INDIAN INSTITUTE OF INFORMATION TECHNOLOGY

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A Project Report On

"Face Mask Detection & Alert System"

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CERTIFICATE

This is to certify that the Project Work entitled— **"Face Mask Detection and Alert System "** is a bonafide work carried out by M.Joshasree(19BCS069), P.Lalithaanjale(19BCS087), S.Pranay Sai Teja(19BCS102), M.Anupama(19BCS123) in fulfillment for the IOT Project of Bachelor of Technology in Computer Science & Engineering of the Indian Institute of Information Technology Dharwad during the year 2021-2022. The Project Report has been approved as it satisfies the academics prescribed for the Bachelor of Technology degree.

Signature of Supervisor(s)

Name(s)

Department(s)

(Month, Year)

DECLARATION

We declare that this written submission represents my ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

The novel Coronavirus has brought a new normal life in which the social distance and wearing of face masks plays a vital role in controlling the spread of the virus. But most of the people are not wearing face masks in public places which increases the spread of viruses. This may result in a serious problem of increased spreading. Hence to avoid such situations we have to scrutinize and make people aware of wearing face masks. Humans cannot be involved in this process, due to the chance of getting affected by corona.Hence here comes the need for artificial intelligence(AI), which is the main theme of our project. Our project involves the identification of persons wearing face masks and not wearing face masks in public places by means of image processing and AI techniques and sending alert messages to authority persons. The object detection algorithms are used for identification of persons with and without wearing face masks which also gives the count of persons wearing mask and not wearing face mask and Internet Of Things (IOT) is utilized for sending alert messages. The alert messages are sent to the authority persons through mobile notification and Email. Based on the count of persons wearing and not wearing face masks the status is obtained. Depending upon the status warning is done by means of using buzzer and LED's.

CONTENTS

CHAPTER 1

INTRODUCTION

India is struggling to recover from the virus attack, and the government has imposed a long-term lockdown. The world economy was put under strain by the lockdown. As a result, the authorities relaxed the lockdown. The WHO has declared that a potential speech must be avoided by maintaining a safe distance and wearing a mask. After relaxing, the government requires the most support: social separation and the wearing of masks by the public. However, many people are leaving without using a face mask, which could spread Covid-19. According to the Economic Times India, "90 percent of Indians are aware, but only 44 percent are wearing a mask."This survey clearly shows that people are aware of the mask, but they do not wear it owing to pain and carelessness. This could make it easier for covid-19 to spread in public settings.

Wearing masks and social separation are crucial measures to prevent virus spread until vaccinations are discovered, according to the World Health Organization.

As a result, forcing individuals to wear masks in public areas is critical. It is difficult to locate and warn people who are not wearing a face mask in densely populated areas.Hence we are using an integrated model of machine learning,electronics and Internet of things concepts to design a hybrid model which can identify the person is wearing a mask properly or not and also check for the temperature of that individual, and if the threshold permits then the gate will open otherwise an alert will be sent to concerned authorities.

The Internet of Things (IOTs) connects objects such as cellphones, Internet TVs, laptops, computers, sensors, and actuators to the Internet, allowing for new types of communication between things and people, as well as amongst things themselves.IOT is used to send notification messages to authority figures.

Face mask detection involves detecting the location of the face and then determining whether it has a mask on it or not. The problem is similar to broad object detection in terms of detecting object classes.Face identification is the process of identifying a certain collection of entities, namely faces.It has a wide range of applications, including autonomous driving, education, and monitoring.This paper presents a simplified approach to serve the above purpose using the basic Machine Learning packages such as TensorFlow, Keras, OpenCV and Scikit-Learn.

Chapter 2 explains the literature review part, Chapter 3 explains in detail the step by step procedure of the proposed algorithm. The experimental setup of the proposed hardware model is explained in detail in Chapter 4. The experimental results obtained are briefly plotted in Chapter 5. Chapter 6 concludes the proposed method performance and its related future work.

CHAPTER 2

LITERATURE SURVEY

2.1 Introduction

There are three basic types in the literature review. The literature on mask detection using deep learning and machine learning techniques is discussed in the first category. The Internet of Things (IOT) topics are covered in the second category. The literature on combined IoT devices and deep learning approaches is briefly reviewed in the third category.

2.2 Machine learning for mask detection

- Sanzidul Islam et al., published a deep learning-based assistance system to categorise COVID-19 Face Mask in rasbperrypi-3 in the year 2020.
- Velantina et. al., 2020, used the Caffe model to detect COVID-19 facemasks.
- In his work for face recognition, Senthilkumar et al. 2017 examined the two most often used machine learning algorithms, K-Nearest Neighbor and Support Vector Machine.
- Senthilkumar et al. (2018) suggested a new and rapid facial recognition method.

2.3 Internet of Things

- Luigi Atzori et al. examined various versions of the Internet of Things as well as the enabling technologies.
- In their work, Lu Tan et al. and Neng Wang discussed the Future Internet.
- In their work, Feng Xia et al. and others briefly examined the Internet of Things, 2012.

