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MACHINE LEARNING AND OPEN-CV BASED SYSTEM FOR COVID-19 INDOOR SAFETY MONITORING

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Abstract – *An affordable IOT based solution is proposed in aiming to provide COVID19 indoor safety, covering several relevant aspects:*

1. Contactless temperature sensing
2. Mask detection
3. RFID Module
4. Automatic sanitizer dispenser

Contactless temperature sensing subsystem relieves using infrared sensor or thermal camera, while mask detection and check are performed by leveraging computer vision techniques on camera-equipped raspberry pi and details of people who show vulnerability to the infection or the details of people who does not strictly follow the protocols of the infection are extracted through the RFID module.

It is cost effective IOT based system aiming to help organizations respect the COVID19 safety rules and guidelines in order to reduce the disease spread is present and it focus on most common indoor measures people with high body temperature should stay at home, wearing mask is obligatory and distance between Person should be work don't put we at least 1.5-2 meters. For the first scenario use raspberry pi Controller board with contactless temperature sensor is used, and rely on raspberry pi single board computer equipped with camera and decided to use these devices due to their small size and affordability.

Key Words: **Computer vision, Machine Learning, COVID-19, Raspberry Pi, ontology, Fully Convolutional Network, Semantic Segmentation, Face Segmentation and Detection**

1.INTRODUCTION

Since the last days of the previous year, the emergence of COVID-19, a novel viral flu-like respiratory disease triggered by the SARS-Cov-2 virus (also known as corona virus), has had an effect on almost every part of people's lives around the world. It was first found in China, but it soon spread to other continents in a matter of weeks. The country's second wave of the deadly virus has gone rogue, making the government's and people's job of dealing with the crisis even more difficult. Many state governments have enforced another full lockdown across their cities, requiring residents to stay at home, while the governments of the remaining states are taking different steps to bring the situation under control. According to the sources, until April 28, 2021, the cumulative number of confirmed reported cases was 1,80,07,010, with 2,01,246 deaths. Not to mention the fact that the virus is spreading at an alarming pace.

Fever, tiredness, sore throat, nasal inflammation, and loss of taste and smell are all common signs of corona virus infection. It is most often transmitted directly (from person to person) by respiratory droplets, but it can also be transmitted indirectly through surfaces. The time of incubation can be very long and varies (between 14 and 27 days in extreme cases). Furthermore, even asymptomatic people (nearly 45 percent of the time) will spread the disease, exacerbating the problem. As a result, the use of face masks and sanitizers has proven to be effective in reducing disease transmission. The most serious issue, though, is the shortage of licenced vaccines and medications.

As a result of these realities, policymakers have implemented a variety of health and safety policies to reduce disease transmission, including obligatory indoor mask wearing, social distancing, quarantine, self-isolation, and restricting citizens' travel across country borders and internationally, frequently in conjunction with the banning and cancellation of large public activities and gatherings. Despite the fact that the pandemic seemed to be weakening at times, due to the uncertain situation, most safety rules are still in place. Corona virus disease affects anything from organisational activity to social affairs, sports and culture.

We learned from the reference paper that many people in the covid19 pandemic suffer from a shortage of artificial ventilators, so we devised a solution to minimise the number of people affected by the disease by developing a safety monitoring device.

2.LITERATURE SURVEY

2.1 Facial Mask Detection using Semantic Segmentation

Author: Toshanlal Meenpal , Ashutosh Balakrishnan and Amit Verma. Published year: 2019. Volume: 2, Issue:1.Journal: 2019 4th International Conference on Computing, Communications and Security (ICCCS).

This paper suggests a model for face detection in an image that involves classifying each pixel as face or non-face, essentially generating a binary classifier, and then detecting

the segmented region. The style fits well on both frontal and non-frontal faces. The paper also reflects on removing the inevitable false predictions that will arise.

2.2 IoT-based System for COVID-19 Indoor Safety Monitoring

Author: Nenad Petrović and Đorđe Kocić. Published year: 2020. Volume: 2, Issue:1. Journal: IcETRAN 2020 At: Belgrade, Serbia.

