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A SAFE ROOM FOR LIFE POST COVID-19

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ABSTRACT

According to data obtained by the World Health Organization, the global pandemic of COVID-19 has severely impacted the world. Wearing face masks and following safe social distancing are two of the enhanced safety protocols that need to be followed in public places in order to prevent the spread of the virus. To create a safe environment that contributes to public safety, in this project an efficient TensorFlow and computer vision-based approach focused on the real-time automated monitoring of people to detect face masks in public places by implementing the model on Image Processing to monitor activity and detect violations through camera. After detection of a breach, the Image Processing gives audio feedback. First the person needs to show their hand in front of the contactless temperature sensor, if their body temperature is normal, it'll pass the command to the hand sanitizer dispenser after that it will pass the information to python for face mask detection. Only if a face mask is detected the door will be opened. Along with that, we added total number persons allowed inside the room if it exceeds

the limit the door will not be opened. The room lights are also automatically controlled depending on the person inside. If there's no one inside that room the power will be turned off automatically to save energy.

CHAPTER 1

INTRODUCTION

1.1 GENERAL

A coronavirus is a group of viruses which aims at impacting and infecting the respiratory system of individuals. This group of coronaviruses includes SARS and the other commonly known cold and influenza viruses. Multiple nurses and medical workers of the PICC crew are immersed completely into the task of taking care of the infected patients and working around the clock to restore them to their normal health conditions on a global scale.

However, normalcy has to be restored even though the COVID situation has left several students, teachers, and working personnel homebound. As a global pandemic, COVID-19 has been inflicting major casualties and losses to the human population across the world from all walks of life. Approximately,
31.9 million people have been affected by the SARS-CoV-2 virus with close to 977K deaths reported under the radar.

In India alone, 5.73 million people were and are affected by COVID of which close to 91K people have succumbed to the virus. Maharashtra, Andhra Pradesh, Tamil Nadu have whooping numbers of COVID infected people.

The novel coronavirus covid-19 had brought a new normal life. India is struggling to get out of this virus attack and the government implemented a lockdown for the long way. Lockdown placed a pressure on the global economy. So, the government gave relaxations in lockdown. Declared by the WHO that a potential speech by maintaining distance and wearing a mask is necessary. The biggest support that the government needs after relaxation is social distancing and wearing of masks by the people.

So, it is important to make people wear masks in public places. In densely populated regions it is difficult to find the persons not wearing the face mask and warn them. So, there is a need to design such a system which analyses mask wearing and analyses the temperature of people at public places.

Hence, image processing techniques is used for identification of persons wearing and not wearing face masks.

First the person needs to show their hand in front of the contactless temperature sensor, if their body temperature is normal, it'll pass the command to the hand sanitizer dispenser after that it will pass the information to python for face mask detection. Only if a face mask is detected means only the door will be open along with that, we added a to number for allowed persons inside the room if it exceeds the limit the door will not be open. The room lights are also automatically controlled depending on the person inside. If there's no one inside that room the power will be turned off automatically to save energy.

1.2 TECHNOLOGIES USED

1.2.1 Deep Learning

Deep learning is the computer software that mimics the network of neurons in a brain. It is a subset of machine learning and is called deep learning because it makes use of deep neural networks. Fig.1.1 shows the deep learning layers

Deep learning algorithms are constructed with connected layers.

- The first layer is called the Input Layer.
- The last layer is called the Output Layer.
- All layers in between are called Hidden Layers. The word deep means the network joins neurons in more than two layers.

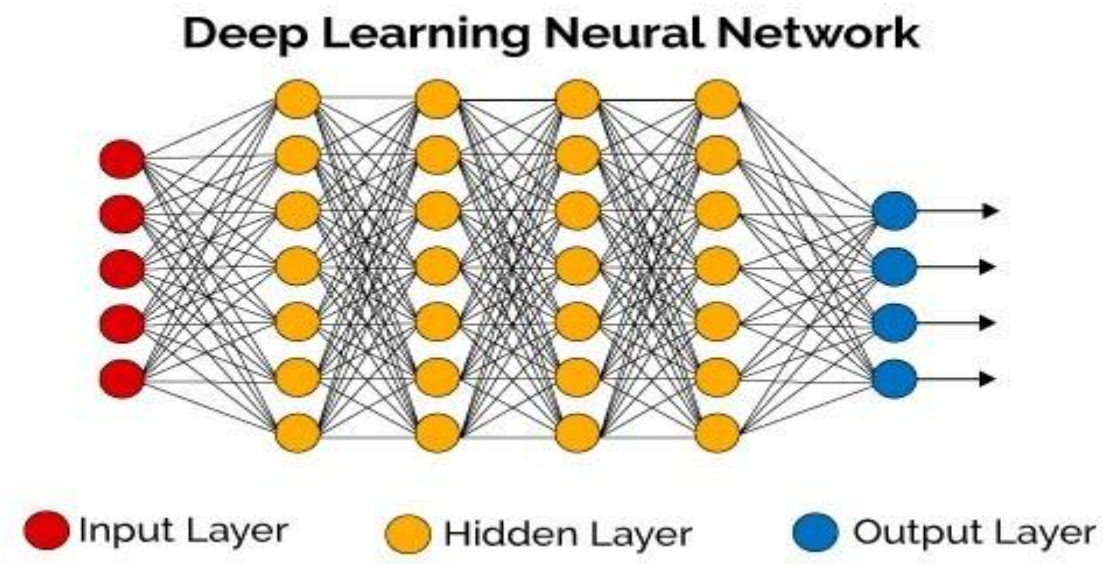


Fig. 1.1: Deep Learning Layers

Each hidden layer is composed of neurons. The neurons are connected to each other. The neurons will process and then propagate the input signal it receives to the layer above it. The strength of the signal given to the neuron in the next layer depends on the weight, bias and activation function.

