EARLY WARNING FOR PRE AND POST FLOOD RISK MANAGEMENT

2021-124

Project Proposal Report

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B.Sc. (Hons) Degree in Information Technology Specializing

in Information Technology

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DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Signature of the Supervisor: _____   Date: __3/22/2021____

ABSTRACT

Flooding and landslides have been a very treacherous situation in Sri Lanka where many areas are flooded for the slightest rain. As of today, flooding is more frequent in most of the areas in Sri Lanka specially the rural areas. Due to such incidents, people loss their properties, affect their agriculture, their businesses and lead to loss their lives. Flooding happens due to various reasons such as human and natural factors.

When it comes to crowdsourcing, the term comes under the citizen science section. Crowdsourcing has the capability of providing support for flood early warning systems. Develop crowdsourcing solution to gather weather information from public crowd, analyze and present them to the end users. The purpose of this objective is to collect weather information from the public crowd. Since people who lives in the area knows the about the current weather more than any of other media sources, it is very important to collect it from them. For an example, filling a survey with predefined set of questions might be helping to gather information about weather conditions. Also, these collected data will be presented to the end users.

As a post solution of the system, we will be providing an early warning alert to all the users. Usually, our end users are state officials, non-state officials and the public crowd. All the above-mentioned solution components are integrated within our proposed solution and data will be represent to the end-users in most relevant and simplified manner. The implementation of the crowd sourcing solution will comply of a web application and mobile application will visualize the finalized data for the end users based on their needs. By implementing this above-mentioned structure, we hope to make the life easy for the public during adverse weather conditions and hope that this system structure will be of very much use to the state authorities to plan and be in readiness to face the situation.

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

1.1Background & Literature Survey

In Sri Lanka, most people suffer from floods. Floods are one of the most dangerous and threatening disaster that humans face in the society. It can be due to heavy rain fall conditions, inappropriate land use and landslides which will lead to unsecure living environments for people who live in those areas. Flooding situation is a common disaster in Sri Lanka for years.

Mainly flooding is caused by heavy rainfall and inappropriate land use. The concept of flood risk management is now growing fast in globally to extract the warnings about flooding, monitoring, and detecting floods, predictions and what are the possibilities that could occur due to flooding. The goal of flood risk management and flood tracking is to reduce human and economic losses which are caused by in the event of flooding.

For many countries, the factors that effect is weak flood monitoring structure led to damage, loss of lives and economic losses when a flooding situation takes place because of weak and poor flood monitoring it can cause devastating effect for human and environment.

The information technology is evolving fast in now days and people are using technology to transform their living style to be more productive. Crowdsourcing has been an innovational approach for solve problems by participating public crowd and with the help of information technology-based crowdsourcing the main goal is to gather responses from public crowd through their devices and analyze, validate the gathered data. lots of weather factors can be analyzed and gathered in the occurrences of floods in this matter. Applying the practices of crowd sourcing-based information technology to analyze flood risk management and detecting floods will make it more productive for public and officials, therefore having an early warning structure consisting above mentioned factors will be more helpful for public to overcome the flooding situations and to be prepared in any circumstances.

1.2 Research Gap

There are many research areas are conducted in flood predictions and flood monitoring and tracking. When it comes to crowdsourcing, there are least number of the research are available. Extracting the available research papers, the research [1] has successfully conducted gathering information through public crowd in a crisis and visualize the gathered data to rescue teams and officials. The authors have only concerned about gathering information which is the main part of the crowdsourcing approach. Referring to the bellow table research [2] also gathered weather data from public crowd by using crowdsourcing approach.

