EARLY WARNING FOR PRE AND POST FLOOD RISK MANAGEMENT

2021-124

INTRODUCTION

Overall Project Description

- Flooding and landslides have been a very treacherous situation in Sri Lanka where many areas are flooded for the slightest rain.
- Flooding happens due to various reasons such as human and natural reasons.
- Comprehensive analysis on utilizing IOT devices for weather prediction
- Analyze 3rd party API solutions which provides and real-time weather information and develop Proof-of-Concept to verify the accuracy of weather information.
- Usage of data Mining algorithm for the weather prediction based on historic data analysis.
- The implementation of the solution will comply of a web application and mobile application will visualize the finalized data for the end users based on their needs

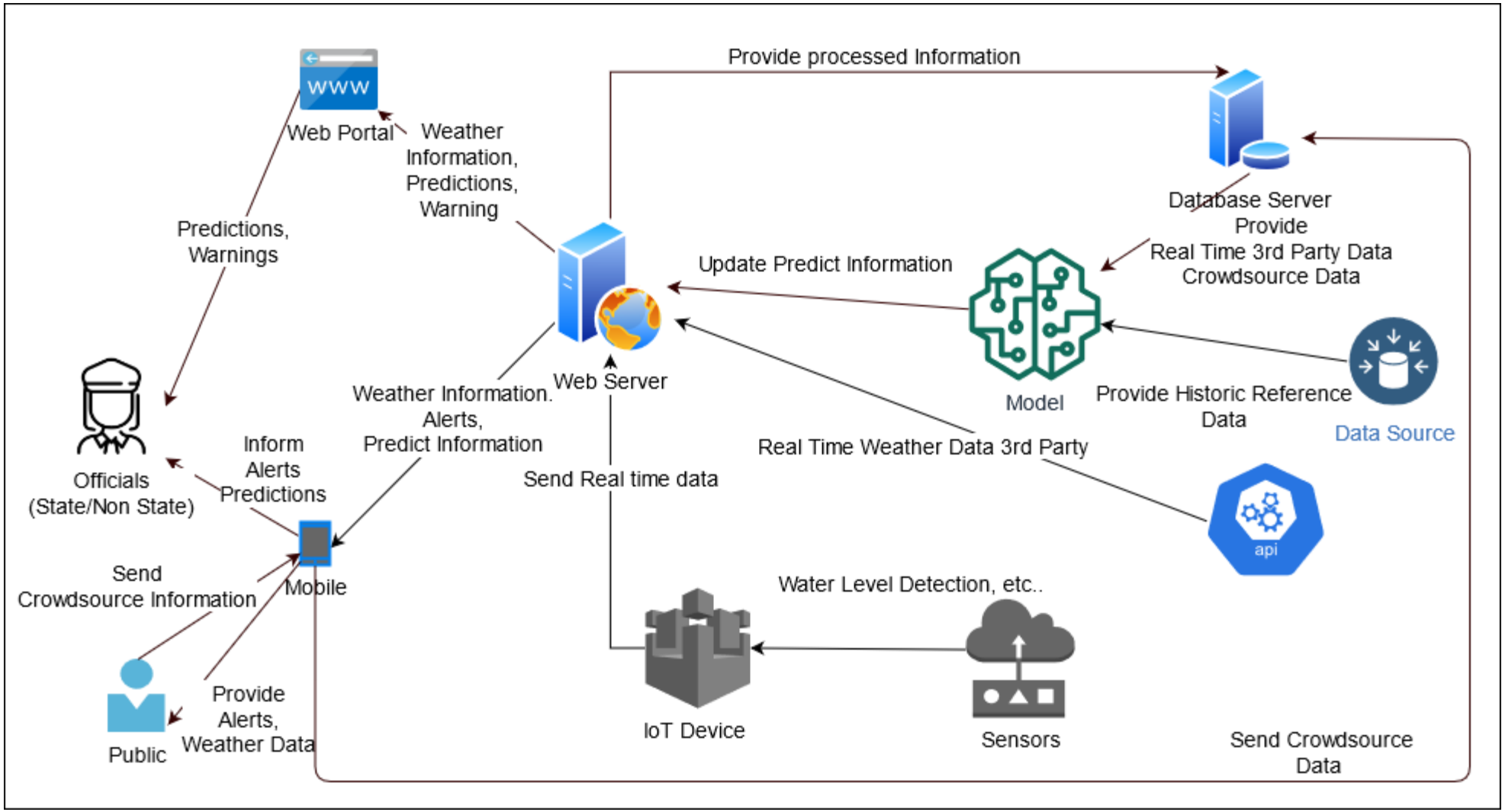
Research Problem

- Unavailability of an early warning tool will be very costly for most of the countries
- One of the major problems that countries face when a flooding situation takes place is, loss of human lives, property losses, agricultural losses, and economic losses.
- Due unadvanced system, poor coordination between people and the officials increase the flood disaster loses and recovery plans are delayed.
- To address these situations, we propose to develop an early warning structure to minimize the devastating destruction that could be caused.

Objectives

- Main Objective
  - Provide an early warning mechanism and predict severe weather conditions which may cause flooding with the use of real-time and historical data.
- Sub Objectives
  - Provide near real-time data collected from IoT devices feeds.
  - Develop severe rainfall prediction model based on historic data analysis and provide suggestions to the end users.
  - Develop crowdsourcing solution to gather weather information from public crowd, analyze and present them to the end users.
  - Create the Flood Forecasting Model to predict the flooding for the selected specific area using historic data collected from past years.

Overall System Diagram



Commercialization

- Use for weather information application.
- Weather predictions for farmers near river basin.
- First Responders in disaster management.
- Government authorities.

IT18022902 | ILUKKUMBURE S. P. M. K. W

Information Technology

INTRODUCTION

Background

- Even though from other researches a flood tracking was done that was based on the rainfall a prediction.
- Use the verified data to build an active learning model.

Research Gap

Flood Prediction	Integration of Hydrological Model	Integration of Neural Network	Integration of Decision-Making Model
Development Of A Flood Forecasting And Data Dissemination System For Kalu River Basin In Sri Lanka [1]	✓		
River Flood Forecasting With A Neural Network Model [2]	✓	✓	
On the Operational Flood Forecasting Practices Using Low-Quality Data Input of a Distributed Hydrological Model [4]	✓	✓	
Proposed System	✓	✓	✓

Research Question

- Sudden Flooding from a Rainfall can be predicted by pre-existing models.

- Can residents in that area get informed as soon as possible before a heavy rainfall result it to flooding.

- Use of Data Driven Hydrological Models

  - Compared with hydrological models, data-driven models can obtain better or comparable forecasting results [3].

Challenges

- Forecasting Shorter Times
  - ❑ Urban Areas
- Forecasting Longer Times
  - ❑ Forecasting near river basin areas.
- Low Levels of accuracy
- Low Levels of performance

Objectives

Specific Objective

- Create the Flood Forecasting Model to predict the flooding for the selected specific area using historic data collected about past 3 years.

Sub objectives

- Analysis on river basin flooding using Hydrological model and data-driven model.
- Provide method to overcome challenge of low performance and low accuracy.

RESEARCH METHODOLOGY

Data going to be used

Amount of rainfall occurrence and Real-time basis
Water Levels of change in **river** on time basis
Number of water levels discharged in a specific station.
Real-time Water levels
Rainfall Durations.
Precipitation
Elevation
Flow Directions of the river.
Rainfall model prediction's data

