Temperature and Face Mask Scan Entry System

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***Abstract*— COVID 19 pandemic is causing a global health epidemic. The most powerful safety tool is wearing a face mask in public places and everywhere else. The COVID 19 outbreak forced governments around the world to implement lockdowns to detect virus transmission. According to survey reports, wearing a face mask at public places reduces the risk of transmission significantly. A machine learning model for monitoring body temperature and face mask detection. The proposed model can be used for any shopping mall, hotel, apartment entrance, etc. As an outcome a cost-effective and reliable method of using AI and sensors to build a healthy environment. Evaluation of the proposed framework is done by the Face Mask Detection algorithm using the open-CV software library. Besides, the body temperature of the individual is monitored using a non-contact temperature sensor.**

1.INTRODUCTION

Since the last days of the previous year, the occurrence of novel infectious flu-a like respiratory disease COVID-19 caused by SARS-Cov-2 virus (also known as corona virus) has affected almost every aspect of people's lives globally. However, the crucial problem is the lack of approved vaccine and medication due to these facts, many protection and safety measures were taken by governments in order to reduce the disease spread, such as obligatory indoor mask wearing, Social distancing, quarantine, self-isolation etc.., We focus on most common indoor measures - people with high body temperature should stay at home, wearing mask is obligatory and distance between persons should be at least 1.5-2 meters.

The purpose of the project is to detect the person perfectly wearing mask or not and temperature detection of the person if the both are correct then the door allows the person in. The first step to detect COVID is by scanning for fever. Also, we need to monitor every person for a mask. We have temperature checking systems for every entrance for scanning but manual temperature scanning has a lot of disadvantages. To solve this problem, we here propose a fully automated temperature scanner and entry provider system. It is a multipurpose system that has a wide range of applications. The system makes use of a contactless temperature scanner and a mask monitor. The scanner is connected directly with a human barrier to bar entry if high temperature or no mask is detected. Any person will not be provided entry without temperature and mask scan. Only person having both conditions is instantly allowed inside. The system uses temperature sensor and camera connected with a raspberry pi system to control the entire operation.

BLOCK DIIAGRAM:

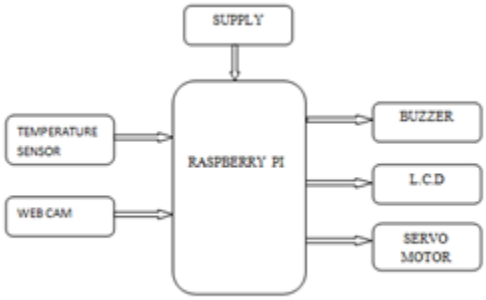

Fig 1.1 block diagram

EXPLANATION

The purpose of the project is to detect the person perfectly wearing mask or not and temperature detection of the person if the both are correct then the door allows the person in and there will be automatic sanitization these consists of temperature sensor, raspberry Pi model 3b also we are using a IOT based technology to store the data and some other

components like buzzer, motor, LCD. Having both conditions is instantly allowed inside. The system uses a temperature sensor and camera connected with a raspberry pi system to control the entire operation. The camera is used to scan for masks and temperature sensors for forehead temperature. The raspberry processes the sensor inputs and decides whether the person is to be allowed. In this case the system operates a motor to open the barrier allowing the person to enter the premises. If a person is flagged by the system for high temperature or no Mask the system glows the red light and bars the person from entry. Also the face and temperature of a person is transmitted over IOT to the server for authorities to take action and test the person for covid.

2.CONVOLUTIONAL NEURAL NETWORK AND MASK DETECTION MODULE

The second module in our proposed system is to detect the mask-wearing by people who are passing through it. We used five pre-trained deep learning models, which are VGG-16, Mobile NetV2, Inception V3, ResNet-50, and Convolutional Neural Network (CNN), to detect a face mask wear in three classes: face with proper mask (FWPM), face with improper mask (FWIPM), and face without a mask (FWOM). Further, our proposed model identifies and classifies the types of face masks in two classes, which are N-95 and a surgical mask. We fine-tuned these five pre-trained models with transfer learning for training, which is much faster and easier than training a model from scratch with randomly initialized weights. In a similar way, the authors used a deep neural network to analyze vibration signals that are caused by walking persons on the floor to detect the person localization in large buildings. We set the output layer of these models as non-trainable by freezing the weights and other trainable parameters in each layer to not be trained or updated when we feed our dataset. Further, we added an output layer train on our dataset. This output layer would be the only trainable layer in our new model. We used the Adam optimizer with a learning rate of 0.0001, cross entropy for our loss and accuracy for our matrix.

