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Face Mask and Auto-Temperature Detector

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Abstract
World health infrastructure collapsed due to global pandemic COVID-19 caused by novel corona virus. The whole world including developed countries are going through health crisis. Hence, prevention is better than cure becomes true. Accordingly, many precautionary measures can be taken to reduce the spread of corona virus. One such method of prevention is wearing a mask and regular monitoring of body temperature. As it was already proposed by WHO, wearing a mask reduces the transmission of corona virus. This project dealt with detection of a person with facemask or not. The same will be detected with the help of deep learning and computer vision. This deep learning architecture is trained on a dataset that consists of images of people with and without masks and this model will also detect the temperature of the person without any human interference. All this data will be stored in IoT cloud service and for any abnormality, emails will be triggered.

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I. INTRODUCTION

It is said that roughly in every 100th year world faces a pandemic and unfortunately we are in midst of one such pandemic called COVID-19. It proved to be very disastrous, as it hampered many economies around the world and also took many lives. It led to huge unemployment as many governments were forced to declare lockdown. It effected the GDP of many countries and also reduced lifestyle of people. Many people died of hunger and many children became orphan due to this novel virus. Hence reducing the transmission becomes very important. According to WHO, COVID-19 is an infectious disease and the best way to prevent and slow down its transmission is by wearing a mask especially when we are in crowded places. As COVID-19 spreads primarily through droplets of saliva or discharge from the nose hence wearing mask becomes very essential to break its chain and reduce its transmission, so that more lives can be saved. Along with wearing mask, checking body temperature may also comes handy to reduce its transmission especially when we are in crowded places like educational institutions, malls, offices etc. Before entering the respective place, the data about our body temperature and the status of our mask is taken and if so ever it is found that a person is having abnormal body temperature or not wearing a mask then that information is reported to the respective higher authorities, so that such person can be isolated and spread of corona virus can be minimized. During this hard times, not only our medical infrastructure should be strengthened but also our technologies should be used in a way that it helps to reduce the hardship. Thus, the proposed project uses artificial intelligence based on Machine learning to reduce COVID-19 transmission. In this project webcam is used to detect the person's facemask. The learning algorithm Convolutional Neural Network (CNN) is used to teach the system and it is done through a dataset of images with and without mask.

II. LITERATURE SURVEY

- Social distancing alert system is also made using CCTV cameras combined with computer vision to detect whether the people are following social distancing norms.
- Self-assessment apps were provided by several governments across the globe to coach people regarding safety measures to forestall the transmission of corona virus.

- Artificial Intelligence (AI) based Quarantine and self-isolation system were also proposed to identify and track infected persons and helps implementing quarantine.
- Artificial Intelligence was also used for clinical management to diagnose infected person so that relevant treatment can be given.
- Artificial Intelligence based contact tracing to detect the person who was in close vicinity or in contact with the infected person, so that such person can be isolated.

III. PROPOSED SYSTEM

At entry point of public places like educational institutions, malls, offices etc. this system can be adopted. In this proposed system we will be detecting the status of mask using webcam along with measuring the temperature of the person using MLX90614 Non-Contact temperature sensor and this information will also be displayed on 16x2 LCD. The information is updated at the same time to the IoT cloud server. For abnormal temperature and mask status the same information is transmitted to the higher authorities. In this project we will also use ultrasonic sensor which turns ON the model only if the person is detected.