2.4 IOT device and Machine Learning

- Yair Meidan et al. (2017) developed nine IoT devices, each of which was regarded as a different class. Deep learning techniques were employed for classification purposes.
- Using machine learning approaches, Yair Meidan et al. and Michael Bohadana et al. suggested a security solution for detecting unauthorized IoT devices in 2017.
- Liang Xiao and colleagues updated IoT security solutions based on machine learning and the Artificial Intelligence concept in 2018.
- We created a novel deep learning system for face mask detection based on the above literature reviews. The details will be explained in the next chapters.

CHAPTER 3

EXPERIMENTAL SETUP FOR PROPOSED MODEL

3.1 Flow chart

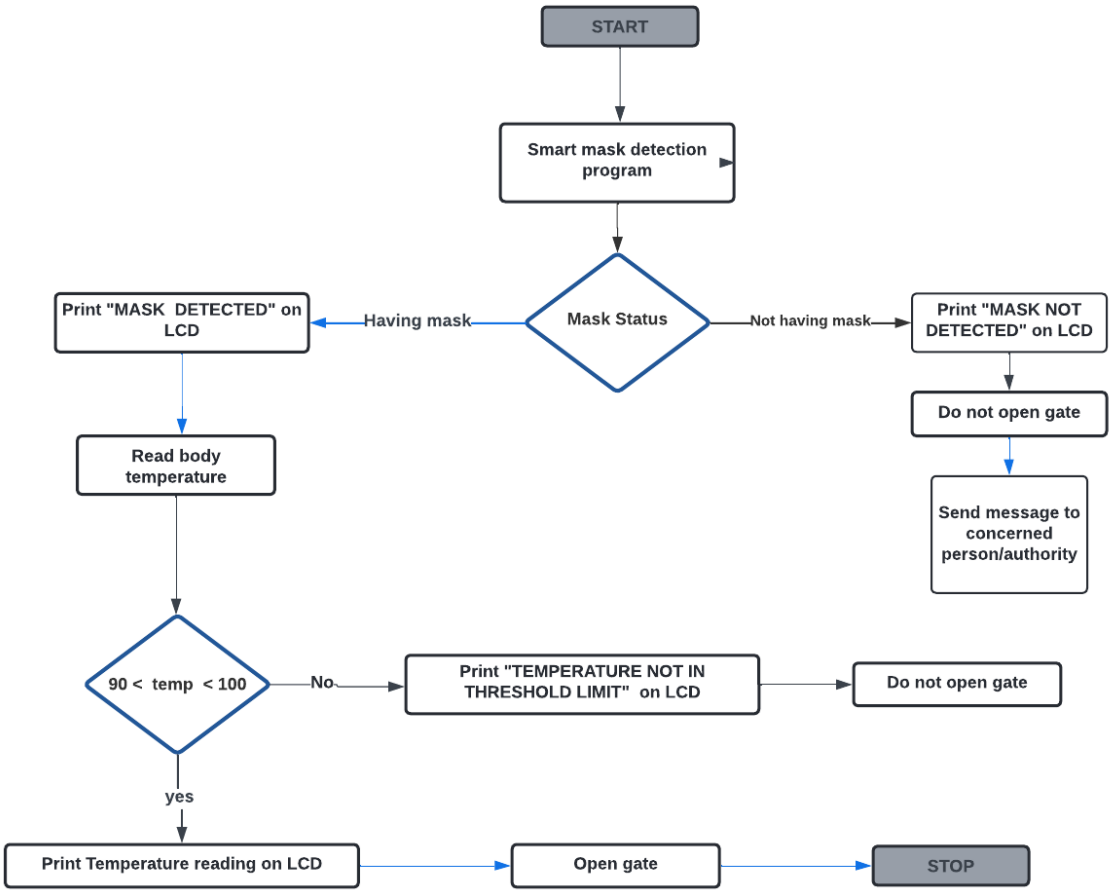


Figure 3.1

3.2 Block Diagram

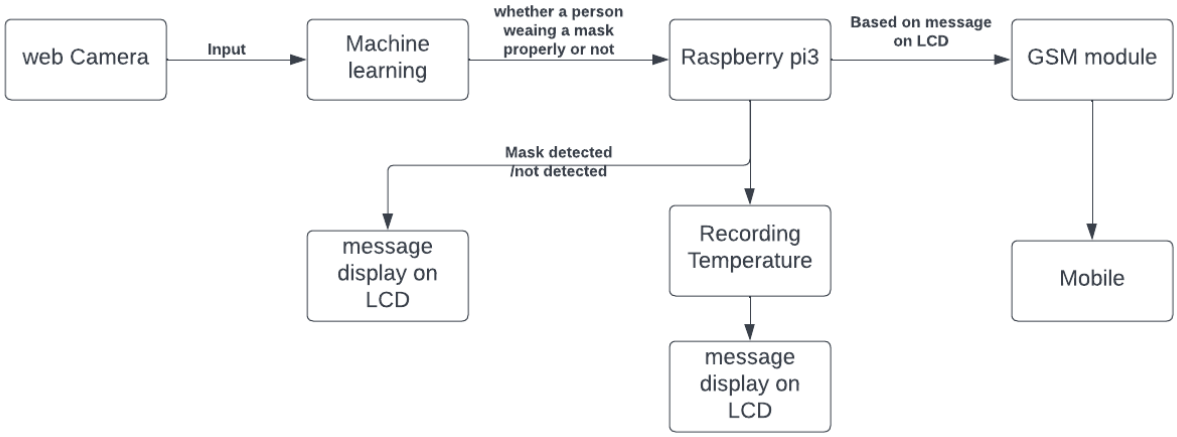


Figure 3.2

3.3 Software Description

3.3.1 Proteus 8 Simulator

Virtual System Modelling (VSM) by Proteus combines mixed-mode SPICE simulation with the fastest microcontroller simulation available. It allows rapid software prototyping of both hardware and firmware ideas.
Before ordering a physical prototype, we can design, test, and debug your embedded projects with the Proteus electrical circuit simulator. The embedded systems workflow can benefit from agile development.

3.3.1.1 Simulator Design

Proteus VSM provides the environment for design entry and development using our proven Schematic Capture software. Proteus Schematic is a well-known programme that combines ease of use with strong editing capabilities. It can be used to capture schematics for both simulation and PCB design. Designs submitted for testing in Proteus VSM can be netlisted for PCB layout using either our own PCB Design products or third-party PCB layout software. ISIS also gives you a lot of control over the drawing's aesthetics, such as line widths, fill schemes, fonts, and so on. These skills are fully utilized in the creation of circuit animation visuals.

3.3.1.2 Simulation

The capacity of Proteus VSM to simulate the interaction between software running on a microcontroller and any analogue or digital devices linked to it is its most intriguing and crucial feature. Along with the other aspects of your product design, the microcontroller model is placed on the schematic. It emulates the execution of your machine code (object code) on a real chip. If your programme code writes to a port, the logic levels in the circuit will change, and if the circuit changes the state of the processor's pins, your programme code will notice, just as in real life.

Each supported processor's I/O ports, interrupts, timers, USARTs, and other peripherals are fully simulated by the VSM CPU models. It's not just a basic software simulator because the interaction of all these peripherals with the external circuit is thoroughly described down to the waveform level, simulating the entire system.

Proteus VSM remains the leading choice for embedded simulation with over 750 supported microprocessor types, thousands of embedded SPICE models, and one of the world's largest libraries of embedded simulation peripherals.

