A Minor Project Report on

"Weather Forecasting using LoRa and Machine Learning"

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Introduction

- Weather forecasting using LoRa is a simplified and cost effective method for predicting weather.

- We will be using it to predict real time weather condition at high altitudes.

Problem Statement

- Done using Satellite Communication
    - Expensive
    - Limited Coverage
    - Power Limitation
    - Latency
    - Signal Degradation

- Cellular Communication(3G, 4G) not possible

Objectives

- To develop LoRa communication system for real time weather data transmission.

- To design and implement prototype system for real time weather forecasting.

- To investigate the use of machine learning algorithms for weather prediction.

Literature Review

- Machine Learning can perform better than the traditional mathematical models in the scope of weather prediction over time through research into related work coupled with our experimentation.[5]

- Recently, there has been growing interest in the possibility of using neural networks for both weather forecasting and the generation of climate datasets.[10]

- LoRa can be considered as a good candidate in solving the complexity of the problems in the development of IoT in the next future.[2]

- The experiment with LoRa transmission has shown that the LoRa technology is very suitable for the air pollution system especially in long range transmission compared to other wireless transmission techniques.[11]
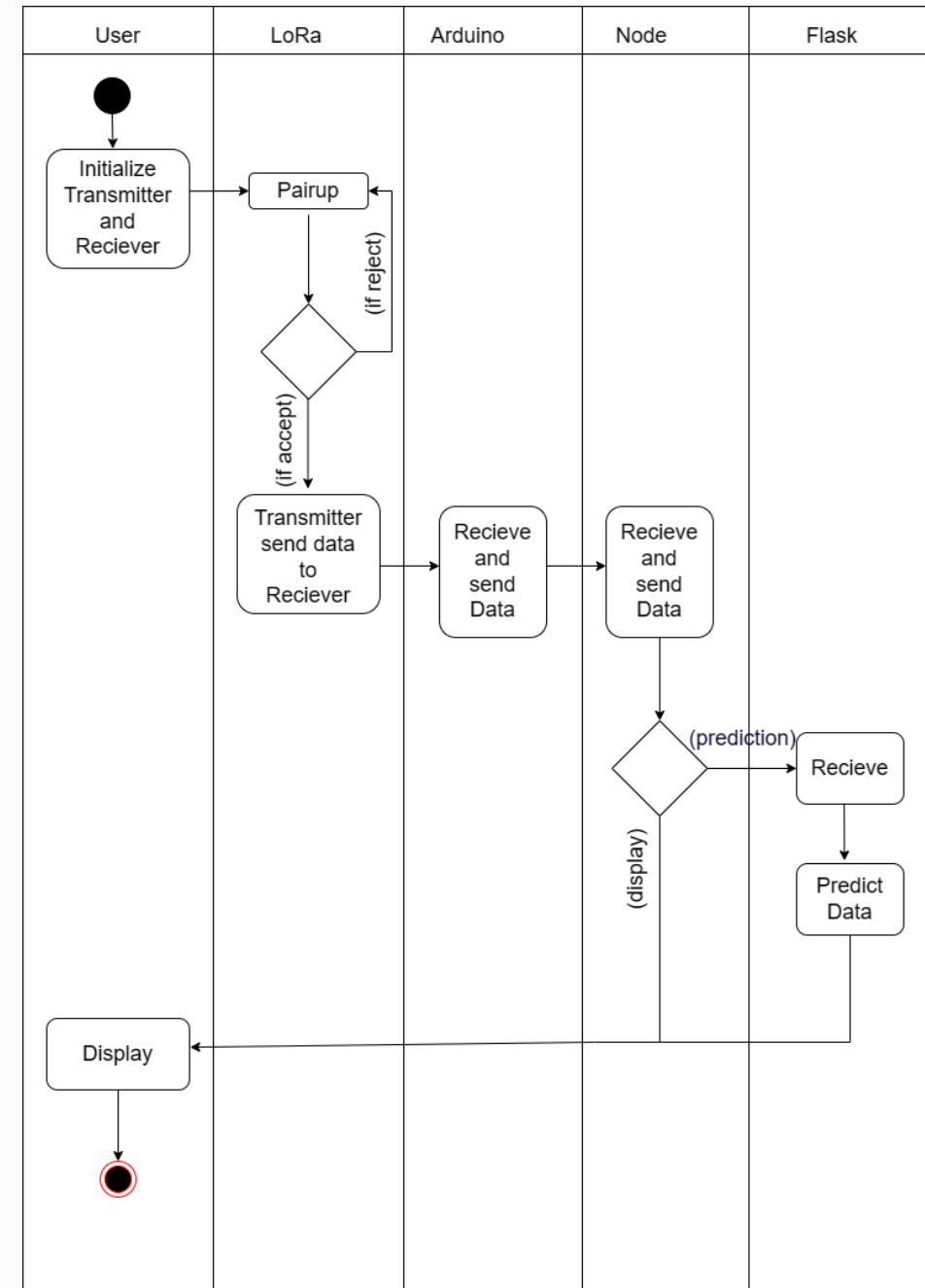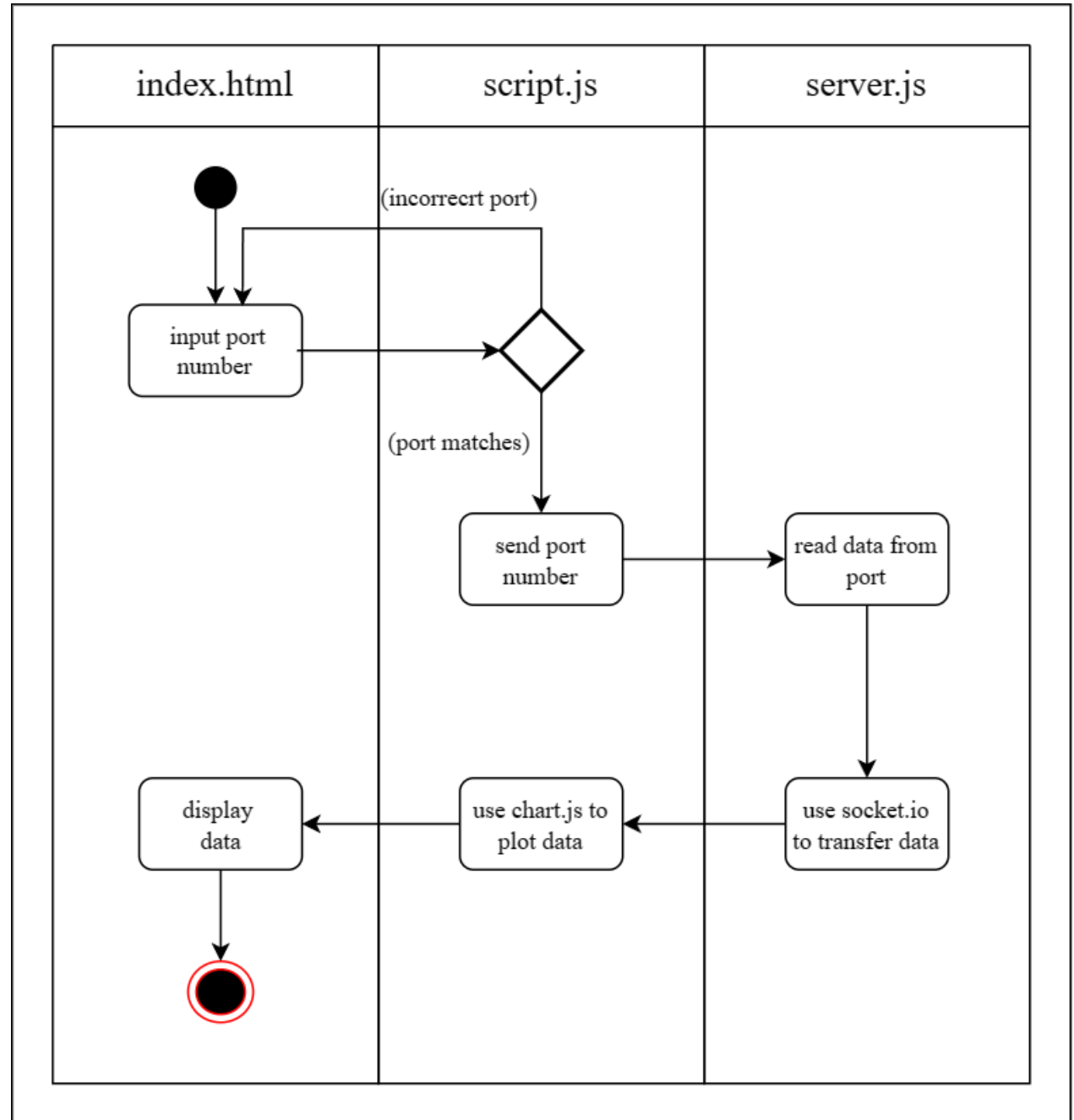
Methodology

