

Foggy Weather Prediction Analysis for Smart Vehicle System

Swetha.J¹

Lecturer, E&C Department S.J(Government) Evening Polytechnic, Bangalore

Leela.R²

Lecturer, E&C department Government Polytechnic, Nagamangala

Sujatha.A³

Lecturer, E&C department Government Polytechnic, Tumkuru

Abstract— Utilizing science and technology to forecast the weather in a specific area is known as weather forecasting. It is one of the world's most challenging problems. This project uses predictive analysis to make weather predictions. This calls for examination of various data mining techniques prior to application. This study demonstrates the use of logistic regression techniques for classification and introduces a classifier approach for forecasting weather conditions information about things like temperature, humidity, and wind speed, etc. After comparing the data from the database with the input, this system will use this parameter to forecast the weather. As a result, classification (i.e., training) and prediction (i.e., testing), two fundamental tasks, will be carried out.

Keywords — Motion Compensation, Motion Estimation, Motion Smoothing, Video Stabilization.

I. INTRODUCTION

The production operations of several industries, including farming and transportation, are impacted by the weather. The current climate is drastically changing, making it harder and less accurate to predict the weather using conventional methods. To overcome these challenges, more reliable and accurate weather forecasting approaches are required. These forecasts have an effect on a nation's economy and standard of living. The main goal of this research is to develop a weather forecasting system that can be used in remote areas. Rainfall prediction is one of the primary techniques for predicting the weather in any country. Data analytics and machine learning methods like logistic regression and random forest classification are used in weather forecasting. The problem of decreased visibility brought on by inclement weather is one of the major factors causing an increase in accidents. Burning rice stubble in northern states like Punjab and Haryana also has an impact on vision. As a result of the smoke's detrimental impact on visibility, traffic accidents are more frequent. Fog also affects a number of human endeavors, such as travel, conflict, and shipping. Uprooted trees are another important cause of traffic accidents during rainstorms and thunderstorms. The motorist

cannot see any obstacles, like uprooted trees, cars in the other lane, or other vehicles, when there is poor vision. The major goal of this study is to anticipate rainfall and visibility.

“Smart Vehicle System for Road Safety During Foggy Weather” by Ravinder Kaur et al. [1] studies propose a Vehicle Ad hoc Networks based smart vehicle system that employs optical sensors to deliver visual and audio alarms and notify the driver to manage the speed of the vehicle in low visibility. In order to alert other vehicles, it will save the position where visibility is reduced with a threshold value. For this, the meteorological data will be kept in Road side units and on-board units.

By employing ridge regression, V Venkatrama Ravi et al. [2] suggest a model to predict the weather. Ridge Regression is a model-tuning technique that may be used to evaluate any multicollinear data. To support the paradigm he has suggested, mean square error is being calculated.

An extensive quantity of information on the applications of forecasted weather is provided by Hani S. Mahmassani et al. in their article [3]. He elaborates on the difficulties that drivers have in congested traffic and inclement weather.

“Machine Learning based Rainfall Prediction” by R. Kingsy Grace et al. [4] study presents a multiple linear regression model for predicting rainfall using an Indian dataset. The input data includes various meteorological parameters, enhancing the model's predictive accuracy. The model's performance is evaluated using Mean Square Error (MSE), accuracy, and correlation metrics. When compared to other techniques in the literature, the suggested machine learning model produces superior outcomes. Using IoT-based smart systems, Manan Praful Ravalet et al. [5] propose a model to track several weather-related factors and forecast future values. The key benefit of employing this idea is that it facilitates the development of a microclimate system by assisting in the monitoring of local weather conditions. It forecasts the weather for a specific zone based on the monitored database, making the result more accurate and pertinent to the zone. In order to transfer the sensed data to the open-source platform, the author interfaces a microcontroller with a Wi-Fi module.

The primary driving force behind this effort was a weather forecasting system Nitin Singh et al. [6] presented that might be utilised in remote locations. To forecast weather, data analytics and machine learning methods like random forest classification are used. A cheap and transportable method for forecasting the weather is proposed in article [6].

4 Based on variables including temperature and rainfall in residential regions and tourism hotspots, Jiwan Lee et al. [7] conduct weather research. Additionally, he discovers that they are the main causes of the heavy traffic in such places. He investigates the relationship between the weather and traffic and congestion, suggests a model employing big data, and makes weather predictions. The final multiple linear regression model is presented in [7] and has an explanatory power of 0.6555 based on the R squared value. Prediction accuracy for the model is 84.8%.

5 Using factors such as dry ball temperature, wet ball temperature, dew point, relative humidity, cloud cover, wind direction, wind speed, and visibility, Riastiana Dewi et al. [8] created a model that focuses on the prediction of fog.