3.3.1.3 Circuit diagram of Proposed model in proteus

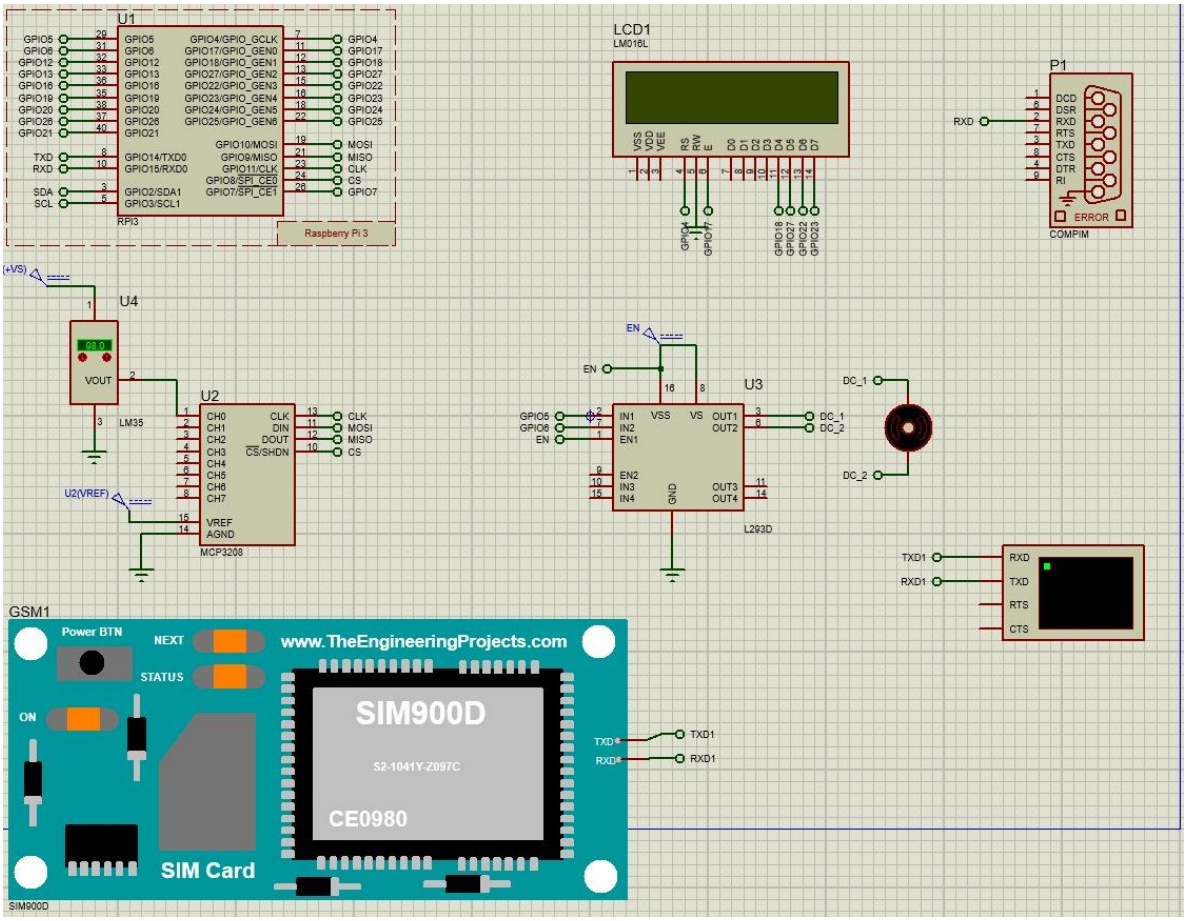


Figure 3.3

3.3.1.4 Source code for proteus

[PROTEUS SIMULATOR SOURCE CODE LINK]

3.3.2 Virtual Serial port emulator

VSPE is designed to assist software engineers and developers in creating, debugging, and testing serial port applications. It may construct a variety of virtual devices to send and receive data. Virtual devices, unlike ordinary serial ports, offer unique capabilities: for example, the same device can be opened multiple times by different applications, which is advantageous in many situations. You can use VSPE to exchange physical serial port data between many applications, expose serial ports to the local network (through TCP protocol), and build virtual serial port device pairs, among other things.