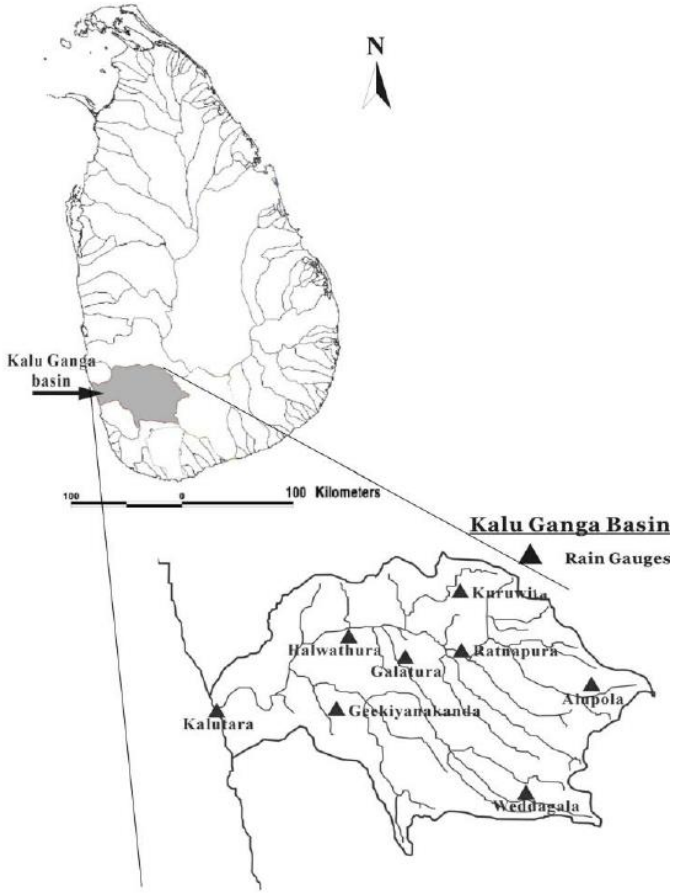
Study Area in Research

Kalu River Basin

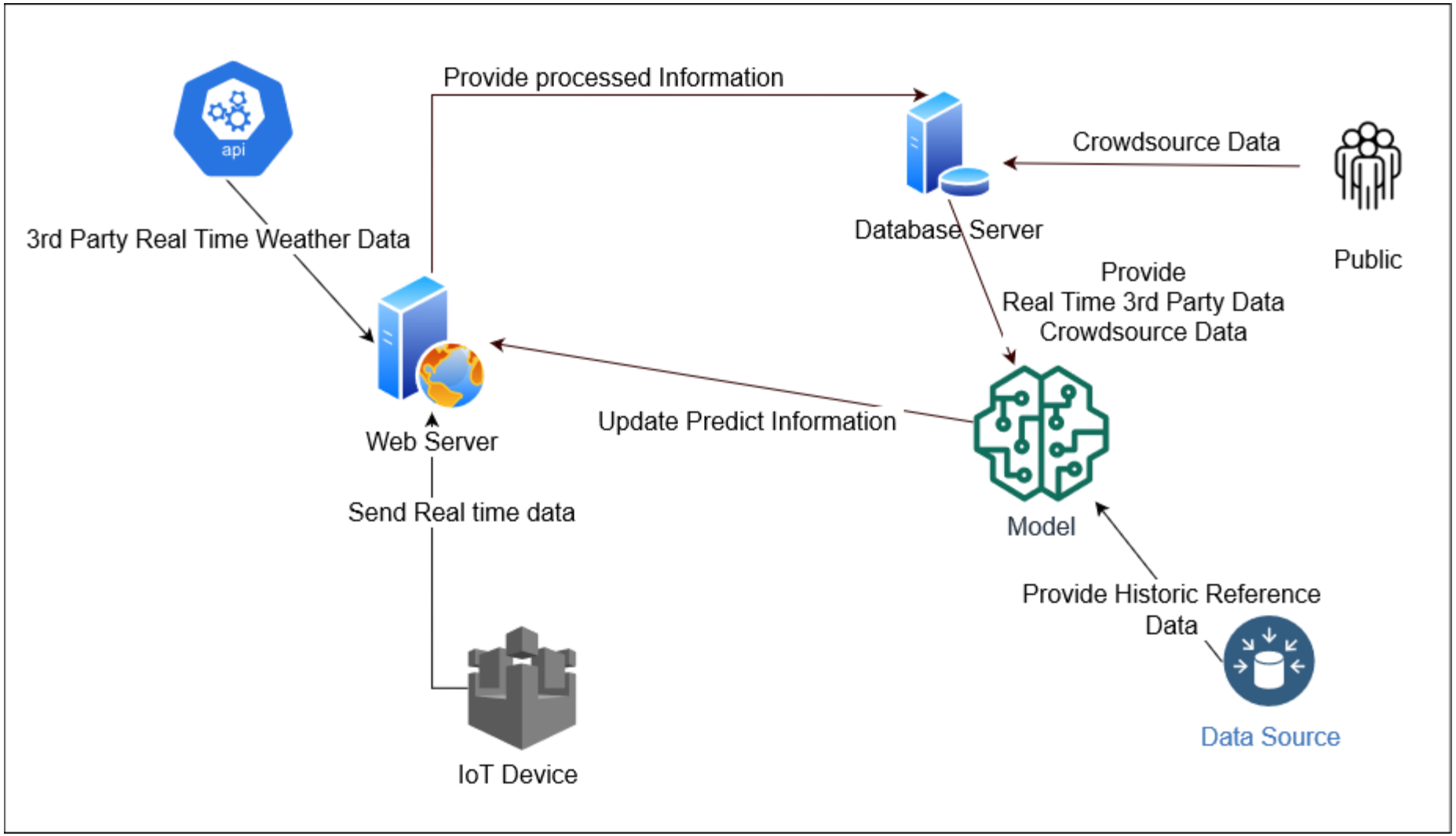
Why?

Suitable for Poof-Of-Concept

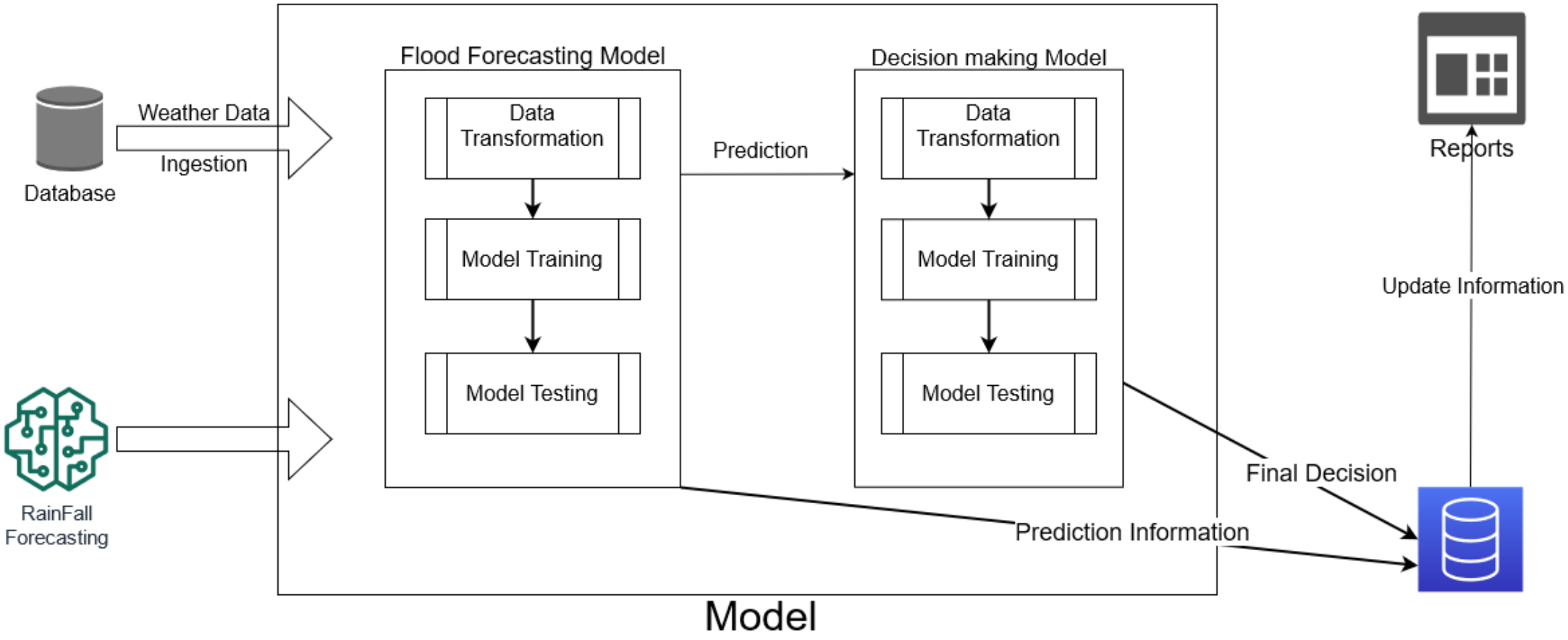
- Urban Areas
- Riverside Areas
- Availability of Riverside data



