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Nose Mask Detection And Temperature Checking System With Automatic Hand Sanitizer Dispensing Unit

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Abstract: ***Presently due to the outbreak of COVID-19 in the whole world, the need for proper use of nose masks, temperature checking detection units, and hand sanitizer are now in high demand for major public entrances like banks, railway entrance, airport entrance, office entrance, museums, amusement parks, and other Public Places so as to ensure safety. Normally at those public entrance points, operational steps involve manual checking by security personnel at various entrances thus bringing the security personnel in close contact with the people to be checked. To mitigate the problem of COVID-19, this research work introduces an affordable solution aiming to reduce the spread of COVID-19 and also improve the health safety of the security personnel at the entrance point. The research work comprises three major components like temperature sensing subsystem that relies on Raspberry Pi using a temperature sensor, nose mask detection subsystem which is actualized by leveraging computer vision techniques on camera-equipped Raspberry Pi, and the automatic hand sanitizing unit that is achieved by a relay module, a pump connected with the IR (infrared) sensor and Raspberry Pi. For a person to be allowed entry, he must be subjected to a nose mask scan, temperature check and hand sanitizing. Only the person having the conditions satisfied by the system is instantly allowed entry, else the speech notification will alert the individual and the security about the situation of things, and if there is any violation observed. From the simulation results, it is clearly observed that the proposed method has high accuracy when compared to the existing methods. Thus the system provides a 100% automated system to prevent the spread of COVID-19.***

Keywords: COVID-19, Raspberry Pi, Infrared Sensor, Relay, Hand Sanitizer.

I. INTRODUCTION

On the 17th day of November 2020, the occurrence of novel infectious flu-like respiratory disease COVID-19 caused by the SARS-Cov-2 virus (also known as coronavirus) has affected almost every aspect of people's lives globally [1]. Firstly, it was discovered in China but spread quickly to other continents including our great country Nigeria in just a few weeks. According to the World Health Organization (WHO), on the 11th of July 2020, the total number of identified cases was 12,653,451, while taking 563,517 lives (date rate) worldwide. Fever, tiredness, sore throat, nasal congestion, loss of taste and smell are some of the symptoms of coronavirus disease. This disease is transmitted from person to person through respiratory droplets and can be contacted indirectly through surfaces. The incubation period could be quite long and varies (between 14 and 27 days in extreme cases).

The first step to detect covid-19 is by temperature checking of individuals for fever. Also, we need to monitor everyone for a mask. Presently we have in Nigeria a manual temperature checking system for every entrance for scanning. This at times goes with human error while reading the value [2]. However, the crucial problem is the lack of generally approved and acceptable vaccines and medication. Due to this

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fact, 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, limiting citizens' movement within the country borders and abroad, often together with prohibition and cancellation of huge public events and gatherings. To solve the issue of the error as a result of a manual temperature checking system, we are going to propose a fully automated temperature scanner and entry provider system.

From workplace behaviour to social relations, sport, and entertainment, coronavirus disease poses many changes to our everyday routine, habits, and activities, and this led to our design and development of a cost-effective Nose mask detection and temperature checking system with an automatic hand dispensing unit aiming to help organizations respect the COVID-19 safety rules and guidelines in order to reduce the spread of the disease. This design and developed work involve a technique used to detect the presence of someone, find out whether the person before entering a premise is wearing a mask, if the degree of the person's temperature is normal and also to automatically dispense hand sanitizer having satisfactory fulfilled the first two conditions [3].

II. REVIEW OF RELATED WORKS

In this section, some of the recent techniques for face mask detection techniques using the machine learning method and other techniques were discussed.

Authors in [4] proposed a system that restricts the growth of COVID-19 by finding out people who are not wearing nose masks in a smart city network where there is presence of Closed-Circuit Television (CCTV) cameras that monitor the city network and a person without a mask is detected and reported to the corresponding by the system. A deep learning architecture that is able to distinguish between people with and ones without face masks is trained.

In [5], a design was done in such a way that it used a binary face classifier that can detect any face present in the frame irrespective of its alignment. The authors developed a process of generating accurate face segmentation masks from any arbitrary size input image. The method uses a Predefined Training Weights of VGG – 16 Architecture for RGB image feature extraction. Training is done through Convolutional Networks to syntactically separate the faces present in that image. Binomial Cross-Entropy is used for loss function whereas, Gradient Descent is used for training the system. Further, the output image from the FCN is processed to remove the unwanted noise and avoid false predictions if any and make a bounding box around the faces. Furthermore, the proposed model has also shown great results in recognizing non-frontal faces.