3.3.2.1 Configuration of VSPE

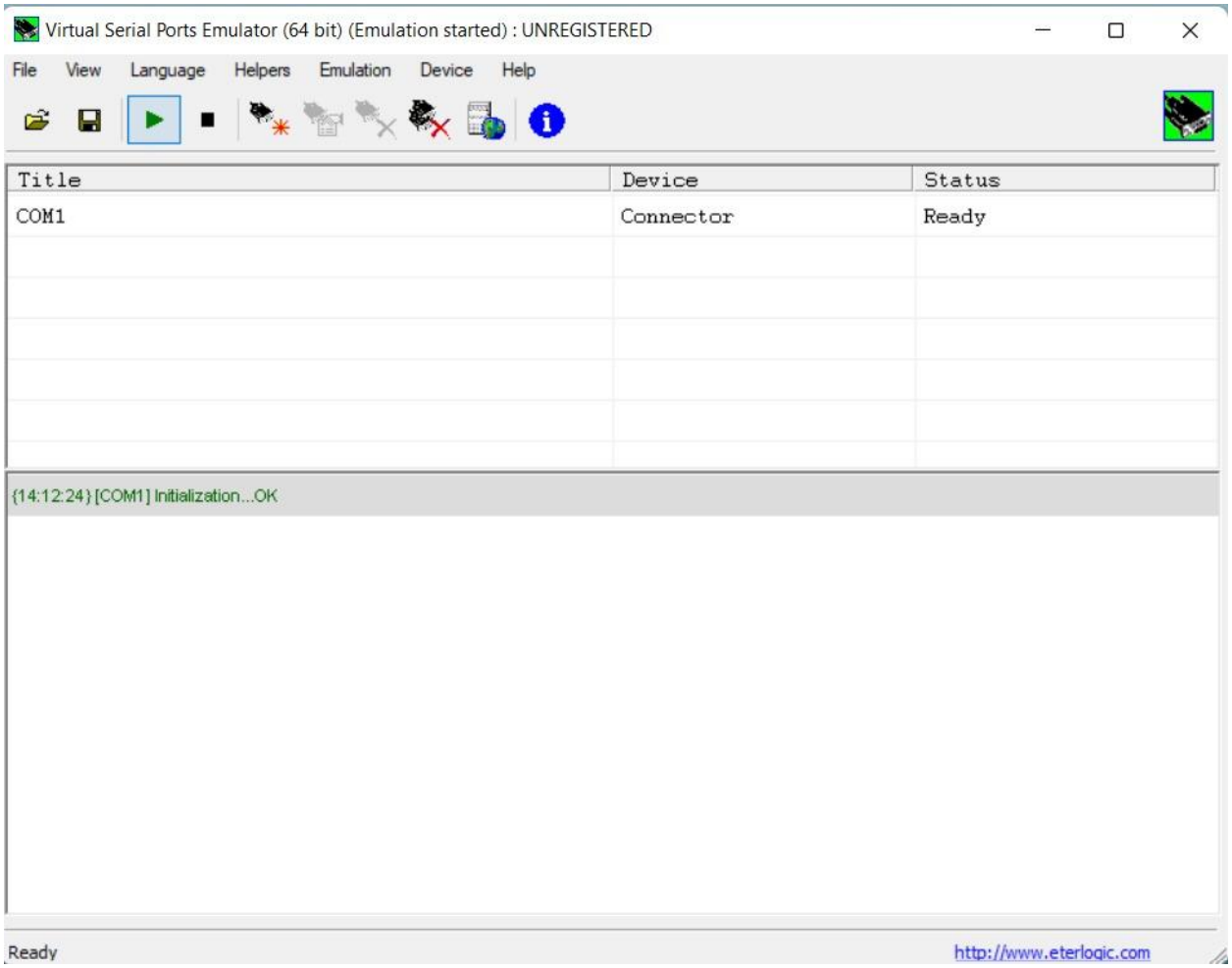


Figure 3.4

3.4 Hardware Description

3.4.1 Raspberry pi

This face mask detection system employs the Raspberry Pi3 Development Kit. The Raspberry Pi is a very cheap computer that runs Linux, but it also provides a set of GPIO (general purpose input/output) pins, allowing you to control electronic components for physical computing and explore the Internet of Things (IoT).Because of its processing speed and compactness, it is also employed for image processing tasks. It acts like a mini computer.

As an input a camera is employed. Gsm 900d , Lcd , Temperature sensor are attached to the Raspberry Pi , these all are simulated in ml code that was connected through the compin module to VSP where ML code is embedded.

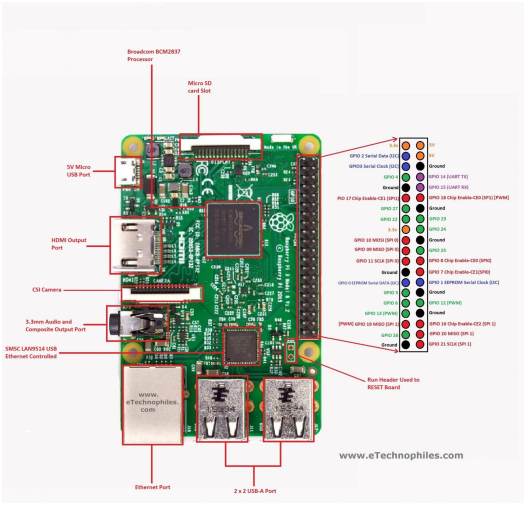


Figure 3.5

3.4.2 GSM SIM 900D

The SIM900 is a complete Quad-band GSM/GPRS solution in an SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption.