System Design



Model Design



Techniques and Technologies

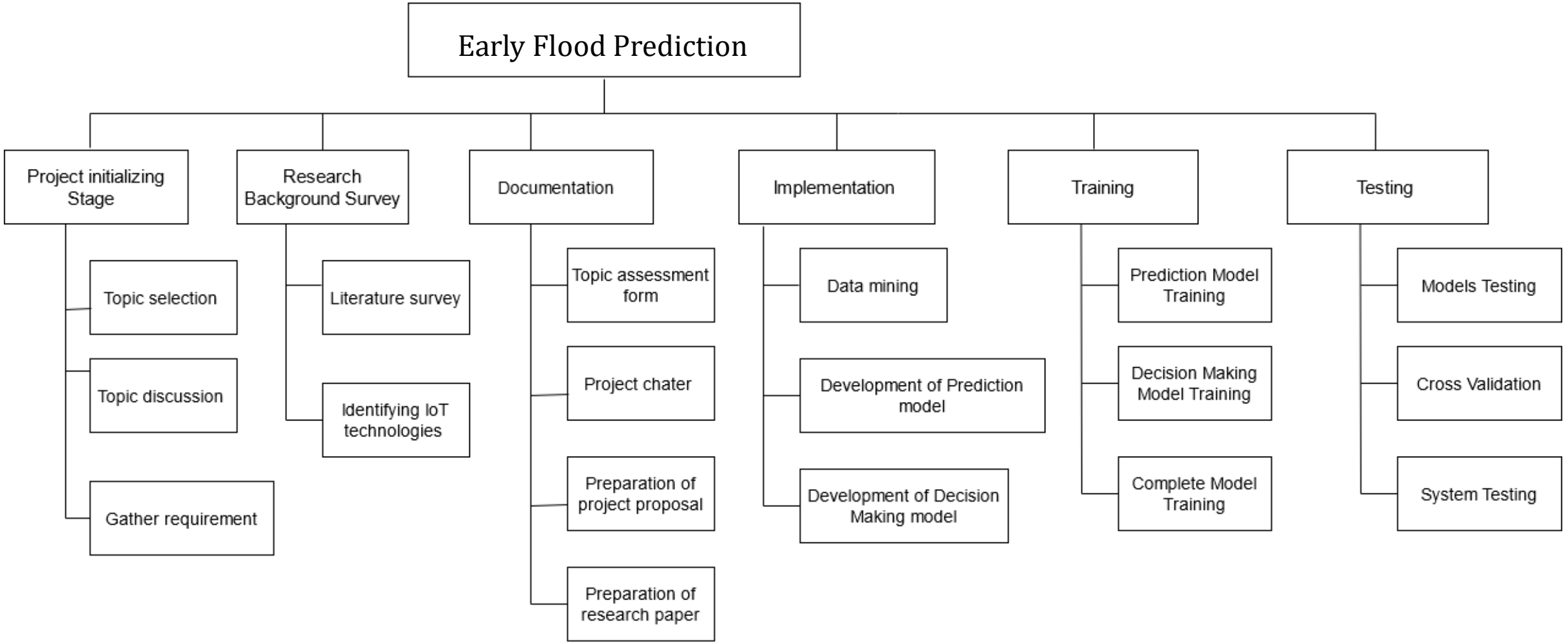
- Machine Learning Frameworks (Keras, PyTorch, Scikit)
  - ➢Deep Learning
  - ➢Artificial Neural Network

- Programming Language (Python)

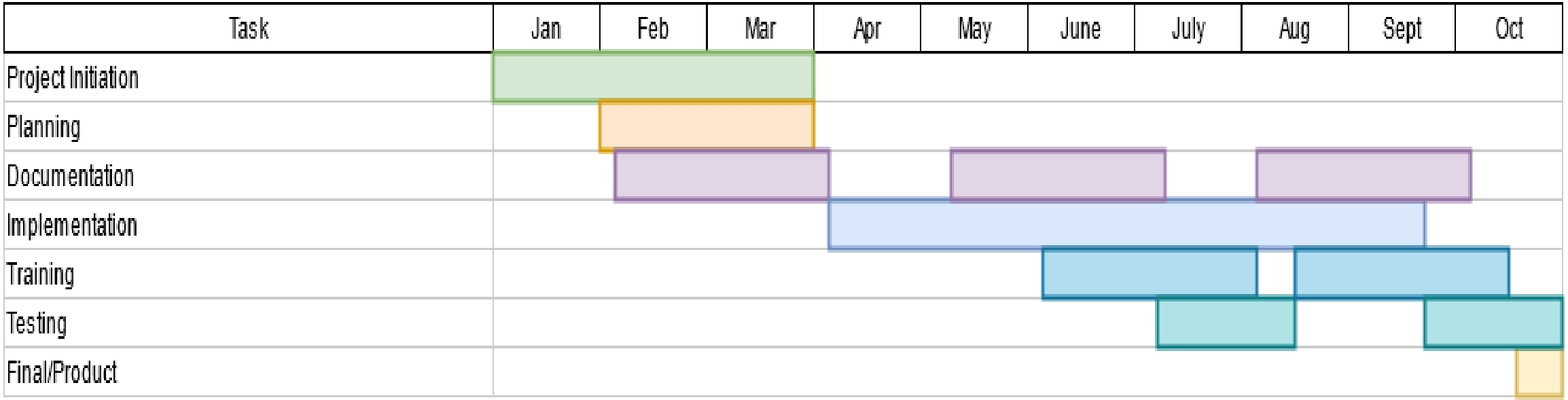
System, personal and software requirements

- Knowledge on data science.
- Knowledge on data-mining.
- Knowledge in raw weather data.
- Knowledge and data for the selected River
- Knowledge in machine learning.
- Knowledge in ANN (Artificial Neural Networks).

Work Breakdown Structure



Gantt Chart


Task
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July
Aug
Sept
Oct
Project Initiation
Planning
Documentation
Implementation
Training
Testing
Final/Product

SUPPORTIVE INFORMATION

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Budget

Phase		Amount (LKR)
Historic Data Obtained by Metrology (Past 3 years)	LKR	5,925.00
Real-time Data from API provider(9 months)	LKR	4,560.00
Model Training Cost (On-Demand)(Nvidia Tesla K80)	LKR	19,000.00
Storage	LKR	7,600.00
Ingest Database Cost	LKR	3,900.00
Web server Cost	LKR	1,900.00
Other	LKR	1,350.00
Total	LKR	44,235.00

IT18003406 | MOHAMED M. F.

Information Technology

Background

IoT will be used to monitor all live weather data factors

Gathered live data will be validated using various other techniques

Solution for non-subscribed users

Maintain a constant data transmission in extreme weather conditions

Research Comparison

Research Paper	Usage if IoT devices		Other Sensor types	Solution for non-subcribed users	Solution for incase of network distructions
	Ultrasonic Sensor	Water droplet sensor			
Smart IoT Flood Monitoring System	✓	×	×	×	×
Design of Information Monitoring System Flood Based Internet of Things (IoT)	✓	✓	×	×	×
Computer Vision and IoT-Based Sensors in Flood Monitoring and Mapping: A Systematic Review	✓	✓	✓	×	×
Flood Detection and Water Monitoring System Using IOT	✓	✓	✓	×	×
Proposed Solution	✓	✓	✓	✓	✓

Research Problem

- Non-subscribed users to be able to consume weather data.
- Despite of power interruptions transmit data to the system

We will be mainly focusing on a comprehensive solution to overcome such issues.

Objectives

Specific Objective

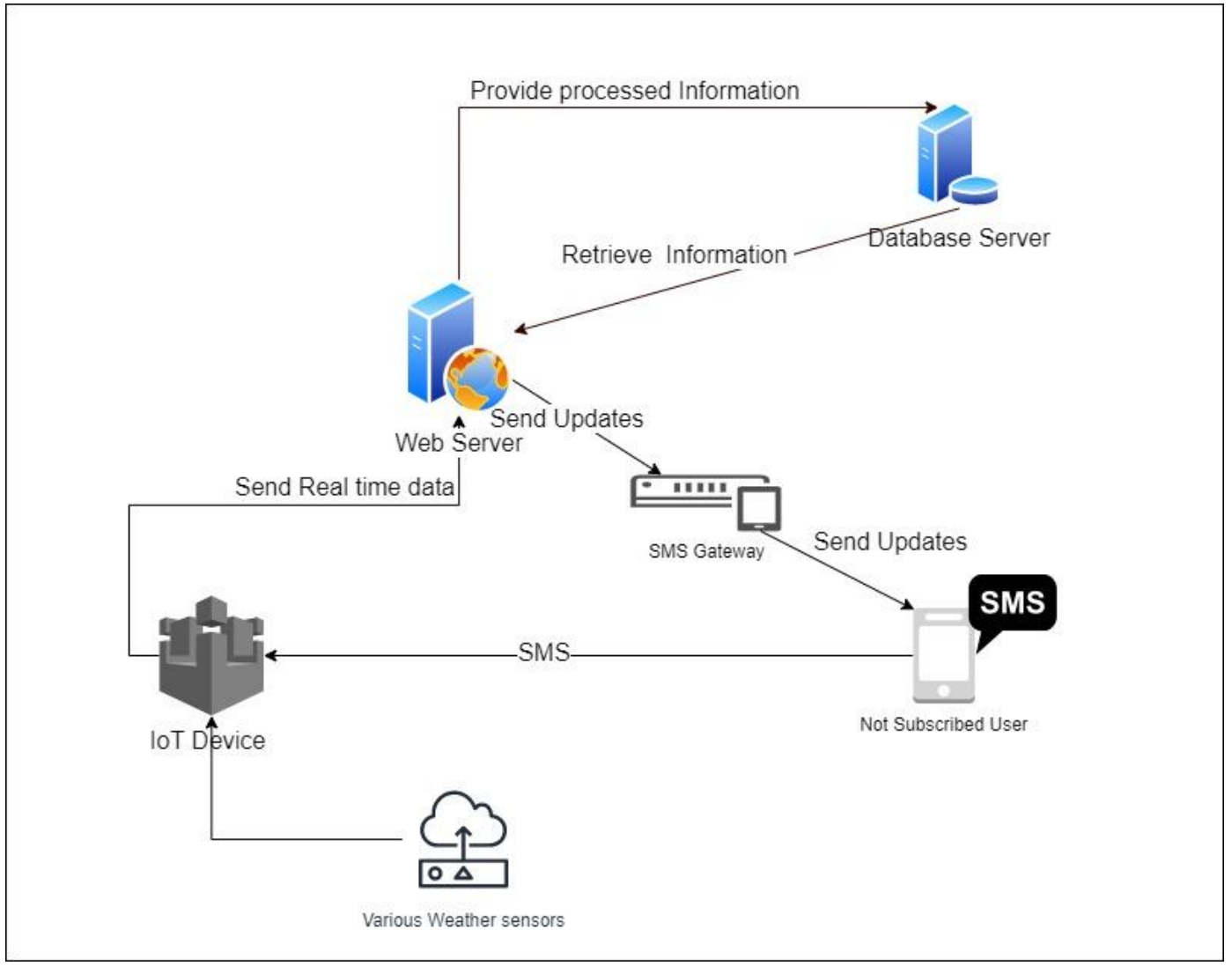
- Minimize the disruptions in data transmission in extreme weather conditions and solution for non-subscribed users.