The aim of this paper is to provide a cost-effective IoT-based framework that will assist organizations in adhering to COVID-19 protection rules and recommendations in order to prevent disease transmission. It concentrates on the most common indoor precautions: people with elevated body temperatures should remain at home, masks must be worn, and people should be separated by at least 1.5-2 meters.

3.PROPOSED SYSTEM

In the existing system, manual temperature screening and sanitizer dispensing is employed in most of the public gathering/destination. In the proposed system, we are using the ML and Computer Vision Modules, through which we used to make people effectively follow COVID protocols to avoid mass infections to take place at public gathering places such as commercial trade centres, schools, college, IT offices etc. We introduce an affordable IoT-based solution aiming to increase COVID-19 indoor safety, covering several relevant aspects:

1) contactless temperature sensing.
2) mask detection.
3) social distancing check.
4) Automatic sanitizer dispenser.

Contactless temperature sensing subsystem relies on Arduino Uno using infrared sensor or thermal camera, while mask detection and social distancing check are performed by leveraging computer vision techniques on camera-equipped Raspberry Pi.

3.1 BLOCK DIAGRAM

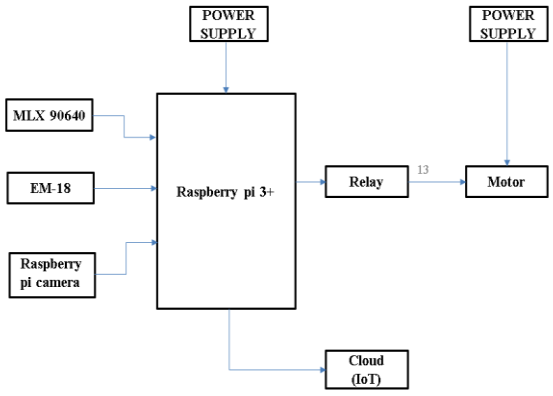

Fig -1: Block diagram

3.2 MERITS:

During the ongoing public health crisis, implementing an IOT approach will have various advantages, including:

- Support touch tracing protocols to monitor COVID-19's spread.
- Providing proof to encourage conformity with local, national, and federal health standards, as well as avoiding fines for noncompliance.
- Encourage employees' physical and mental well-being.
- To keep track of the condition of staffs in terms of how well they obey the COVID-19 protocols.

3.3 CIRCUIT DIAGRAM

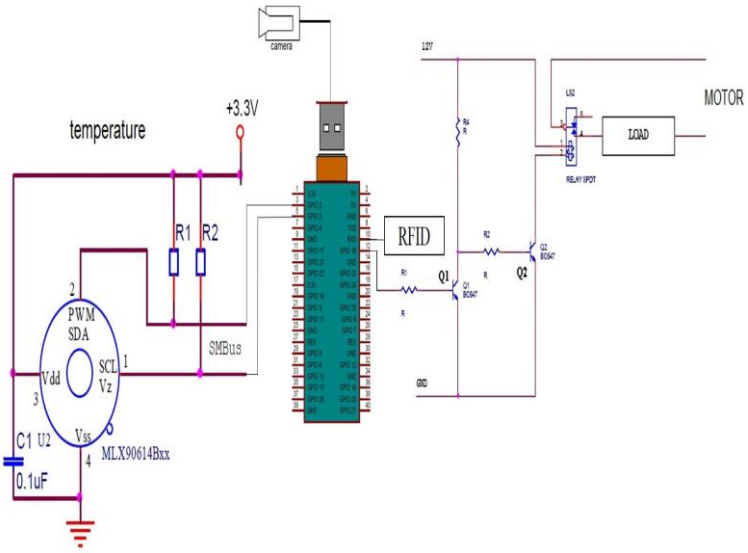

Fig -2: Circuit Diagram

4. WORKING

1- Entry of people
2- The temperature reading
3- Signal for the door to open or shut
4- MQTT alert indicating that a person's body temperature is higher than normal.
5- Does or does not wear a mask
6- Satisfied/unsatisfied social distancing
7- MQTT warning message stating that an individual without a mask is attempting to enter;
8- MQTT warning message stating that passengers disregard social distance controls.
9- People breaching COVID-19 safety precautions in different building rooms were the subject of eight MQTT warning messages sent to security workers' smartphones.