II. METHODOLOGY AND IMPLEMENTATION

The goal of any video stabilization algorithm is to create a new video sequences where the motion between the frames has effectively removed. In general any digital video stabilization algorithm consist of three modules: motion estimation module (ME), motion smoother module (MS) and motion compensation module (MC) as in Fig. 1. ME estimate the motion between the frames, and send the motion parameters to MS, which removes the unwanted camera motions. MC then computes the global transformation necessary to stabilize the current frame.

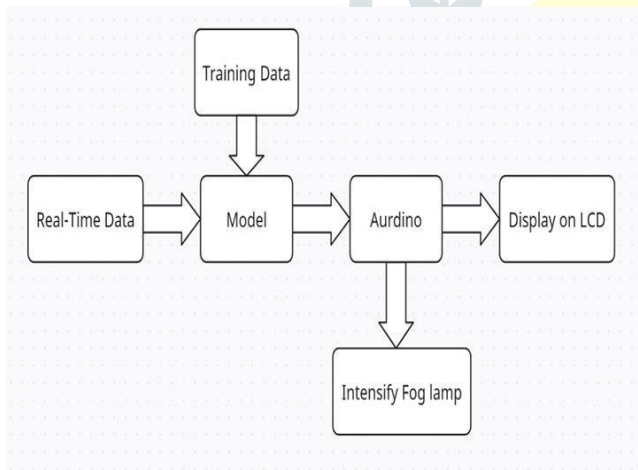


Figure 1:Block diagram of the project

Initially, the data is processed according to the requirement of the model. For example, in the dataset that we have used the visibility is given in the scale of 1 to 10 with values above 7 as good visibility and values less than 7 as poor visibility. To use this data in our model, we need to classify the visibility as High, Poor. Then the data is used to train the model. After training the model, the accuracy score of the model is calculated. If we are satisfied with the accuracy score of the model then we continue with the prediction otherwise, the model is trained again until the accuracy score is good enough for better prediction. After training the model, the real-time weather data is applied to the model and the model predicts the rainfall and visibility corresponding to the data supplied. If the prediction indicates the bad weather, a message will be displayed about the rainfall status and speed limit of the vehicle will be set accordingly. If visibility is low then the fog lamp intensity will be increased.

III. HARDWARE AND SOFTWARE IMPLEMENTATION

ARDUINO UNO: A microcontroller board called Arduino Uno is based on the ATmega328P. (datasheet). It has a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 6 analogue inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything needed to support the microcontroller; to get started, just plug in a USB cable, an AC-to-DC adapter, or a battery. With our Uno, we can track without too much concern that we are doing it incorrectly; in the worst case, you can replace the chip for a few dollars and start over.

LCD: A flat-panel display or other electronically controlled optical device that makes use of polarizers and the light-modulating capabilities of liquid crystals is known as a liquid-crystal display (LCD). Liquid crystals do not directly emit light; instead, they create colour or monochromatic pictures using a backlight or reflector. There are LCDs that can show random images or fixed images with little information that can be seen or hidden. Examples of gadgets using these displays include preset words, digits, and seven-segment displays, such as those seen in digital clocks. They both utilize the same fundamental technology; however different displays use larger parts while others use a grid of tiny pixels to create random images. LCDs can either be normally on (positive) or off (negative), depending on the polarizer arrangement.

LED: A light source device is an LED, or light emitting diode. Current flowing through it causes it to emit light. The LED idea is based on a semiconductor device where electrons and holes combine to create photons, which are light particles. The current, not the voltage, is what determines how bright an LED is. The simplest way to adjust intensity in relation to voltage is to add a series resistor, which essentially transfers variations in supply voltage to variations in current in a more linear manner than the diode itself

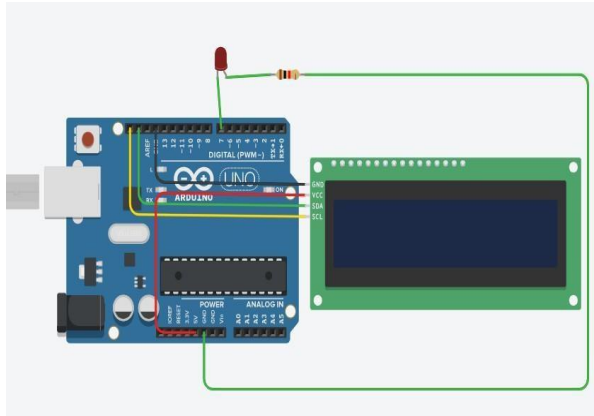


Figure 2: Circuit Diagram

INTEGRATED DEVELOPMENT ENVIRONMENT

A software programme known as an integrated development environment provides computer programmers with broad software development capabilities. IDEs often include a debugger, build automation tools, and a source code editor. Python is the programming language we will be using for this project, hence the popular Python IDEs are: A web IDE for Python called Google Colaboratory, also referred to as Colab, was made available by Google in 2017. For data scientists to carry out Machine Learning projects with cloud storage capabilities, Colab is a great platform.