1) System Block Diagram
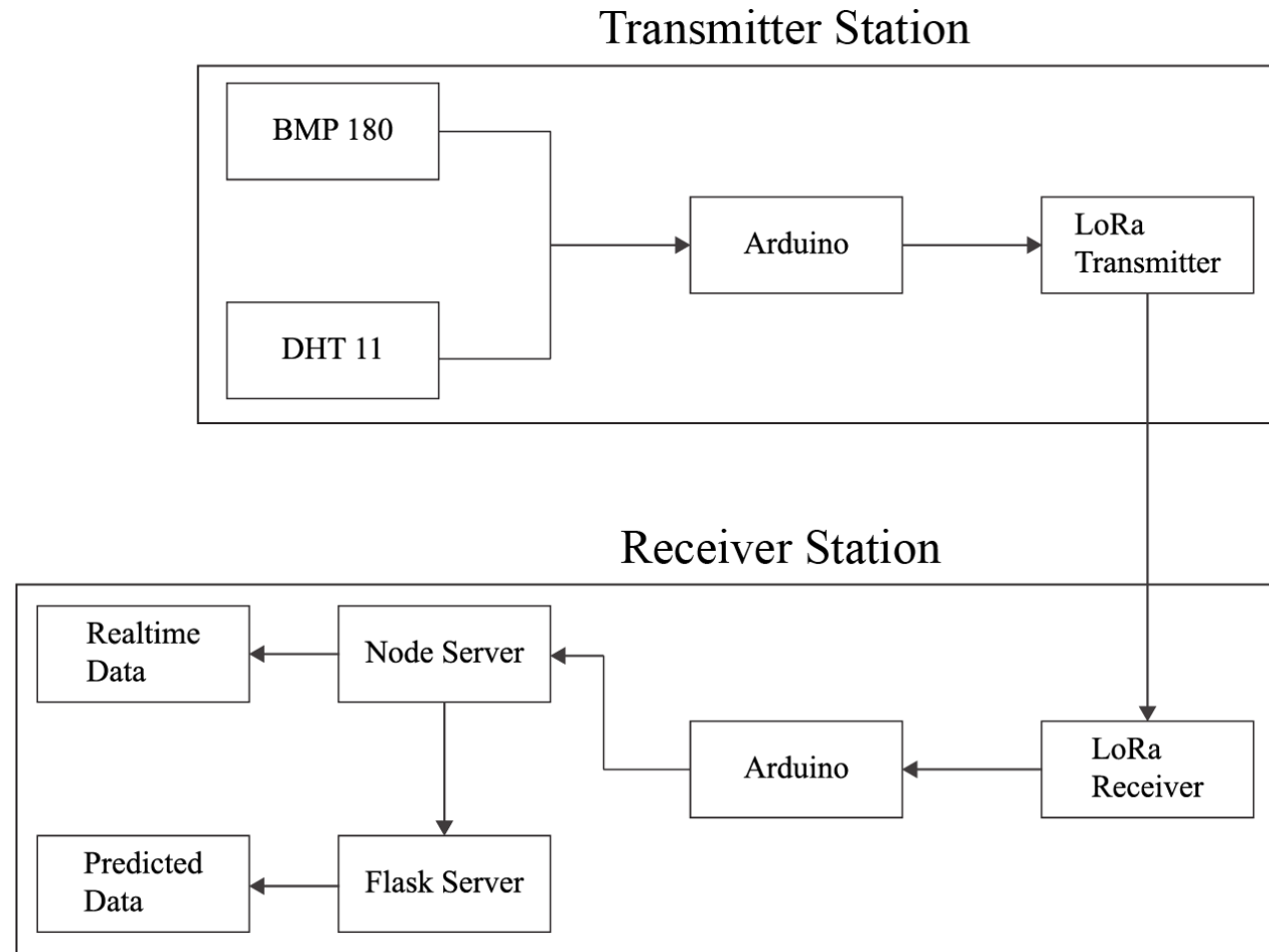
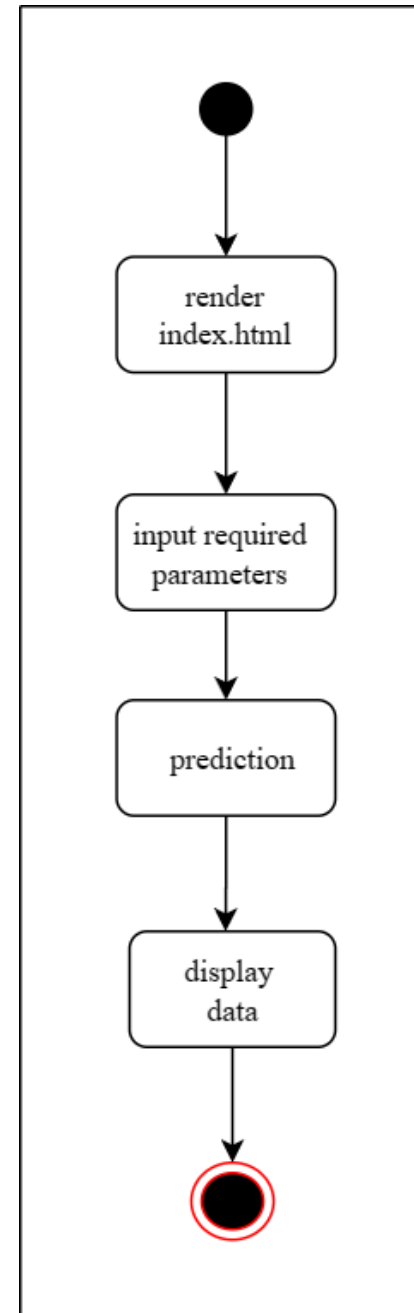# Methodology