Sub objectives

- Design an IoT device to monitor all weather data factors.
- Solution for non-subscribed users
- Minimize the disruptions in data transmissions at extreme weather conditions.

RESEARCH METHODOLOGY

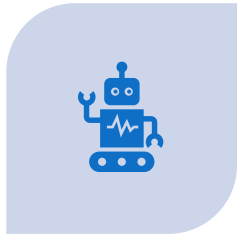
System Diagram



Technologies and Techniques

IOT TECHNOLOGIES

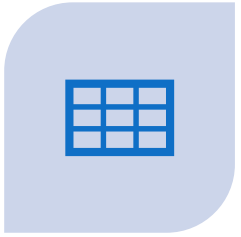
IOT DEVICES AND SENSORS



IOT DEVELOPMENT PLATFORM(ARDUINO IDE)

ARTIFICIAL INTELLIGENCE

CONNECTIVITY(WI-FI)/GSM



NOSQL(MONGODB)

OPTIMAL DATA CAPTURING AND PROCESSING TECHNIQUES

JAVA, C++

System, personal and software requirements

SUITABLE HARDWARE ARCHITECTURE

KNOWLEDGE ON HOW SENSORS WORK

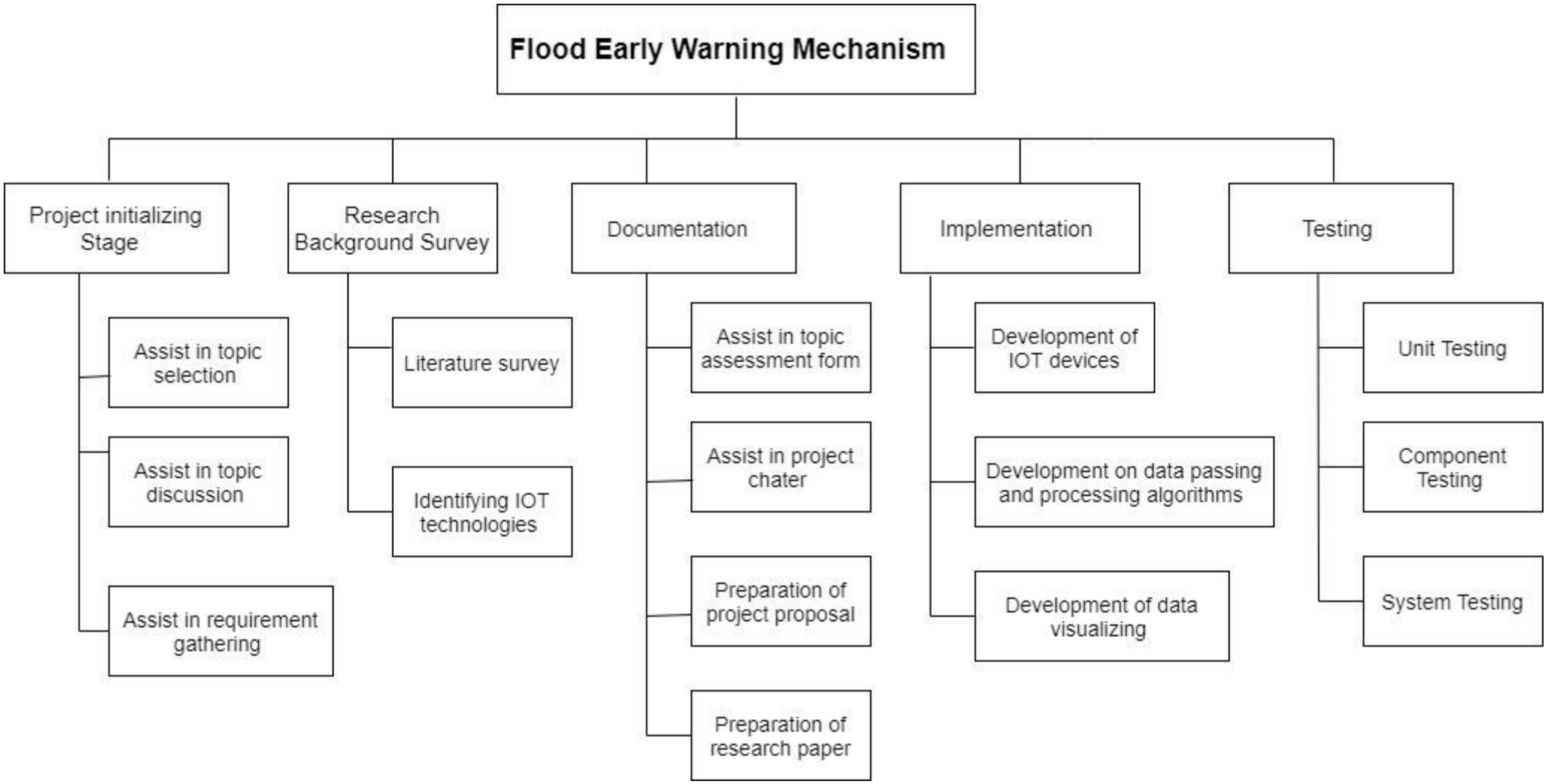
KNOWLEDGE IN MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