Deep learning can outperform traditional methods. For instance, deep learning algorithms are 41% more accurate than machine learning algorithms in image classification, 27 % more accurate in facial recognition and 25% in voice recognition.

1.2.2 Convolutional Neural Network

In deep learning, a convolutional neural network (CNN/ConvNet) is a class of deep neural networks, most commonly applied to analyse visual imagery. It uses a special technique called Convolution.

CNN is a type of deep learning model for processing data that has a grid pattern, such as images, which is inspired by the organization of animal visual cortex and designed to automatically and adaptively learn spatial hierarchies of features, from low- to high-level patterns.

As one layer feeds its output into the next layer, extracted features can hierarchically and progressively become more complex. The process of optimizing parameters such as kernels is called training, which is performed so as to minimize the difference between outputs.

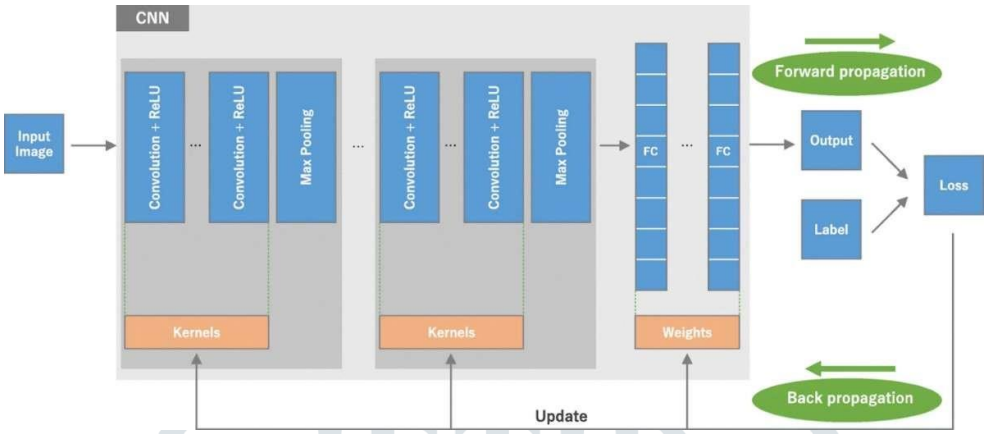


Fig 1.2: CNN architecture and the training process

Fig.1.2 shows an overview of convolutional neural network architecture and the training process. A CNN is composed of a stacking of several building blocks: convolution layers, pooling layers and fully connected layers. A model's performance under particular kernels and weights is calculated with a loss function through forward propagation on a training dataset, and learnable parameters, i.e., kernels and weights, are updated according to the loss value through backpropagation with gradient descent optimization algorithm.

Building Blocks of CNN Architecture:

- **Convolution layers -** A convolution layer is a fundamental component of the CNN architecture that performs feature extraction, which typically consists of a combination of linear and nonlinear operations.

- **Pooling layer -** A pooling layer provides a typical down sampling operation which reduces the in-plane dimensionality of the feature maps in order to introduce translation invariance to small shifts and distortions.

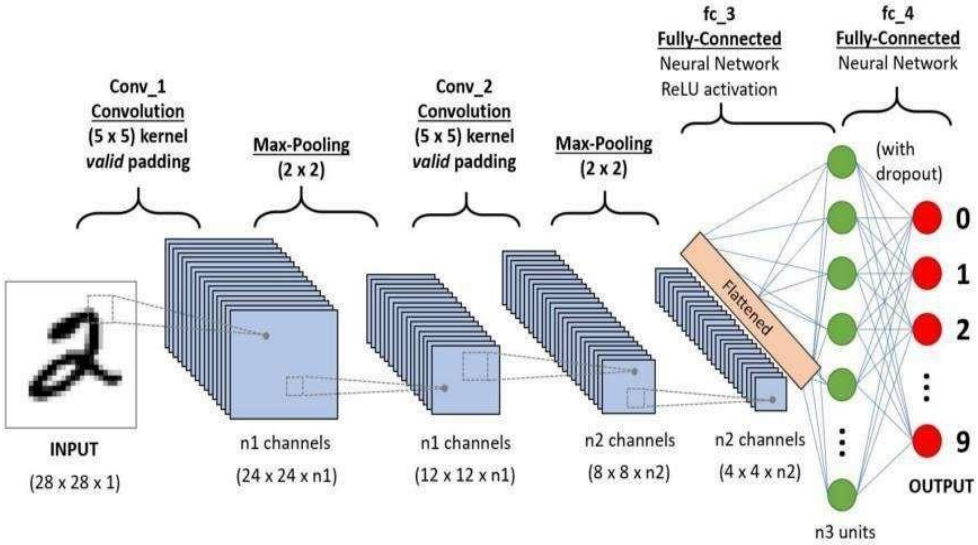


Fig 1.3: Overall structure of CNN

- **Fully connected layer** - The output feature maps of the final convolution or pooling layer is typically flattened, transformed into a one-dimensional array of numbers or vector and connected to one or more fully connected layers, also known as dense layers, in which every input is connected to every output by a learnable weight.

1.3 OBJECTIVES

- To prevents people from entering the desired place without a mask.
- To provides automatic and contact less temperature sensing and sanitizing.
- To count the number of people while entering and exiting.
- To limit the total number of persons in a particular space.
- To develop and implement an effective solution for life after Covid-19.

The introduction chapter gives a brief introduction to the technologies and algorithms used in the proposed model. It helps in understanding the concepts behind the working of the system which is explained in the following chapter.

1.4 ORGANIZATION OF REPORT

The thesis consists of five chapters and they are arranged in the following order

- Chapter 1 describes an introduction and the purpose of the project.

