Regional Analysis on Forecasting Social Impact of Natural Disasters and Weather Extremes

Team Members

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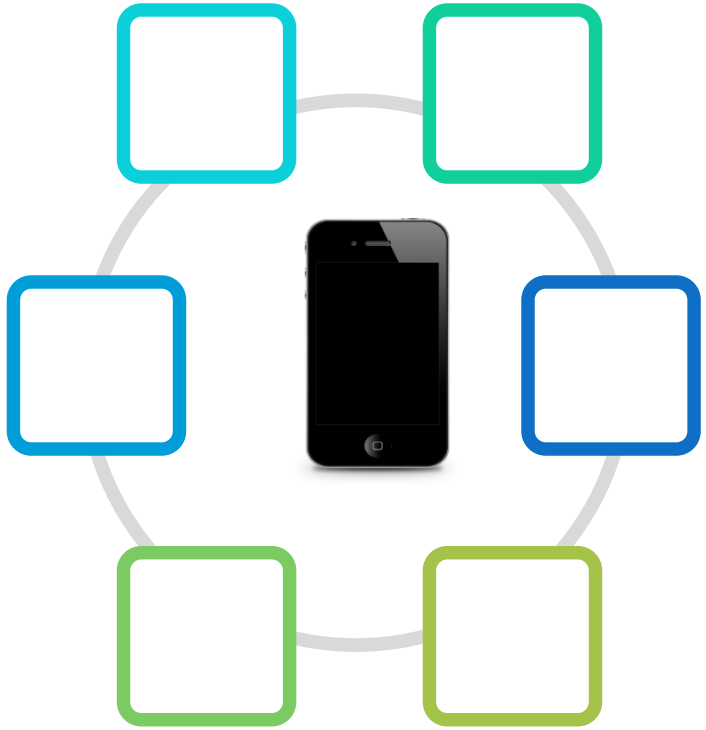
Introduction

- Weather changes in a country can greatly impact people's lives and wellbeing.
- Knowing about weather changes in advance can help people prepare and minimize the impact of natural disasters.
- Being aware of weather changes can help people make informed decisions and take necessary precautions.
- Risks to people's safety can be increased by failing to pay attention to weather changes.

Introduction

- Weather changes are unpredictable and can occur rapidly, making it important to stay vigilant.
- People should seek reliable sources of weather information to stay informed and prepared.
- Accurately predicting weather changes can help reduce potential risks and damages to property and lives.
- People can take steps to protect themselves, their families, and their communities by understanding how weather changes affect them



Research Question

01

How to identify specific regions which are greatly affected by extreme weather conditions and disasters ?

02

How to identify weather and disaster parameters that has an impact to Sri Lanka and identify methods of forecasting them?

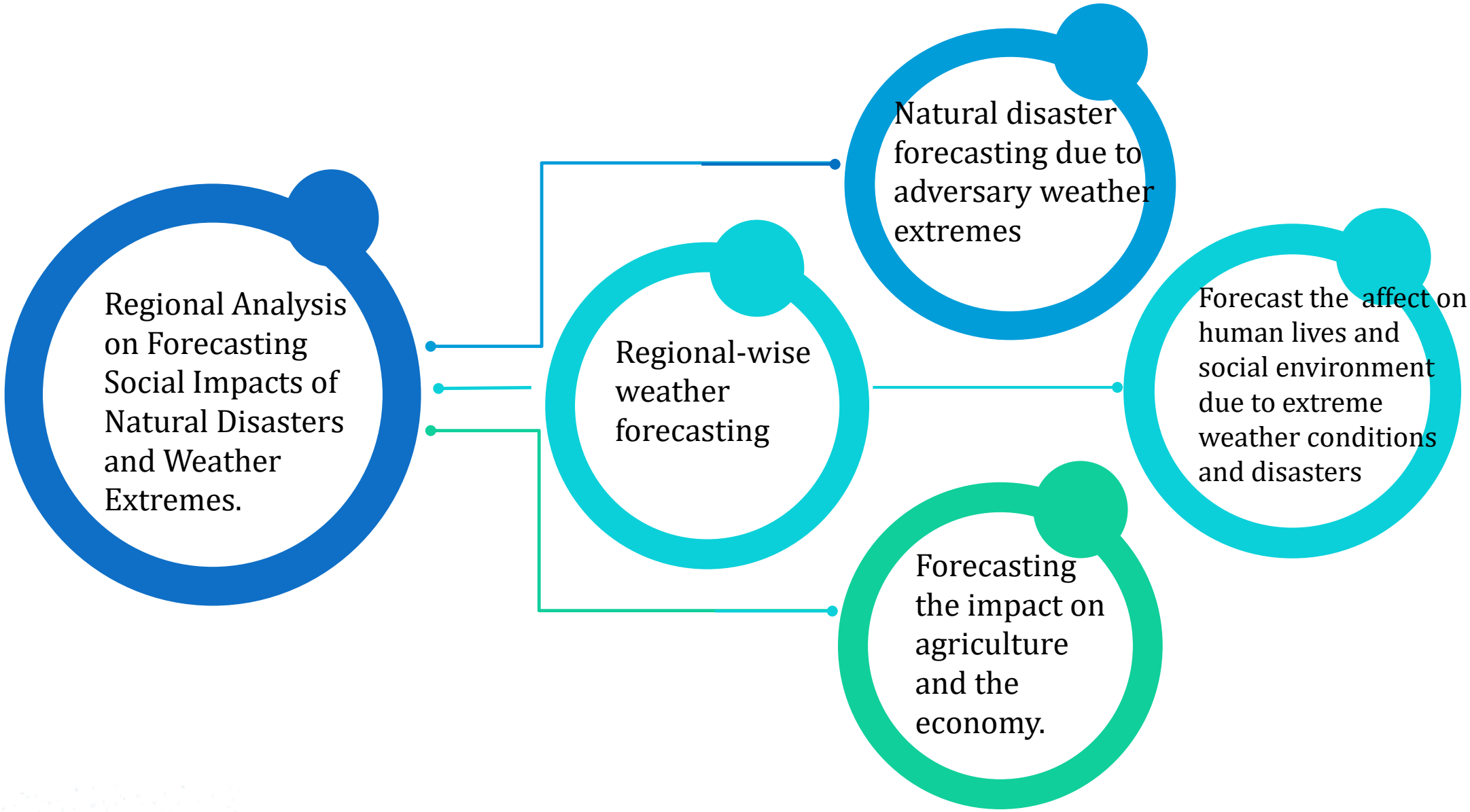
03

How to identify and forecast agricultural and economical impact due to extreme weather conditions ?