In the gap analysis of crowdsourcing approach by going through available research papers the authors have directed future works on the data accuracy and validity of crowdsourcing data and those data need to be received in a precise and concise format to enforce accuracy of information in crowdsourcing data. Finally, the proposed solution will have a complete package of mentioned functions. Gathering data from public crowd, Accuracy and validity of data and receiving data in precise and concise format will support the future works of crowdsourcing approach

Research	Gather Information Regarding Flood	Accuracy and Validity of Data	Receive Data in Precise and Concise format
[1]	✓	✗	✗
[2]	✓	✗	✗
Proposed System	✓	✓	✓

Table 1: Comparison with Research

1.3 Research Problem

When a flooding situation takes place at a specific location as the water rises quickly it will take some time to get fully prepared for public to evacuate from the area. When the water level reaches the peak, it will start to flood in their living area and cause immediate damage, therefore with the help information technology-based crowdsourcing we can implement a solution for this major matter.

When it comes to disaster management and flood tracking the major problem that we identified was its not about unavailability of technology or existing information it is about communication and unavailability of accurate information when a flooding situation occurs. Most of the times it might take some time to authorities to give warnings about disasters and floods, because of late communication of information it will lead to a very disastrous situation. By implementing crowdsourcing solution and active participation of public crowd will bridge the gap between government officials and public crowd

The purpose of implementing crowdsourcing solution is to gather inputs from public crowd to forecast severe weather conditions which may cause flooding to a specific area. In addition to the other whether prediction solution provided within the scope of "Early Warning for Pre and Post Flood Risk Management" project, crowdsourcing solution is mandatory to validate other source of information. Usually, the input source of data for a crowdsourcing solution gathered from the public crowd. Hence, when designing the solution for this project, we may need to overcome following challenges specific to the crowdsourcing.

1. Sourcing the right crowd
2. Validate the accuracy of data (Data integrity)
3. Receive data in precise and concise format
4. Periodically receive live data

Above extracted factors shows that an early warning tool is the key to overcome above situations, therefore there is a need of an early warning tool handle the flooding situation and reduce the economic and social losses in a country which is affected by floods.

During this research comprehensive analysis on above challengers required to be done based on the existing studies on the related topics and the data collection on the occurrences of flooding situations by evaluating the practicality of Crowdsourcing solution in real world. During the solution evaluation, inputs of subject matter experts will be considered to optimize and improve the proposed solution.

In addition to that, statistical data analysis required to be done to compare the collected data from the proposed Crowdsourcing solution and the data collected from IoT devices and the 3rd-Party Weather APIs. Standard Statistical Data Analysis methodologies such as T-Test, ANOVA, etc. will be utilized by comparing datasets to identify how they are statistically different each other. Since Crowdsource data is gathered through user inputs based, difference of both datasets is expected however, should not reach the threshold values that declared within the system. Threshold values will be defined during this research.

2 OBJECTIVES

2.1 Main Objective

Main objective is to collect weather information from public crowd, analyze and validate gathered information using other live data sources such as Third-Party Weather APIs, inputs from IOT devices and finally produce analytical reports, notifications to the target audience (rescue managers, Dept. of Meteorology officers, people in respective area)

Validating data gathered from Crowdsourcing solution against with other sources (IoT, Weather APIs) will be done using Statistical Data Analysis methodologies such as T-Test, ANOVA, etc. by comparing datasets to identify how they are statistically different each other.

2.2 Specific Objectives

To full fill above mentioned main objective, the specific objectives that need to be covered as follows,

1. Implement a way to source the right crowd

In order to overcome the first challenge of choosing right crowd, first step is to identify the specific area and the volunteers in that identified area to gather inputs from them in a situation of a natural disaster therefore to source the right crowd we will provide a mobile application with registration page. Also, we will get data inputs from people through the mobile application. Therefore, it is mandatory for people to register through the mobile application to provide data inputs. This will partially solve the problem of sourcing right crowd. In addition to that, providing fault information will be resulted to block users.

2. validate the accuracy of crowd sourcing data

Data accuracy plays the major role of this crowdsourcing problem. Therefore, it is mandatory to validate data received from people. Therefore, data will be validated

against data received through other sources such as third-party APIs, IoT devices before publishing them through the system. In addition to that, when user enters data inputs, mobile application will automatically capture his current location and that will

be sent along with the input data. This will help to validate whether user is currently located into the specific area whether he send data inputs regarding whether.