- Chapter 2 deals with literature survey.
- Chapter 3 deals with existing methods and proposed methods.
- Chapter 4 explains in depth the actual working of the project.
- Chapter 5 ends with the conclusion and future enhancement ideas.

CHAPTER 2

LITERATURE REVIEW

[1] AUTHOR NAME Abhishek jain, Hemant hasija, Ashish Dwivedi, Amanpreet Kaur, Pankaj Rakheja

TITLE Virtual person counter with Real-time automation.

DESCRIPTION Virtual person encounter is implemented using hardware part Arduino have been used and for software part OpenCV coding and MATLAB have been used for execution. This project is designed in order to count the number of people present in the room. The system tells the total number of people present in the room using face recognition technology. After implementation, it tells the number of people in the room and controls the appliances present in the room autonomously.

[2] AUTHOR NAME Anandu Ajayan, Sunitha Beevi.K

TITLE Automizer-An Automatic Sanitizer Dispenser.

DESCRIPTION The design of this sanitizer dispenser is done in such a way that it has a flow controller, a level detector, 24 hours battery life, and can be recharged with a mobile charger. The automatic sanitizer dispenser body is divided into two compartments. The lower compartment is used for storing sanitizer. The upper part is used for placing electronic circuits, batteries, etc. When a hand is placed near the nozzle IR rays from IR LED fall on the hand and reflect back and are received by IR receiver (TSOP) thereby the presence of the hand is detected.

[3] AUTHOR NAME Arjya Das, Mohammad Wasif Ansari and Rohini Basak **TITLE** Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV.

DESCRIPTION The proposed method detects the face from the image correctly and then identifies if it has a mask on it or not. This paper presents a simplified approach to achieve this purpose using some basic Machine Learning packages like Tensor Flow, Keras, Open CV and Scikit-Learn. The method attains accuracy up to 95.77% and 94.58% respectively on two different datasets. We explore optimized values of parameters using the Sequential Convolutional Neural Network model to detect the presence of masks correctly without causing over-fitting. The main challenges faced by the method mainly consist of varying angles and lack of clarity. Indistinct moving faces in the video stream make it more difficult.

[4] AUTHOR NAME Asif A. Rahimoon, Mohamed Noor Abdullah, Ishkrizat Taib

TITLE Design of a contactless body temperature measurement system using Arduino.

DESCRIPTION This paper presents the remote monitoring of human body temperature (HBT) wirelessly by means of an Arduino controller with different sensors and open-source internet connection. The proposed monitoring system uses an internet network via wireless fidelity (Wi-Fi) connection to be linked with an online portal on smart phone or computer. The proposed system consists of an Arduino controller, LM-35 (S1), MLX-90614 (S2) temperature sensors and ESP-wifi shield module. The obtained result has shown that real time temperature monitoring data can be transferred to authentic observers by utilizing internet of things (IoT) applications. The findings from this research indicates that the difference of average temperature between Sensor S1 and S2 is about 15 0C.

[5] AUTHOR NAME Jeong Woo Choi, Dae Hyeon Yim, Sung Ho Cho

TITLE People Counting Based on an IR-UWB Radar Sensor.

DESCRIPTION IR UWB radar uses an impulse signal that occupies a wide bandwidth. It is a technology that transmits an impulse signal and recognizes various situations by processing multiple signals that are received after being reflected from multiple humans and objects". The algorithm devised for this method is implemented using ARM Cortex-M4 and Raspberry Pi 2 modules. Two IR-UWB sensors with antennas are fixed to count the number of people. Though the system can detect multiple people at a time, it is not cost efficient. The sensors are expensive in the market.

[6] AUTHOR NAME M. M. Srihari

TITLE Self-Activating Sanitizer with Battery Imposed System for Cleansing Hands.

DESCRIPTION This paper gives a brief idea about the automatic hand wash sanitizer. There are two ways of automatic hand wash sanitation. One is without a microcontroller and the other is with a microcontroller. The Automatic Hand Wash Sanitation with Microcontroller (AH WSWM) has a microcontroller to control the whole setup, it has an external power supply SMPS to power up the circuit for automation. The human hand detected by the IR Sensor, sends the signal to the microcontroller to control the sanitizer liquid with the help of a Servo motor. The Automatic Hand Wash Sanitation without Microcontroller has the transistor to control the whole setup, it has a battery as the power supply to power and controls the circuit. The IR Sensor used for sensing the human hand send the signal to the transistors to turn ON the pump motor to supply the droplet of sanitizer to the human hand. Now it will be easy to use a hand wash without pressing or giving an external touch to the system.

[7] AUTHOR NAME Mullapudi Chaitanya Krishna

TITLE Implementation of Arduino-based Counter System.

DESCRIPTION This paper attempts to provide a unique solution which can automatically count the number of people. It intelligently discovers and counts the number of people with the help of internal code from the Arduino UNO. This has been achieved by using an Infrared sensor, piezoelectric sensors. The ultrasonic sensor plays a dominant role in identifying objects and accurately calculates the distance between the sensor and the objects.

[8] AUTHOR NAME Mohammad Marufur Rahman, Md. Motaleb Hossen Manik, Md. Milon Islam, Saifuddin Mahmud

TITLE An Automated System to Limit COVID-19 Using Facial Mask Detection in Smart City Network.

DESCRIPTION In this paper, a system is proposed that restricts the growth of COVID-19 by finding out people who are not wearing any facial mask where all the public places are

monitored with Closed-Circuit Television (CCTV) cameras. While a person without a mask is detected, the corresponding authority is informed through the city network. The learning algorithm Convolutional Neural Network (CNN) is used for feature extraction from the images then these features are learned by multiple hidden layers. A deep learning architecture is trained on a dataset that consists of images of people with and without masks collected from various sources. The trained architecture achieved 98.7% accuracy on distinguishing people with and without a facial mask.