In our model we have connected GSM 900D in Proteus 8 Simulator. To send the message to authority that a person is wearing a mask or not.

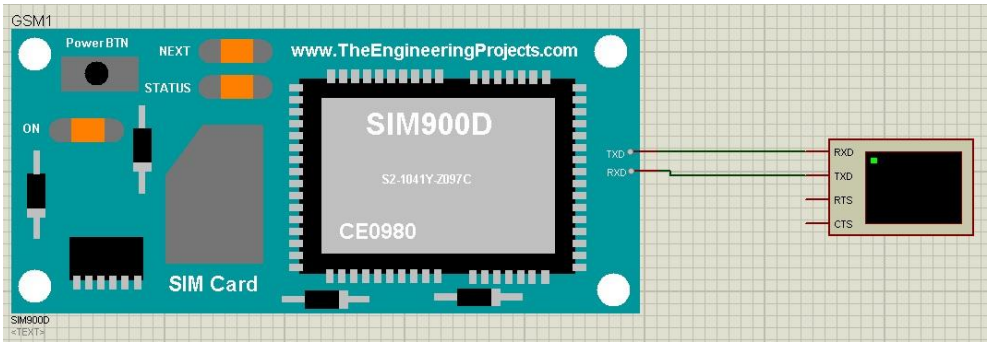


Figure 3.6

3.4.2.1 Commands to use GSM 900D in proteus 8

- The first command is for testing our GSM module : AT
  - If it replies as " Ok " it means it is working correctly.
- The second command is for converting our GSM module to text messages : AT+CMGF=1
  - If it replies " OK " it means it has been accepted correctly.

  Now we are ready to send our SMS.

- The third command is for giving phone number to which we want to send message :AT+CMGS="+91**********″
  - If it replies with a sign ">" it means the GSM module is asking for the message body.
- Enter the message to authority and enter "Ctrl+Z "
  - If It send the SMS then it replies back with "+CMGS: 01".

3.4.3 LCD

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. It is connected to the raspberry pi and displays whether a person is wearing a mask or not .