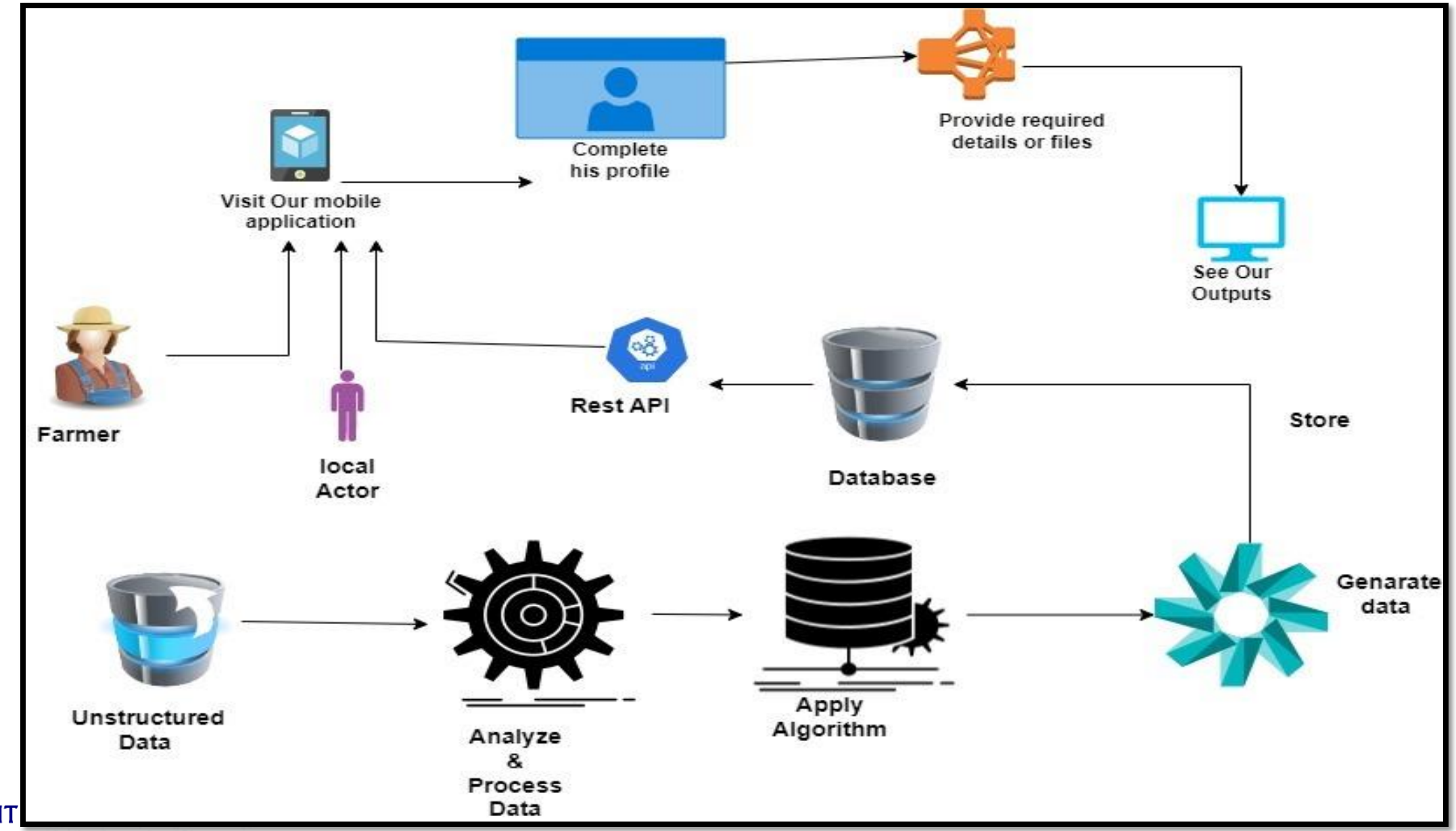
04

How to identify and forecast social impact of human lives due to extreme weather conditions and disasters ?

Specific Objectives & Sub Objectives



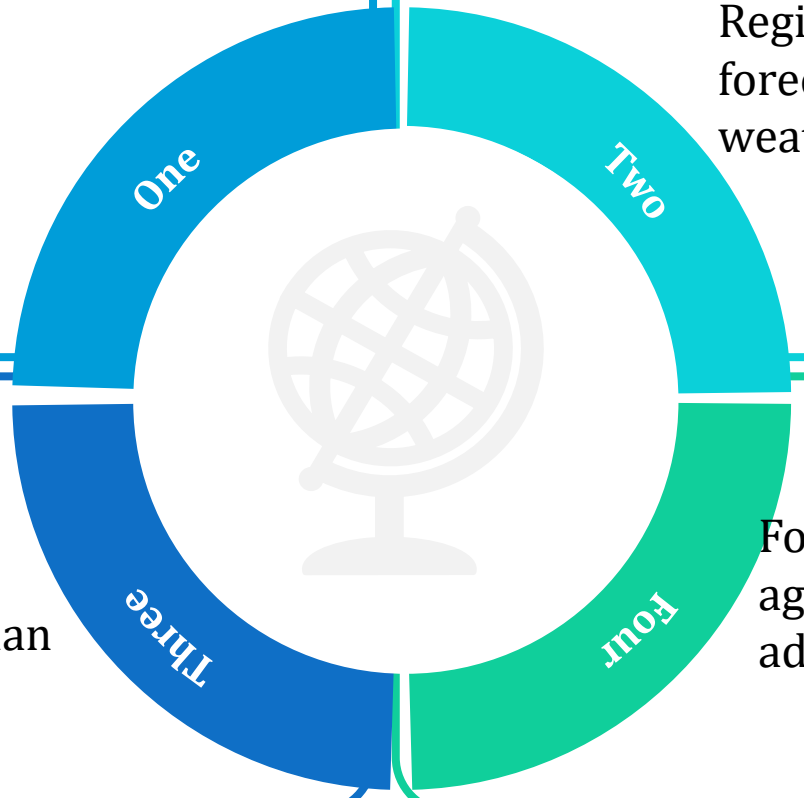
System Overview Diagram



Individual Function Overview

Develop a machine learning model for weather forecasting

Regional-wise natural disaster forecasting due to adversary weather extremes



Developing a machine learning model to predict effect on human and social environment due to natural disasters.