Fig.1: Working model of proposed system

IV. BLOCK DIAGRAM

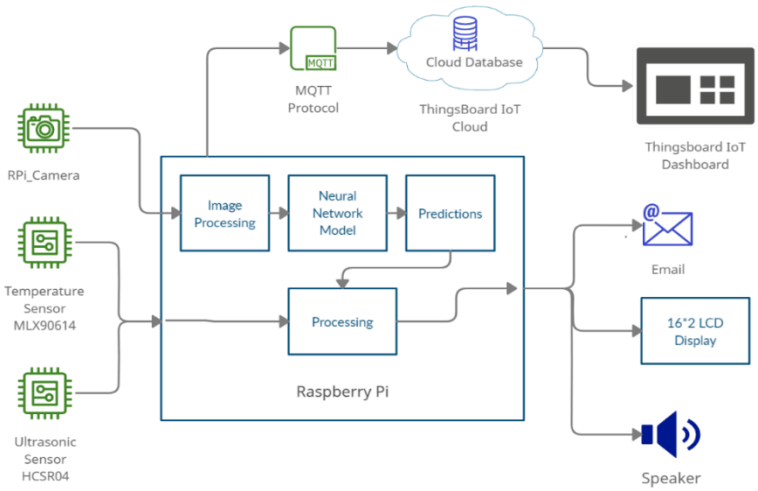

Fig.2: Block diagram of proposed system

Description:

1. **Raspberry Pi:** The Raspberry Pi model 3B+ is used to do all computations of this system. This is a mini sized compact CPU having sufficient computing power (1.4GHz) and RAM memory (1GB) for small scale applications. Various peripherals like sensors and IO devices can be interfaced with it. It also provides internet connectivity through Wi-Fi which also allows the system to access internet for IoT applications.

2. **Ultrasonic sensor:** The ultrasonic sensor HCSR04 is interfaced through Raspberry Pi's GPIOs. The distances within 3 meters can be measured precisely using this sensor. In this system, the sensor is used to detect distance of the person standing in front of the system. The program continuously monitors the distance. Whenever the distance is below 40 cm, next process of capturing image is triggered.
3. **MLX90614 Temperature sensor:** The non-contact temperature sensor MLX90614 is used to detect the body temperature. The non-contact feature facilitate temperature measurements without any proximity, which is crucial for avoiding transmission of virus. The sensor is able to detect temperature of an object from 5cm.
4. **Raspberry Pi Cam:** Raspberry Pi 5MP Camera module is used for face detection. RPi Camera is attached on the camera slot provided on the raspberry pi.
5. **LCD Display:** A 16x2 Liquid Crystal Display is used to display instructions and output of the system. The LCD is used in nibble mode to interact with the Raspberry Pi.
6. **Power supply:** The system implementation requires regulated 5V power supply.

V. WORKING

This system can be deployed at the entrance of offices, hospitals, medical stores, malls, shops as well as government and corporate offices for guests and employees. As employees, users, visitors or patients walk close to the system, the ultrasonic sensor will detect the person and trigger the next process. The system will then ask user to look into the camera by using voice instructions and displaying corresponding text on LCD. The image will get captured by the RPi camera and that image will be passed through an image processing algorithm. The processed image is then fed to the trained neural network model to make predictions. If the mask is not detected the system will ask user to wear mask. After successful verification, the system will ask user to bring user's hand near the temperature sensor. The non-contact temperature sensor will then measure the body temperature of the user. If the temperature detected is above the pre-set value, the system will generate voice instructions as "abnormal temperature" and notice will be delivered to the higher authorities using email which will contain the person's image and corresponding body temperature. Along with it real time reports will get generated on the Thingsboard IoT cloud. This system will help to reduce the risk of virus transmission and will provide seamless entrance access.