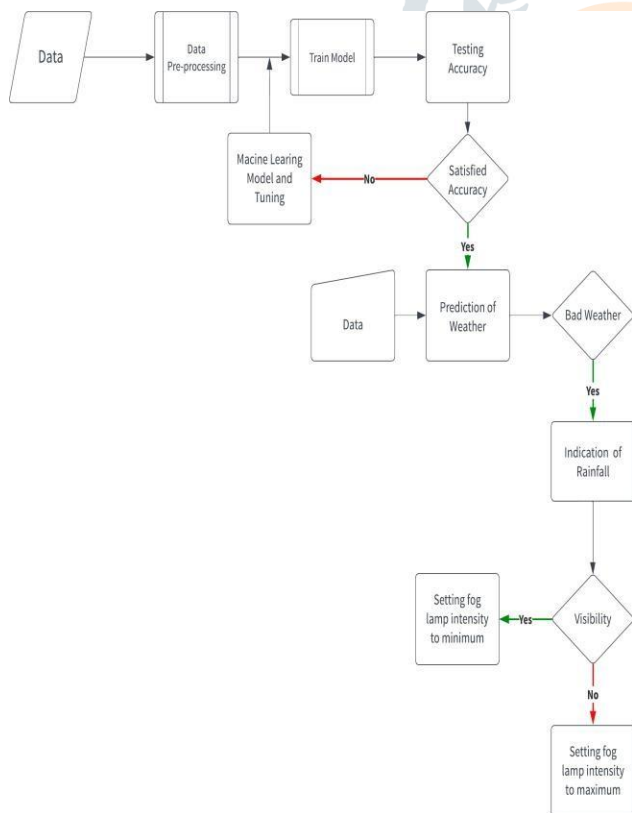


Figure 3: Flowchart

IV. RESULTS AND DISCUSSIONS

1. NEW YEAR

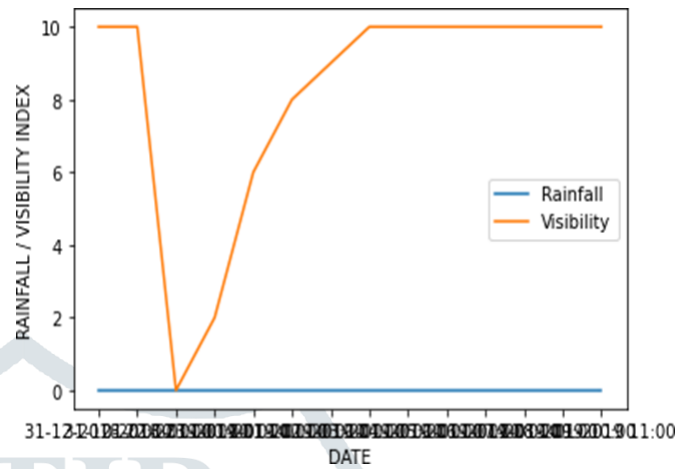


Figure 4: Variation of rainfall and visibility index during New Year

In figure 4, visibility and rainfall data are taken from 31st Dec 2018 8:00 pm to 1st Jan 2019 8am, visibility in Bengaluru drops down during 0:00 am of 1st Jan then it increases gradually. Celebrations like bursting crackers during new year might be the reason as the by-products of bursting crackers lead to disturbance in the clarity of air.

2. NAVARATRI

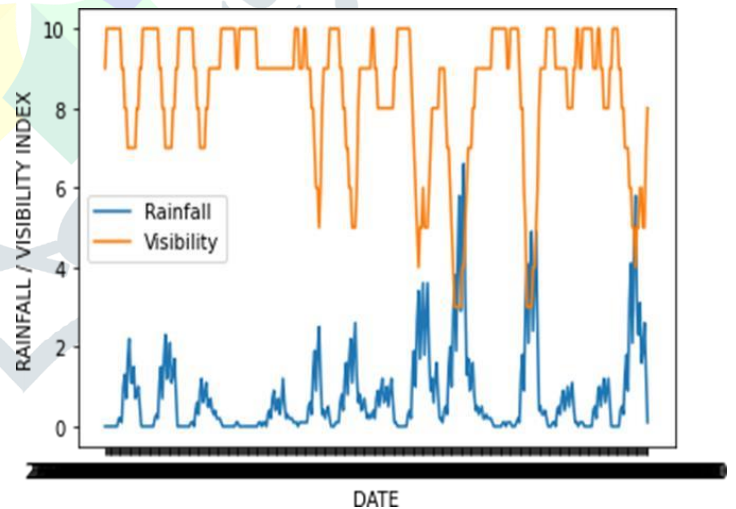


Figure 5: Variation of rainfall and visibility index during Navaratri

In figure 5, visibility and rainfall pattern from 26/09/2019 to 10/10/2019 is observed i.e., starting from 3 days prior to Navaratri to 3 days after Navaratri. Visibility index is related to the rainfall at the same date. As the rainfall increases the visibility index drops. Thus, this fluctuation in visibility index is mainly because of the rainfall during that time.