Forecasting the impact for agriculture and economy due to adversary weather extremes

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Background

- Weather affects several field such as people's health and lifestyles, the economy, agriculture, transportation, energy consumption and tourism in a country
- Weather forecasting is essential for helping people to plan their daily activities, make informed decisions about travel and outdoor events, helping framers manage crop cultivation
- weather extremes bring some natural disasters such as flood, landslide, drought. So it is important to prepare natural disasters. weather forecasting helps people to prepare the disasters

Research Question

01	How can machine learning and artificial intelligence be used to improve the accuracy of weather forecasts?
02	Which weather parameters to be forecasted and which frequent are they forecast? (hourly, daily, weekly, monthly)
03	What is the best machine learning model to forecast weather indicators ?

Summary of literature review

Ref	Functionality	Support Vector Machines	Neural Networks	Random Forest	Artificial Neural Network	Long Short-Term Memory (LSTM) Networks
1.	A Comprehensive Study on Weather Forecasting using Machine Learning				✓	✓
2.	Weather Forecasting Using Machine Learning Algorithm	✓		✓	✓	
3.	Machine Learning Based Weather Prediction Model for Short Term Weather Prediction in Sri Lanka	✓			✓	✓
4.	Machine Learning for Applied Weather Prediction	✓	✓	✓	✓	
5.	Regional wise weather forecasting	✓	✓			✓

Objectives

Main Objective

Developing a machine learning model for regional wise weather forecasting.

Sub Objectives

- Identify the which weather parameter to be forecast?
- Identify the respective frequent parameters to be forecast?
- Identify the region which has highest weather affect?
- Identify the most accurate weather forecasting?

Solution and specification

- We hope to build an weather forecasting system using machine learning and AI develop a mobile application with weather alert.

- It will be a regional weather forecasting system which will rate each regions based on weather conditions .

Methodology

Weather Attributes

- Precipitation(Daily, Weekly & Monthly)
- Humidity (Daily)
- Maximum Temperature
- Minimum Temperature
- Average Temperature
- Wind Speed

Data available

- Department meteorology Sri Lanka

Machine learning Models and algorithms

- Artificial Neural Networks (ANNs)
- Long Short-Term Memory (LSTM) Networks
- Support Vector Machines (SVMs)
- Random Forests

Work Breakdown Chart

Initiation	Planning	Designing	Implementation	Finalization
Finding a Supervisor	Develop project plan and timeline.	Develop data collection and cleaning plan	Collect and clean data according to the data plan	Conduct user satisfaction tastings
Background Studies on the topic	Create a detailed requirement specification	Design data architecture and database schema	Model Identification	Do necessary changes according to the testing outcome and user feedbacks
Define project scope and objectives	Set up development environment and tools	Design over roll use case diagram for the model	Train personalization module	Deploy the application to get efficient and accurate outcome
Research on available datasets and tools	Identify team roles and responsibilities.	Develop user interface design and user experience flow	Implement algorithms for personalized recommendations	
			Integrate module with third party APIs and collected data.	

References

1. Deepti Mishra GLBajaj Institute of Technology & Management, Greater Noida, India itsdeepti.s@gmail.com, Pratibha Joshi GLBajaj Institute of Technology & Management, Greater Noida, India joshipratibha1916@gmail.com2, "A Comprehensive Study on Weather Forecasting using Machine Learning".
2. K.M.S.A. Hennayake, Randima Dinalankara, Dulini Yasara Mudunkotuwa, "Machine Learning Based Weather Prediction Model for Short Term Weather Prediction in Sri Lanka. Department of Computer Engineering Faculty of Engineering University of Sri Jayewardenepura
3. Machine Learning Based Weather Prediction Model for Short Term Weather Prediction in Sri Lanka.
4. Nitin Singh, Saurabh Chaturvedi, Shamim Akhter, Department of Electronics and Communication Engineering Jaypee Institute of Information
5. Naveen L Mohan H S Research Scholar Professor and Head,naveenlingaraju@gmail.com. Department of ISE, SJBIT mohan_kit@yahoo.com,
6. J. S. A. N. W. Premachandra ; P. P. N. V. Kumara, " A novel approach for weather prediction for agriculture in Sri Lanka using Machine Learning techniques"
7. T. Dananjali, S. Wijesinghe, J. Ekanayake, "Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka Belihuloya, Sri Lanka "," Forecasting Weekly Rainfall Using Data Mining Technologies "

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Background

- Floods and Landslides are the most commonly occurring natural disasters in Sri Lanka.

- Past major flood and landslide situations in Sri Lanka.
  - May 2017: Major flooding and landslides situation in Kalutara, Ratnapura, and Matara. Over 200 people were killed.
  - May 2016: Major flooding and landslides situation in districts of Kegalle and Colombo. Over 100
  - December 2014: heavy rainfall and flooding in districts of Kilinochchi, Mannar, and Mullaitivu. 30

Regional wise natural disaster forecasting due to adverse weather extremes.

Research Questions

How to use data efficiently to improve the prediction and early warning systems to a specific geographical region?

Literature Review Summary

Ref	Research Paper	Artificial Neural Network	Support Vector Machine	K-Nearest Neighbors	Random Forest	Decision Tree	Long Short-Term Memory	Linear Regression
[1]	Prediction of Floods, Evacuation Plan and Reservoir Inflow, Based on Deduru Oya Basin.	✓	✓	✓			✓	
[2]	Flood Forecasting with Machine Learning Technique.	✓				✓		✓
[3]	Development of a Flood Forecasting Model For Kelani River			✓				
[4]	landslide prediction using machine learning models		✓		✓	✓		
[5]	machine learning algorithms to predict landslides in Kegalle district				✓	✓		
[6]	Flood prediction using machine learning in Mahaweli river basin		✓		✓			
	Regional wise natural disaster Forecasting due to adverse weather extremes.		✓		✓	✓		

Objectives

Main Objective

Regional wise natural disaster forecasting due to adverse weather extremes.