[9] AUTHOR NAME Mohammed Azher Therib, Heyam A. Marzog and Marwa Jaleel Mohsin.

TITLE Smart Digital Bi-Directional Visitors Counter Based on IoT.

DESCRIPTION The major focus is on counting the huge number of humans entering one place from multiple entrance gates. The central processing unit (CPU) receives all the data from these gates and finally makes the studies about the overall human number, men number, women number, the period of the day that this number reaches the highest and smallest number, etc. The proposed project hardware contains multiple Wi-Fi based Arduino microcontrollers. One Arduino in each gate which is called transmitter and one in CPU which is called receiver, multi ultrasonic sensors for each transmitter placed on the entrance gates.

[10] AUTHOR NAME Zhou Chun-rong

TITLE Research on Face Recognition Technology Based on Deep Learning

DESCRIPTION This paper studies face recognition technology based on deep learning. For the image to be recognized, the HOG feature is used to detect the face target in the image. In order to avoid the influence of facial expression and posture, face alignment processing is performed. After extracting the face recognition features in the image, the neural network is used to realize face recognition. Through comparison experiments with traditional face recognition technology, it is verified that the recognition technology using deep learning improves the recognition efficiency by about 1.5 times and has better recognition adaptability.

In this chapter, the approach of literature surveys which are related to this project is explained. Using the outcomes and results obtained from these papers, the proposed system with deep learning algorithm for face mask detection, contactless temperature sensing,

automatic sanitizing and count of number of people in the room. The details are elaborated in forthcoming chapters.

CHAPTER 3 PROPOSED SYSTEM

3.1 EXISTING SYSTEM

In the existing system there is a person with a temperature gun standing outside the building to check our temperature. Once checked a person sprays sanitizer. There doesn't exist any technology for the detection of the mask in the existing system. It was only mandatory for people to wear masks in hazardous areas which were less in number and people not wearing masks would not only affect their health but others too, so there was not any effective system.

There are no contactless solutions for every need which may lead to the further spread of the Virus.

3.1.1 Disadvantages of Existing System

- There are no contactless solutions for every need so it may lead to an increase in the spread of viruses.
- Number of people entering the room cannot be kept in control in the existing system, this was the major reason why schools and colleges were kept closed.
- Accuracy is less.

3.2 PROPOSED DESIGN

A contactless temperature sensing technology that will sense the temperature of the persons entering the room. Mlx60914 Temperature Sensor is used to check the temperature. Next, automatic sanitization will be done. Next, the camera is used to monitor if people are wearing a mask or not. If and only if the mask is detected they will lead to the next process. Image Processing is used for the detection of masks. Convolution Neural Network – CNN is the algorithm used. If all these conditions are satisfied the person will be allowed in. IR sensors are used to check the person entering and leaving the room. If the maximum number that can be let inside the room is reached buzzer buzzes and no more people can be let in. One person has to leave for the other one to enter. Specified number of lights can be switched ON for a specified number of people rather than turning ON all the lights.

3.2.1 Advantages

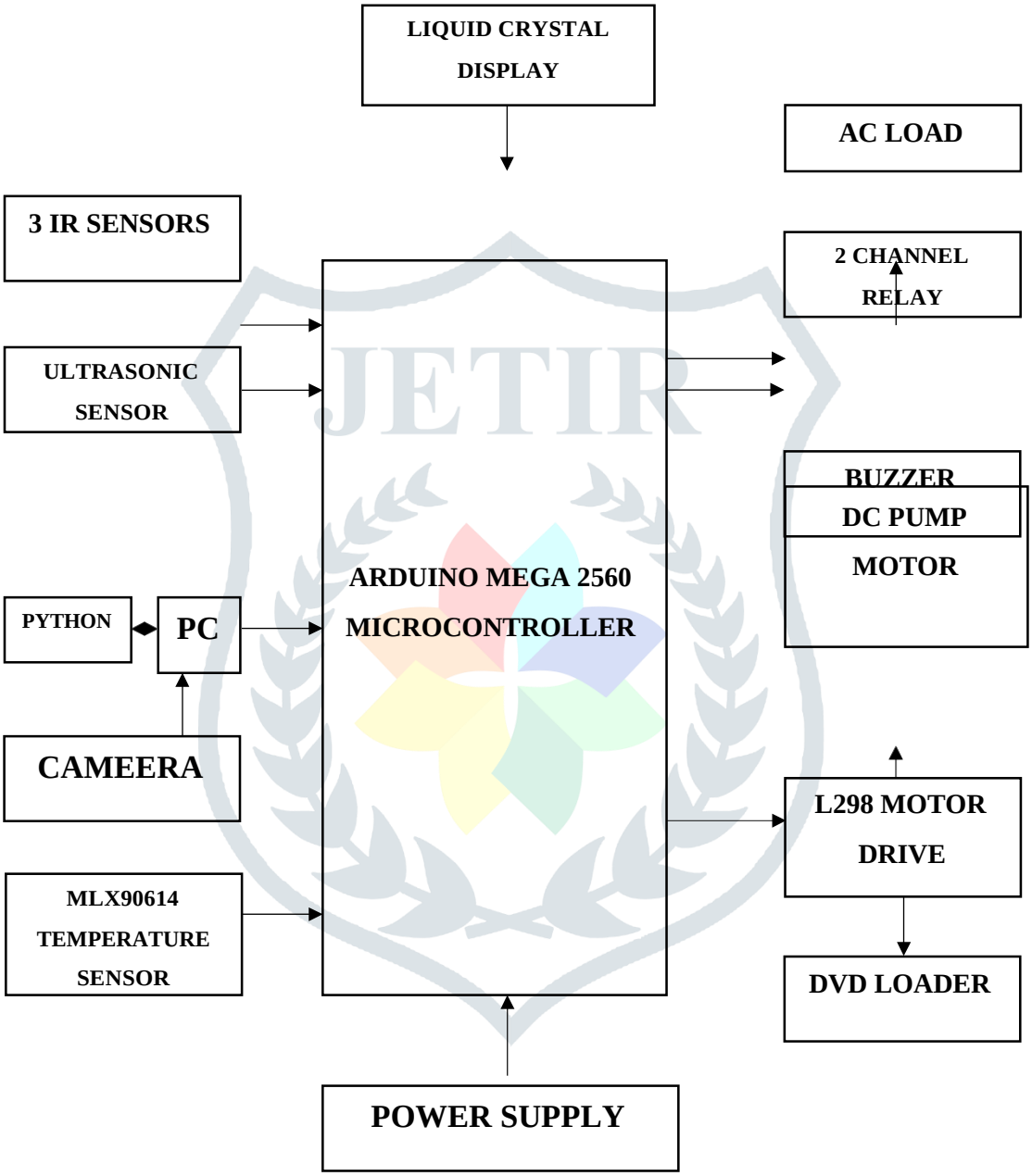
- Only people wearing masks are allowed into the room.
- Temperature is sensed by contactless means.
- Automatic sanitization is done.
- Allows only a specified number of persons inside the room.
- Saves electricity.