3. Structure the data in precise and concise format

Also, our system should be intelligent enough to validate user input data. Since no admin user manually validate these data, it is mandatory for users to send these data in precise and concise format. In order to enforce that to the mobile app users, we will be providing a questionnaire with predefined set of questions as an application form. This will help system to easily identify and validate data

4. periodically receive live data

In order to overcome the active participation in public crowd in a disaster situation the systems need to receive live data periodically Therefore, during a situation of severe weather, mobile application will provide periodic based alerts for the user to send the current status of the weather.

3 METHODOLOGY

The proposed early warning system is capable and have the below mentioned functionalities in terms of crowdsourcing,

- Gathering data from public crowd
- Validating and analyzing the gathered data
- Structuring data in precise and concise format
- Receiving weather information periodically from public crowd
- Providing analytical reports and notifications

Crowdsourcing is the process of gathering information from a "crowd". Crowd sourcing offers a technique of devolved and a low-cost approach for gathering and exchanging information. The main goal is to capture real-time information in a real-time flood warning. The proposed solution will meet the primary objective collecting weather information from public crowd, analyze and validate gathered information using other live data sources such as Third-Party Weather APIs, inputs from IOT devices and finally enables to produce analytical reports, notifications to the target audience.

The early warning structure includes the latest design patterns and techniques. Mainly the application consists of a UI containing to gather information from public crowd and it enables to receive real time updates in a specific location and helps users to monitor floods in nearby locations during the crisis. Although it is real-time data the gathered data should be validated and analyzed. Data validation and analyzing part will be done using other live data sources such as third-party weathers APIs, inputs form IOT devices before the crowd sourcing data is published through the system. Statistical Data Analysis methodologies such as T-Test, ANOVA will be used to overcome the data validation

Since the user can enter any kind of data through the system it is mandatory to validate because there is no admin user to validate these data. Therefore, the data should be received in a precise and concise format. In order to enforce that the data will be

gathered through a questionnaire with predefined set of questions as an application form related to real-time flooding and severe weather conditions. In the process of gathering information the user current location also will be captured and this will help to validate whether user is currently located in the specific area and user is sending weather information in that area. To provide information of the situation to users it is mandatory to receive live data from public crowd time to time, therefore users need to update about the weather conditions actively. To enforce that the proposed mobile application will provide periodic based alerts for the users to send status of weather in their living area which will help nearby people to be in touch with the current weather situation.

The final dashboard does a major role in visualizing data and it provides real time data management. By integrating all the components will proceed to the final step to visualize data and provide warnings to the end-users based on analyzed data