Sub Objectives

Flood occurrences prediction using machine learning model.

Landslides occurrences prediction using machine learning model.

Develop a warning system .

Solution and the Specification

- We hope to make a disaster forecasting system based on machine learning as well as a warning system using mobile technologies.

- This specific study, prediction is made for two specific disasters such as floods and landslides for a specific region at the same time.

Methodology

1. Data Collection and the Availability.

- Department of Meteorology.
- Disasters Recovery Center.
- Department of Irrigation.

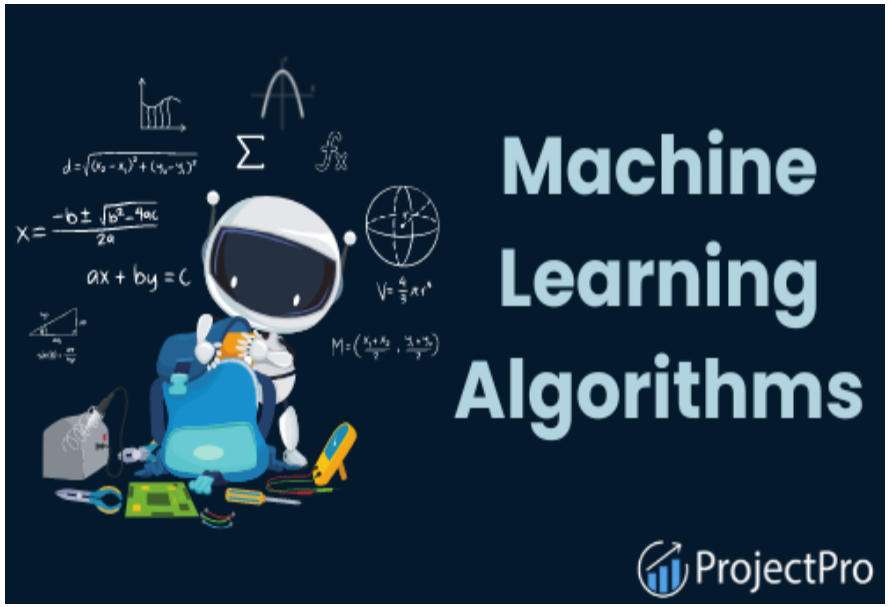
2. Available data parameters and Indicators.

- Flood prediction Indicators :-
  - precipitation(mm)
  - Water levels(m)
  - Discharge Amount(m^3s^{-1})
  - Catchment Area (Km^2)
  - Elevation
  - Topographical slop.
  - Soil Type.
  - Land Cover.

- Landslide prediction Indicators :-
  - precipitation(mm)
  - Water levels(m)
  - lithology.
  - Soil depth.
  - Slope.
  - Distance From the rivers and roads
  - Soil Type ,Aspect.
  - Land Cover.

❑Machine learning models/ Algorithms :-

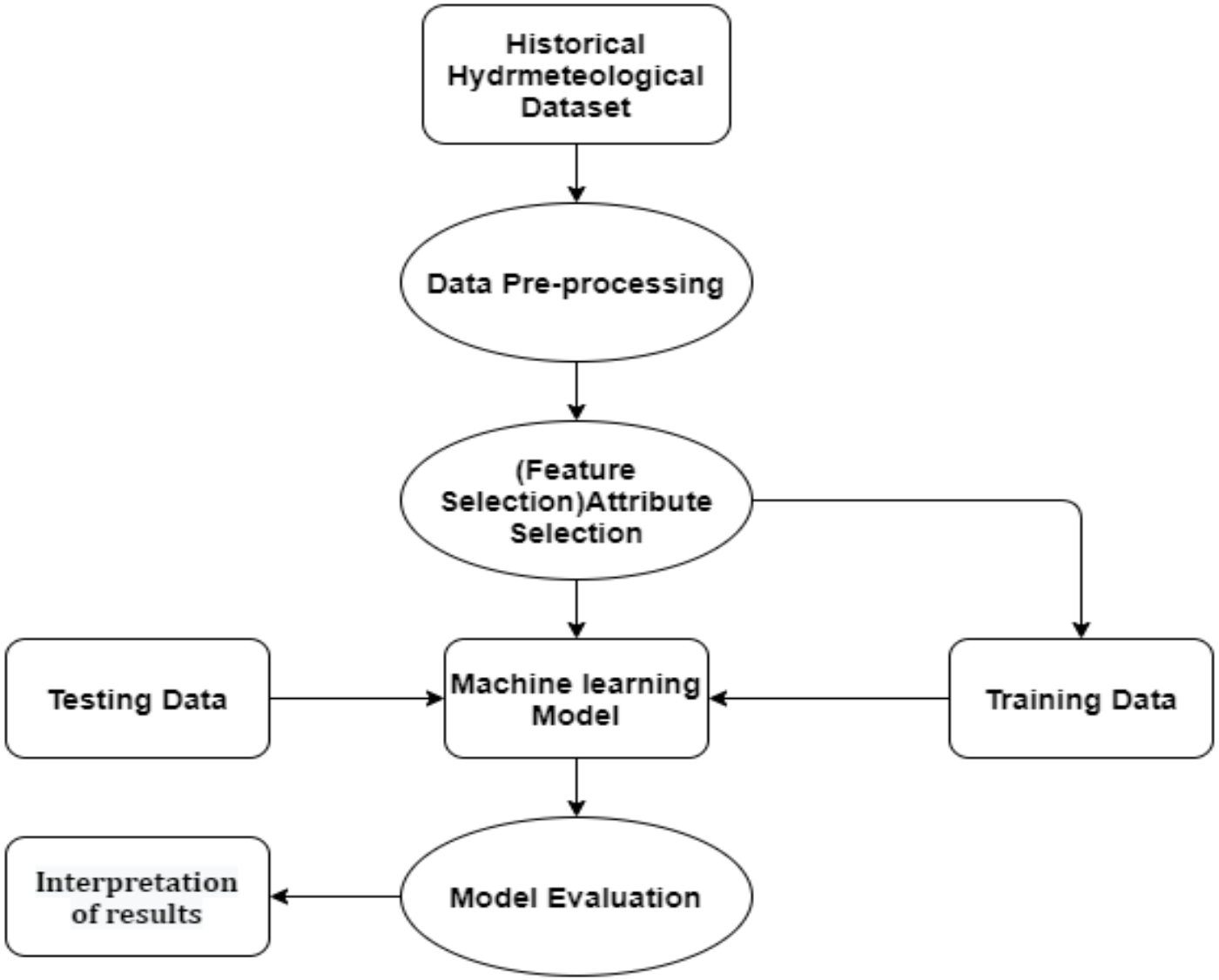
- Support Vector Machine.
- Decision Tree.
- Random Forest.