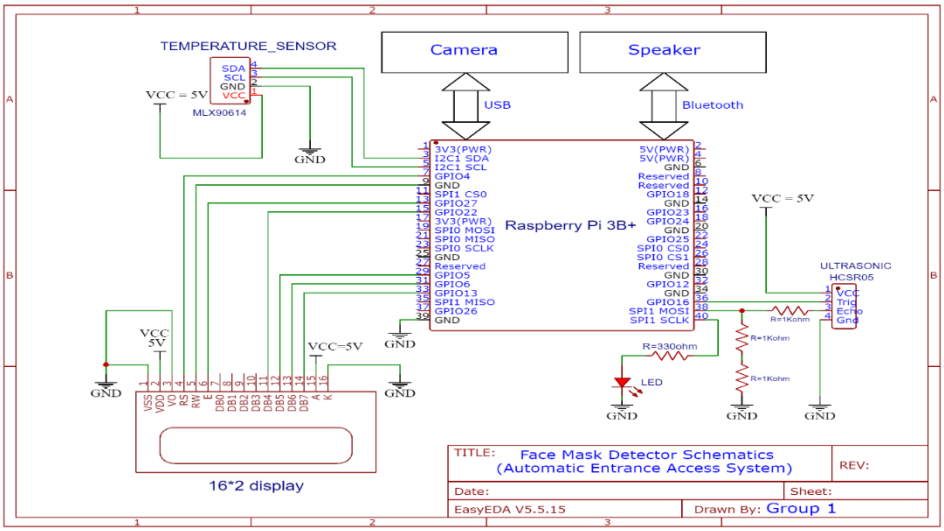

Fig.3: Circuit diagram

Training of Neural Network Model:

a) Data Collection and preprocessing: We have used a Face Mask Detection Dataset that is publicly available on Kaggle and available under creative commons license. This dataset is provided by the vendor named WooBot Intelligence. It contains the images of human faces wearing various types of masks, more specifically the images in the dataset are divided into 20 categories namely 'face_with_mask', 'mask_colorful', 'face_no_mask','face_with_mask_incorrect', 'mask_surgical', 'face_other_covering', 'scarf_bandana', 'eyeglasses', 'helmet', 'face_shield', 'sunglasses', 'hood', 'hat', 'goggles', 'hair_net', 'hijab_niqab', 'other', 'gas_mask', 'balaclava_ski_mask' and 'turban'. The dataset is filtered such that we have images belonging to two classes i.e. face with mask and face without mask. From here on we call these two classes as compliant and non-compliant. The filtered dataset contains approximately 3K images for the combined two classes. The dataset contains 1569 non-compliant and 4180 compliant images. The rest of the classes are discarded as they were of no use for training the model. The images are initially resized to the dimension of 224x224 pixels. To make the model generalize well, we have used several augmentation techniques such as brightness shift, shear wrap, rotation, flipping, horizontal shift and vertical shift. Data augmentation also helps the model to perform well on real life images and aids in prevention of high variance while training the data.