2) System Activity Diagram
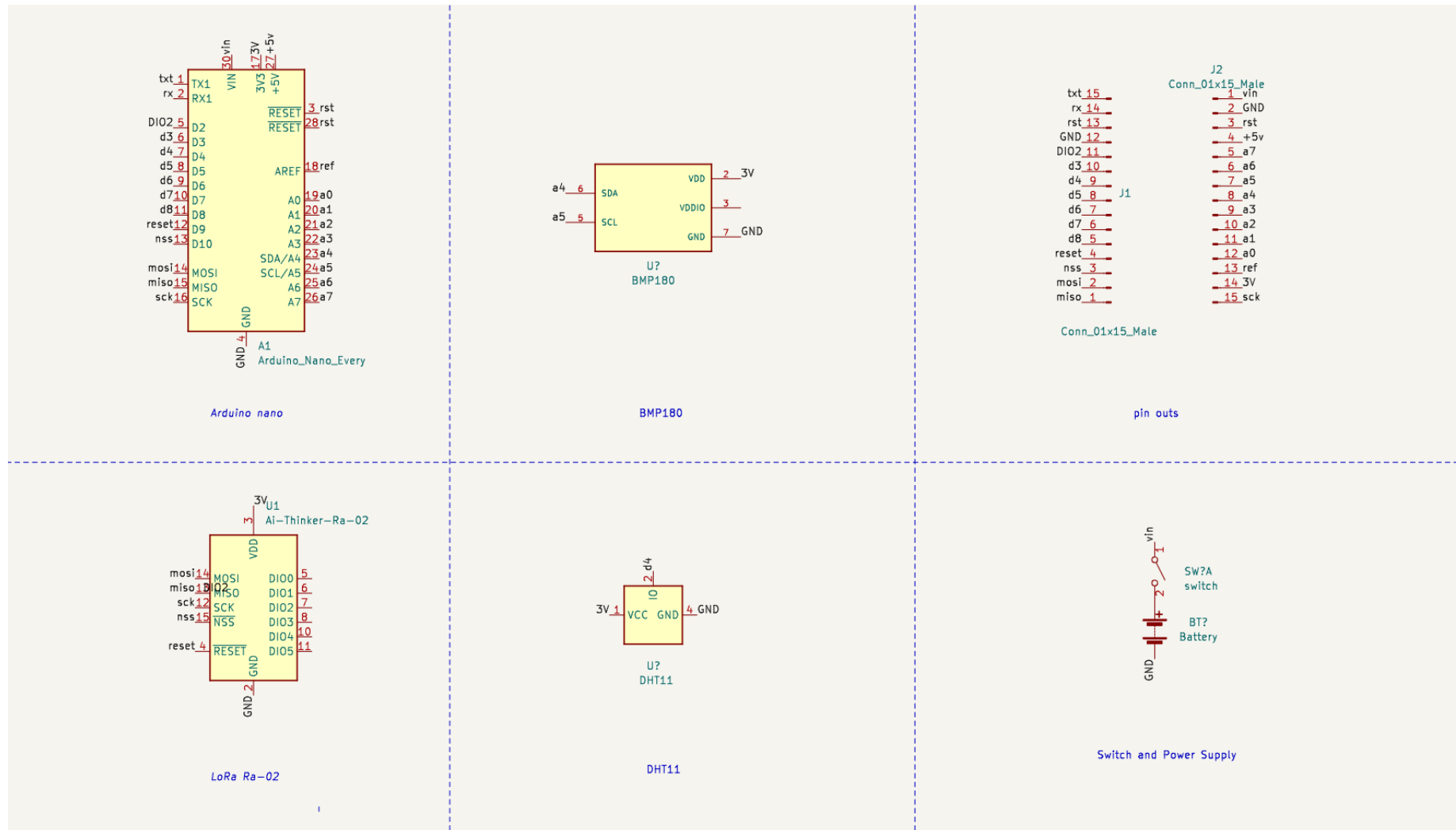
Methodology

3) Node Activity Diagram

Methodology

4) Flask Activity Diagram

Methodology

5) System Circuit Diagram

Methodology

- Weather data from BMP 180 and DHT 11 sensor are transmitted from transmitter to receiver section using LoRa.

- Arduino at receiver station sends the sensor data to the Node Server.

- Node server displays the live weather data using chart.js.

- Node servers calls API to Flask server for weather prediction.

- Flask server calls machine learning model when user enters input parameters for weather prediction.

Methodology

6) Machine Learning Pipeline

a. Data collection for model training.

b. Data filtering

	Formatted Date	Summary	Precip Type	Temperature (C)	Apparent Temperature (C)	Humidity	Wind Speed (km/h)	Wind Bearing (degrees)	Visibility (km)	Loud Cover	Pressure (millibars)	Daily Summary
