Indian Institute of Technology Jodhpur

Engineering Design-1(OAE1010)

Group 6

Team C

Team Name- TECHIE 30S

Product Name- IMAGTRIX

Report

Team members:

1. **Kalbhavi Vadhi Raj(B21EE030)**
2. **Shreejan Kumar (B21BB030)**
3. **Rohan Doda (B21MT030)**
4. **Jaydeep Prajapati (B21ME030)**
5. **Rohan Galgat (B21AI030)**
6. **Om Nirne (B21CI030)**
7. **Simran (B21CH030)**
8. **Gavva Sathwika (B21CS030)**

Contents:

1).Introduction

2). Methodology

3).The design

4).Result

Introduction:

Problem:

Weather conditions on different parts of the road are different, Hence it is really important to keep caution while entering a part of road which has fog, rain etc Normally the speed limits boards are static and hence they may not be appropriate for different weather conditions. Hence we decided to make this device which will basically provide a speed limit based on different weather conditions before the drivers enter that region.

Aim:

To make a device that can predict the weather by diagnosing images taken by it using artificial intelligence and give prior warning to the driver about the weather conditions on the road ahead.

Methodology

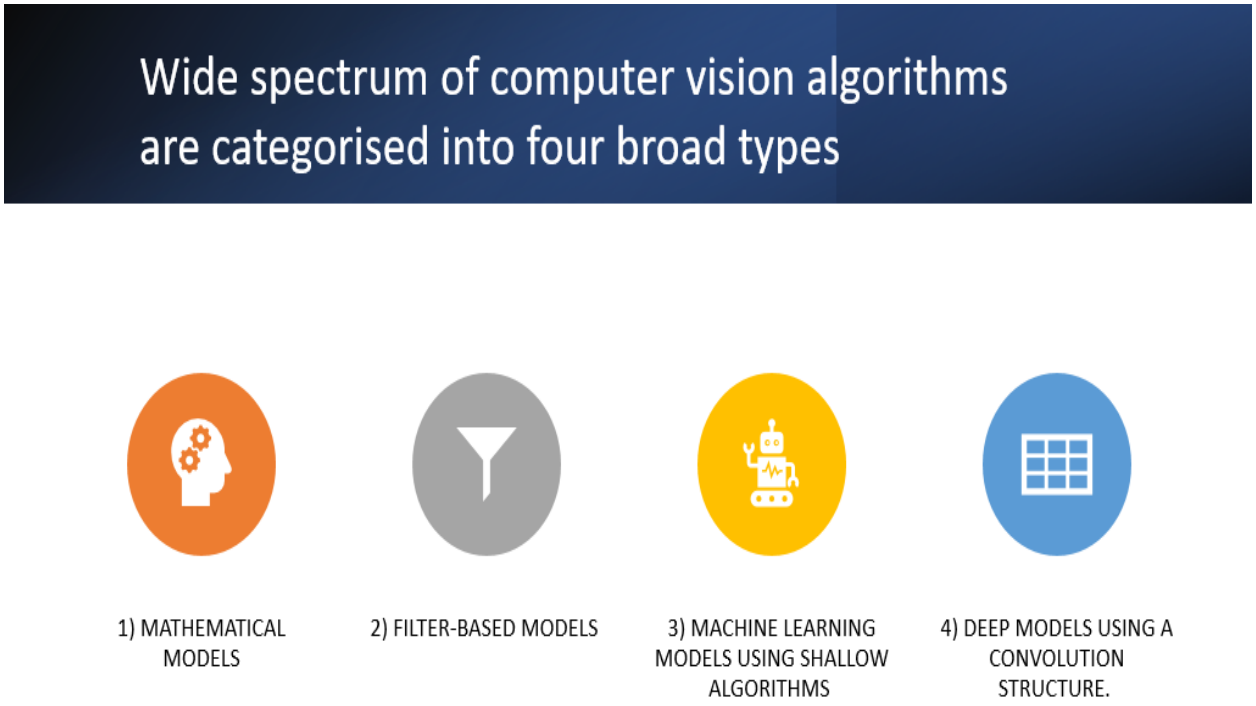
Basic Principle involved:

Device takes images to predict the weather by using grayscale method and colorful image methods.

- This device has a pre-trained module, which is trained using data sets of different images of different weather conditions.
- After the module is trained it can compare the input image received from the camera module.
- The image clicked by the camera will not be stored, will be directly input into the code and will be deleted once output is received hence reducing the space required.
- After we input an image into the program it will list down the similarity percentage with each of the image in the data set
- Then the Output will be shown on matrix display in such a way that if fog score is high, then it will display (“Fog ahead go slow”) and in similar fashion for others

Theoretical background (For the program):

There are mainly four types of models for predicting weather:



1)Mathematical model:

- This model is generally used for detecting rain in computer vision techniques.
- In this method we must know the settings for capturing images such as camera optics and the viewing distance, etc.
- This method can also be used to detect fog in daytime and to estimate visibility distance from images, based on the theory of how the apparent luminance of an object is observed against the background on the horizon.