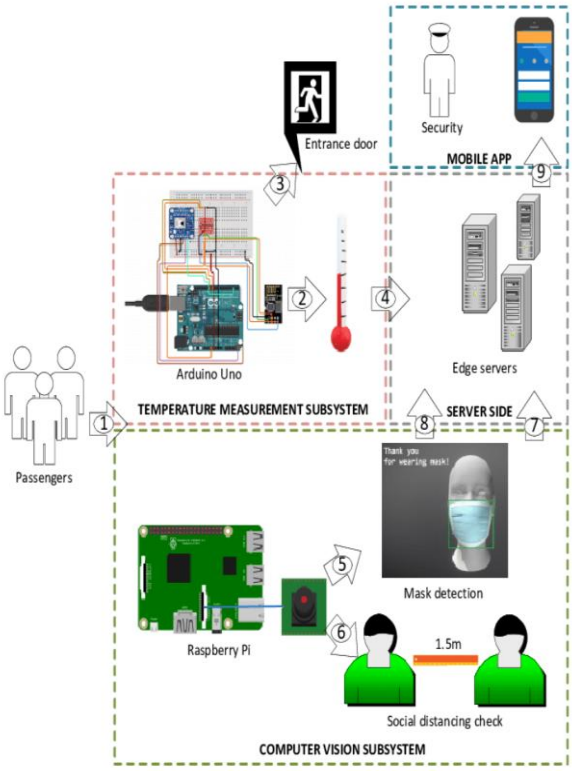

Fig -3: System Design

4.1OPEN-CV

Mask detection and social distance search algorithms were implemented using the Python version of Open CV, an open-source computer vision library. It was licensed for use with older Raspberry Pi computers, so we decided to use it. The current Open CV implementation of the Viola-Jones object detection architecture based on Haar attribute cascades is used in the face and body detection algorithms.

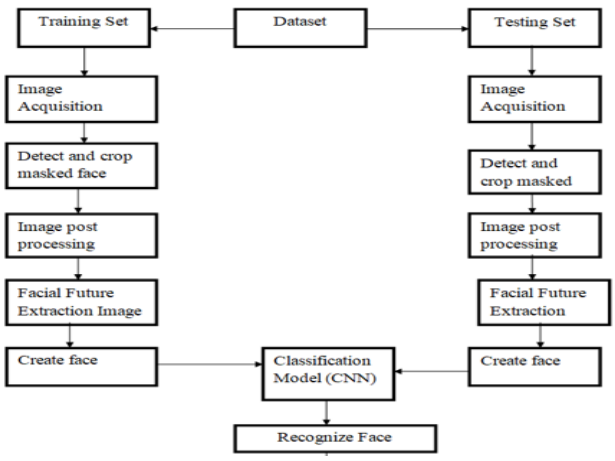

Fig -4: Face Detection Flow

It's a machine learning method in which a vast number of positive and negative images are used to train the cascade algorithm. This function is then used to identify objects in new photographs. Both a trainer and a detector are used in OpenCV. Open CV, on the other hand, comes with pre-defined classifiers for detecting common items like the human face, the whole body, and body and face bits (both front and back for some of them). As a result, in this paper, we make use of the Open CV library's current classifiers, which were sufficient to meet the requirements of the applied solution. In, the Open CV library's face detector was used to monitor multimedia replication systems based on Raspberry Pi devices inside museums and cultural heritage sites, and the results were satisfactory, even in real-time.