ANDROID AND WEB APPLICATION DEVELOPMENT

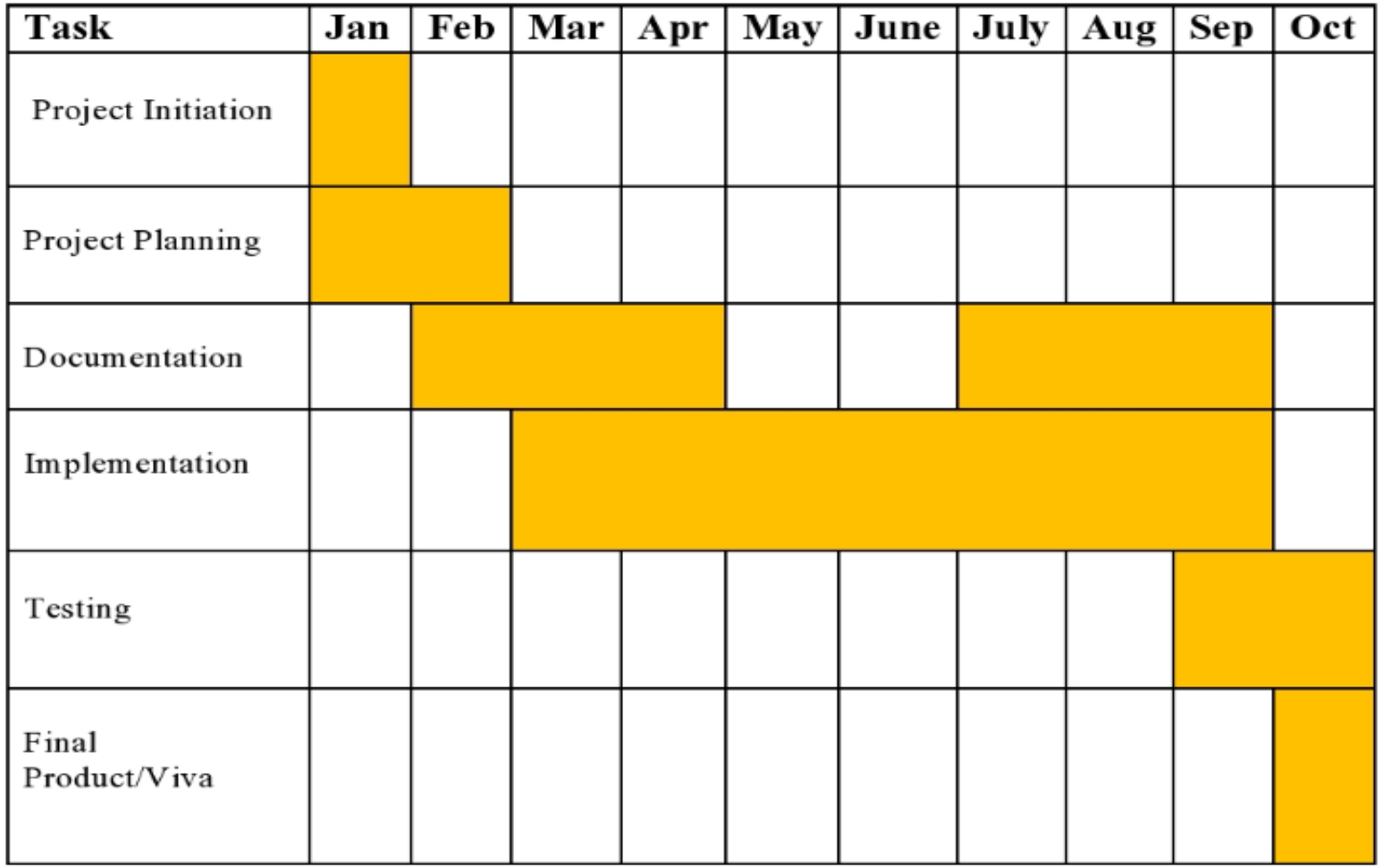
IOT DEVICE MANAGEMENT REQUIREMENTS

FINALIZED DATA MANAGEMENT REQUIREMENTS

Work Breakdown Structure



Gannt Chart


Task
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Project Initiation
Project Planning
Documentation
Implementation
Testing
Final Product/Viva

SUPPORTIVE INFORMATION

Budget

Component	Amount (LKR)
Variable Cost (Per IoT Device)	
NodeMCU	LKR 925.00
DS18B20 1-Wire Temperature Sensor	LKR 390.00
DHT22/11 Humidity and Temperature Sensor	LKR 760.00
Ultrasonic Sensor - HC-SR04	LKR 250.00
Water Level Sensor Module	LKR 110.00
Breadboard	LKR 250.00
Ublox NEO-6M GPS Module	LKR 1,350.00
Total	**LKR 4,035.00**
Fixed Cost (Annual)	
Domain Name Registration	LKR 2,550.00
Hosting	LKR 1,800.00
Total	**LKR8,385.00**

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Information Technology

INTRODUCTION

Background

- Crowdsourcing is the process of gathering information from a “crowd”
- low-cost approach for gathering and exchanging information.
- crowdsourcing solution is mandatory to validate other source of information.
- As an outcome, real- time accurate notifications should be passed to the target audience in specific areas.

Research Gap

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

Research Problem

- Usually, the input source of data for a crowdsourcing solution gathered from the public crowd.
- Identified challenges
  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
- During this research, the primary focus is to design a comprehensive solution.

Objectives

Specific Objective

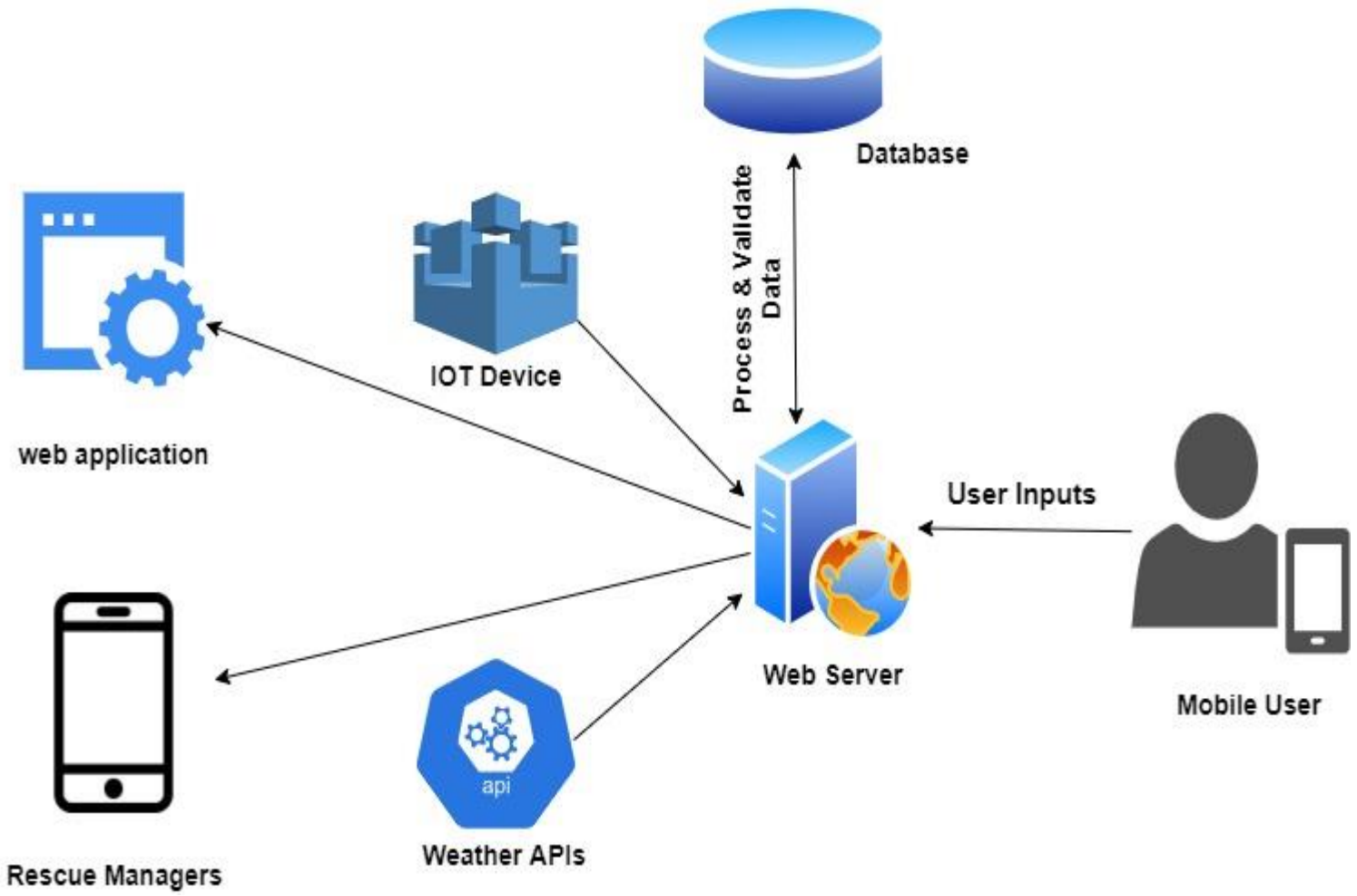
- Main objective is to collect weather information from public crowd, analyze and validate gathered information using statistical data analysis techniques