3.1 System Architecture
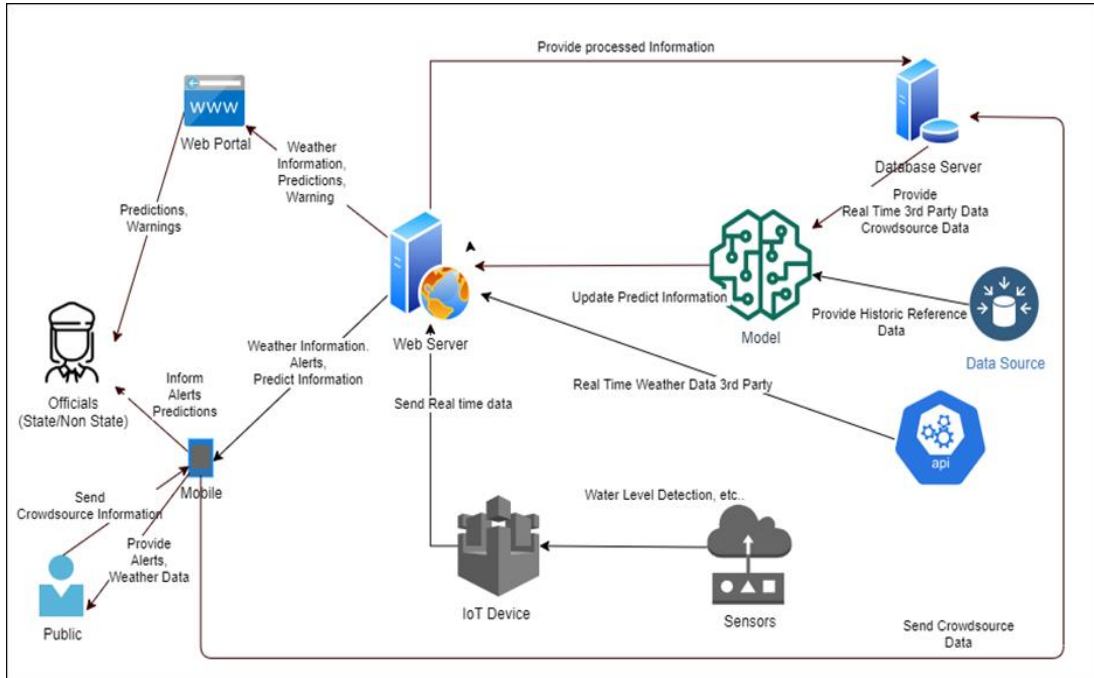
The system architecture is shown in the figure

Figure 1: Logical View of Proposed System

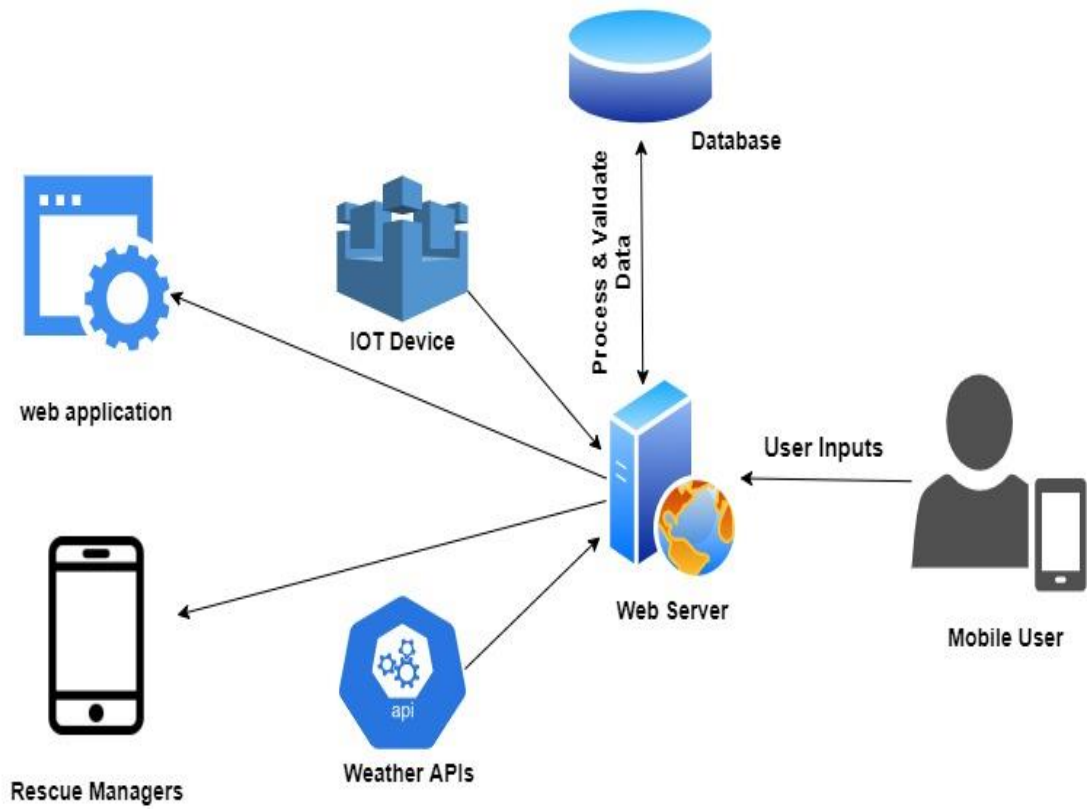## 3.2 High-level Component Diagram of Crowd Sourcing Solution