Architecture of CNN model:

The architecture of CNN consists of an input layer, an output layer, and multiple hidden layers. The hidden layers typically consist of convolutional layers, pooling layers, fully Architecture of Convolutional NeuralNetwork (CNN)model to connected layers and normalization layers (ReLU). This network's input is the images with face mask (proper and improper) and without a face mask input size of 224 by 224 and three RGB channels. The first layer is a convolutional layer with the Relu function, as shown in Equation , with a kernel size of 224 by 224 and 64 output channels.

Relu(x) = max(0.x)

Relu function returns 0 if it receives any negative input, but it returns that value for any positive value

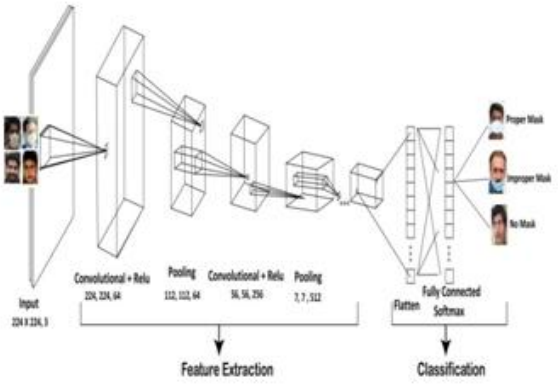

Fig.2.1Architecture of Convolutional Neural Network

of x. The next layer of the architecture is max pooling, which involves shrinking the image stack. To pool an image, the window size is defined as (112 112,64 output channels).The window is then filtered across the strides' appearance, with the max value being recorded for each window. With the max-pooling layer, we have a normalization layer that is known as the Rectified Linear Unit (Relu) process, which is shown in Equation, which changes all of the negative values within the filtered image to 0. This step is then repeated on all of the filtered images, and the Relu layer increases the non-linear properties of the model. On the third layer, the same as the first layer, we had a convolution layer that process images with a kernel size of (5656) and process RGB to256 output channels. There is also a pooling layer before the fully connected layer with the kernel size of 7x7. We have a flattened layer with a fully connected

layer with the soft max function shown in Equation(1).

$$pi = (e^{x_i}) / \sum_j e^{x_j} \quad .. \quad (1)$$

where xi is the total input received by unit i and pi is the prediction probability of the image belonging to class i. In this layer, every value gets a vote to predict the class of image. The fully connected layers are often stacked together, with each intermediate layer voting on phantom hidden categories. In effect, each additional layer allows for the network to learn even more sophisticated combinations of features towards better decision making. Finally, we have an output, which is a label of proper face mask, improper face mask, and without a facemask

Fig.2.2 Mask recognisation

Open CV

For the purpose of the images being captured on the camera we use the algorithm from the Python Open CV's (Open Source Computer Vision Library) is an open source computer vision and Machine learning software library. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms.

These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects etc

3. RASPBERRY-PI

The Raspberry Pi is a credit-card-sized computer that plugs into a monitor and a keyboard. It also plays high-definition video. Several generations of Raspberry Pi's have been released. Raspberry Pi 3 Model B released in February 2016 is bundled with on-board Wi-Fi, Bluetooth and USB Boot capabilities. As of January 2017, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi.

PERFORMANCE:

The Raspberry Pi 3, with a quad-core Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1. This was suggested to be highly dependen tupon task threading and instruction set use. Benchmarks showed the Raspberry Pi 3 to be approximately 80% faster than the Raspberry Pi 2 in parallelized tasks. Raspberry Pi 2 includes a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM. It is described as 4–6 times more powerful than its predecessor. The GPU is identical to the original. In parallelized benchmarks, the Raspberry Pi 2 could be up to 14 times faster than a Raspberry Pi 1 Model B+.

While operating at 700 MHz by default, the first generation Raspberry Pi provided a real-world performance roughly equivalent to 0.041 GFLOPS. On the CPU level the performance is similar to a 300 MHz Pentium II of 1997–99. The GPU provides 1 Gpixel/s or 1.5 Gtexel/s of graphics processing or 24 GFLOPS of general purpose computing performance. The graphical capabilities of the Raspberry Pi are roughly equivalent to the performance of the Xbox of 2001.