3.2.2 Application

- Can be used in Highly Crowded areas.
- Can be used in Schools, colleges, offices and in any organizations.
- Can be incorporated in Malls, Worship places, Markets.

3.3 SYSTEM DESIGN

3.3.1 Architectural Diagram



3.5 MODULE DESCRIPTION

- Power supply Module
- Processing Module
- Contactless Temperature sensing Module
- Automatic Sanitization Module
- Person Counter Module

3.5.1 Power Supply Module

The power supply circuit as shown in the Fig.3.1 consists of a step-down transformer which is 230v step down to 12v. In this circuit 4 diodes are used to form bridge rectifier which delivers pulsating dc voltage & then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any
A.C components present even after rectification.

The filtered DC voltage is given to the regulator to produce 12v constant DC voltage. 230V AC power is converted into 12V AC (12V RMS value wherein the peak value is around 17V), but the required power is 5V DC; for this purpose, 17V AC power must be primarily converted into DC power then it can be stepped down to the 5V DC. AC power can be converted into DC using one of the power electronic converters called Rectifiers.

There are different types of rectifiers, such as half-wave rectifiers, full- wave rectifiers and bridge rectifiers. Due to the advantages of the bridge rectifier over the half and full wave rectifier, the bridge rectifier is frequently used for converting AC to DC.

Fig 3.1: Power supply

3.5.2 Processing Module

The Arduino Mega is a powerful microcontroller board based on the ATMega2560 chip shown in the Fig.3.2. It's packed with 54 input/output pins, 15 analog inputs, and 4 serial ports. It also has 256 KB of ROM, 8 KB of RAM, and 4 KB of EEPROM, and as it operates at 5 V.

The Arduino Mega2560 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega2560 provides four hardware UARTs for TTL serial communication. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the ATmega8U2 chip and USB connection to the

computer but not for serial communication on pins 0 and 1.

The Arduino Mega2560 can be programmed with the Arduino software. The Atmega2560 on the Arduino Mega comes pre-burned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol.

Fig 3.2: Arduino Mega 2560

3.5.3 Temperature Sensing Module

3.5.3.1 MLX90614 - Temperature sensor

The MLX90614 as shown in the Fig.3.3is a Contactless Infrared (IR) Digital Temperature Sensor that can be used to measure the temperature of a particular object ranging from -70° C to 382.2°C. The sensor uses IR rays to measure the temperature of the object without any physical contact and communicates to the microcontroller using the I2C protocol.

As mentioned earlier, the MLX90614 sensor can measure the temperature of an object without any physical contact with it. This is made possible with a law called Stefan-Boltzmann Law, which states that all objects and living beings emit IR Energy and the intensity of this emitted IR energy will be directly proportional to the temperature of that object or living being. So, the MLX90614 sensor calculates the temperature of an object by measuring the amount of IR energy emitted from it.

Features: Small size and low cost. Easy to integrate. Factory calibrated in a wide temperature range: -40 to 125°C for sensor temperature and -70 to 380°C for object temperature. High

accuracy of 0.5°C over a wide temperature range. Medical accuracy of 0.1°C in a limited temperature range available on request.

Fig 3.3: MLX90614 Contactless Temperature Sensor Module

3.5.1.2 Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. Fig.3.4 shows HC-SR04 Ultrasonic Sensor.

The working principle of this module is simple. It sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated. Ultrasonic sensors are a great solution for the detection of clear objects

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 20,000 hertz, by turning electrical energy into sound,

then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

Fig 3.4: HC-SR04 Ultrasonic Sensor

3.5.4 Automatic Sanitization Module

The **L298 Motor Drive** is a high voltage, high current dual full bridge driver designed to accept standard TTL logic levels and drive inductive loads such relays, solenoids, DC and stepping motors as shown in the Fig.3.5. Two enable inputs are provided to enable or disable the device independently of the input signals.