Figure 2: High-level Component Diagram

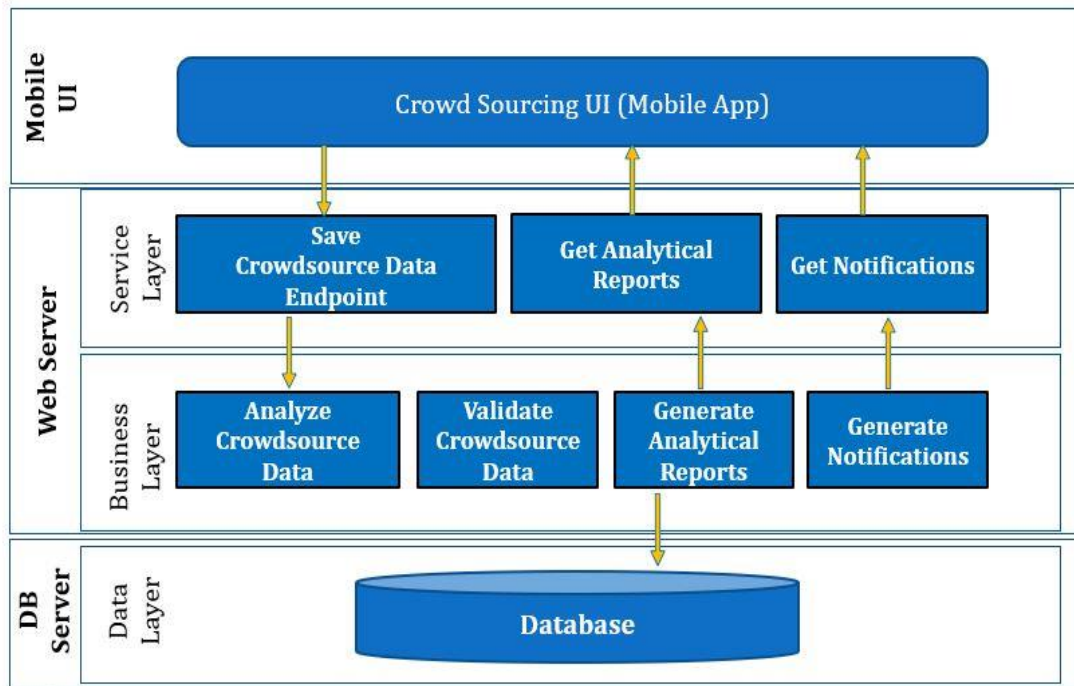## 3.3 Logical View of The Crowd Sourcing Solution

Figure 3: Logical view of Crowdsourcing Solution

3.4 Requirement Gathering and Analysis

Requirement gathering and analysis is done by using techniques such as conducting surveys, existing documents analyzation, prototyping. By investigating the survey results the research team gathered some important factors which cause floods and heavy rainfall and the details about flooding occurrences. As an example, which part of the year people who live in a certain area will get affected by flooding and heavy rainfall. Selecting a specific area to get crowdsourcing details will be mainly done through analyzing the survey results.

Gap analysis is done by reviewing the existing documents. Prototyping the solution is used to build a initial version of the solution before it gets approved and then adding additional requirements, changes will be done according to user friendliness of the system because the crowdsourcing UI will be directly interacted with the general public.

Feasibility Study

By conducting a feasibility study, it was identified that below mentioned factors should be considered prior to implementation of the project

- **Schedule feasibility**

  The proposed early warning structure should be finalized and ready deploy within the time limits specified and by completing each stage of project maintaining a timeline and finally display the final outcome of the product on the arranged due date.