2)Filter-based model:

- This model works on an algorithm, which rely on information such as histogram of colors and gradient amplitude.

3)Machine learning models using shallow algorithms:

- Machine learning models have shown progress in recognising the multi-class conditions of weather.
- This model can be used to classify weather conditions using a Support Vector Machine (SVM) trained on single colour images.
- However, the model is limited to detecting three weather conditions; clear weather, light, and heavy rain.

4)Deep learning models using a convolution structure:

- A range of applications based on classifying, segmenting and localizing pixels from street-level images has become a common approach for understanding the various components of an urban scene.

Libraries used in program:

- **NumPy**:

NumPy is the fundamental package for scientific computing in Python. It is a Python library that provides a multidimensional array object, various derived objects (such as masked arrays and matrices), and an assortment of routines for fast operations on arrays, including mathematical, logical, shape manipulation, sorting, selecting, I/O, discrete Fourier transforms, basic linear algebra, basic statistical operations, random simulation and much more.

- **OpenCV:**

This is the main library used in this project.We are using ORB Algorithm of OpenCV to find the key points in images. Then we are using brute force matchers to find the similarity between two images on the basis of their key points.

When an image is inserted into this program first this program will generate key points of all the train images and inserted image. Then the program will

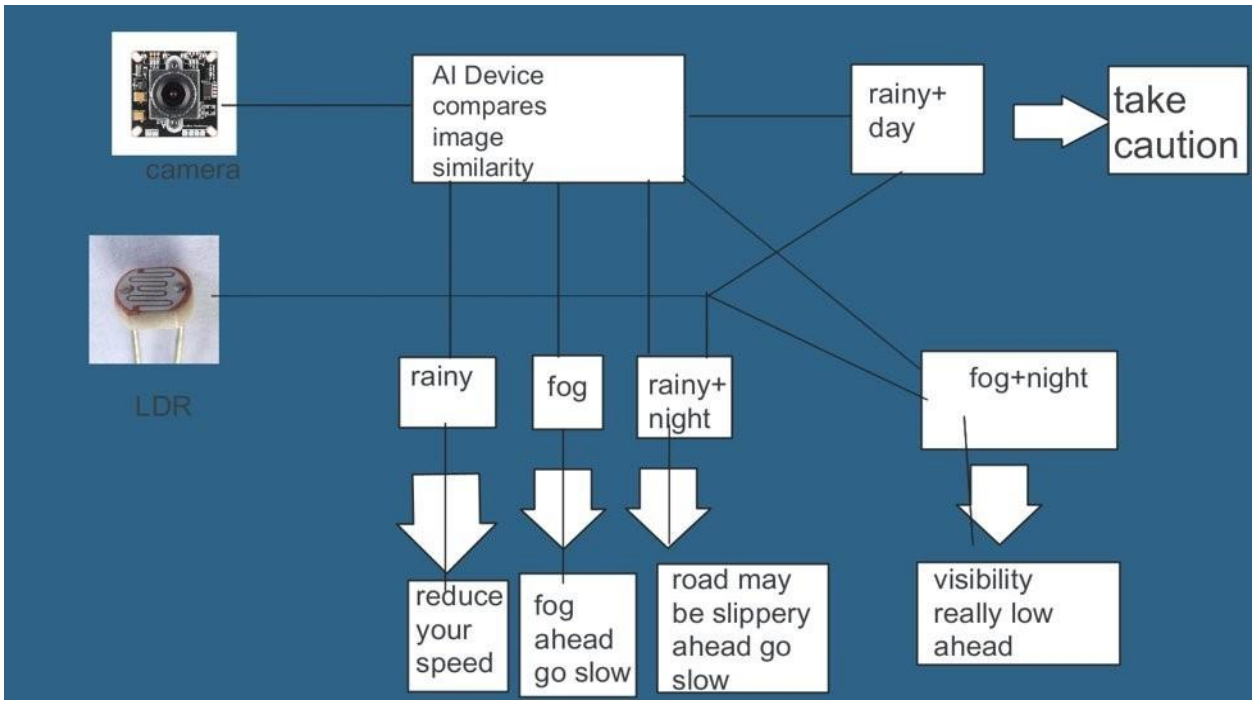
match each keypoint of train images with inserted one and find the number of matches and then the program will search which image has maximum similarity and then according to the label of that image we will get the output of weather.