Authors in [6] developed an algorithm that processed infrared images by detecting automatically and tracking the path or route of moving subjects with a fever. The detection of the images involves two basic features, which are the difference between the geometry of a human face and other objects within the capture point of the camera and the temperature of the radiating object. These features are used for tracking the identified person with a fever. The position of the camera with respect to the direction of motion of the walkers appeared to be critical in this process. An infrared thermal imaging tool is a remote sensing tool used to measure temperatures based on emitted infrared radiation through a process called Infrared thermography. This Infrared thermal imaging tool can be used for fever screening in public places like banks, churches, airports and hospitals.

In [7], authors developed a Neural Network Regression not only to reduce the error from 0.6 degrees to 0.12 degrees, which is close to the medical instrument-level but as well to elongate the useful range of distance from 50 cm to 100 cm. Furthermore, this study developed an embedded automatic body temperature estimation system that could continuously and unconsciously measure the human temperature in real-time.

In [8], the authors proposed an IoT-based system aiming to help organizations respect the COVID-19 safety rules and guidelines in order to reduce the disease spread is presented. It focuses on most common indoor measures - people with high body temperature should stay at home, wearing a mask is obligatory and the distance between persons should be at least 1.5 to 2 meters. This developed system has three cases; the first case involves the use of an Arduino Uno microcontroller board with a wireless temperature sensor, while the two other cases involve the Raspberry Pi single-board computer equipped with a camera, thus making use of computer vision techniques. Python version of OpenCV was used to enforce/implement detection of face mask and also implementing algorithms that ensure social distance check.

Authors in [9] implemented a low-cost smart hand sanitizer dispenser with a door controller based on ATMEGA328P (Microcontroller), electromagnetic lock, and Ultrasonic sensor that can help to solve the physical challenges faced by security guards at different points of entry of public stations like school gates, hospital gates, etc. in enforcing this hand sanitizing action before letting people into where ever they intend to enter. That is to say, when a person(s) wants to access the entrance door, they must first sanitize their hands, or else the door will remain locked. This smart hand sanitizer dispensing unit consists of an ultrasonic sensor that continuously checks the presence of stretched hands that wish to be sanitized. This sensor continuously monitors and checks the distance between the sanitizing unit and the sensor itself, thus signaling the microcontroller to turn on the servo motor whenever the distance is less than 10cm to push the sanitizer out and as soon as the sanitizer outlet drops some amount into the stretched hands, the electromagnetic lock will unlock the door, while the LED comes on with a green colour and the LCD displays "The Entrance Door is Open". Otherwise, the door will not unlock and the LED will show red colour while the LCD displays "Please Sanitize Here".

In [10], authors explained that in today's environment with an increased population, it's difficult to tell if someone is wearing a mask or not, and physical inspection is impractical since it adds to labour costs. In this research, the authors presented a mask detector that uses a machine-learning facial categorization system to determine whether a person is wearing a mask or not, and this is connected to a CCTV

system, which is used to verify, confirm and ascertain that only persons wearing masks are allowed in.

The authors in [11] presented an intelligent method to automatically detect when facemasks are being worn incorrectly in real-time scenarios. The proposal uses Convolutional Neural Networks (CNN) with transfer learning to detect not only if a mask is used or not, but also other errors that can contribute to or enhance the spread of this COVID-19 virus. The main problem that was detected is that there is currently no training set for this task. It is for this reason that the authors requested the participation of citizens by taking different selfies through an app and placing the mask in different positions. Thus, they were able to solve this problem by looking at the outcome and effect of the achieved result. Finally, the authors also developed an Android-app demo that validates the proposal in real scenarios.

III. METHODOLOGY

This project would apply artificial intelligence in the area of computer vision. The system would be trained with visual data such as images (basically, images with faces and nose masks) and stored in a database for identification/recognition on retrieval.

The system is based on Linux powered raspberry pi machine which controls all the logic necessary for the design. It consists of ports that will be interfaced to our peripherals such as sensors and PI camera. This system is dual powered.

Running on raspberry pi, we used a facial AI algorithm with a temperature sensor and an AI camera, also interfaced with a Proximity sensor and a solenoid valve for automatic dispensing of liquid (hand sanitizer).