❑Model Accuracy evaluation metrics :-

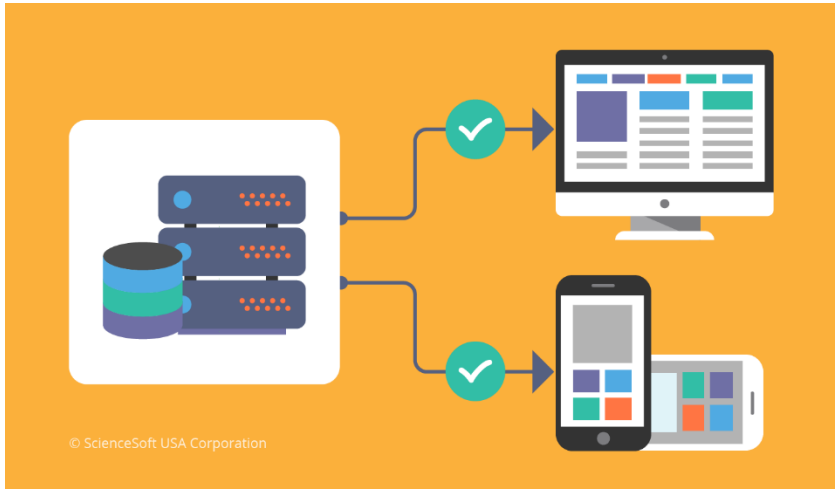
- Precision
- Recall
- F1 score
- Confusion Matrix

Proposed architecture for the individual component.



Completion of the Project

- Predicting the occurrences of the natural disasters such as Flood and Landslide.
- Machine learning model development and preview the interpretation of the result through the mobile application.
- Create an alert message warning system through the mobile application with the actions as well.



References

[1].Thiman Krishly, B.H Sudantha, Dilanka Tharindri “Water Level Modelling and Prediction of Floods, Evacuation Plan and Reservoi Inflow, Based on Deduru Oya Basin, Sri Lanka” Thiman Krishly, B.H Sudantha University of Moratuwa.

[2]. “Flood Forecasting with Machine Learning Technique on Hydrological Modeling” Jeerana NOYMANEEaITMO University, 49 Kronverksky Pr. St. Petersburg, 197101, Russian FederationbDigital Government Development Agency (Public Organization) (DGA)cAcademy of Science, the Royal Society .

[3]. Development of a Flood Forecasting Model For Kalu River and Kelani River Basins in Sri Lanka using Radial Basis Function Neural Networks Seenipellage Chaminda Sugeeswara Supervisor: Prof. A. W. Jayawardena.

[4]. Perera et al. (2019) “landslide prediction using machine learning models in Sri Lanka”.

[5]. Gunarathna et al. (2020) “machine learning algorithms to predict landslides in the Kegalle district of Sri Lanka”

[6]. Jayawardena et al. (2021) “Use of machine learning algorithms for flood prediction in the Mahaweli river basin in Sri Lanka”

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Impact of natural disasters and adverse weather conditions on human life and social environment.

Background

- Natural disasters and adverse weather can impact human life and its basic needs.
- Infrastructure damage and endangered lives are high risks.
- Diseases spread faster due to abnormal weather patterns and natural disasters.
- Preparedness is critical for individuals and communities to face such emergencies.
- Disaster relief efforts are critical to providing immediate assistance to affected communities.

Research Question

01	What are some of the consequences Sri Lanka has faced due to floods and landslides that have occurred in recent years?
02	How has the disruption of basic services like water, food, and healthcare due to natural disasters and adverse weather events impacted Sri Lanka's social environment?
03	What are some ways that the fishing and aviation industries can adapt to cope with adverse weather conditions caused by climate change, which can threaten human life and infrastructure?

Summary of literature review

Ref	Functionality	Support Vector Machines	Neural Networks	Decision Tree	Random Forest	K-Nearest Neighbors	Bayesian Networks
1.	Weather conditions contribute to the spread of diseases.	✓		✓			
2.	Loss of life in certain areas due to severe weather and mitigation practices.		✓				✓
3.	Predicting bad weather damage to people.				✓	✓	
4.	A warning message about areas of bad weather.	✓			✓		
5.	Ability to receive and notify mining industry workers about severe weather.	✓		✓	✓		✓

Why is this component specific?

- Historical data aids in accurate predictions
- Vulnerable populations and infrastructure can be identified.
- Real-time monitoring and timely action.
- Mobile application warnings.
- Predictive focus on minimizing damages.
- More effective disaster response strategies.