0	2006-04-01 00:00:00.000 +0200	Partly Cloudy	rain	9.472222	7.388889	0.89	14.1197	251.0	15.8263	0.0	1015.13	Partly cloudy throughout the day.
1	2006-04-01 01:00:00.000 +0200	Partly Cloudy	rain	9.355556	7.227778	0.86	14.2646	259.0	15.8263	0.0	1015.63	Partly cloudy throughout the day.
2	2006-04-01 02:00:00.000 +0200	Mostly Cloudy	rain	9.377778	9.377778	0.89	3.9284	204.0	14.9569	0.0	1015.94	Partly cloudy throughout the day.
3	2006-04-01 03:00:00.000 +0200	Partly Cloudy	rain	8.288889	5.944444	0.83	14.1036	269.0	15.8263	0.0	1016.41	Partly cloudy throughout the day.
4	2006-04-01 04:00:00.000 +0200	Mostly Cloudy	rain	8.755556	6.977778	0.83	11.0446	259.0	15.8263	0.0	1016.51	Partly cloudy throughout the day.

Unfiltered Data

|	Date & Time	Temp	RH	press
0	2006-04-01 00:00:00.000 +0200	9.472222	0.89	1015.13
1	2006-04-01 01:00:00.000 +0200	9.355556	0.86	1015.63
2	2006-04-01 02:00:00.000 +0200	9.377778	0.89	1015.94
3	2006-04-01 03:00:00.000 +0200	8.288889	0.83	1016.41
4	2006-04-01 04:00:00.000 +0200	8.755556	0.83	1016.51