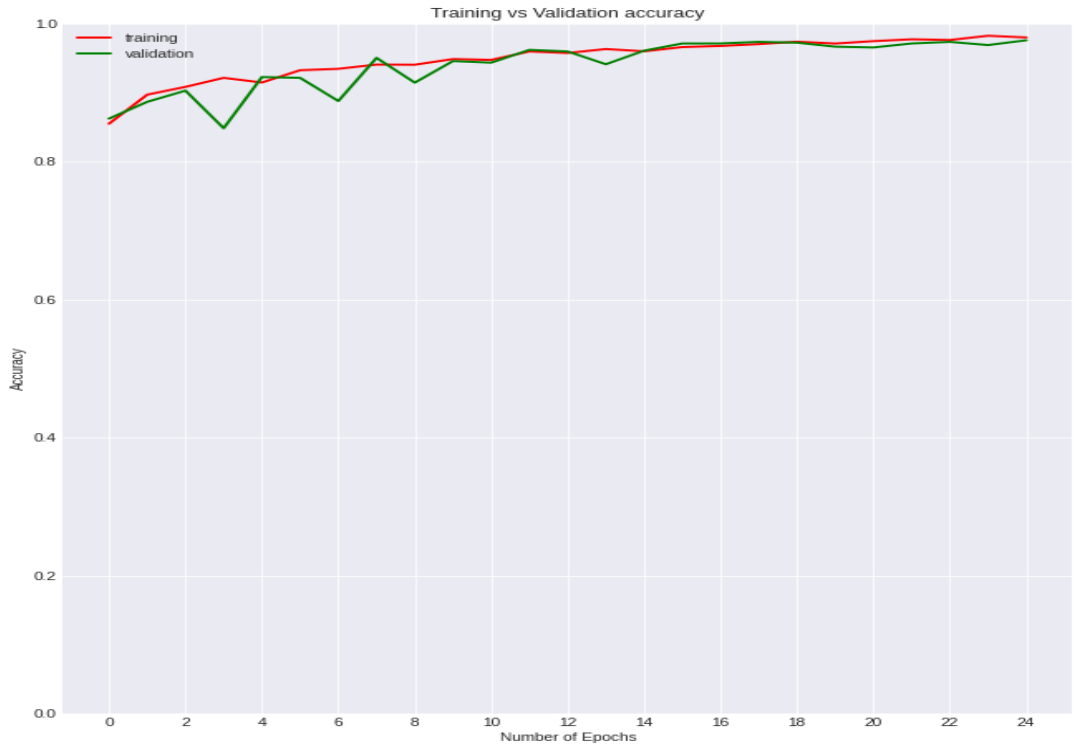

Fig.4: Accuracy of the developed system for training and testing phase

b) Model Architecture and training: The model architecture is based on Convolutional Neural Networks also called as CNN. It is a 7 layer model (excluding the input layer) of which the first 4 layers are convolution layers. Each convolution layer is a sequential combination of Conv, Batch Normalization, ReLu and MaxPool layers. Next layer is used to reshape the volume of convolution from the 4th layer into 2D matrix. Sixth layer is a fully connected dense layer. Seventh layer is a classification layer used to classify images into two categories. Adaptive learning rate is used with the initial learning rate set to 0.001. Batch size of 32 is used while training the model. Lower batch size ensures optimal use of memory and large number of gradient descent steps. The model is trained for 25 epochs.

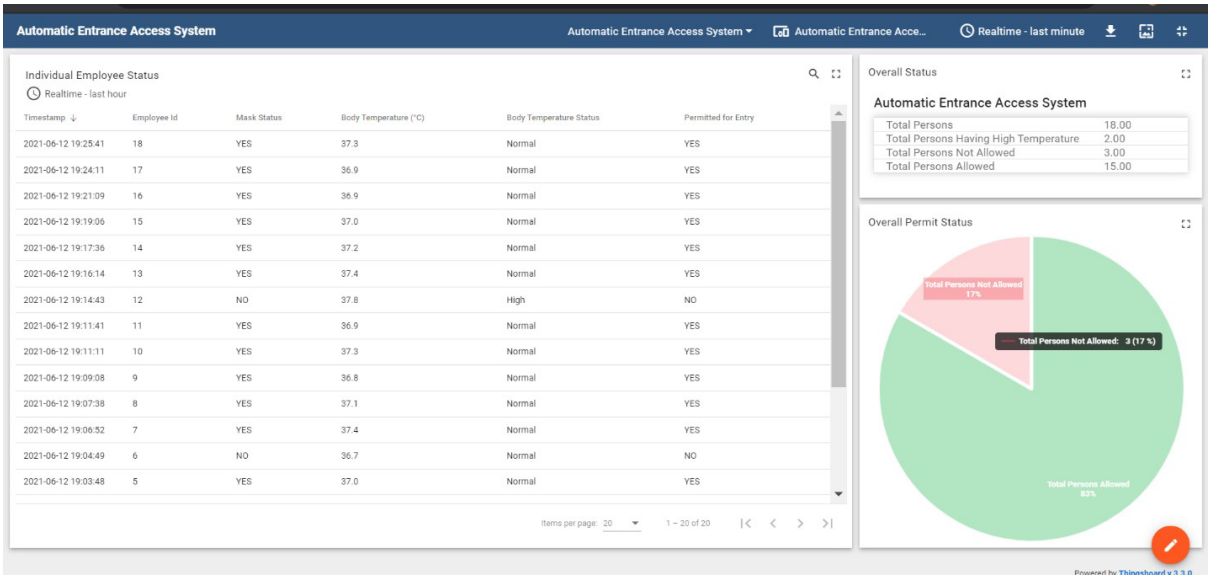

Fig.5: Typical IoT form of employee data available with higher authorities

VI. CONCLUSION

This paper dealt with reducing the spread of virus transmission using technologies like machine learning and computer vision. The motivation for this work comes from the people who are not abiding by the protocol. In this system deep learning algorithm is used to detect whether the person is wearing a mask or not and the model is trained using dataset containing images of people with mask and without mask. This model also helped to detect temperature of person without any human involvement. Thus this project acts as a need of the hour and implementing this model would be of great help to the society at present situation.

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