3. DEEPAVALI

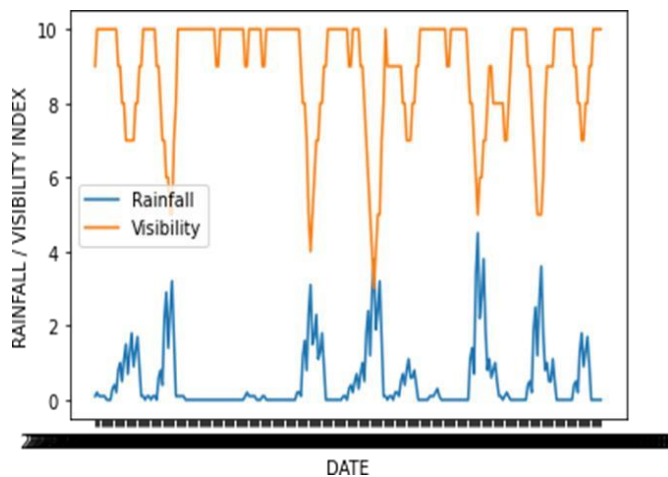


Figure 6: Variation of rainfall and visibility index during Deepavali

In figure 6, visibility and rainfall pattern from 22/10/2019 to 01/11/2019 is observed i.e., starting from 3 days prior to Deepavali to 3 days after Deepavali. During the 2nd and 3rd day of Deepavali of 2019 i.e., 28th and 29th of October, the visibility index drops more than the expected value when compared to other days in the same season, thus this may be due to bursting of crackers.

V. CONCLUSION

We are analysing the variation of rainfall and Visibility during four festival seasons, and they are Deepavali, New year, Navaratri. In New Year, there will be no rainfall. So it does not affect anything on the Visibility, but some other factors do have some effects on the Visibility. Maybe bursting crackers and fog during that time might be the reason. In Navaratri, the rainfall will be more as it is a rainy season. The fluctuation pattern is observed in the Visibility. Here we can observe that as the rainfall increases this in turn decreases the Visibility. In Deepavali, there is a small amount of rainfall and this in turn affects Visibility slightly. But compared to other times during the same rainfall the days of Deepavali have found more drop in visibility, this may be because of bursting crackers.

The amount of water that falls as rain over the course of a week or a month is referred to as rainfall. Since amounts may vary between locations and times, rainfall is estimated by gathering rainwater over a variety of areas and times. The correlation graph shows that Precipitation and Visibility have a correlation factor of -0.48. That means, visibility decreases as the precipitation increases. Similarly, dew point and cloud cover has a correlation factor of 0.24, 0.32 with precipitation. Sunhour has a correlation of -0.18, this means as sunhour increases the precipitation will decrease. That means, as these increase, the Visibility also increases. We have used two Machine Learning models; Logistic Regression model and Random Forest Regression model. Out of these two models, the

logistic regression model gives the best accuracy for rainfall prediction.

The term "visibility" describes the furthest distance at which an object can be observed while still being discernible to the observer. It is a measurement of air clarity and is given in distances like miles, kilometres, or metres. Visibility is influenced by several factors such as atmospheric conditions, air pollution, and the presence of precipitation, fog, and dust. Visibility predictions using weather data involve the analysis of various meteorological factors such as temperature, pressure, humidity, wind speed and direction, cloud cover, and precipitation, to estimate the visibility conditions in a particular location. The correlation graph shows that Precipitation and Visibility have a correlation factor of -0.48. That means, visibility decreases as the precipitation increases. Similarly, Sun Hour, Maximum Temperature and UV Index has a correlation factor of 0.21, 0.19, 0.22 with Visibility. That means, as these increase, the Visibility also increases. We have used two Machine Learning models; Logistic Regression model and Random Forest Regression model. Out of these two models Random Forest Regression model gives the best accuracy.

Further this analysis can be used to reduce traffic congestion in traffic high intensity areas due to weather conditions like heavy rain and fog. This helps in reducing the Traffic congestion in the heavily crowded areas inside the cities. Speed limiting may also be implemented using the predicted weather data and reduce accidents. Vehicles in the highways and other high traffic roads can be implemented with this feature.

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