Filtered Data

Methodology

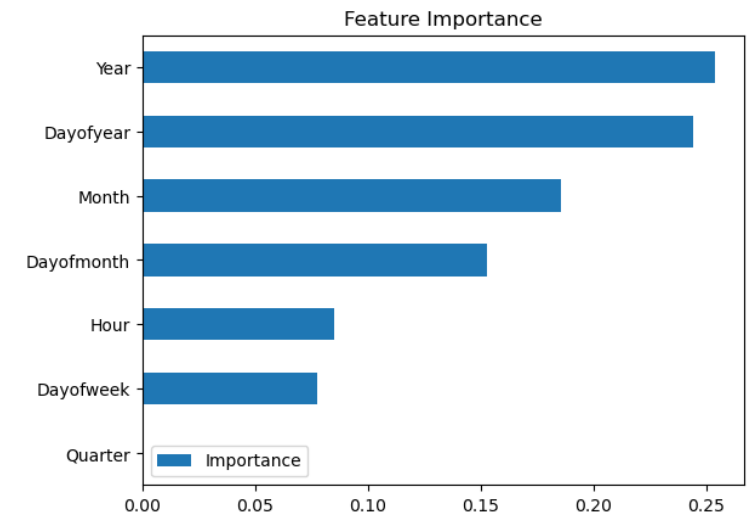## 6) Machine Learning Pipeline

c. Feature Engineering

transforming raw data into a format that is more suitable for machine learning algorithms to extract meaningful patterns and make accurate predictions.
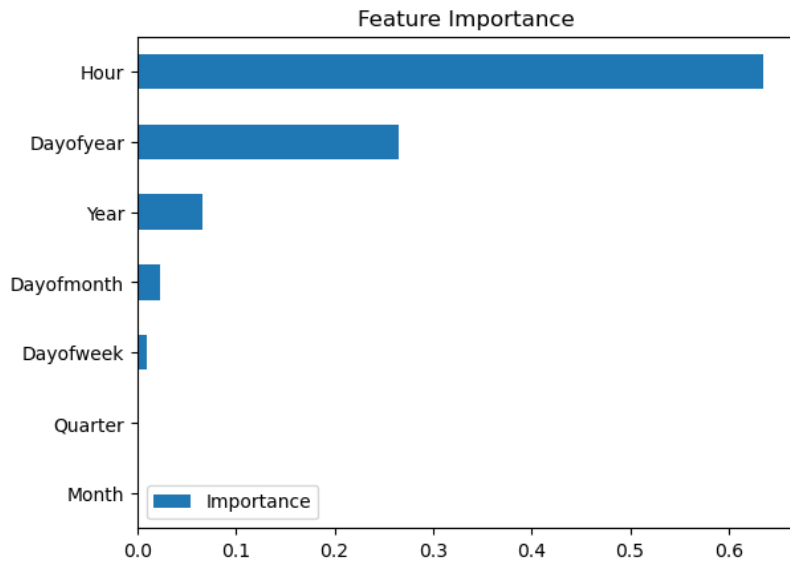
Humidity
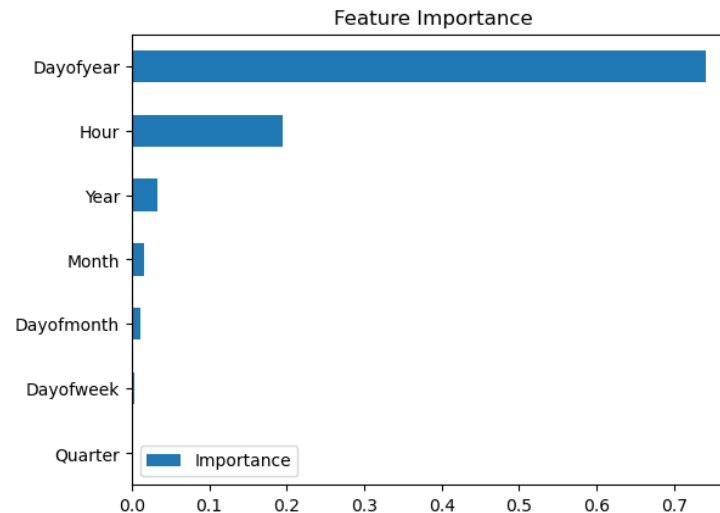
Temperature

Pressure

Methodology

6) Machine Learning Pipeline

d. Selection of Model

XGBoost algorithm was used to train the model due to following reasons:

i.   It has high prediction performance which is designed to handle complex, non-linear relationships in data and can capture subtle patterns that may be missed by other algorithms

ii. It can be used for both classification and regression tasks.

iii. It provides valuable insights into feature importance. It calculates feature importance scores based on the number of times a feature is used to split the data across all the boosting trees.

iv. It is highly optimized and offers fast execution speed.