Sub objectives

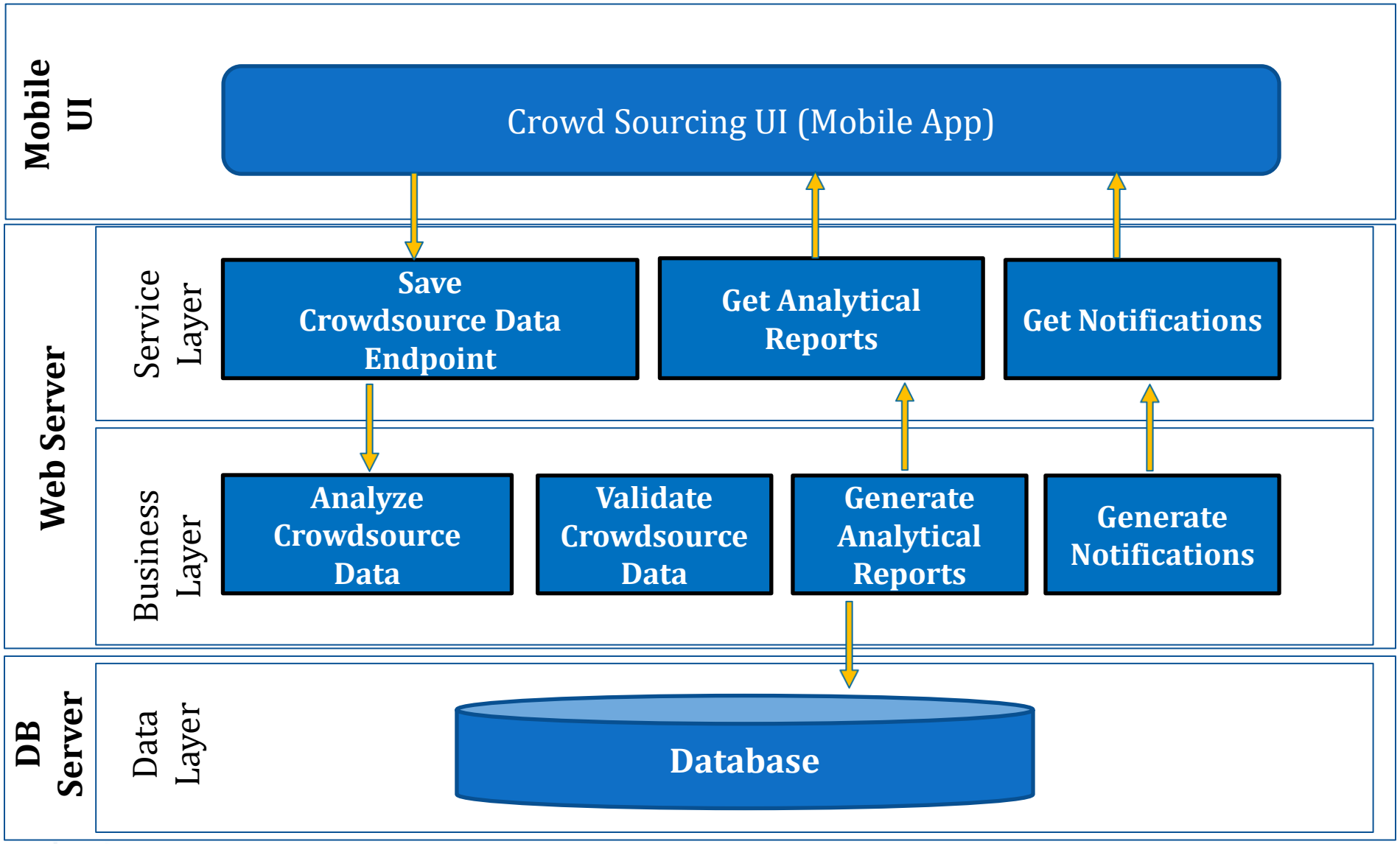
- Implement a way to source the right crowd
- validate the accuracy of crowd sourcing data (Data integrity)
- Structure the data in precise and concise format
- periodically receive live data

RESEARCH METHODOLOGY

High-Level Component Diagram



Crowdsourcing Solution Logical View



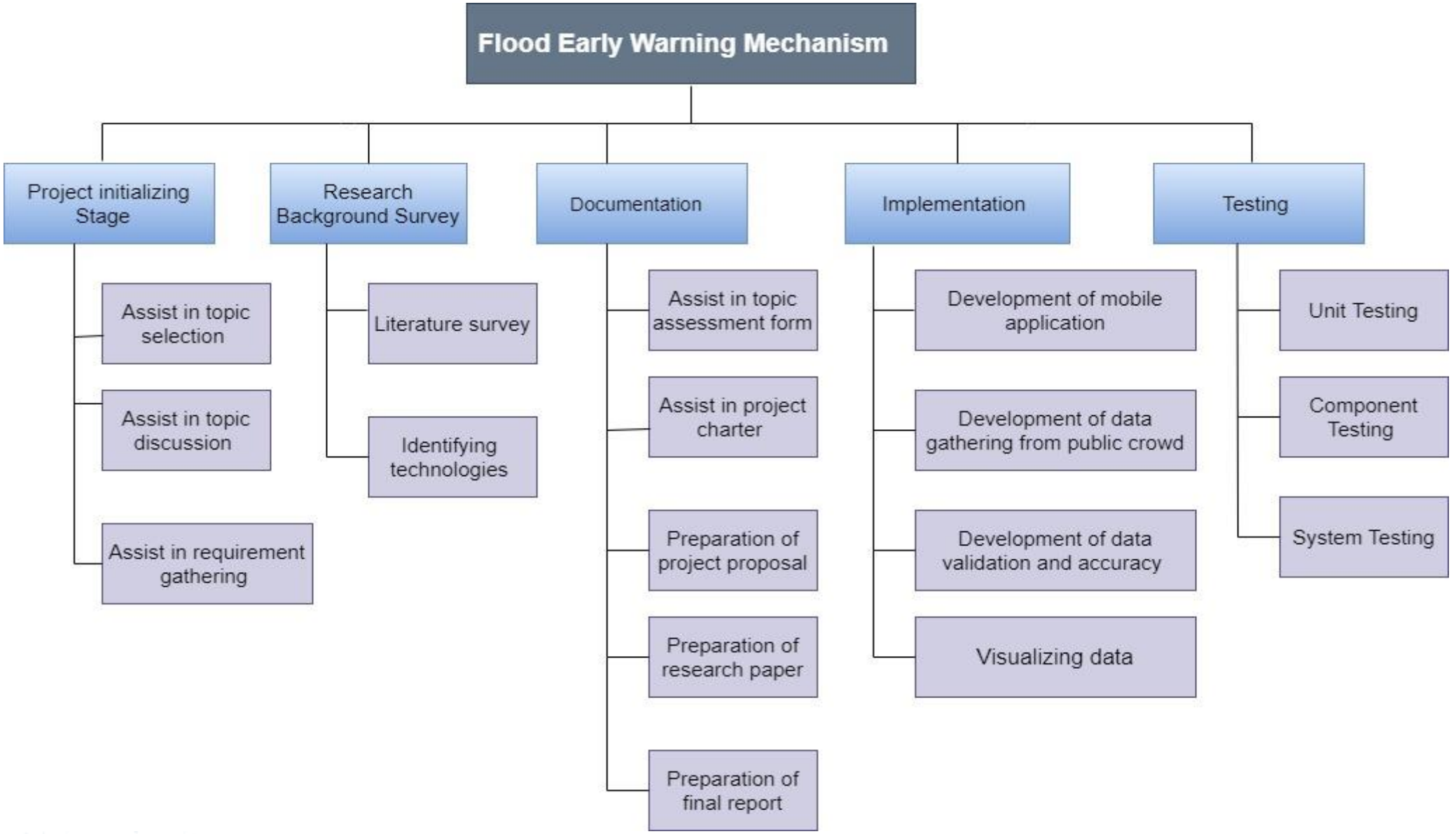
Techniques and Technologies

- Android Studio, Eclipse IDE
- Data processing algorithms
- Data validation algorithms
- Java
- SQLite
- Realtime data validation techniques

System, personal and software requirements

- knowledge in android application development
- Knowledge in web application development
- System design requirements

Work Breakdown Structure



Gannt Chart

Task	January	February	March	April	May	June	July	August	September	October
Project Initiation										
Project Planning										
Documentation										
Implementation										
Testing										
Final Product/Viva										

REFERENCES

[1] S. Frigerio, L. Schenato, G. Bossi, M. Mantovani, G. Marcato, and A. Pasuto, “Hands-on experience of crowdsourcing for flood risks. An android mobile application tested in Frederikssund, Denmark,” *Int. J. Environ. Res. Public Health*, vol. 15, no. 9, 2018, doi: 10.3390/ijerph15091926.

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Information Technology

SLIIT Faculty of Computing

Introduction

- **Rainfall prediction is the one of the most common prediction in metrology.**
- **There are many methods used to predict rainfall.**
- **Using machine learning is also one of the methods to predict rainfall.**
- **There are a lot of algorithms that can be used to predict rainfall in machine learning.**

Background Study

- **Rainfall is the one of natural event which one happens in water cycle.**

- **Main factors that are used to predict rainfall**

1. **Temperature**
2. **Relative Humidity**
3. **Pressure**
4. **Wind speed**

Research gap

Rainfall prediction using Machine learning(researches)	Data used	Models
"Rainfall Prediction for Udaipur, Rajasthan using Machine Learning Models Based on Temperature, Vapor Pressure and Relative Humidity," [4]	Temperature, vapour pressure , Relative Humidity	Regression, Generalized regression, Linear –AS, LSVM, Random tree, Linear, XGBoost Linear, Tree-AS, Random Forest, Neural Network
S. B and J. K.S, "Rainfall Prediction Using Machine Learning Techniques and an Analysis of the Outcomes of These Techniques," [2]	Temperature, humidity, Sea Level Pressure, Windy	Artificial neural network, Logistic Regression, Naïve Bayes, Random forest
K. Dutta and P. Gouthaman, "Rainfall Prediction using Machine Learning and Neural Network," [1]	Temperature, humidity, Wind speed, Sunshine Duration	Neural network, LASSO Regression
"Weather Forecasts Based on Rainfall Prediction Using Machine Learning Methodologies," *Adalya J.*, [3]	MinTemp, MaxTemp, Rainfall, Sunshine, Evaporation & Pressure, Humidity, Cloud, Windspeed in different time period	Decision Tree, SVM, LR,RF
Proposed Research	Temperature, humidity, Pressure, Wind speed, Location, Time(day, month)	Regression (Linear and logistic).