Objectives

Main Objective

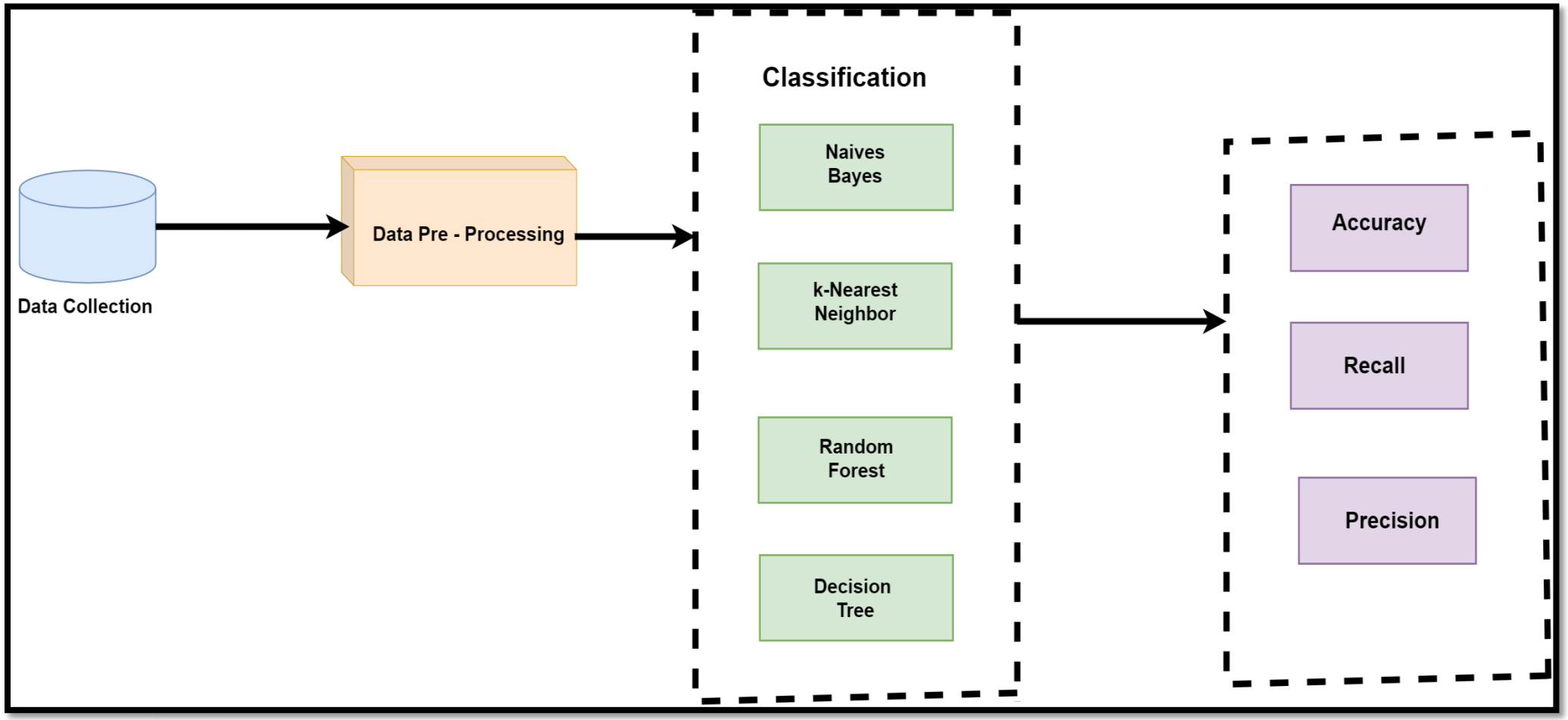
✓A study of how adverse weather patterns affect people's lives, infrastructure, and disease spread in their daily lives.

Sub Objectives

- Describe the process for assessing human impact and infrastructure at the regional level.
- Prediction and early warning systems
- Infrastructure resilience and adaptation
- Informing about the spread of diseases

Methodology

System Diagram



Methodology

- **Data collection** -ministry of disaster management and Provincial General Hospital, preprocess relevant data related to the impact of natural disasters, such as meteorological data, health records, and human impact data. The data must be cleaned and formatted to be compatible with machine learning models.
- **Feature selection and engineering**
- **Model selection and training:** select appropriate machine learning models for the specific research question, such as regression models, neural networks, or decision trees.
- **Model evaluation:** the accuracy and performance of the trained models using appropriate metrics, such as root mean square error or area under the curve.
- **Interpretation of results**

Completion of the project

- Creates a mobile and web application
- Showing areas of people at risk through the web application. Predicting the properties of people affected by the disaster.
- A web application has been developed to show a presentation about the speed of various diseases.
- Sending a notification to the area residents in advance about various adverse weather.
- The mobile application also provides information about epidemic conditions spreading due to severe weather in the area.
- Informs persons engaged in the mining industry whether it is suitable to work in the area.

References

- Ghulam Mudassir, Antinisca Di Marco *Department of Information Engineering Computer Science and Mathematics University of L'Aquila, Italy* ghulam.mudassir@graduate.univaq.it, antinisca.dimarco@univaq.it "Social-based City Reconstruction Planning in case of natural disasters: a Reinforcement Learning Approach"
- Vinay Chamola , *Senior Member, IEEE*, Vikas Hassija , Sakshi Gupta , Adit Goyal , Mohsen Guizani , *Fellow IEEE*, and Biplab Sikdar , *Senior Member, IEEE"* Disaster and Pandemic Management Using Machine Learning: A Survey"
- K. Shibata and H. Yamamoto, "People crowd density estimation system using deep learning for radio wave sensing of cellular communication,"
- R. Xie, I. Khalil, S. Badsha, and M. Atiquzzaman, "Collaborative extreme learning machine with a confidence interval for P2P learning in healthcare,"

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Research on available datasets and tools	Identify team roles and responsibilities.	Develop user interface design and user experience flow	Implement algorithms for personalized recommendations	
			Integrate module with third party APIs and collected data.	

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Forecasting the impact for agriculture and economy due to adversary weather extremes

Background

01 agriculture is one of the main sectors of the Sri Lankan economy

02 Sri Lanka has a rich agricultural history

Research Question

01	There is a no suitable Forecasting the impact for agriculture and economy due to adversary weather extremes
02	Mainly focus for paddy only agriculture.

SUMMARY OF LITERATURE REVIEW

Ref	Functionality	Artificial Neural Network	Support Vector Machines	K-Nearest Neighbors	Random Forest	Decision Tree
1	Evaluation of feature subsets for prediction of paddy crop yield	✓		✓		
2	Crop classification		✓			
3	Crop classification		✓		✓	
4	Prediction of rice grain yield				✓	
5	Prediction of potato yield via Sentinel 2 satellite data	✓			✓	
6	Prediction of rice grain yield		✓		✓	
	Forecasting the impact for agriculture and economy due to adversary weather extremes	✓	✓			✓

Research Specific

01	Most of the research has done the forecasting for paddy only.
02	this research analysis is for paddy, fruit, and vegetables.

