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NOVEL SENSOR BASED MULTI-LAYERED MASK DESIGN FOR USAGE BY THE HUMAN BEINGS DURING THE PANDEMIC TIMES

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ABSTRACT—in this work, we are going to design a doctors need to wear complete protective equipment when large numbers of patient's flood into the emergency room. Many countries have so far managed to prevent a large-scale community outbreak, city forces wearing face masks on public transportation, and keep social distancing to stem the virus from spreading. The protective device may be contaminated and must be replaced often. In the situation of limited resources, how to take care of the physiological needs of the doctor without increasing the chance of contamination during replacement is a consideration. By reducing the chance of contamination during removal and storage, the previous designs have to be analyzed and improved. We are going to propose some novel improved designs to reduce the contact & impact of such design as there are certain drawbacks in the design. Some designs must feature a mask with a water channel that allows the user to remain hydrated without removing the cover. Some design has a folding pattern that hides the outer surface. Some designs combine the mask with the brim of a cap which form an extended air-intake area. Through understanding the problem, related product design by us is going to have a good aesthetic look & security in order to prevent the virus as we are planning a multi-layered mask design with more advantages. The increasing prevalence of infectious diseases in recent decades has posed a serious threat to public health. Routes of transmission differ, but the respiratory droplet or airborne route has the greatest potential to disrupt social intercourse, while being amenable to prevention by the humble face mask. Different types of masks give different levels of protection to the user. The ongoing COVID-19 pandemic has even resulted in a global shortage of face masks and the raw materials that go into them, driving individuals to self-produce masks from household items. At the same time, research has been accelerated towards improving the quality and performance of face masks, e.g., by introducing properties such as antimicrobial activity and super-hydrophobicity. The work is going to give a brief review which will cover

the mask-wearing from the public health perspective, the technical details of commercial and home-made masks, and recent advances in mask engineering, disinfection, and materials and discuss the sustainability of mask-wearing and mask production into the future and our own design prototype.

Keywords—Mask, Corona, Layer, Design, Pandemic, Security, Health, Safety.

I. OVERVIEW

A coronavirus is a group of viruses which aims at impacting and infecting the respiratory system of individuals. This group of coronaviruses includes SARS and the other commonly known cold and influenza viruses. However, the global pandemic caused by the well- known COVID-19 has coined a name 2019-n CoV on January 2020 by the World Health Organisation (WHO). It is expected to have its roots from the initial cases that emerged in Wuhan, capital of Hubei Province of China. Multiple nurses and medical workers of the PICC crew are immersed completely into the task of taking care of the infected patients and working around the clock to restore them to their normal health conditions on a global scale. In the United States, out of the first 300 patients admitted to multiple hospitals across the city, it is noted that 60.7% of them are men. 91.3% of them required ventilator support to facilitate the breathing process. Fig. 1 gives the overview of the datasets [1].

Fig. 1. Overview of the datasets

The challenge to the process of effective detection and testing is that a sizeable proportion of the population remains asymptomatic to the infection and does not display any visible symptoms of contracting the virus which makes the process of tracking its roots an arduous process. However, normalcy has to be restored even though the COVID situation has left several students, teachers, and working personnel homebound. IoT (Internet of Things) allows for the interconnectivity of multiple devices across several regions to ensure connectivity [2].

It can be effectively deployed in the current COVID scenario to tackle the challenges that occur in restoring normalcy while ensuring that safety and security are not compromised at any cost in organizations and institutions. They invent and boom in the use of mobile phones and smart appliances in the health and welfare sector has paved way for the data about everyone to be assessed and evaluated on a mass scale. By the current COVID-19 scenario, IoT offers multiple applications such as the smart ventilators and masks or the provisions made for the allowance of self-isolation at home while being monitored by the medical facilities [3].

Several modern necessities like secured data storage systems, cloud and edge computing, intelligent data management, sensors for smart health devices. What started as a country level scare in China with several speculations raised about its origin has now manifested into a global pandemic with a multitude of research carried out to determine a cure. As a global pandemic,

COVID-19 has been inflicting major casualties and losses to the human population across the world from all walks of life. Approximately, 31.9 million people have been affected by the SARS-CoV-2 virus with close to 977K deaths reported under the radar [4].

The table is topped by countries namely the US, India, Brazil, and Russia accounting for the maximum number of infected individuals. In India alone, 5.73 million people were and are affected by COVID of which close to 91K people have succumbed to the virus. Maharashtra, Andhra Pradesh, Tamil Nadu have whooping numbers of COVID infected people. While several measures are being taken at the State and Central level to combat the situation, it has become the need of the hour, at least for the working population to step out of the comfort of their homes to sustain their living and as well as to resolve the economical imbalance [5].