Research Problems

➢ Where do we collect data?

- Metrology department of Sri Lanka

➢ Accuracy of predict rainfall amount.

- Predicting rainfall amount (mm) it's one of challenging thing, While unexpected storms.

Specific objectives and sub-objectives

Main objectives

To find out effective data set for predict rainfall based on machine learning and identify which dataset contribute to predict flooding.

Specific Objectives

- Analysis of weather historical data(temperature, relative humidity, pressure, wind speed) and predict rainfall.
- Analysis of weather historical data(temperature, relative humidity, pressure, wind speed) based on Location and time(day, month)predict rainfall.
- Checking accuracy different between each model.

RESEARCH METHODLOGY

Datasets going to be used

- **Data set 1**

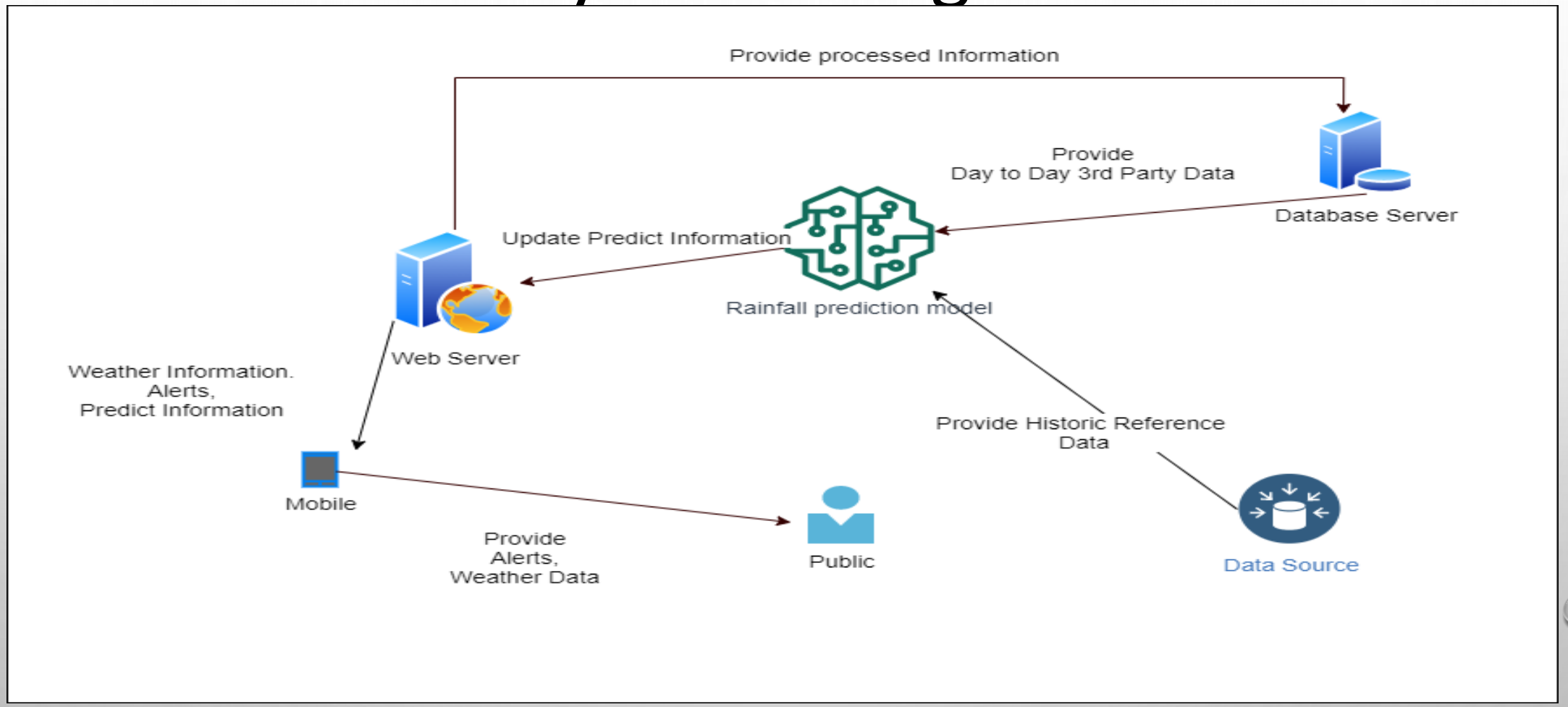
1. **Temperature**
2. **Relative humidity**
3. **Sea level pressure**
4. **Wind speed**

- **Data set 2**

1. **Dataset 1**
2. **Time(Day, Month)**
3. **Location(place)**

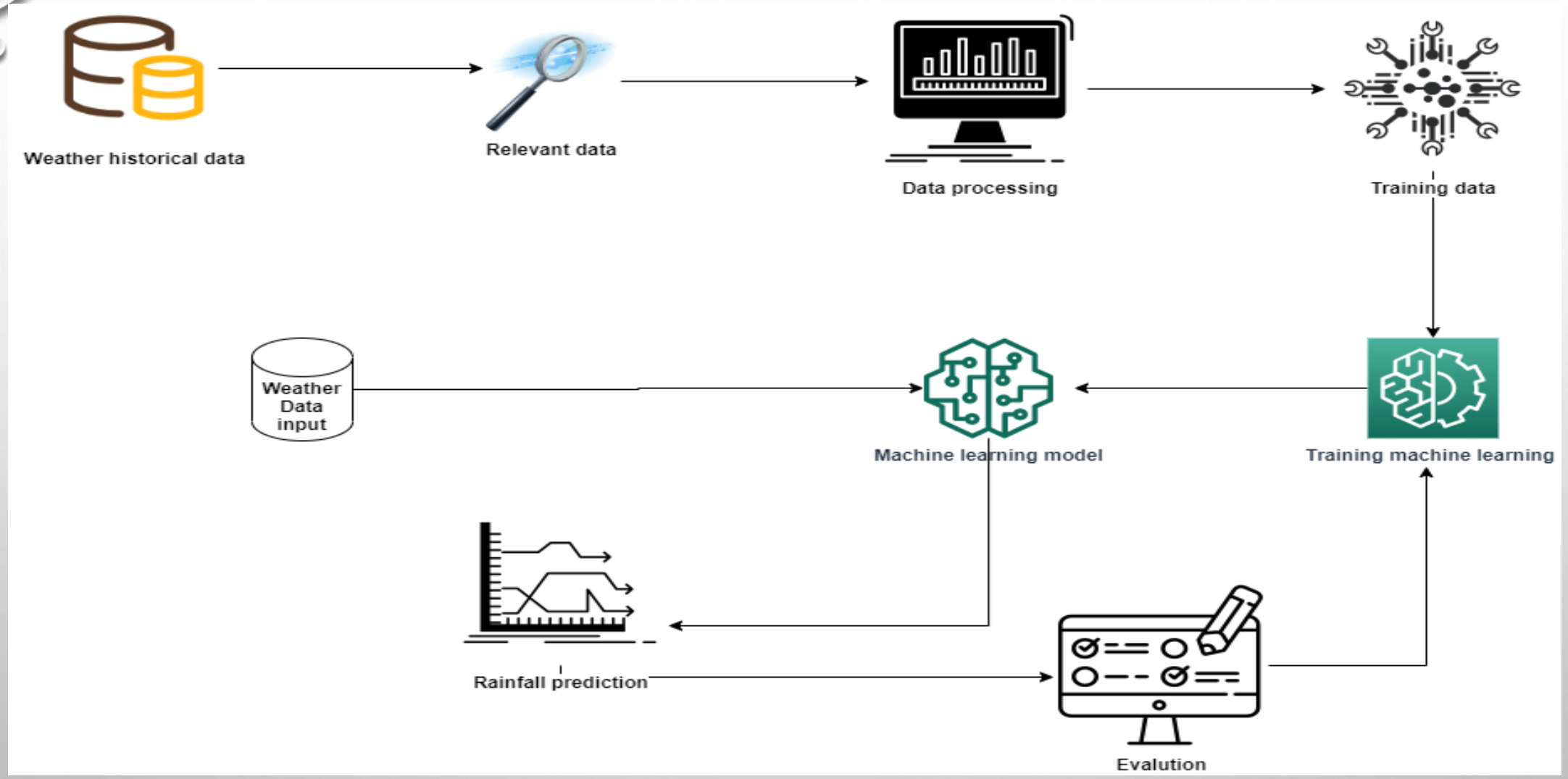
RESEARCH METHODLOGY

System design



SLIIT Faculty of Computing

RESEARCH METHODLOGY



Technologies, Techniques, Algorithm to be used

- Minimum system requirement for development – Windows XP, Linux
- Language – Java, Python
- IDE – Eclipse 4.2.1,PyCharm
- Framework
- Algorithms – Regression (Linear and logistic)