Objectives

Main Objective

Forecasting the impact for agriculture and economy due to adversary weather extremes

Sub Objectives

- Prediction of paddy, fruit, and vegetables yield
- Forecasting the impact for agriculture
- Estimate the fertilizer for paddy, fruit, and vegetables
- Forecasting the impact for economy

Methodology

Agriculture economic Attributes

Extent Cultivated(hectares)
Harvested(hectares)
Production(Mt)
Crop Yield average(kg)
weather patterns
Soil quality

Thirty years of historical Data(30 years)

Data available

Department of Agriculture
Socio Economic Planning center Peradeniya. (SEPC)
Ministry of Agriculture Battaramulla.

Machine learning algorithm/models

Decision Tree(DTs)

classification and regression

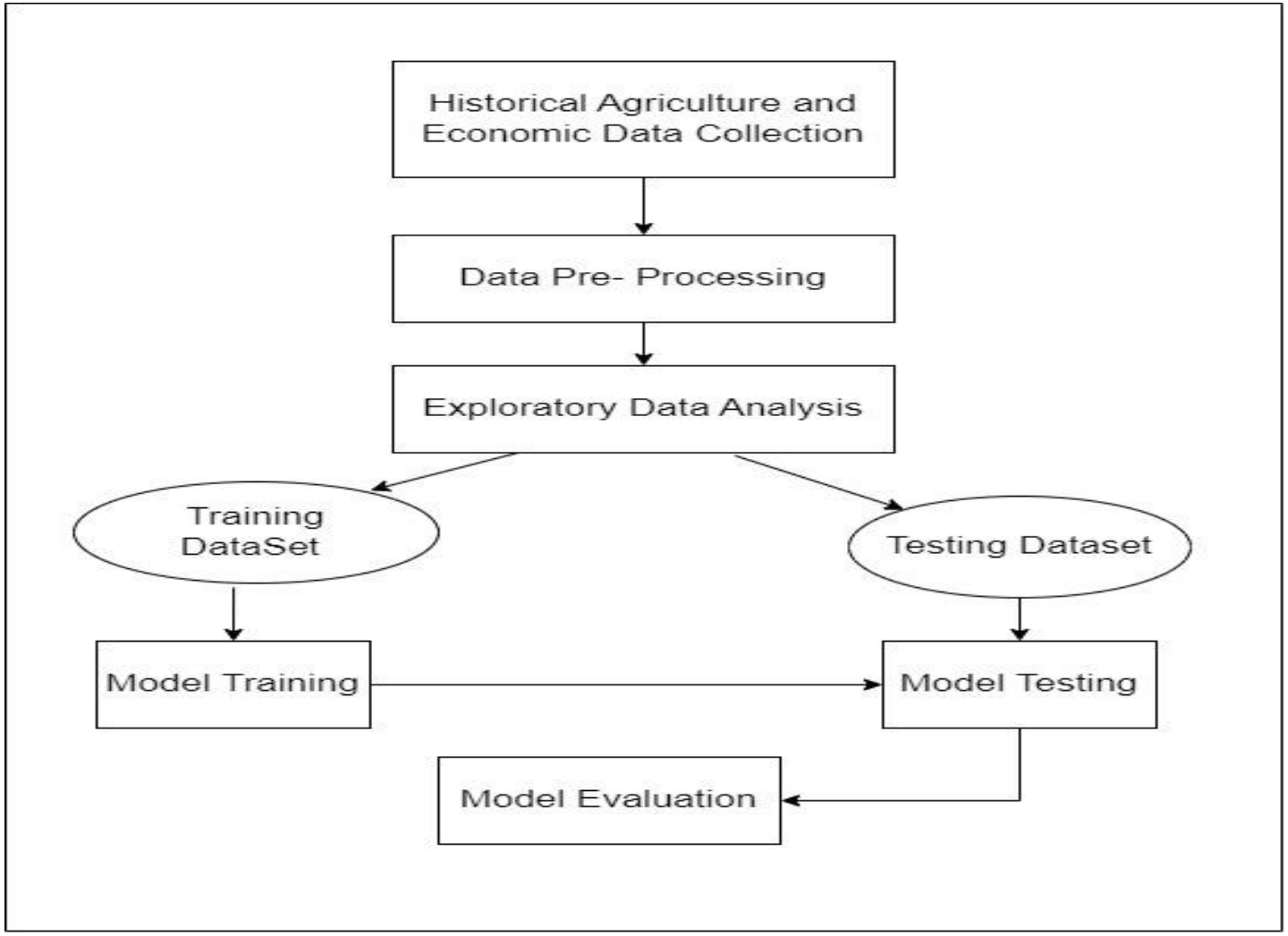
Artificial Neural Network(ANNs)

classification, regression and pattern recognition

Support Vector Machines(SVMs)

type of supervised learning algorithm used for classification and regression analysis.

Proposed architecture



Completion of the project

- Creates a mobile and web application
- Prediction of paddy, fruit, and vegetables yield using mobile and web application.
- Forecasting the impact for agriculture and economy using mobile and web application.

- Help full for
  - Government
  - Farmer
  - Import market
  - Export market

References

1.Maya Gopal P. S. and Bhargavi R.School of Computing Science and Engineering, VIT University, Chennai, India(Performance Evaluation of Best Feature Subsets for CropYield Prediction Using Machine Learning Algorithms)

2. Shelestov, A.; Lavreniuk, M.; Vasiliev, V.; Shumilo, L.; Kolotii, A.; Yailymov, B.; Kussul, N.; Yailymova, H. Cloud Approach to Automated Crop Classification Using Sentinel-1 Imagery. IEEE Trans. Big Data 2020, 6, 572–582.

3. College of Resources and Environment, Southwest University, Chongqing 400716, China; love960223@email.swu.edu.cn(Mapping Rice Paddy Based on Machine Learning with Sentinel-2 Multi-Temporal Data: Model Comparison and Transferability)

4.Grain yield prediction of rice using multi-temporal UAV-based RGB and multispectral images and model transfer – a case study of small farmlands in the South of China

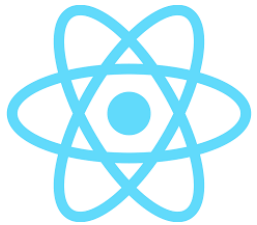
5. Remote Sensing Laboratory (LATUV), University of Valladolid, Paseo de Belen 11, 47011 Valladolid, Spain * Correspondence: diego.gomez.aragon@gmail.com or diego@latuv.uva.es(Potato Yield Prediction Using Machine Learning Techniques and Sentinel 2 Data)

6.Wan, L.; Cen, H.; Zhu, J.; Zhang, J.; Zhu, Y.; Sun, D.; Du, X.; Zhai, L.; Weng, H.; Li, Y.; et al. Grain yield prediction of rice using multi-temporal UAV-based RGB and multispectral images and model transfer—A case study of small farmlands in the South of China. Agric. For. Meteorol. 2020, 291, 108096.