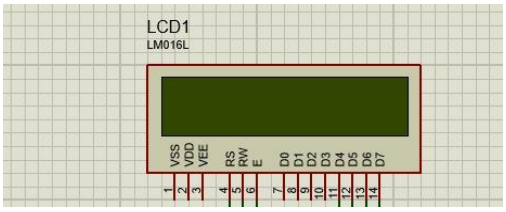


Figure 3.7

3.4.4 Temperature Sensor

MCP3208 sensor is used to detect temperature. It is connected to raspberry pi and displays the information whether the temperature is in limit or not.

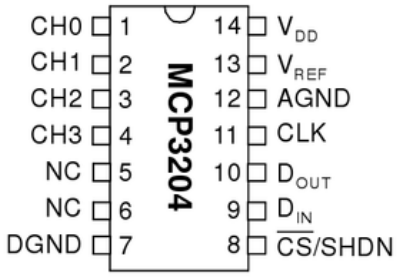


Figure 3.8

3.4.5 Motor

L293D is connected to raspberry pi and opens when a person is wearing a mask properly.

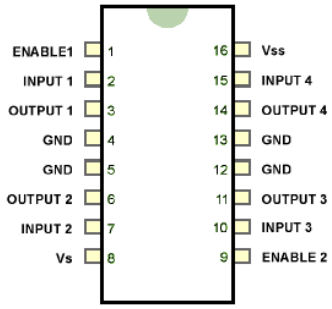


Figure 3.9

CHAPTER 4

FACE MASK DETECTION ALGORITHM DEVELOPMENT

4.1 Machine Learning backgrounds

4.1.1 TensorFlow

To pursue research, TensorFlow, an interface for expressing machine learning algorithms, is used to implement ML systems into fabrication across a variety of computer science areas, including sentiment analysis, voice recognition, geographic information extraction, computer vision, text summarization, information retrieval, computational drug discovery, and flaw detection. The proposed model employs TensorFlow as the backend for the entire Sequential CNN architecture (which consists of numerous layers). It's also used in data processing to restructure the data.

4.1.2 Keras

Keras provides essential reflections and building units for rapid generation and transmission of ML arrangements. TensorFlow's scalability and cross-platform features are fully utilized. Keras' primary data structures are layers and models [19]. Keras is used to implement all of the layers in the CNN model. It aids in the compilation of the overall model, as well as the conversion of the class vector to the binary class matrix in data processing.

4.1.3 OpenCV

OpenCV (Open Source Computer Vision Library), an open source computer vision and machine learning software library, is used to distinguish and recognise faces, recognise objects, group movements in recordings, trace progressive modules, follow eye gestures, track camera actions, remove red eyes from flash photos, find comparative pictures from an image database, perceive landscape and overlay it with enhanced reality, and so on [20]. In order to resize and colour convert data images, the proposed technique makes use of OpenCV's characteristics.

4.1.4 MobileNet

The MobileNet model, as its name implies, is intended for usage in mobile applications and is TensorFlow's first mobile computer vision model.

Depthwise separable convolutions are used by MobileNet. When compared to a network with conventional convolutions of the same depth in the nets, it dramatically reduces the number of parameters. As a result, lightweight deep neural networks are created.

MobileNet is a CNN class that was open-sourced by Google, and it provides us with an ideal starting point for training our incredibly compact and quick classifiers.

4.2 ML Model

4.2.1 Data Collection

Dataset has two directories in which one of them consists of images of individuals with masks and one directory contains individuals without masks.

Dataset - Drive link

4.2.2 Data Preprocessing

Data preprocessing involves conversion of data from a given format to a much more user friendly, desired and meaningful format. The proposed method deals with image and video data using Numpy and OpenCV.

4.2.2.1 Data Visualization

Data visualization is the process of transforming abstract data to meaningful representations using knowledge communication and insight discovery through encodings. It is helpful to study a particular pattern in the dataset.The total number of images in the dataset is visualized in both categories with mask and without mask.

4.2.2.2 Conversion of RGB image to Gray image:

Modern descriptor-based image recognition systems regularly work on grayscale images, without elaborating the method used to convert from color-to-grayscale. This is because the color to-grayscale method is of little consequence when using robust descriptors. Introducing nonessential information could increase the size of training data required to achieve good performance. As grayscale rationalizes the algorithm and diminishes the computational requisites, it is utilized for extracting descriptors instead of working on color images instantaneously.

4.2.2.3 Image Reshaping

The input during relegation of an image is a three-dimensional tensor, where each channel has a prominent unique pixel. All the images must have identically tantamount size corresponding to 3D feature tensor. However, neither images are customarily coextensive nor their corresponding feature tensors.