System requirements

Functional Requirement

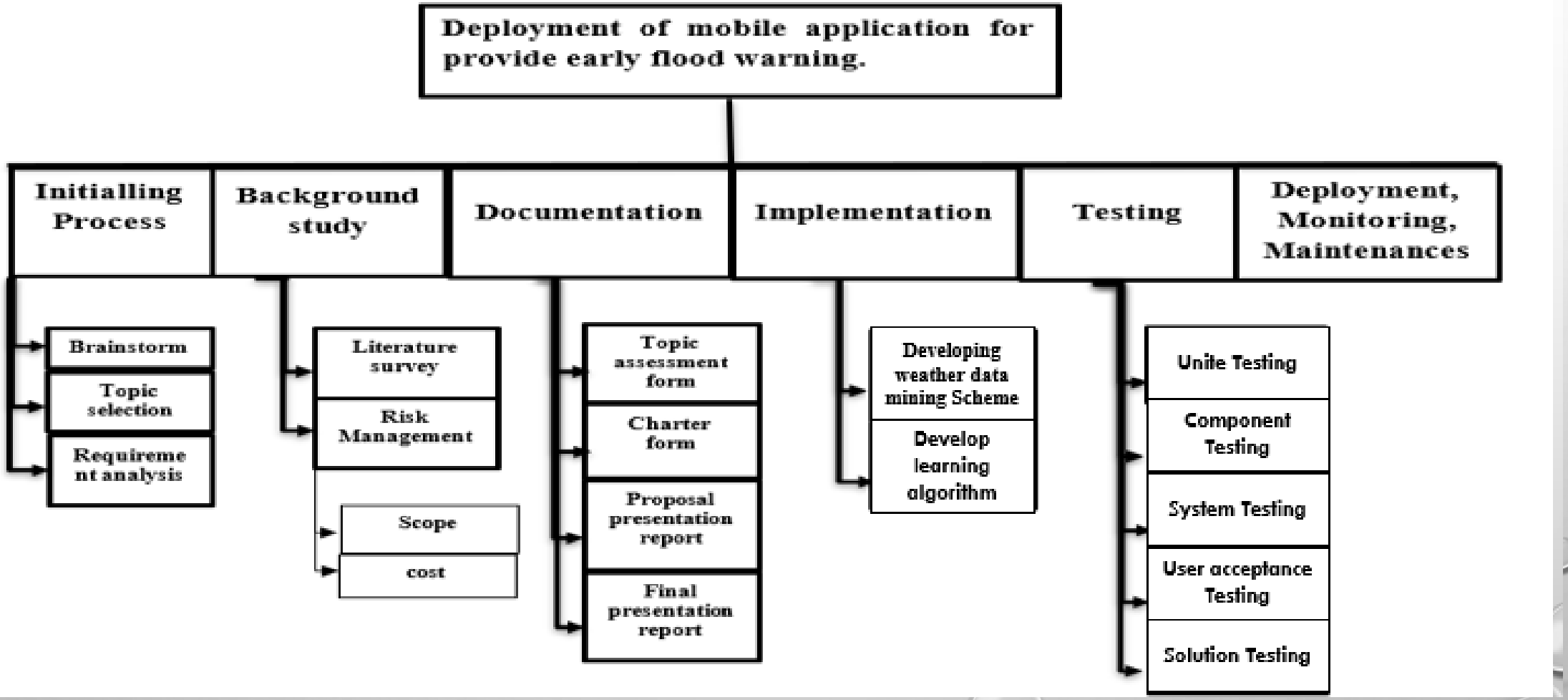
- Accuracy of rainfall prediction.
- Provide rainfall prediction through mobile application.

System requirements continue…

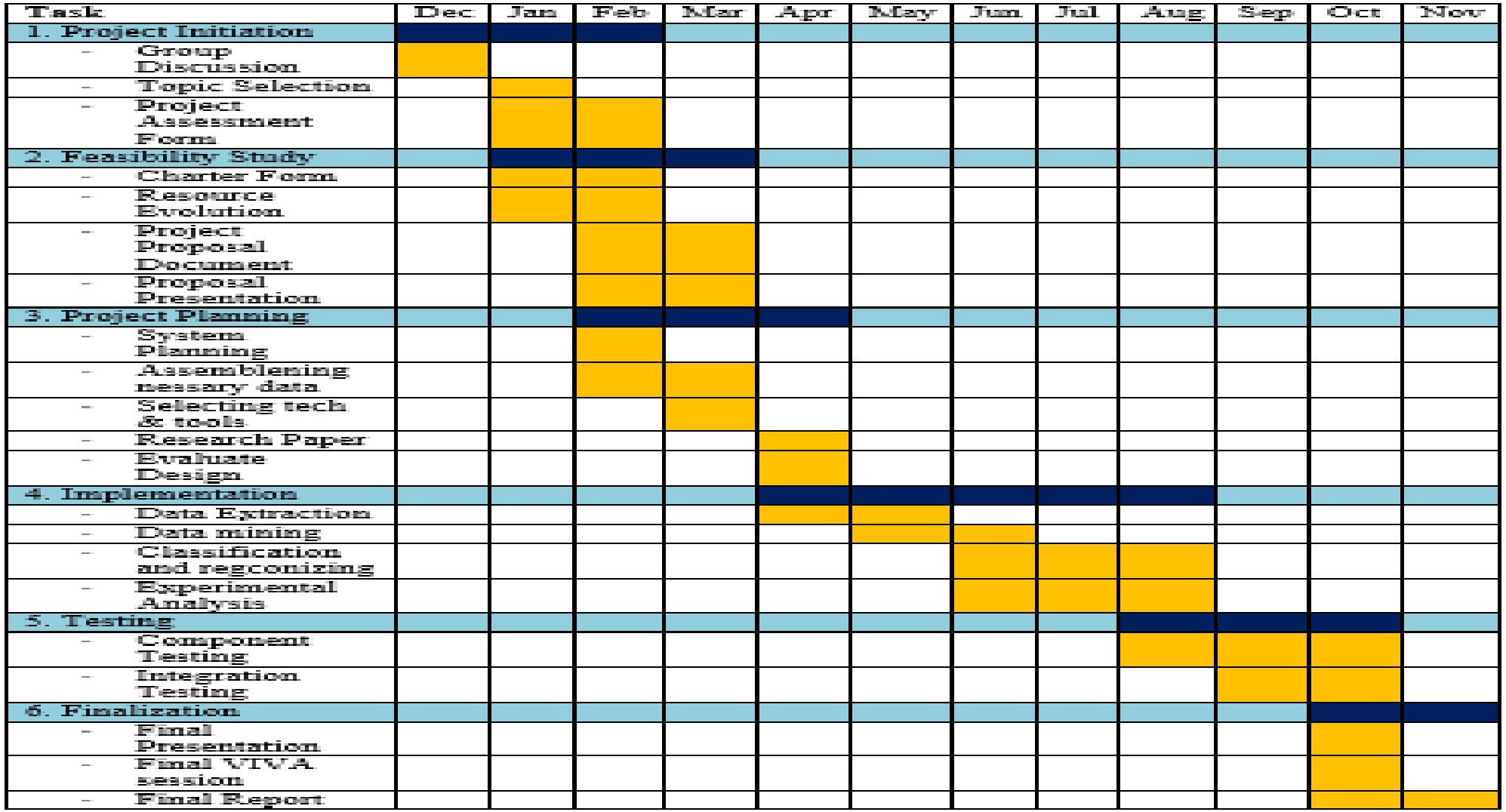
Non-functional requirements

- Usability- This focuses on the appearance of the user interface and how people interact with it to achieve required goals effective and efficiently.
- Performance – Good performance for maintaining good user experience
- User satisfaction

Work breakdown structure



Gantt chart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Nov
1. Project Initiation
– Group Discussion
– Topic Selection
– Project Assessment Form
2. Feasibility Study
– Charter Form
– Resource Evolution
– Project Proposal Document
– Proposal Presentation
3. Project Planning
– System Planning
– Assemblening nessary data
– Selecting tech & tools
– Research Paper
– Evaluate Design
4. Implementation
– Data Extraction
– Data mining
– Classification and regconizing
– Experimental Analysis
5. Testing
– Component Testing
– Integration Testing
6. Finalization
– Final Presentation
– Final VIVA session
– Final Report

SUPPORTIVE INFORMATION

Commercialization

SUPPORTIVE INFORMATION

Budget

COMPONENT	AMOUNT(LKR)
Historical data of weather (last 10 years from 3 different district)	35550.00
database	3900.00
Other	1500.00
Total	40950.00

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Q & A

Thank You!