your username and password. Email: Password: Register Forgot password.

Sign up – Log In. Or, if you are new, please. Create a New Account · Contact our Help Desk · Privacy Policy · Terms of Use

Get the Geo Location– Lat long is a geographic tool which helps you to get latitude and longitude of a place

3.1.2 Hardware interfaces

1. Arduino Uno board
2. Ultrasonic transducers
3. Electret Microphone Amplifier
4. Envelope detector

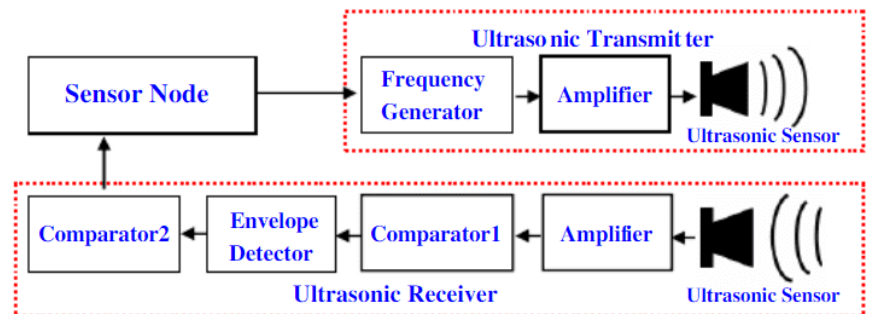


Figure 5 : A block diagram of an acoustic modem

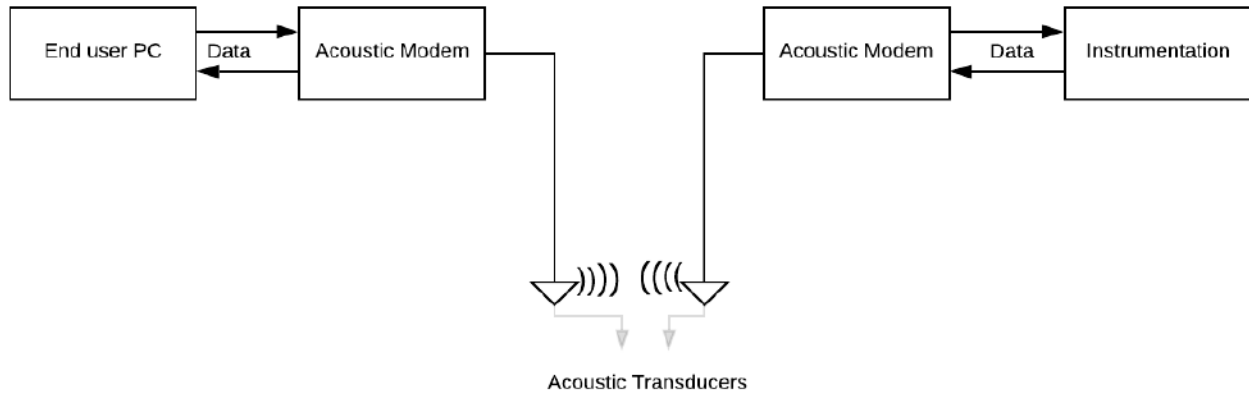
3.1.3 Communication interfaces

According to the Figure 4: User Interface: Packet Formatting,

1. Flag: The flag uses a touch sequence of 11011011. it's accustomed indicate the start and finish of a packet. The length of the flag is one computer memory unit. the beginning little bit of the flag is one. This makes a device node apprehend that a packet arrives. So, the sensor node generates associate degree interrupt to perform a computer code sampling technique which is provided in section four.4.
2. Payload length: The payload length is that the size of the payload. It has 1byte.
3. More bit: The additional bit is employed to acknowledge the tip of the packet. Its length is 1 bit.
4. Ack bit: The ack bit is employed to differentiate between the information packet and therefore the ack packet. The length of the ack bit is one bit.
5. Sequence range bit (SNB): The sequence range bit shows the order of each packet. it's six bits.
6. CRC (Cyclic Redundancy Check): The CRC is at finish of the packet. In our implementation, we have a tendency to use CRC16, that has two bytes, to find the transmitting errors. the worth of CRC16 is extracted from CRC16-Table which is created of 256 parts

3.2 Architectural Design

3.2.1 High level Architectural Design



3.2.2 Hardware and software requirements with justification

Develop an acoustic modem for underwater communication First, develops a low-power primarily based modem. especially, our electronic equipment operates with a 3.3V power provide. to its finish, the period of a device node was prolonged.