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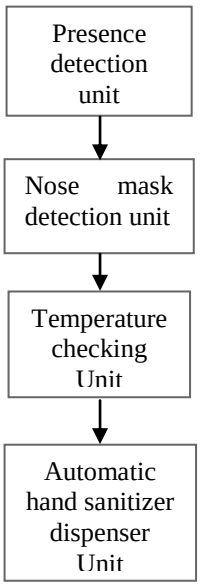

Figure 1: Block diagram of the developed system

A. PRESENCE DETECTION

This entails the means of identifying the presence of a human being at the entrance point. It is achieved using the ultrasonic sensor. The ultrasonic sensor that monitors and detects the presence of a human being displays a digital output of "1" on the screen when a human being is present but displays "0" on the screen when no human being is detected.

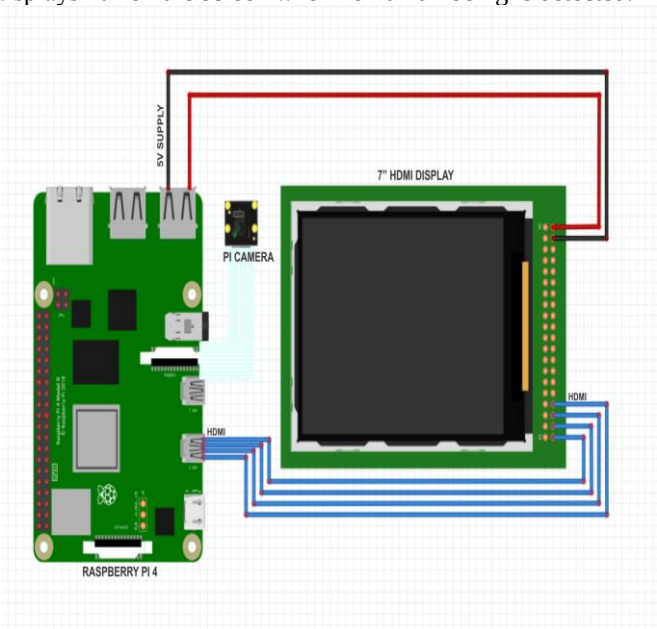

Figure 2: Circuit diagram of the presence detection unit

B. NOSE MASK DETECTION

The nose mask is also detected using the pi camera's input. For checking the nose mask of a person, we used deep learning with image processing using python.

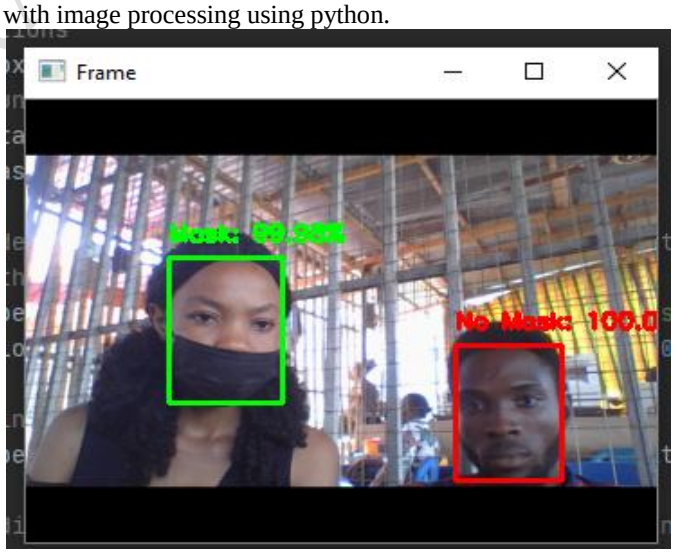

Figure 3: Nose mask detection diagram

C. SPEECH NOTIFICATION SYSTEM

If the nose mask is not worn by the person then the speech notification is turned on by the Raspberry Pi. The speaker will utter a command for the individual to put on the nose mask.

D. TEMPERATURE CHECKING SYSTEM

When a person is detected then the temperature of the person is checked using a mlx90614 sensor connected to the raspberry pi. If the temperature is above 37 degrees Celsius

then an alert message is sent to the COVID centre. If the temperature is around 37 degrees Celsius then the person will be directed by the speech notification to place his or her hand at a particular distance for hand sanitizer dispense.

