REVIEW PAPER

COVID-19 SAFETY GUIDELINES MEASURING (CSPM) SYSTEM

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Abstract

In this paper, we propose a system that will facilitate and employ various components (hardware and software) to check whether COVID-19 guidelines (face mask, body temperature and pulse rate) are being followed. This is achieved by the following processes: image processing, temperature sensing, pulse analysing and motor operation. Regularized iterative algorithms will be used for image processing using Convolutional Neural Network (CNN) containing data sets for training and validation (accuracy up to 98% and 95% respectively). Infrared sensors are installed to detect the temperature whereas the pulse rate detector uses Shock Pulse Method (SPM) sensor to detect the heart rate. The image processing involves Arduino and Python software systems for face mask recognition. An AC-powered servo motor is used for the last stage of the system.

Based on the results and output of the processes mentioned above, the access of an individual into the premises will be determined and those found violating the guidelines will receive an alert on their emails, thereby denying them entry. This system provides all the functionalities of the guidelines in a single framework without using different devices for different requirements.

Keywords: image processing, temperature sensing, motor operation, pulse analysing, iterative algorithm

1. INTRODUCTION

In this project, we propose to develop a Machine Learning system that employs various software and hardware components to detect face mask, check the temperature of individuals and record their heart rate in order to ensure that they are in accordance with the COVID-19 safety protocol issued by the government. All these features are provided in the same system, thus making it one of a kind, and all the components work on a non-contact basis.

This proposed system consists of three methods to ensure the safety of an individual:

1. Image Processing
2. Temperature Sensing
3. Pulse Analysing
4. Motor Operation

The CSPM System can be used at various organizations and institutes like hospitals, educational institutions, airports and office premises to detect people not wearing a face mask or having a high body temperature or heart rate, thus denying them entry into the premises of any institution/organization. This would help in a timely response against COVID-19 in the pandemic era.

The objective of this project is to develop a system that uses artificial intelligence through pipelining to detect faces with and without masks and at the same time, fitted with

temperature sensors to record and display the temperature of people entering an institution. It will also count the number of people and measure their pulse rate, sending an alert on email if the measurements are higher than normal. The servo motor works to control the door in order to allow entry to the individuals whose measurements are normal.

The hospitals can use this system to ensure that the incoming patients and the staff are following the protocols by wearing masks and everyone is getting their temperature checked before being allowed to enter in the premises. Airports can detect travellers without masks or fever easily and restrict their access. Offices of various companies can use this system to detect if the employees are following all the safety standards at work.

We will now define the keywords mentioned in the abstract to help you understand the review paper better.

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. It is mainly of five types: visualization, recognition, sharpening and restoration, pattern recognition and retrieval. A temperature sensor is a device that detects and measures hotness and coolness and converts it into an electrical signal. Pulse wave analysis (PWA) is a technique that allows the accurate recording of peripheral pressure waveforms and generation of the corresponding central waveform, from which the augmentation index and central pressure can be derived. An electric motor is an electrical machine which converts electrical energy into mechanical energy. The basic working principle of a DC motor is: "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". An iterative algorithm executes steps in iterations. It aims to find successive approximation in sequence to reach a solution. They are most commonly used in linear programs where large numbers of variables are involved.

2. LITERATURE REVIEW

The hardware system consists of ESP-32 CAM which uses a deep neural network to detect the face mask [1]. The main detection is done on the Arduino board mounted to the GPU for the graphical image [2]. A servo motor is used to demonstrate the opening and closing of the doors. An HRC-S04 Ultrasonic sensor is used to detect objects up to 13 feet. A 12-C LCD Yellow Backlight and IR sensors are also used whose purpose is described later.

This system will monitor the entry point continuously and detect people not wearing a face mask. It will also alert the individual not wearing a mask by sending an alert to them in real life through an email whose address will be stored in the database corresponding to the name of the individual. The temperature sensors will be used to measure the temperature of an individual before entering any premises and heartrate detector (Pulse Sensor Heartrate Detector) will measure the heartbeat to ensure that it falls in the normal range. Only then will an individual be allowed to enter through the gates.