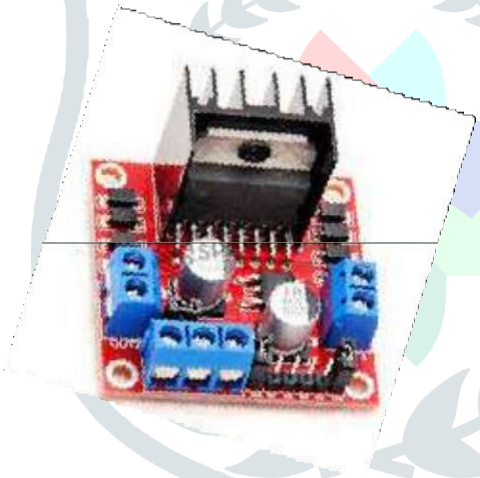


Fig 3.5: L298 Motor drive

Features: Operating supply voltage up to 46 V. Total DC current up to 4 A. Low saturation voltage. Over temperature protection. Logical "0" input voltage upto 1.5 V. An onboard user-accessible 5V low-dropout regulator. Schottky EMF-protection diodes. Screw-terminals for power and motor connections.

DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. DC pump motor is used for pumping the sanitizer out from the sanitizer bottle. When the DC pump motor is turned on it pumps sanitizer for one second automatically.

3.5.5 Person Counter Module

Here, the number of people entering the room will be counted and when a person leaves the room, the count of the number of people is decremented by the number of people exiting the room.

An **infrared (IR) sensor** detects infrared radiation in its surrounding environment as shown in the Fig.3.6. IR is invisible to the human eye, as its wavelength is longer than that of visible light though it is still on the same electromagnetic spectrum.

Fig 3.6: IR Sensor

Anything that emits heat everything that has a temperature above around five degrees Kelvin gives off infrared radiation.

There are two types of infrared sensors: active and passive. Active infrared sensors both emits and detects infrared radiation. Active IR sensors have two parts: a light emitting diode and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems.

A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal or where several circuits must be controlled by one signal.

Fig 3.7: 2 Channel Relay

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

3.6 SOFTWARE DESCRIPTION

3.6.1 Face Mask Detection Module

This system is capable of training the dataset of both persons wearing masks and without wearing masks. After training the model the system can predict whether the person is wearing the mask or not. It also can access the webcam and predict the result.

Dataset

Dataset 1 consists of 1918 images with people wearing face masks and Fig.3.8 shows dataset 1 with_mask.

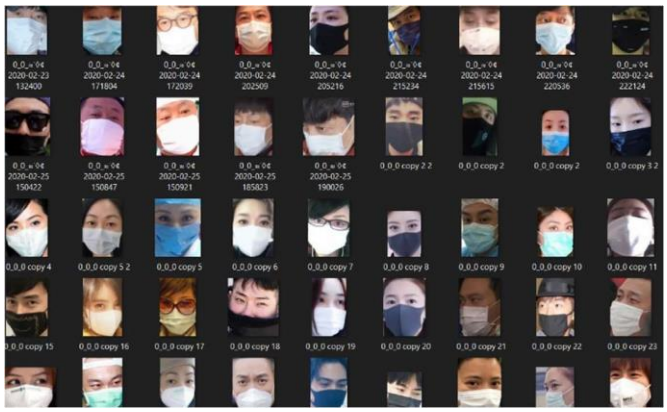


Fig 3.8: Dataset 1 - with_mask

Dataset 2 consists of 1918 images with people not wearing face masks and Fig.3.9 shows dataset 1without_mask.

Fig 3.9: Dataset 2 - without_mask

Dataset Augmentation

Dataset augmentation applies transformations to your training examples: they can be as simple as flipping an image, or as complicated as applying neural style transfer as shown in the Fig.3.10. The idea is that by changing the makeup of your data, you can improve your performance and increase your training set size.

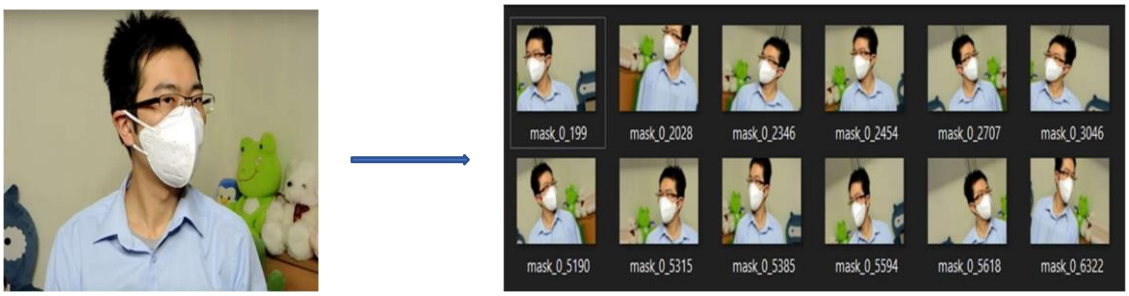


Fig 3.10: Dataset augmentation

3.6.2 Python

Python has been used as the programming language due to the following reasons:

Python is relatively simple, so it's easy to learn since it requires a unique syntax that focuses on readability. Developers can read and translate Python code much easier than other languages. In turn, this reduces the cost of program maintenance and development because it allows teams to work collaboratively without significant language and experience barriers. Additionally, Python supports the use of modules and packages, which mean that programs can be designed in a modular style and code, can be reused across a variety of projects.

One of the most promising benefits of using Python are that both the standard library and the interpreter are available free of charge, in both binary and source form. There is no exclusivity either, as Pythonand all the necessary tools are available on all major platforms.

TensorFlow – It is an interface for expressing machine learning algorithms. It is utilized for implementing ML systems into fabrication over a bunch of areas of computer science, including sentiment analysis, voice recognition, geographic information extraction, computer vision, text summarization, information retrieval, computational drug discovery and flaw detection to pursue research. In the proposed model, the whole Sequential CNN architecture uses TensorFlow at backend. It is also used to reshape the data in the data processing.