- **Economic feasibility**

  The proposed system should be limited to a specific budget and the final product must perform without any errors. The components need to be utilized correctly and having a low cost the quality of the final product and the benefits of the product should not be changed. The goal of the team is to provide a reliable product without much cost.

- **Technical feasibility**

  The knowledge about programming languages and statistical data analyzation methods will be needed under this section when implementing the solution

3.5 Implementation of The Proposed Solution

The implementation of the solution will be done by integrating all above-mentioned methodologies with adhering to the latest technologies. The final output of the early warning structure and data will be provided to the end users using a web application and a mobile application.

- Android Application Development

  The proposed system includes an android mobile application. The mobile application plays a major role when it comes to crowd sourcing. The weather data is gathered from public crowd through the mobile application. Usability and user friendliness will be concerned more when developing the mobile application. Android studio will be used as the development platform and java as the programming language.

- Web Application Development

  The final product contains a web application with a dashboard providing all the final analysis information regarding crowdsourcing. Eclipse will be used as the development platform. Java will be used as the programming language and CSS, bootstrap for frontend development.

- Database Handling

  The generated data will be stored in a database to retrieve the data when it is needed to display to end-users. NoSQL will be used store these crowdsourcing data since interacting with public will generate lots of data. MongoDB will be used as the main data storage location

4 DESCRIPTION OF PERSONAL AND FACILITIES

1. Deciding the accurate and best methods to collect data from public crowd regarding real-time weather.

2. Deciding on which kind of algorithms are there to verify crowdsourcing data and validate those data against third party weather APIs and IOT device which is used to monitor disastrous situation

3. Deciding on a method to validate user input data in order to enforce to receive crowd sourcing data in precise and concise format