The design

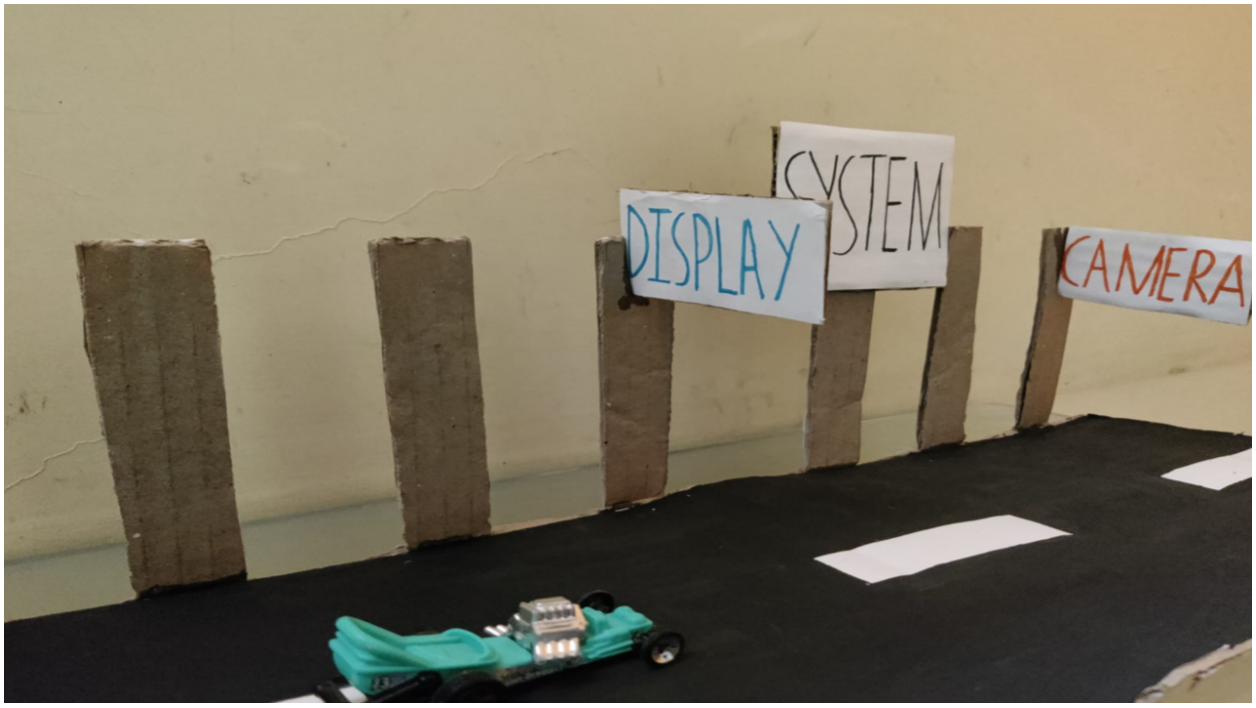
Components Required:

- **Camera:** to capture images on the road.
- **Raspberry Pi:** It will collect the data from camera and send the information to system (Using Wi-Fi), for prediction.
- **LDR:** It will help in predicting whether it's dark or not.
- **Display:** It will display the condition of the road ahead to the driver.

Basic theoretical model of the device:



Basic Physical Model of device:



Result

Why is our product required

Firstly, we started working on the project which was based on the case of Accidents during the foggy season. An ultrasonic vehicle detector and was to be placed on the poles of the road, so whenever there would be some kind of stoppage in the movement of vehicle, there would be notification through LED lights on the pole by the detector and this way the vehicle next to the previous one would get to know that there is something wrong and would slow down its speed to avoid any kind of crash in fog.

But as the project couldn't be worthy for the highways and fast speed roads.

Now we are working on the project AI FOG DETECTION. We TECHIE30S named the project as IMAGTRIX. We used the same concept as there are many accidents in foggy areas. So, to avoid these accidents we are developing the device which will notify the driver through matching the in-built photos with the weather of the surrounding and there would be a matrix display on the road itself to display the moisture consistency and to notify the driver.

Effective Cost:

- Camera=Rs361
- Raspberry Pi Board=Rs4445
- LDR Sensor=Rs15
- Display=Rs970
  Total Cost=Rs5791

Objectives:

Serial Number	Objective	Status	Date of completion
1	Learning python basics	Completed	20th-December
2	Learning basic algorithms of ML	Completed	31st-December
3	Make a basic model of our project	Completed	16th-December
4	Learning Important libraries like OpenCV, Tensorflow	Completed	8th- January
5	Writing a crude code for our project	Completed	31st-January
6	Learning basics of google collab as TensorFlow was not compatible with python	Completed	20th-February
7	Implementing our code using OpenCV	Completed	1st-April
8	Finalize specification of different components used in this device	Completed	8th-April
9	Order all the Components	Completed	13th-April