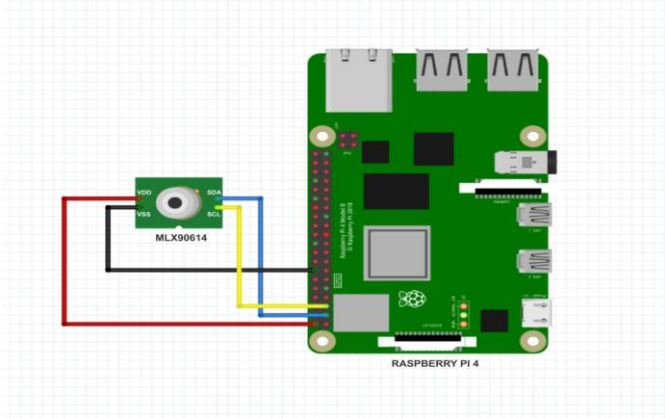

Figure 4: Circuit diagram of the temperature checking unit

E. AUTOMATIC HAND SANITIZER DISPENSING UNIT

This unit consists of a solenoid pump for dispensing liquid and also a relay module that does the automatic switching. When the relay receives a high signal it triggers the switch and causes the pumping of the hand sanitizer. A particular distance is set at which the individual places his or her, this was achieved using a proximity sensor.

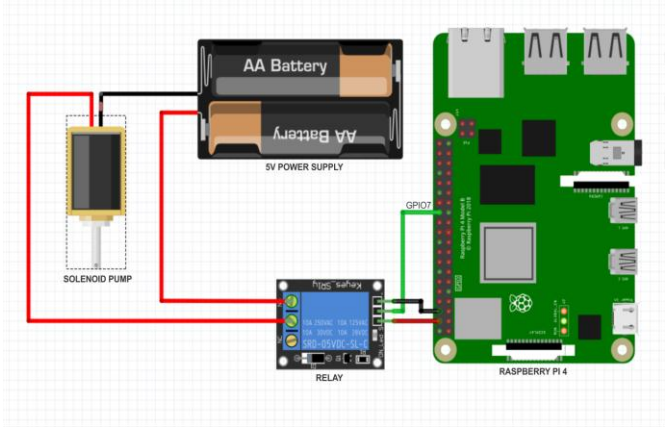

Figure 5: Circuit diagram of the automatic Hand Sanitizer dispensing unit

F. OPERATING PRINCIPLE OF THE DEVELOPED SYSTEM

The work is designed to be mounted at the entrance of any public firm or building and functions in various stages in other to achieve accuracy and desired efficiency. The operational principle of this system begins with the system detecting the presence of an individual, thereafter alerting the individual through a voice notification that the system is running a check and without attending to the notification/alert, the particular individual would be withheld from entering the building. The system has various sub-systems that work sequentially; it detects a face and confirms if that face has a nose mask on, if not, it alerts the individual to put on one. Afterward, the temperature checking phase is activated, once an individual's temperature is above 37 degrees Celsius, it alerts the individual and authorities through a voice notification that the temperature of that individual is above normal and should be subjected to further test, but if the individual passes this stage, the system utters a command for that particular individual to place his or her hand for the dispensing of the hand sanitizer.

The system was deployed as a hardware device that would integrate all components to be used, into a portable box that can be easily installed anywhere. The Raspberry Pi acts as the brain of the whole operation. The entire code/instructions necessary to control the system was written in python; a high-level programming language that handles Artificial Intelligence operations effectively, and then compiled in the python development environment of the raspberry pi, we worked with machine learning algorithms and python libraries such as Sci-kit learn, OpenCV, Numpy, Speech recognition, tensor flow, etc.