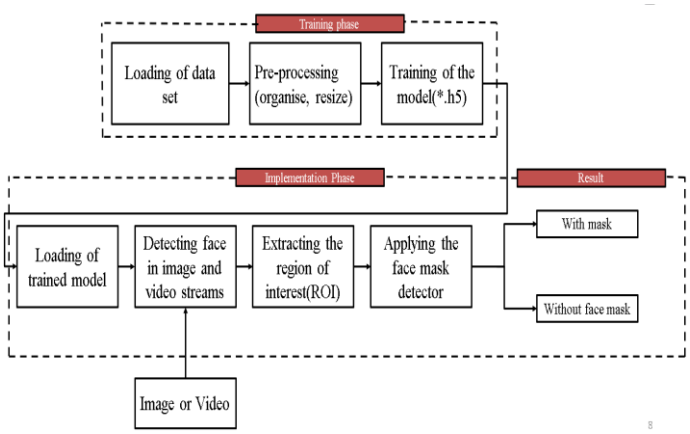

Fig -5: Phases of Data Analysis

4.2 MQTT - Message Queuing Telemetry Transport

The Raspberry Pi, Arduino, Edge servers, and smartphones use MQTT (Message Queuing Telemetry Transport) for machine-to-machine contact. On top of TCP/IP, it's a lightweight publish-subscribe messaging protocol. MQTT was created for use cases where a minimal code footprint is required or network capacity is reduced, making it ideal for IoT solutions based on low-power computing devices like those described in this paper. A message broker is also needed for a publish-subscribe messaging system. We accomplish this by deploying a Node.js MQTT broker implementation within Node-RED4 on a server at the Edge.

PubSubClient5 for Arduino, Paho-MQTT6 for Raspberry Pi, and Paho Android Service7 for smartphones were used as MQTT client libraries for IoT devices. When an individual does not meet the requirements to pass any of the safety check measures, the devices measuring body temperature, detecting masks, and social distancing send MQTT messages to Edge servers. In addition, the Edge server processes collected messages and sends them to the appropriate security staff to warn them of any violations of COVID-19 protection laws. Each message is transmitted as a JSON-encoded string.

4.3 MASK DETECTION

We use three Open CV library classifiers11 to introduce the mask detection algorithm:

1) haar cascade frontal face default — this function is used to detect a human face from the front.

2) haar cascade_ mcs mouth — detects the presence of a human mouth in a picture

3) haar cascade mcs nose — for nose detection The procedure given is executed for each frame from the camera stream.

Fig -6: Mask Detection

DATASET (WITH MASK)

DATASET (WITHOUT MASK)

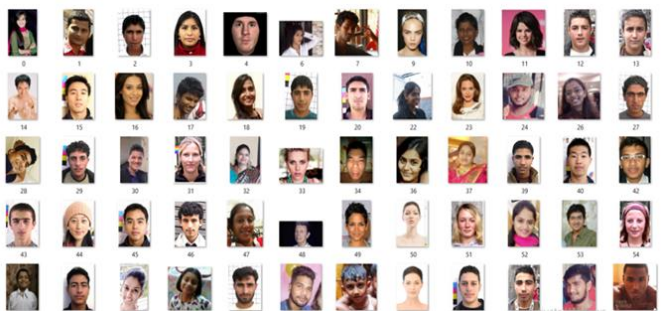

Fig -7: Datasets(Masked and Unmasked)

5. COMPONENTS

The hardware and software components employed in this module are listed below:

Hardware:

- Raspberry pi 3b+
- Contactless Temperature sensor (MLX 90614)
- raspberry pi camera
- RFID (EM-18)
- IR Sensor
- Power Relay
- PIC12F675

Software:

- RASBIAN OS
- PYTHON

6. EXPERIMENTAL RESULTS

According to the achieved results, the proposed solution is usable for its purpose under certain performance limitations (such as number of processed frames or measurements per second). Moreover, it relies on both open hardware and free software, being definite and desirable advantage for such systems. In future, it's planned to experiment with various deep learning and computer vision frameworks for object detection on Raspberry Pi in order to achieve higher framerate.

Moreover, we would like to extend this solution with environment sensing mechanisms for adaptive building air conditioning and ventilation airborne protection in order to reduce the spread of coronavirus indoors, especially during summer. Finally, the ultimate goal is to integrate the system presented in this paper with our framework for efficient resource planning during pandemic crisis in order to enable efficient security personnel scheduling and mask allocation, together with risk assessment based on statistics about respecting the safety guidelines and air quality.