Second, the electronic equipment for our study could be a cheap primarily based modem with the capability for digital communication. as a result of there's no existing electronic equipment with this capability supported cheap, our electronic equipment is important during this respect.

Third, provides the idea for an omnipresent device underwater also as during a terrestrial setting. That is, the electronic equipment is smarter, smaller, and cheaper for underwater also as terrestrial uses. As a result, this work's results are vital, as well as the results of having a technical methodology to perform real-time underwater observance effectively.

Software requirements

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

3.2.3 Risk Mitigation Plan with alternative solution identification

Risk	Impact Level	Impact
Arduino board, which is used to control the whole system	Low	There are no special precautions needed when handling even circuit boards
Ultrasonic transducers	Low	There's no evidence that scans are harmful, if used according to the guidelines
High voltage of power corrupting the system in case of natural disasters, etc.	Moderate	A resistor is being fixed in the system which the power will flow through

3.2.4 Cost Benefit Analysis for the proposed solution

Description	Quantity	Price (Rs)
Arduino UNO Rev3	2	2,900.00
Ultrasonic transducers	1	1,850.00
Electret Microphone Amplifier	1	1,300.00
	Total	6,050

,

3.3 Performance requirements

Acoustic modem could be a low- powered modem. within the energy consumption perspective, our electronic equipment was the simplest of all the others. Electronic equipment could be an inexpensive based mostly modem with the aptitude of digital data communication. as a result of there had been no previous existing electronic equipment with this capability supported inexpensive, our electronic equipment is important during this regard.

The modem with the practicality of the underwater communication can become far more important. Therefore, it is our task to develop the modem to its fullest potential.

3.4 Design constraints

This product is targeted on folks with none age limitation, the user interfaces of the “Smart Guardian” mobile application have to be compelled to be straightforward, enticing also as easy.

Also, the wearable device has to be straightforward and enticing. whereas coming up with the memorable device the size of the device ought to be thought about.

3.5 Software system attributes

3.5.1 Reliability

- As this product address a common issue, the reliability of the proposed product is important. According to this research component,
- The communication through sonar transceiver must be 100% accurate because most important actions will be based on it.
- GPS module should provide highly accurate location details.
- To find locations the internet connectivity should be enabled.
- The underwater communication between wearable and floating devices will be testing using several techniques to make sure it's probability of failure is very low value.
- If there will be a failure in the underwater communication a proper mechanism is going to be implemented to show the failures.
- At a time of failure, there should be a way to overcome through that Immediately

3.5.2 Availability

- Always servers ought to be offered as a result of this technique functions operating with server knowledge.
- This period of time application ought to be offered to access anytime by users.
- The application ought to be a period of time application wherever it shows a period of time knowledge.
- The devices and therefore the mobile app ought to be simply intelligible to users and it ought to be real time

3.5.3 Security

Implement a security mechanism in-order verify the signal has been amended, Error management schemes,

- Automatic Repeat Request (ARQ): Sender corrects errors with retransmission
- Cyclic Redundancy Check (CRC)
- Acknowledgment (ACK): short message sent by the receiver
- Negative Acknowledgement (NACK): Sent by the receiver

3.5.4 Maintainability

For underwater communication, the hardware is going to be used to transfer the signal from the wearable device to floating devices. Alternative algorithms, functions and crowdsourcing knowledge can be handled by exploitation the mobile application and backend server.

Therefore, if any change happens within the system; it'll be easier to take care of that situation by exploitation an application update or dynamical the server knowledge.

3.6 Other requirements

The requirements that are explained during this section are the wants that are good to own and recognized standards.

- User-friendly interfaces for the mobile application
- Interfaces are analyzed with the prototypes
- Feasibility of the transferring knowledge in underwater
- Acoustic-electronic equipment ought to be with battery power
- The mobile ought to be with enough memory, RAM, and battery power.

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