Technologies and Tools

Technologies
React Native Node js Python Firebase

Tools
Git Figma Draw.io VS Code Postman

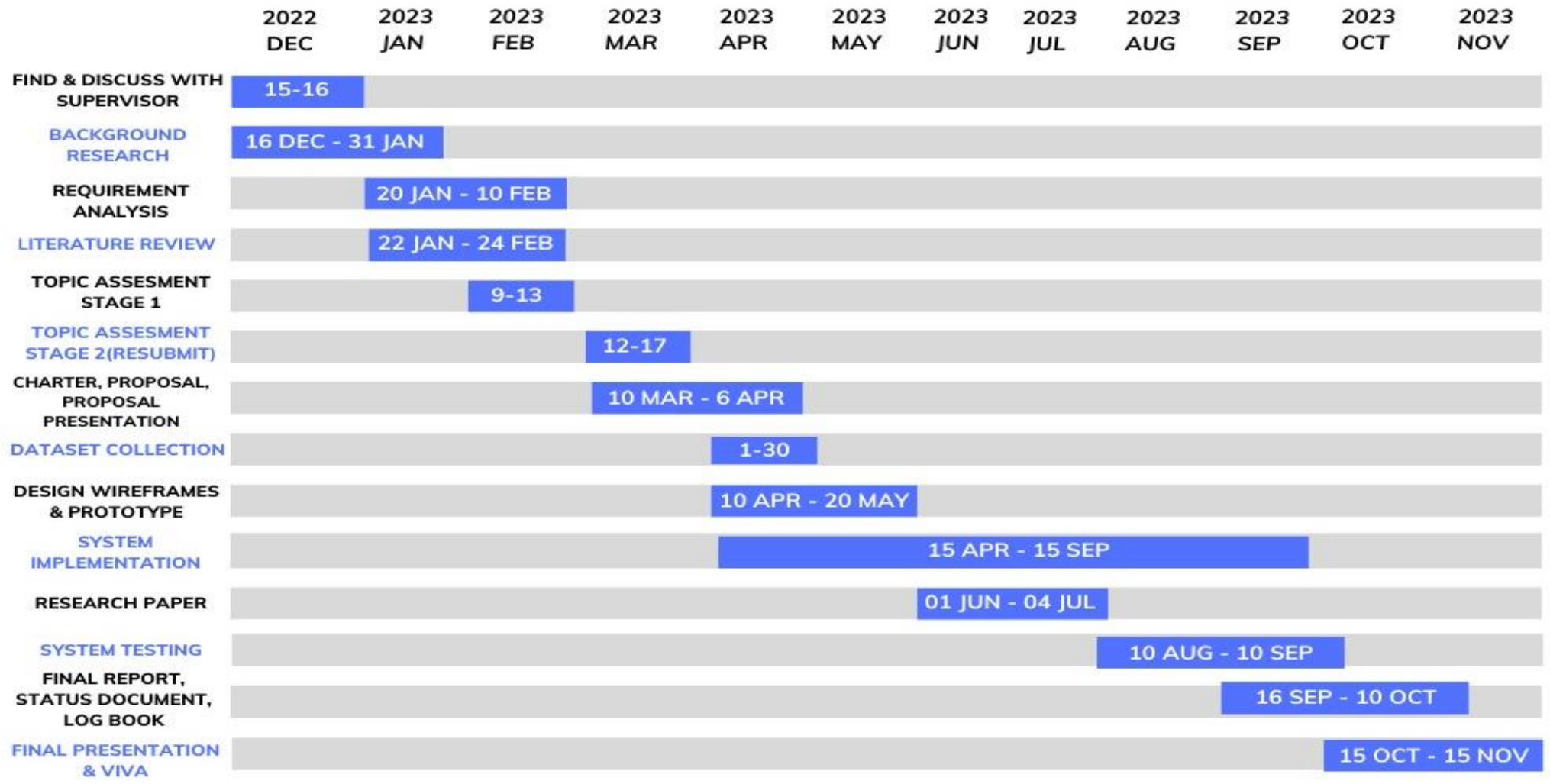


Commercialization

Commercialization:

- We Plan to commercialize this by targeting mainly on civilians in relevant regions.
- We hope to provide this system as a recommendations system to the department of Meteorology and the Department of Disaster Management.

Gantt Chart


2022 DEC
2023 JAN
2023 FEB
2023 MAR
2023 APR
2023 MAY
2023 JUN
2023 JUL
2023 AUG
2023 SEP
2023 OCT
2023 NOV
FIND & DISCUSS WITH SUPERVISOR
15-16
BACKGROUND RESEARCH
16 DEC - 31 JAN
REQUIREMENT ANALYSIS
20 JAN - 10 FEB
LITERATURE REVIEW
22 JAN - 24 FEB
TOPIC ASSESMENT STAGE 1
9-13
TOPIC ASSESMENT STAGE 2(RESUBMIT)
12-17
CHARTER, PROPOSAL, PROPOSAL PRESENTATION
10 MAR - 6 APR
DATASET COLLECTION
1-30
DESIGN WIREFRAMES & PROTOTYPE
10 APR - 20 MAY
SYSTEM IMPLEMENTATION
15 APR - 15 SEP
RESEARCH PAPER
01 JUN - 04 JUL
SYSTEM TESTING
10 AUG - 10 SEP
FINAL REPORT, STATUS DOCUMENT, LOG BOOK
16 SEP - 10 OCT
FINAL PRESENTATION & VIVA
15 OCT - 15 NOV

Budget Justification

Description	Amount (Rs)
Traveling fee	3000.00
Dataset Charges	5000.00
Hosting Fees	8000.00
Other Charges	2000.00
Total Amount	18000.00

THANK YOU !

Q & A