4. Design a method to receive crowdsourcing data periodically during severe weather conditions

5. Generate analytical reports and notification alerts to the end users by analyzing collected crowd sourcing data

6. Design a method to visualize the final data to end users using a dashboard

4.1 Functional Requirements

Identified functional requirements are bellow

- Authentication of the user

- Validate crowdsourcing data

- Generate report function

- Users can change the password

- Generate notifications

- User input validations

- Visualization of information in the dashboard

4.2 Non-Functional Requirements

Identified non-functional requirements are bellow

- Usability of the system
- Availability
- Reliability
- Performance and scalability
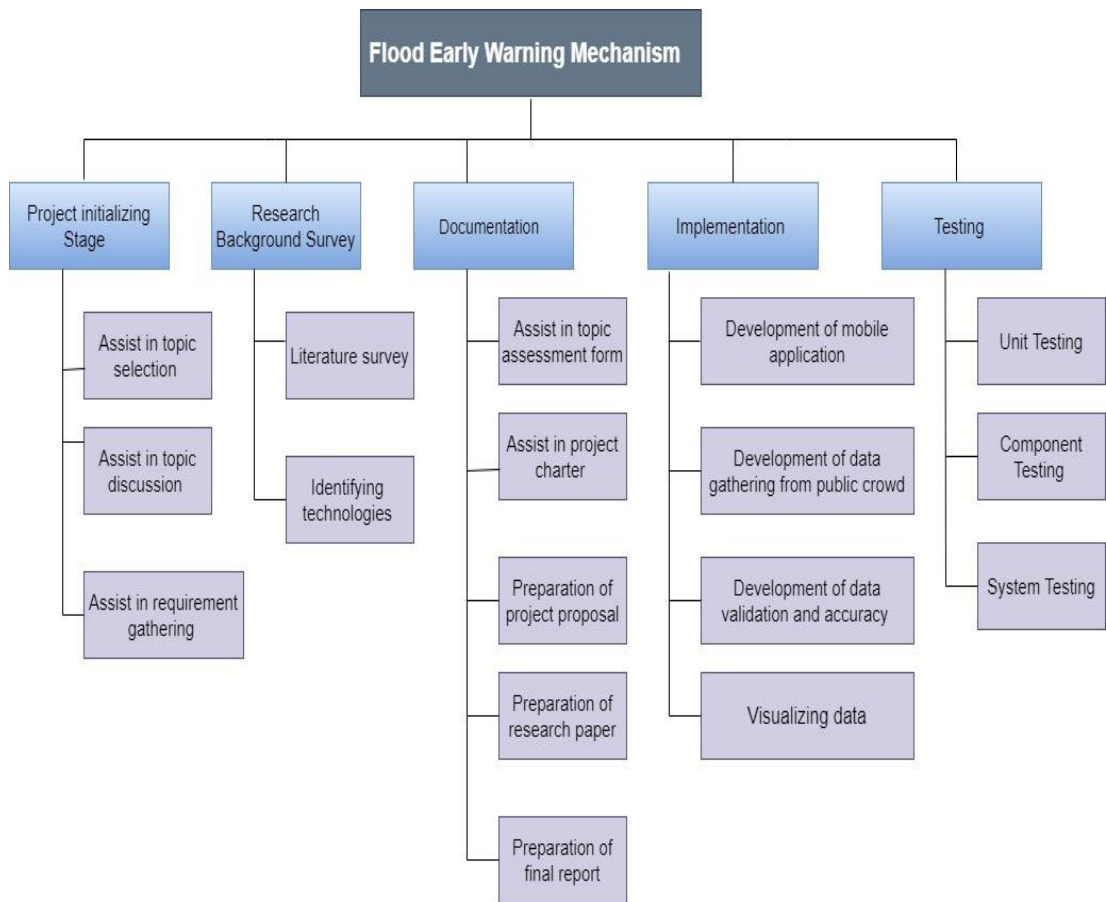- Portability and compatibility

5.WORK BREAKDOWN STRUCTURE

Figure 4: Work breakdown Structure

6 GANTT CHART

Task	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct
1. Project Initiation	██	██	░	░	░	░	░	░	░	░
Group Discussion	▒									
Topic Selection	▒									
Project Assessment Form		▒								
2. Documentation	██	██	██	░	░	██	██	░	░	░
Charter Form		▒								
Project Proposal Document		▒	▒							
Proposal Presentation			▒							
Research Paper						▒	▒			
3. Project Planning	██	██	██	██		░	░	░	░	░
System Planning	▒	▒	▒							
Assembling Necessary data			▒	▒						
Selecting tech & tools			▒	▒						
4. Requirement Gathering	██	██	██	██	░	░	░	░	░	░
Crowdsourcing Data Extraction		▒	▒							
Crowdsourcing Data Analysis		▒	▒							
Finalize Crowdsourcing Data		▒	▒							
Finalize User Interfaces		▒	▒							
Finalize Data Representation		▒	▒	▒						
5. Designing	░	░	░	██	██	██	░	░	░	░
User Interface Design				▒						
Middle Layer design (Business, Service)				▒	▒	▒				
Database component design				▒	▒	▒				
Design Document				▒	▒	▒				

Task	1	2	3	4	5	6	7	8	9	10
6. Implementation	░	░	░	▓	▓	▓	▓	▓	▓	░
Database component implementation				█	█					
Service endpoint implementation					█	█				
Business component implementation					█	█				
Data access component implementation						█	█	█	█	
Dev Testing of Services						█	█	█	█	
Mobile App UI Implementation						█	█	█		
Mobile App and backend service integration						█	█	█	█	
Mobile App data representation						█	█	█	█	
Mobile App user registration and dashboard						█	█			
7. QA Testing								▓	▓	▓
Define Test Cases								█	█	
Functional Testing								█	█	█
User Interface Testing									█	
8.Final Product / VIVA									▓	▓
Final Presentation										█
Final VIVA session										█
Final Report									█	█

Table 2: Gannt Chart

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