v.   XGBoost has built-in capabilities to handle missing data. It can learn how to handle missing values by making informed decisions during the tree-building process.
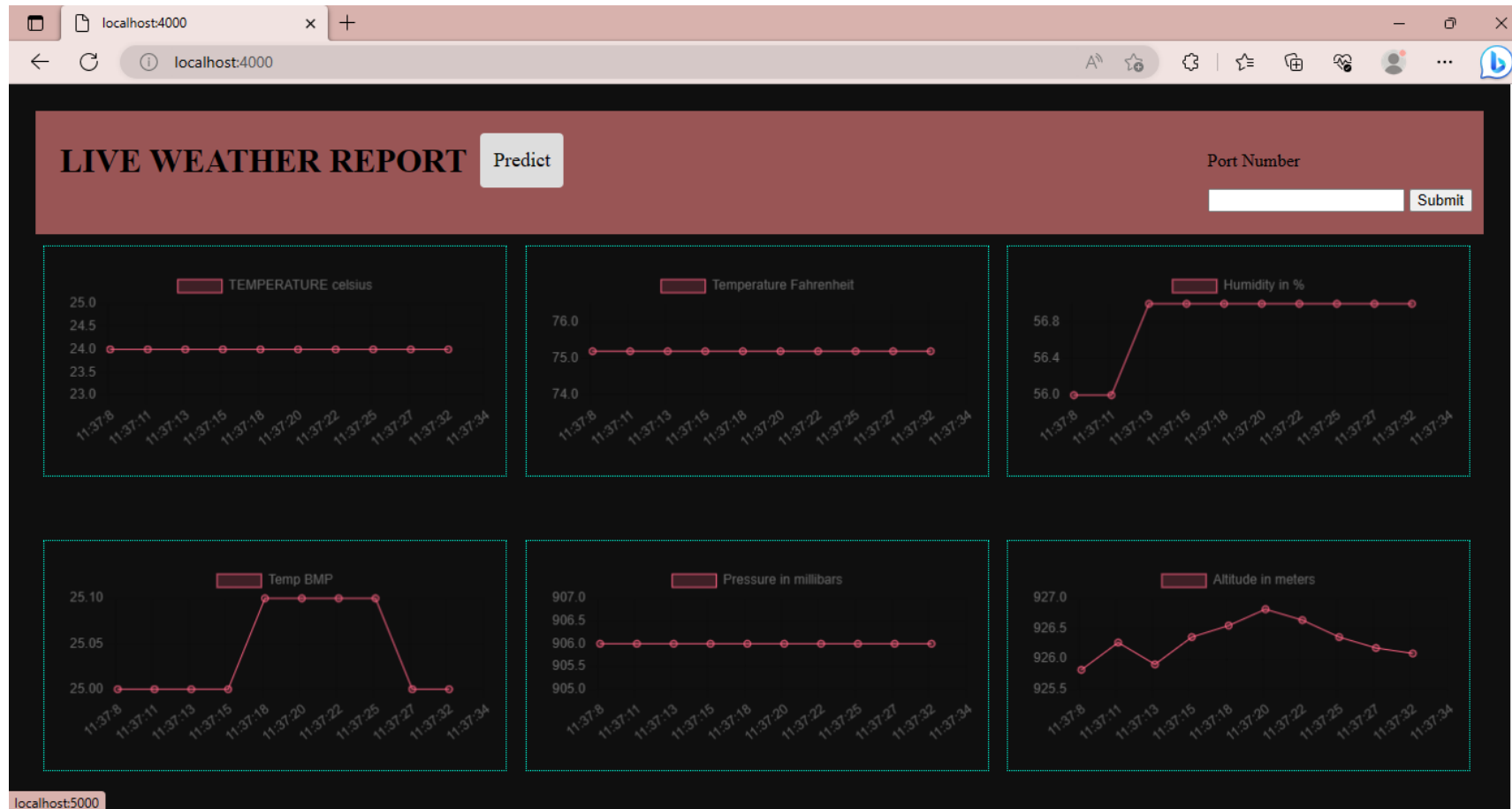
Methodology

6) Machine Learning Pipeline

e. Selected Model is trained using the collected data. 80% of the data is used for training and remaining 20% data is used for the testing.

f. Root Mean Square Error calculation for following parameters

Parameters	RMSE score
Temperature	3.89
Humidity	0.13
Pressure	4.09

Result

Live Weather Report

Result

Weather Prediction

Future Enhancement

- The machine learning can be improved using more dataset and better algorithms.

- The LoRa's data can be collected in database to use it as a training dataset for more accurate weather prediction.

- The project can be expanded to include more atmospheric data's to predict rain and chances of avalanches at mountainous terrain.

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