On the Model B and B+ the Ethernet port is provided by a built-in USB Ethernet adapter using the SMSC LAN9514 chip. Microchip's LAN9514 is a Hi-Speed USB 2.0 hub and high-performance 10/100 Ethernet controllers. The LAN9514 is specifically designed to provide system architects with a low-cost, power-efficient, small-footprint USB to Ethernet and multi-port USB connectivity.

Fig.3.1 Raspberry pi 3 kit

Raspberry Pi 3

Raspberry-pi consists of 40 GPIO (general purpose input/output) pins. GPIO pins do not have specific function and can be customized by using software.

Fig.3.2 Raspberry pi GPIO pin diagram

4. TEMPERATURE SENSOR

Contact less temparature sensor(MLX90614)
Contactless Infrared Temperature Sensor measures the surface temperature of an object depending on the emitted IR waves of the target without touching it and also measures the average temperature over an area. It is a Contact-less, high precision, high resolution and a fast response sensor.

FUNCTIONAL DIAGRAM:-

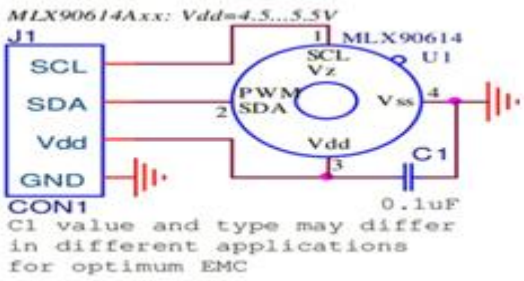

Fig.4.1 Temperature sensor functional diagram

GENERAL DESCRIPTION:-
The MLX90614 is built from 2 chips developed and manufactured by Melexis:

- The Infra Red thermopile detector MLX81101.
- The signal conditioning ASSP MLX90302, specially designed to process the output of IR sensor.
- The device is available in an industry standard TO-39 package.
- It has low noise amplifier, high resolution 17-bit ADC and powerful DSP unit of MLX90302 high
- Accuracy and resolution of the thermometer is achieved. The calculated object and ambient temperatures are available in RAM of MLX90302 with resolution of 0.01 ˚C. They are accessible by 2 wire serial SM Bus Compatible protocol (0.02°C resolution) or via 10-bit PWM (Pulse Width Modulated) output of the device.
- The MLX90614 is factory calibrated in wide temperature ranges: -40 to 125 ˚C for the ambient temperature and -70 to 382.2 ˚C for the object temperature. The 10-bit PWM is as a standard configured to transmit continuously the measured object temperature for an object temperature range of -20 to 120 ˚C with an output resolution of 0.14 ˚C. The PWM can be easily customized for virtually any range desired by customer by changing the content of 2 EEPROM cells. This has no effect on the factory calibration of the device.
- The PWM pin can also be configured to act as a thermal relay (input is To), thus allowing for an easy and cost effective implementation in thermostats or temperature (freezing/boiling) alert applications. The Temperature threshold is user programmable. In a SMBus system this feature can act as a processor Interrupt that can trigger reading all slaves on the bus and to determine the precise condition. As a standard, the MLX90614 is calibrated for an object emissivity of 1. It can be easily customized by the Customer for any other emissivity in the range 0.1-1.0 without the need of recalibration with a black body.

- The thermometer is available in 2 supply voltage options: 5V compatible or 3V (battery) compatible.
- The 5Vcan be easily adopted to operate from a higher supply voltage (8-16V, for example) by use of few external components (refer to "Applications information" section for details).An optical filter (long-wave pass) that cuts off the visible and near infra-red radiant flux is integrated in the packages to provide sunlight immunity

5 .SERVO MOTOR

A servomotor is a linear actuator or rotary actuator that allows for precise control of linear or angular position, acceleration, and velocity. It consists of a motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

A servomotor is a simple electric motor, controlled with the help of servomechanism. If the motor as a controlled device, associated with servomechanism is DC motor, then it is commonly known as a DC Servo Motor. If AC operates the controlled motor, it is known as a AC Servo Motor.