7. OUTPUT

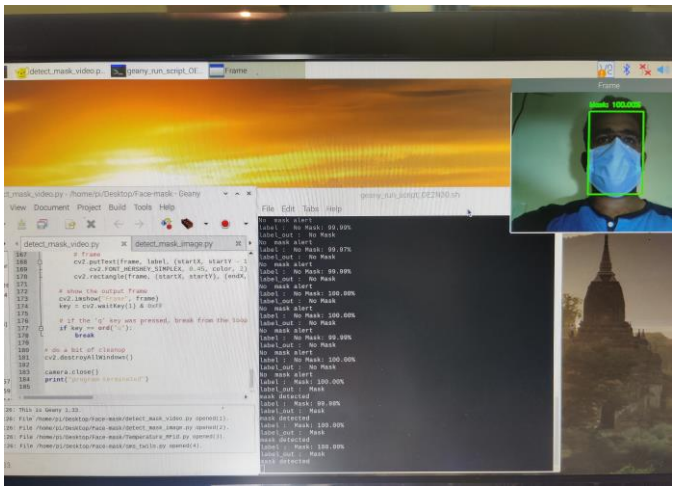

Fig -7: Mask Detection - Masked

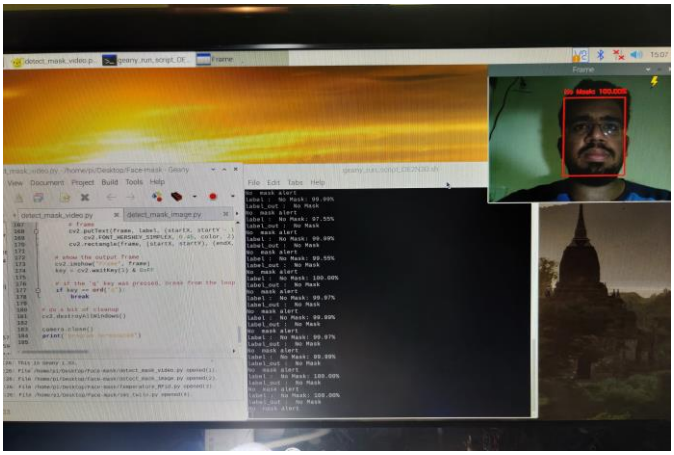

Fig -8: Mask Detection - Unmasked

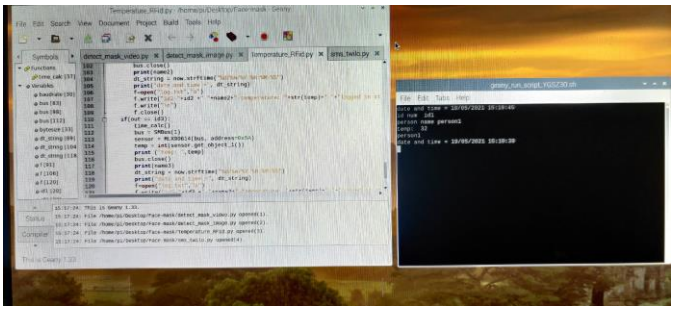

Fig -9: RFID and Temperature

8. FUTURE SCOPES

- We can link Aadhar card to check the temperature and update the details of the person
- We can develop this model by giving alert signal
- It also developed by adding rotating camera to scan multiple persons at a time
- It saves time and this product can be developed into bigger level in future

9. CONCLUSION

According to the achieved results, the proposed solution is usable for its purpose under certain performance limitations. Moreover, it relies on both open hardware and free software, being definite and desirable advantage for such systems. Finally, the ultimate goal is to integrate the system presented in this paper with our framework for efficient resource planning during pandemic crisis in order to enable efficient security personnel scheduling and mask allocation, together with risk assessment based on statistics about respecting the safety guidelines and air quality.

10. ACKNOWLEDGEMENT

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