4.2.3 Training of Model

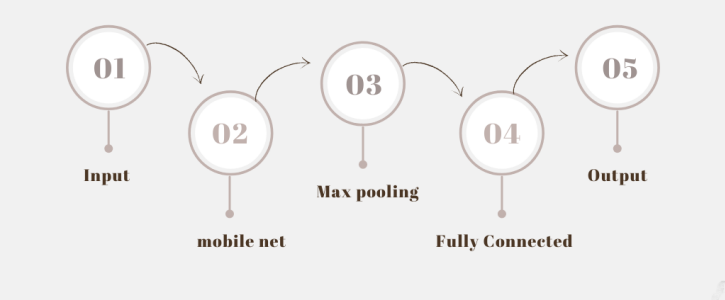


Figure 4.1

- **Input :** Load the Face mask data set after preprocessing to train the model.
- **Mobile net :** In this **convolution** process takes place.In which it converts all the pixels in its receptive field into a single value. For example, if you would apply a convolution to an image, you will be decreasing the image size as well as bringing all the information in the field together into a single pixel. The final output of the convolutional layer is a vector.
- **Max Pooling :** It is a pooling operation that calculates the maximum, or largest, value in each patch of each feature map. The results are down sampled or pooled feature maps that highlight the most present feature in the patch
- **Fully Connected :** Fully Connected layers in a neural network are those layers where all the inputs from one layer are connected to every activation unit of the next layer.
- **Output :** It detects whether a person is wearing a face mask or not and gives output.

4.2.4 Results

The model is trained, validated and tested upon two datasets. Corresponding to the dataset , the method attains accuracy . depicts how this optimized accuracy mitigates the cost of error is more versatile as it has multiple faces in the frame and different types of masks having different colors as well.

Figure 4.2

We can see that The accuracy of our training model is increasing gradually.The loss is decreasing eventually . So we are able to conclude that our ML model is working well.

4.3 Python code for the implemented model

Machine learning model python code

CHAPTER 5

EXPERIMENT RESULTS AND DISCUSSION

The experimental results obtained in this project work is discussed here.The results are analyzed at various levels.The face mask detection python file is compiled and the program will be accessing the input from the webcam of the device(where the python code is compiled). The program will be checking if the individual is wearing a mask properly or not.

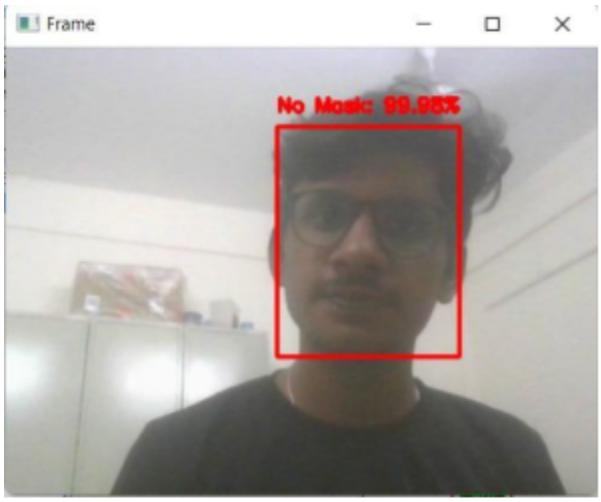


Figure 5.1 without mask

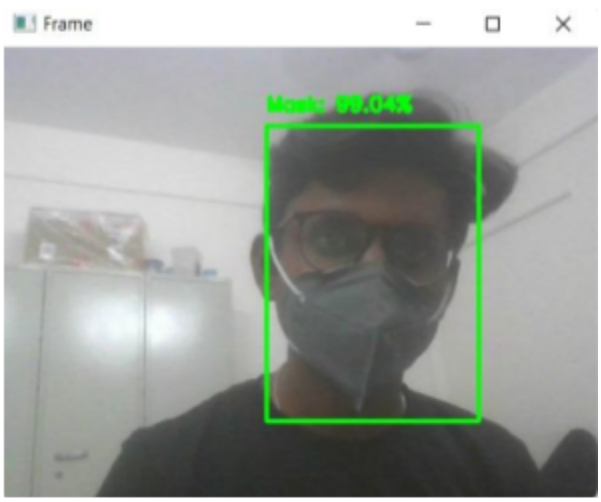


Figure 5.2 with mask

The input is processed as a binary value to the raspberry pi3 (in proteus 8 simulator) and based on that binary value the message will appear on the LCD display accordingly.

Mask condition	Message on LCD
With mask(wearing properly)	Mask detected
Without mask	Mask not detected