The previous works suggest that work has been done in this field mainly in the Asian regions because COVID-19 was more prevalent and deadly in this part of the world. The continent of Asia also accounts for about 60% of the total population of earth according to the data shown by the official website of Worldometer.

Various research has been done regarding face recognition using expression recognition, pose recognition and face tracking with the help of machine learning and artificial intelligence. This can be particularly tiresome work to do because the expressions and features of a face are dynamic and mutable. In case of a masked face, the researchers have found two major problems. The first problem is to ignore the expressions of the face as the system might consider different expressions of the same face as different faces and count them multiple times. The second problem is to select a huge amount of data set including both masked and unmasked faces. The face mask recognition system must perform two tasks, namely: identify the image correctly and identify if it has a mask on it.

A temperature sensor works based on the change in the electric signal with respect to the change in temperature. This is also called real-time monitoring. For this to be done on a human body, the electrical signal are the changes in the IR rays emitted from the body by placing the sensor on the tip of the fingers because fingertips are more sensitive to these sensors and the skin on the tips is thin, so the change is easily detectable. The pulse rate can be detected by pulse oximeter which contains a sensor, signal generator, filter, amplifier, ADC, pulse rate detection module and LCD to display the rate.

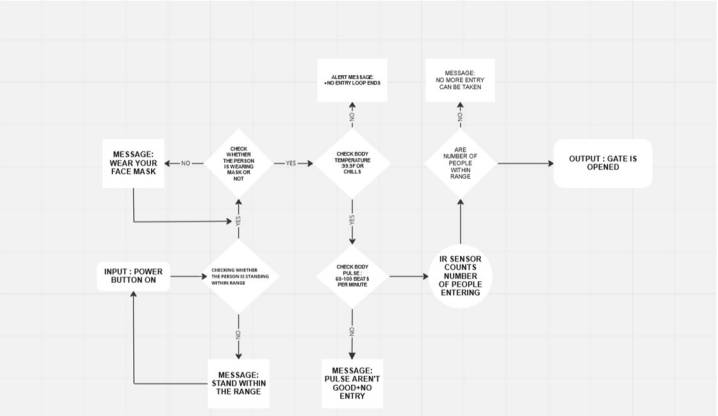


Figure 3

3. FLOWCHART

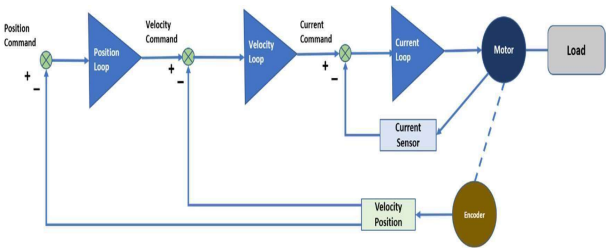


Figure 1

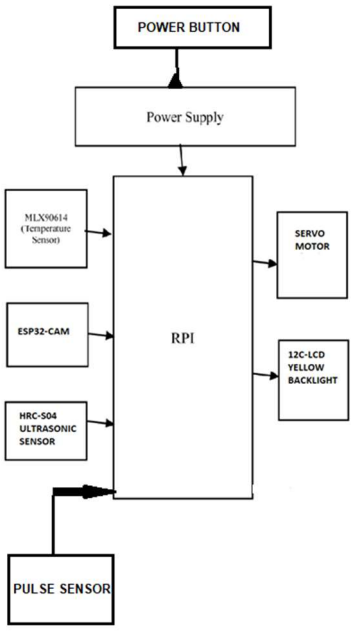


Figure 2

4. PROPOSED SYSTEM

The ESP-32 CAM consists of OV2640 camera and a slot for SIM card which has applications in wireless video monitoring. It supports Wi-Fi+ Bluetooth and contains a RAM of 512 KB [15].

The dataset is split into training and validation set: the training set is used for machine learning while the validation set is used for the actual detection [3-4, 10]. Convolutional Neural Network (CNN) is designed using Python. It has many layers, the mains of which are convolutional layer, pooling layer and fully connected layer [5]. After designing the CNN, we train the model. The model is then deployed to make predictions as accurately as possible [6-7]. A face recognition system is created and all the recognized faces are stored in a database.