Keras – It gives fundamental reflections and building units for creation and transportation of ML arrangements with high iteration velocity. It takes full advantage of the scalability and cross-platform capabilities of TensorFlow. The core data structures of Keras are layers and models. All the layers used in the CNN model are implemented using Keras. Along with the conversion of the class vector to the binary class matrix in data processing, it helps to compile the overall model.

OpenCV - Open-Source Computer Vision Library, an open-source computer vision and ML software library, is utilized to differentiate and recognize faces, recognize objects, group movements in recordings, trace progressive modules, follow eye gesture, track camera actions, expel red eyes from pictures taken utilizing flash, find comparative pictures from an image database, perceive landscape and set up markers to overlay it with increased reality and so forth.

The proposed method makes use of these features of OpenCV in resizing and colour conversion of data images

Python Numbers - Numeric values are stored in number data types. When you give a number a value, it becomes a number object.

3.6.3 Arduino IDLE

The Arduino IDE a is an open-source software, which is used to write and upload code to the Arduino boards as shown in the Fig.3.11. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment.

The program or code written in the Arduino IDE is often called sketching. We need to connect the Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '. Ino'.

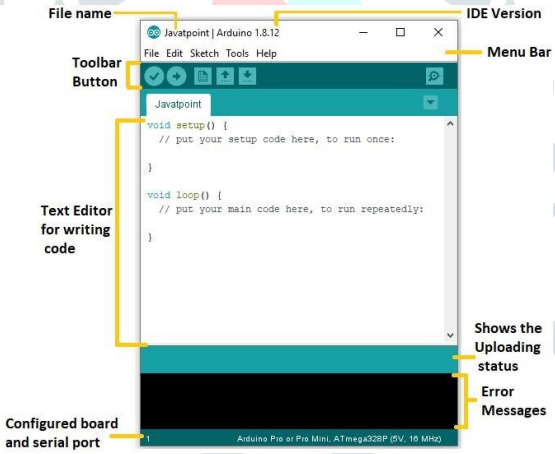


Fig 3.11: Arduino IDE

CHAPTER 4 RESULTS AND DISCUSSION

The result description of our project consists of both hardware and software. The experimental results obtained in this project work are discussed here. The results are analysed at various levels. The detailed description is given below.

4.1 TEMPERATURE SENSING

The temperature sensor senses the temperature when the hand is placed above near the sensor as shown in the figure 4.1. Here the sensor used is MLX60914 Temperature Sensor. In order to obtain accurate body temperature ultrasonic sensor is used which avoids the confusion between body temperature and the room temperature.

Fig 4.1: Temperature sensing

Lcd Display - After the detection of body temperature via hand LCD displays "Temperature Not Safe" if the temperature is above normal body temperature as shown in the figure 4.2. or the otherwise.

Fig 4.2: LCD Display

Buzzer - The buzzer buzzes when the temperature sensed is above normal body temperature

4.2 SANITIZATION

The sanitization is done using a DC pump motor. The motor driver L298 is used respectively. The sanitization is done when a hand is placed near the sensor as shown in the figure 4.3.

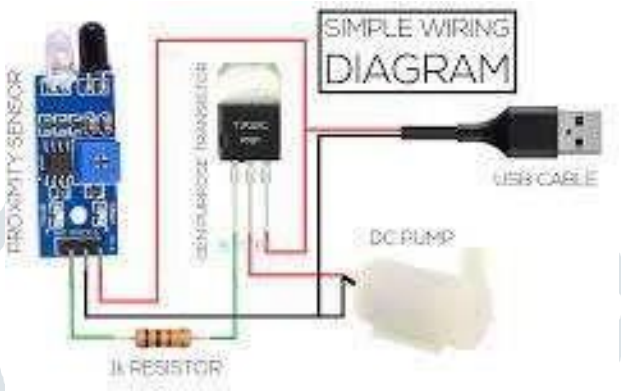


Fig 4.3 Automatic Sanitization

4.3 FACE MASK DETECTION

The face mask detection python file is run in the processor along with the deep learning files so the images are fed and the identification of persons wearing mask as shown in the Fig.4.5 and not wearing masks as shown in the Fig.4.4 is processed.

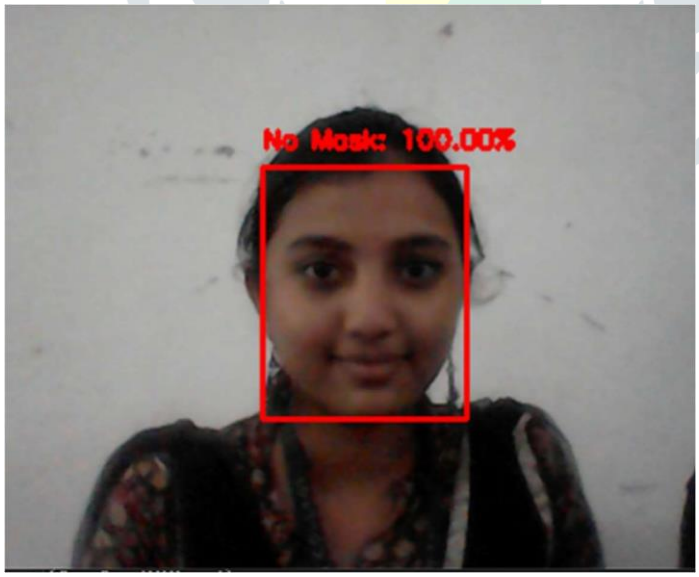


Fig 4.4: Without mask

Fig 4.5: With mask

Here after detection, based on status, it is displayed in the LCD. When a face with the mask is detected, the timer starts as shown in figure 4.7.