Table 5.1

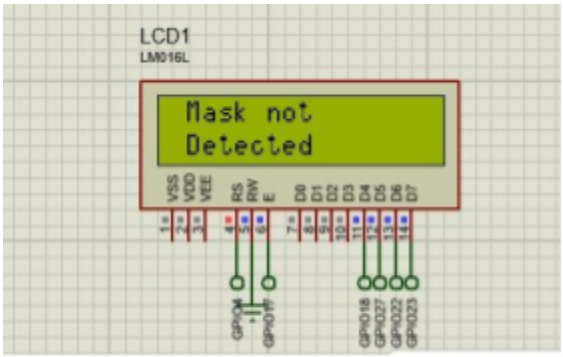


Figure 5.3-LCD message1

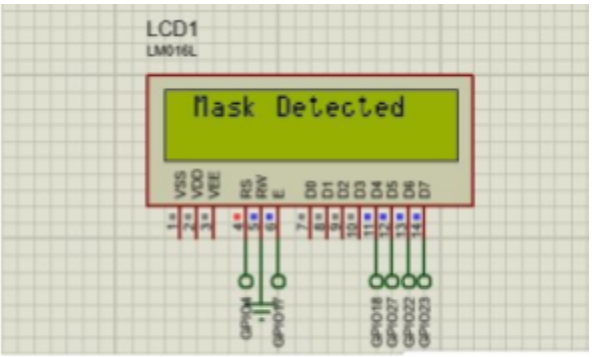
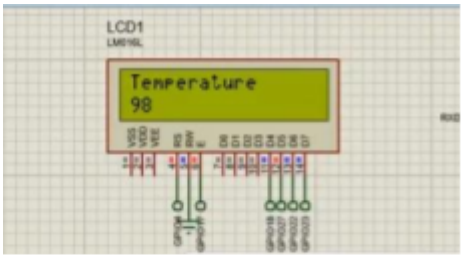


Figure 5.4-LCD message2

Then temperature will be recorded (if and only if he/she wears a mask properly) using a temperature sensor. Then the gate will be open if the recorded temperature falls in the threshold. And if in any case of violation, an alert will be sent to the concerned authority.

Message on LCD	**Temperature recorded**	**Gate Condition**	**Alert Message to authorities**
Mask detected	>90 and <100	open	No message
	Other cases	close	Alert Message will be sent
Mask not detected	No checking	close	

Table 5.2



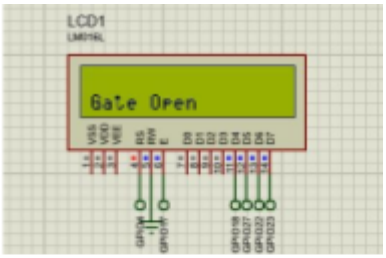


Figure 5.5 & 5.6- LCD Message1 regarding temperature(falls in threshold limit)

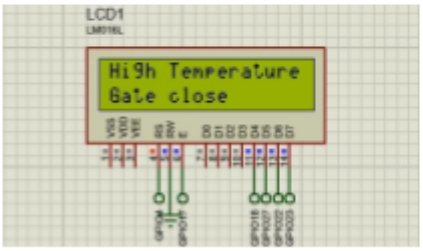


Figure 5.7 LCD Message2 regarding temperature(not falling in threshold limit

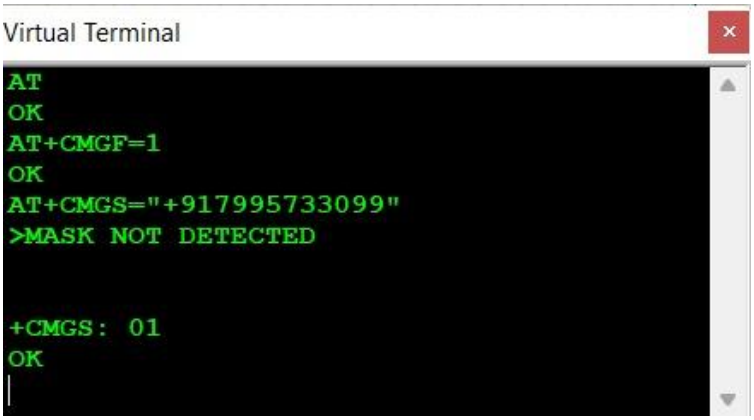


Figure 5.8-Message to authority(using GSM)

5.1 Demo Video - [Simulation Demo]

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

In this face mask detection project, we used mobilenet to efficiently detect people wearing and not wearing face masks, as well as send an alert message to authority figures via IOT. Its image performance is excellent, and our detection findings were likewise excellent. This detection is also applicable to video streams and camera-fed inputs.But, we can also design a machine learning algorithm which can detect the percentage of people not wearing masks properly in a public place and set a threshold for that percentage so that we can send any alert in the violation case. The detection algorithm can be implemented on a Raspberry Pi with a greater RAM variation, such as 4GB or 8GB RAM, for enhanced performance and speed. The project's future growth plans include identifying a person and sending an alert message to those who were not wearing face masks while on the move.This can be implemented in offices and institutions by training the database with employee or student images, and then using face recognition to identify the person, obtaining the person's mobile number and other details from the database, making it simple to notify that person or useful for taking any actions regarding not wearing a face mask. Various characteristics such as people count, social distance, and temperature measurement can be added to the suggested model to improve it. This project will be extremely beneficial and can be applied in hospitals, airports, schools, colleges, offices, stores, malls, theaters, temples, and apartments, among other places.

CHAPTER 7

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