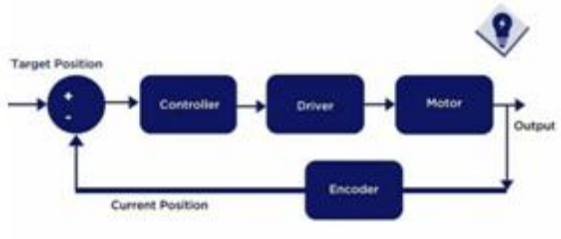

Fig.5.1 Block diagram of servo motor

Fig.5.2 Servo motor

WORKING PRINCIPLE:

The principle of operation of ac servo motor is same as that of an ordinary two-phase induction motor. When two voltages with time phase difference of 90 electrical degrees are applied to the two stator phases 90 electrical degrees apart in space, a rotating magnetic field is produced. As the field sweeps over the rotor, e.m.f.s and hence the currents are induced in the rotor conductors forming a closed path. The rotating magnetic field interacts with these currents producing a torque on the rotor in the direction of field rotation.

HOW TO CONTROL A SERVO MOTOR WITH A RASPBERRY PI:

To make a Raspberry Pi control a servo motor, connect the +5 V and GND lines of the servo to an external power supply and the remaining signal wire to any I/O pin of the Raspberry Pi. Don't forget to connect any GND pin of the Raspberry Pi to the ground of the power supply as well. As mentioned above, servos typically expect a PWM signal that tells them where to turn. Therefore, there are several methods to rotate a servo to a specific angle. One method is to use the gpio zero library that contains a Servo module. You can use pip to install the library on a Raspberry Pi

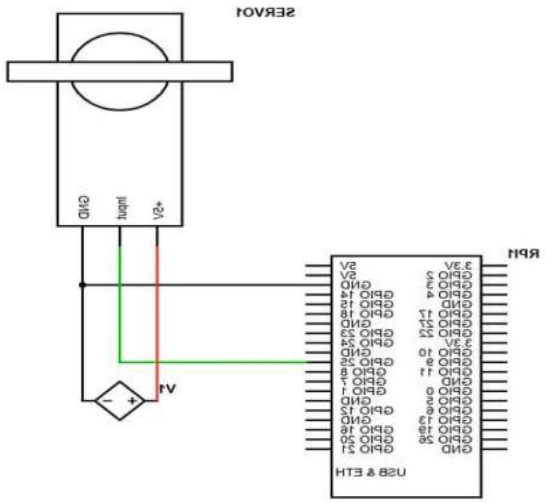

Fig.5.3 Interfacing of servo motor with raspberry pi

6.RESULTS

New developments and the availability of smart technologies force to the creation of new models, which will help meet the needs of developing countries. In this work, we developed a device to monitor body temperature and detect face masks that can enhance public safety. This will help to reduce manpower while also providing an extra layer of protection against the spread of Covid-19 infection. The components used in this device are Raspberry pi, Temperature sensor-MLX90614, Servo motor, web

cam, buzzer, Lcd display and acrylic sheet. The model uses a real-time deep learning system using Raspberry pi to detect face masks, and temperature detection at any given time. The device performs excellently when it comes to temperature measurement and mask detection, the trained model was able to achieve a result of 97 percent. The test results demonstrate a high level of accuracy in detecting people wearing and not wearing facemasks, as well as it also generates buzzer sound.

Fig.6.1 temperature and face mask detection

From the above figure6.1 if the person wearing a mask and having a permissible temperature then the toll gate will open.

Fig.6.2 temperature and face mask detection

From the above figure6.2, if the person doesn't have a face mask or permissible temperature then the toll gate will be at closed position and generates a sound using buzzer.

CONCLUSION

COVID-19 has become a pandemic and it is now spreading rapidly through direct
and indirect contacts among individuals. Manual systems of measuring temperature and disinfecting are being used in homes and public places for disinfection, but these systems may become a source of the spread of infection of COVID-19. Now, this virus will stay in our lives, and we have to live with it, but we need to adopt precautions strictly to break the chain of this virus. This research aims to control the spread of COVID-19 by preventing and minimizing local transmission carriers. Our proposed model is a practical approach for rapid screening and disinfecting numerous people with an automated system. The modules of our proposed system are measuring temperature in a contact-free manner and detecting the person wearing a face mask or not which can play a pivotal role in controlling and tracing the person who may suspect of COVID-19.The modules of our proposed system gave us very impressive results and showed that Smart Screening and Disinfection Walk through Gate can help to control the local transmission and defeat this novel COVID-19 pandemic. Our mask detection and classification module gave us accuracies of 99.71%, 99.86%, 99.26%, 99.22%, and 99.07% by using the VGG-16, MobileNetV2, Inception V3, ResNet-50 and CNN respectively for facemask detection We highly suggest implementing of this system in public places, such as at the entrance of the housing communities, shopping malls, mosques, schools, colleges, universities, hospitals, and hotels, etc.

REERENCE

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