The subject must be in the range of the camera (30-65 cm) in order to get detected and this is done using the HC-SR04 Ultrasonic sensor [8-9]. HC-SR04 ultrasonic distance sensor consists of two ultrasonic transducers, one of which is the transmitter and the other is the receiver.

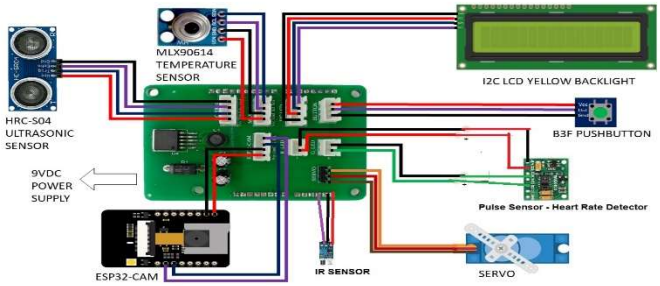
Graph 1 Training Loss vs Accuracy

An MLX 90614 temperature sensor consists of low noise amplifier, 17-bit ADC and powerful DSP unit is used for the purpose of measuring the body temperature. The human body emits infrared rays that change according to the temperature of the human body and are invisible to the human eye. This sensor detects the infrared rays and is thus suitable for this project than any other temperature sensor as it is a noncontact temperature sensor. The range for temperature detection is 91.4 F to 102.2 F. Any number beyond this range displays an error in the device [11-12].

The Pulse Sensor Heartrate Detector is also used in this system as a high heart rate is also an indicator of COVID-19. It uses the Shock Pulse Method (SPM) sensor for heartbeat detection. This is done by placing the sensor on the fingertip, emitting Infrared light from the body surface. It detects the change in the blood flow during one heartbeat as a function of the change in the amount of light transmitted through the body using photons. The fingertip is preferred because the photons can easily pass through the thin skin on the tip [13].

The servo motor used in this system is an AC-powered servo motor which consists of a potentiometer, gear assembly and controlling circuit. The servo motor in this system is used to allow entry to the individuals who fulfil the COVID precaution criteria and is controlled by an external control system. It also has a feature of manual override in case the system crashes due to any emergency [14]. A 12-C LCD Yellow Backlight is used to provide basic text wrapping. Infrared sensors are also used to count the number of people entering and leaving the room.

5. CIRCUIT DIAGRAM



6. SOFTWARE/HARDWARE USED

The software used for this system is Arduino and uses Python script whose command line arguments include dataset (of faces and faces with masks) and model (of the face).

Following is the hardware used for this project:

1. ESP-32 Cam
2. MLX 90614 Temperature sensor
3. HC-SR04 Ultrasonic sensor
4. AC- powered servo motor
5. 12-C LCD Yellow Backlight
6. Infrared sensor
7. Pulse Sensor Heartrate Detector

7. SCOPE OF THE PROJECT

This project would find its application in all the institutions and organizations dealing with many people on a daily basis like airports, hospitals, educational institutions, office spaces and much more. It will contribute towards communal health and mass immunity.

Airports – This project can be used at airports to detect people traveling without masks or with a temperature higher than usual.

Hospitals – The system will be able to ensure that the patients and the staff follow the required safety protocols and ensure that people are always wearing masks inside the premises.

Office Spaces – This system can also be used at offices to check whether the employees are following COVID-19 prevention guidelines.

8. CONCLUSION

The primary project requirement for the Bachelor of Electronics and Communication Engineering degree will be satisfied by this project effort. COVID-19 Safety Measuring Protocol (CSPM) System was selected because it includes both the sensors that will be used in it and the design of a real-time embedded system. The model proposed here achieves accuracy in face mask detection and temperature sensing using appropriate hardware and software resources to ensure public safety. Efforts have been put to reduce false detection and handle the large amount of dataset, which is highly suitable for COVID-19 related mask and temperature detection. Because of the aforementioned criteria, COVID-19 Safety Measuring Protocol (CSPM) System was a successful project for us.

9. REFERENCES

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