10	Make a basic physical model	Completed	27th-April
11	Test the accuracy of code using test data	Completed	11th-May
12	To make a physical model of our project	Completed	15th june
13	Testing output using physical model made earlier	Completed	25th june

Milestone:

Serial Number	Milestone	Date achieved
1	Write complete code of the project before the end of first sem.	31st January
2	To get accuracy above 75 percent	11th-May
3	To make a physical model of the project	15th June
4	To test our physical model in real time using images	25th June

Comparison

Decision Matrix:

	Mathematical model	**Filter based model**	**ML model using shadow algorithm**	**Deep Models using convolution structure**
Time taken	4	3	2	1
Memory taken	5	4	3	5
Complexity of code	3	4	4	5
Inaccuracy	4	3	2	2
Total	16	14	11	13

All the models have been given points out of 5 for each parameter. All these parameters are to measure the efficiency of our algorithm, and the model with the lowest total will be the most efficient algorithm for our program. So by this decision matrix, it is clear that ML models using shallow algorithms are most efficient for our program.

Contribution:

- **Kalbhavi Vadhi Raj**
    a. I suggested ideas and problems regarding our previous device which was a device to give prior warning before accident during foggy climate.
    b. I started working on this project by first learning python and machine learning.
    c. I made the basic theoretical model of this project along with my teammate Jaydeep Prajapati.
    d. I made all the presentations demonstrating our group progress in classes.
    e. Even presented those presentations in class.
    f. After that I helped in writing code of this project.
    g. I shifted from Tensorflow to openCV.
    h. I wrote the entire code in OpenCV, Which is an image similarity matcher made using ORB algorithm and brute force matcher.
    i. I managed to get a working raspberry pi from my sources when there was no stock anywhere.
    j. I finalized which version of Raspberry pi will best for this project.
    k. I brought an Ldr sensor.
    l. I made a complete Video Report for final evaluation.
    m. I imported code to raspberry pi and connected it to pc using ssh.
    n. I made the written report.
    o. I established the connection between raspberry pi and laptop using VNC and Putty in order to send and receive data from raspberry pi.
    p. I formed the general workflow of our project, I tinkered for a while before deciding the most efficient plan to execute this project.

- **Shreejan Kumar**
    - My part in our project was related to the programming and training of the necessary modules.
    - I already knew about the basics of python, so I learned advanced python and about the libraries and modules which we could use in our program.
    - I helped my team fix the bugs that arose in our program in due course of time.
    - I also suggested that we could use a matrix display to finally display the output of our predictions to the drivers.
    - I helped in selecting our group name and the project name.
    - Finally, I also presented and explained our slides during the classes.

- **Jaydeep Prajapati**
    - My part in this project was the electrical circuit building.
    - I learnt how to assemble the main breadboard to the rest of the components like camera, matrix display, LDR, and the power supply.
    - Power supply was a challenge and we've come across various possible ways. But for the prototype we're powering it with our laptop or 5v battery.
    - Original model will be powered by the street light from which it'll be attached.
    - I also have researched about the ratings of various components like voltage and current rating for camera, matrix display etc
    - I bought a Matrix Display for this project.

- **Rohan Doda**
  - My contribution to this project was in the coding and presentation part.
  - I presented our ideas and progress in the class on several occasions and also made the slides sometimes.
  - In the coding area first, I started learning python basics.
  - I also found some datasets that we are using in the project.
  - I along with the help of my teammates fixed a lot of bugs that we encountered in our code.
  - I also did research on the type of camera that we should use for the project and finalized that.
  - I purchased Raspberry pi for our project.

- **Om Nirne**
  - I worked for research team at start and we together started working on basics things to be learned for the project.
  - I helped my team members in finding the required electrical components and work related to its research.
  - I then started working for electrical team learnt the basics for building a circuit using breadboard.
  - I learnt basics of Raspberry Pi.
  - I helped in finding a power source.
  - I made a basic physical model of the project.

- **Simran**
  - As the project is about weather detection so my contribution was to collect data set.
  - I learned python as it is AI based project.
  - I worked for basic structure of the project and did help in finding the code related or similar to the Project.
  - I'll be working with the electrical team in assembling the project.
  - I purchased camera module for this project

- **Rohan Galgat**
    - I started learning python from the very basics as I'm new to the programming world.
    - I searched for various libraries like Numpy, Pandas ,etc with my peer groups.
    - I shared the theory of our project from various similar Projects done by various university.
    - I Collected some of the images for the data set.
    - We all worked as a team to debug the error in our program.
    - I completed python and learned about various libraries used in this project.

- **Sathwika**
    - Basically, for this project I was assigned for the programming part.
    - I have completed python basics.
    - I have searched some of the libraries required for the project.And also collected some test images required for the project.
    - Analyzed the code to compare the actual images with the test images
    - I am working on making a 3D printable model for this project.