Fig 4.6 Before the timer

Fig 4.7 After the timer

4.3.1 Performance Matrix

The table is used to calculate the performance metrics like accuracy, precision, recall or sensitivity, specificity, F1 score. Table.4.1 shows the performance metrics of the proposed model.

Table 4.1 Performance metrics of the proposed model

Accuracy	Precision	Recall	Specificity	F1 Score
99.93%	99.63%	99.63%	384	99.63%

It is trained for about 30 epochs before the process of optimization. An epoch can be described as the time interval for training and then testing the trained algorithm with all the testing datasets collected. In every epoch the datasets are divided into certain batch levels and

the loss and accuracy of the model are calculated.

Thus, the value of accuracy and loss are calculated for different epoch and values are plotted in a graph. The train loss and train accuracy are the values of loss and accuracy calculated in the training phase of each epoch whereas the validation loss and validation accuracy are the value of loss and accuracy obtained in the testing phase of each epoch. The train loss and accuracy will always be smaller when compared with the validation loss and accuracy. The obtained performance metrics of the proposed system computed using equations (1 to 5) are shown in Table 4.2.

Table 4.2 Training and Validation values

Epoch	Train Loss	Train Accuracy	Validation Loss	Validation Accuracy
1	0.3600	0.5762	0.2991	0.8934
5	0.347	0.8773	0.0954	0.9688
10	0.1939	0.9405	0.0413	0.989
15	0.1515	0.9442	0.0238	0.9945
20	0.1287	0.9563	0.0126	0.9982
25	0.1405	0.95	0.0116	0.9963
30	0.0903	0.9699	0.0114	0.9982

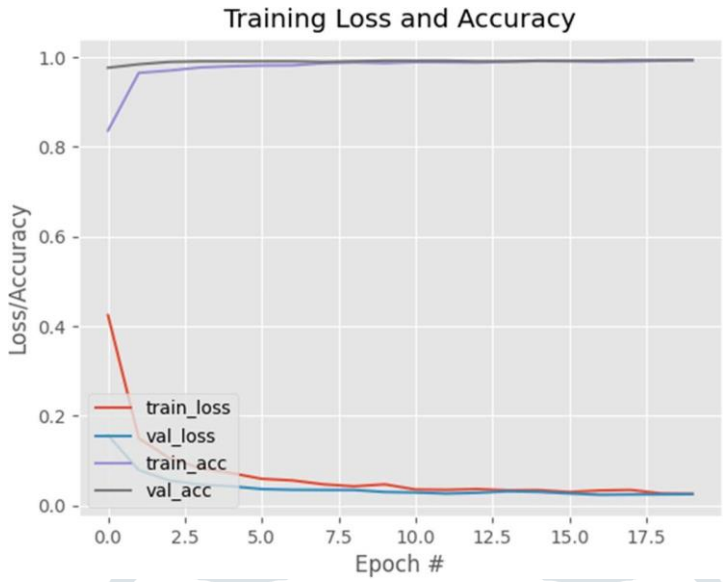


Fig.4.8 Training and Validation Graph

The values in Table 4.2 and Fig.4.8 concludes that at the end of the 20 epochs the optimized model has a train accuracy of 96.99%, and a train loss of 7.98% in the training phase. In the testing phase, the model has a validation accuracy of 99.86% and validation loss of 1.02%. Thus, the loss in both training and testing phase is considerably reduced. Fig.4.8 shows the Training and Validation Graph of Optimized model.

After all these conditions are satisfied, the door is opened as shown in the fig.4.10 or remains closed as in the fig 4.9.

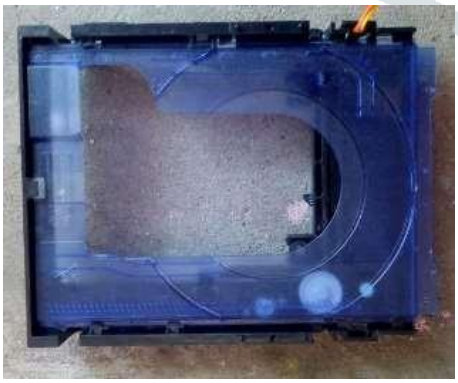


Fig 4.9 Door Closed

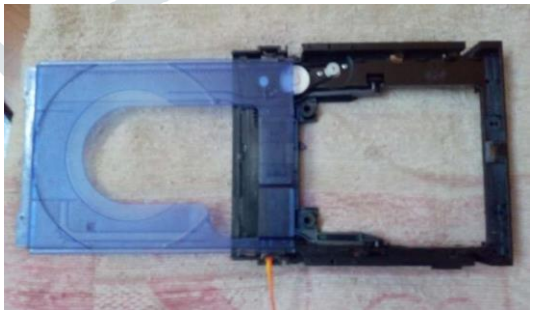


Fig 4.10 Door Opened

CHAPTER 5 CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The coronavirus pandemic has taught the world the importance of wearing a mask especially in public or crowded places. So, here we have developed a safe room where a person can enter only after is body temperature is checked, sanitized and checked whether he is wearing a mask.

The contactless temperature checking system checks the human body temperature. The automatic sanitizers sprays sanitizer automatically when the persons hand is sensed by IR sensor. The model discussed is trained with a comprehensive dataset that consists of several images of "mask" and „"no mask" used for training. After different phases like training, performance correctness, and testing stages, the model provides the probability percentage of the mask worn by the people with high accuracy.

Once all this is verified the door open for the person and he/she can enter the room. Depending on the number of people inside the room the lights is turned on and this in turn saves electricity.

5.2 FUTURE SCOPE

In future, this project can be applied in Schools, College, Malls and in highly crowded areas. All the organizations must quickly approve and make use of this machine learning techniques and new digital data assets, in order to use more unstructured data resources for more planning, prevention against COVID-19.

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