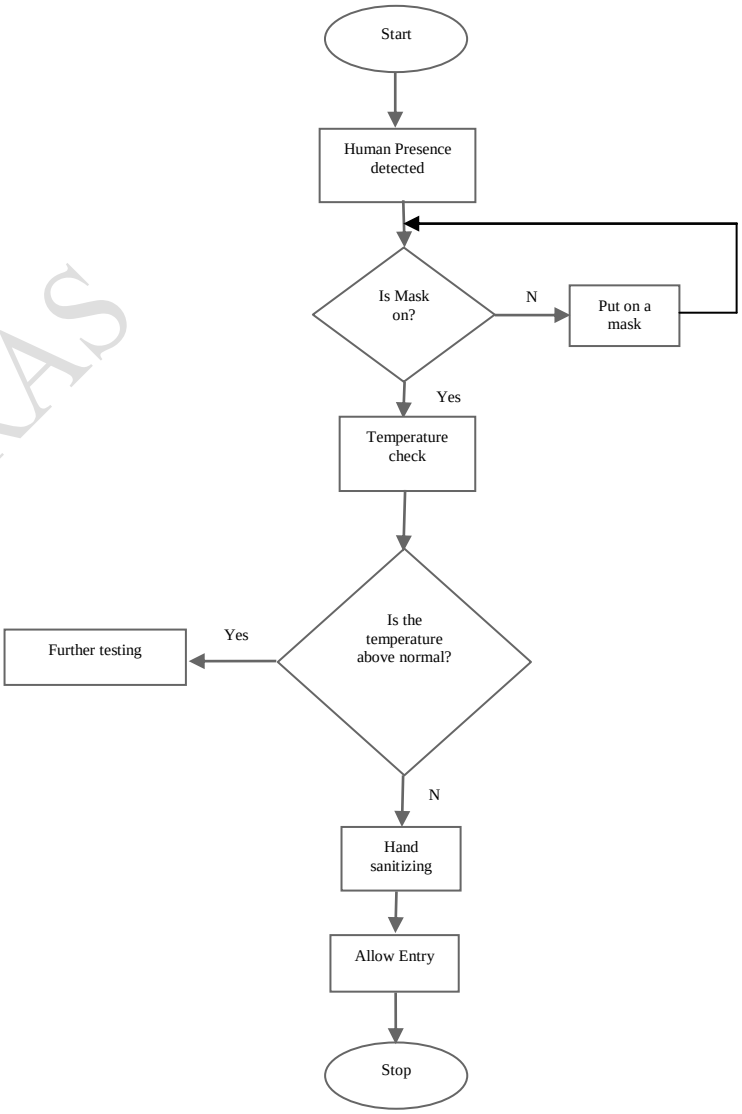

Figure 6: Flow chat of the proposed system

IV. RESULT

The developed system was able to automatically sense the presence of an individual, checks if the person is putting on a nose mask and if it is a YES, it successfully checked if the person's temperature is above 37^{o}C and if it is a No, it then automatically sanitizes the hand of the person using the hand sanitizer.

V. CONCLUSION

The COVID-19 pandemic has taken a significant toll on the world's economy and is considered one of the most deadly health problems that mankind has faced for a long time. The current solutions put in place to curb the spread of the virus are the production of hand sanitizers and soap, the use of nose masks and applying a set of preventive measures like social distancing, etc. The preventive and testing measures put in place to help subdue the spread of this deadly disease are cumbersome and therefore inefficient due to the various processes an individual has to go through especially when going into an official facility or a public firm. From the nose mask check to the temperature check to the hand sanitizer dispensing which were manually carried out.

Our project is simply automating all these processes and placing them in one compact and efficient system. This project is actually a huge breakthrough in health and medical line. It would be mounted at the entrance of any public firm or building and functions in various stages in order to achieve accuracy and desired efficiency. These stages include detecting the presence of an individual, alerting the individual through voice notification that a check is going on which must be responded to otherwise he/she won't be permitted to enter the building.

The system works sequentially, it detects a face and confirms if the face is putting on a nose mask or not, if the face is not on a nose mask, he/ she would be asked to put on one. After this stage, the temperature check stage is activated. If the individual temperature is above 37degree Celsius, he/she will be subjected to further testing but if the temperature is normal the system utters a command for the individual to place his/her hand at a certain distance to the proximity sensor for the automatic dispensing of the hand sanitizer, after which he/ she is permitted to enter the building.

We also intend to achieve our solution using affordable cost and readily available materials so that the overall cost of the system would not be too high.

VI. RECOMMENDATION

This project is recommended to be used in public halls, schools, or Government establishments as it will help in reducing the rate of spread of COVID-19 and also lead to the following benefits:

- ✓ It will be commercially viable thus also creating revenue and employment for people who would be used for the manufacturing process.
- ✓ The use of this system would also save costs for institutions using it as it would be very expensive to employ enough security forces to carry out the same activity.
- ✓ We believe that the compact and scalable nature of our product, will go a long way to solve this problem and facilitate the safer operation of academic activities.

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