With these reasons on the front, the proposed model will certainly help to ensure the safety and health wellness of all the employees when administered in their organizations. Beginning in December 2019, the sudden new type of coronavirus pneumonia (COVID-19) quickly raged across the country and even the world [1]. As of July 15, 2020, more than 13.65 million confirmed cases have been reported in more than 220 countries and regions around the world, and more than 580,000 patients have died [6].

At present, it is still continuing to spread on a large scale. The new type of coronavirus is highly infectious. It can be spread through contact, droplets, aerosols and other carriers in the air, and it can survive for 5 days in a suitable environment. The "Guidelines for the Prevention of New Coronavirus Infection Pneumonia" issued by the National Health Commission emphasized that when individuals go out to public places, seek medical treatment and take public transportation, they need to wear medical surgical masks or N95 masks to prevent the spread of the virus [7]. Therefore, it is everyone's responsibility to wear masks in public places during the epidemic, but this requires not only the conscious compliance of the individual, but also the adoption of certain measures to supervise and manage. Fig. 2 gives the type of face detections uisng the data-sets. At present, although there is no algorithm specifically applied to face mask wearing detection, with the development of deep learning in the field of computer vision, neural network-based target detection algorithms are used in pedestrian target detection, face detection, and remote sensing image targets [8].

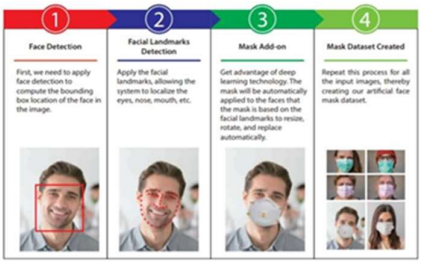

Fig. 2. Type of face detections uisng the data-sets

Detection, medical image detection and natural scene text detection are widely used in fields. Face recognition algorithms rely on a high degree of recognition accuracy, and have huge application potential in classroom attendance, identity authentication, access control systems, login and unlocking, and social media platforms. At present, face recognition devices on the market have relatively single functions and have relatively high requirements on faces. When the face is in a state of large-area occlusion, the recognition accuracy drops rapidly. Especially in the face of the current epidemic situation where all people wear masks, the capabilities of

traditional face recognition systems appear to be stretched. Considering that we will try our best to resume production and work while ensuring people's safety, we have designed a smart detection and recognition system for mask wearing. The system is mainly composed of face mask detection algorithm and face recognition algorithm. The main functions of the system can be divided into three parts: face mask detection, face recognition, and voice prompts [9].
When multiple pedestrians pass by the camera, the camera equipped with this algorithm will first detect the pedestrian's face mask. When the pedestrian wears the mask normally, it will not give a voice prompt. When a pedestrian wears a mask incorrectly, the voice will announce to remind him to wear the mask correctly. When a pedestrian is not wearing a mask, the system will trigger the face recognition module to speak his name and remind him to wear a mask. The system can be used in high-speed rail stations, subways, shopping malls and other crowded areas. Through researching related target detection algorithms, it is found that the deep learning model used for face detection can be applied to the task of mask wearing detection [10].
In this paper, the more accurate face detection algorithm RETINAFACE is used as the basic algorithm for mask face detection, and on this basis, the network structure of the RETINAFACE algorithm is improved, and the attention mechanism is introduced to meet the needs of new functions; In this system, we calculate the mask and the key point positions of the face, and the confidence that the mask is worn on different faces is returned to determine whether the person wears the mask in a standard manner. The calculation is fast and accurate, and the algorithm is stable and efficient; for the current popular ones For the face recognition method, we use the DEEPFACE algorithm. The algorithm divides the face recognition problem into several related subproblems [11].SMART MASK USING ARDUINO
Body temperature measuring is adequate for preventing an outbreak of COVID-19. Fever, dry cough, sore throat, headache, muscle or body aches, congestion or runny nose, nausea or vomiting, and diarrhea are the most significant common symptoms of COVID-19. To measure individuals' temperature manually consumes a considerable number of human resources, time, and administrative resources. introduced a prototype system that consists of a contact-free temperature sensor. Their proposed system has the features of contact-free temperature measurement and attendance, which are taken at the entrances of school campuses in Hong Kong. Their experiments showed that the system could measure body temperature with adequate accuracy for screening purposes. A pandemic-like flu requires rapid temperature measuring. ref. authors designed a low-cost, scalable device used for measuring temperature to control the spread of the flu pandemic.
Their proposed temperature measuring module is developed by a medical- grade version of the Melexis MLX90614 series of smart infrared temperature sensors. When the temperature is high, an alarm will alert the authorized person at the entrance to find the suspected student. We also used the Melexis MLX90614 contact-free temperature measure sensor in our proposed model. The Fig. 13 gives the saving of the program developed, whereas the Fig. 14 gives the compiling of the program. Finally, the Fig. 15 gives the uploading of the program.

Fig. 3. Saving of the program developed

Type and save the program of temperature sensor to upload the code into Arduino Uno.

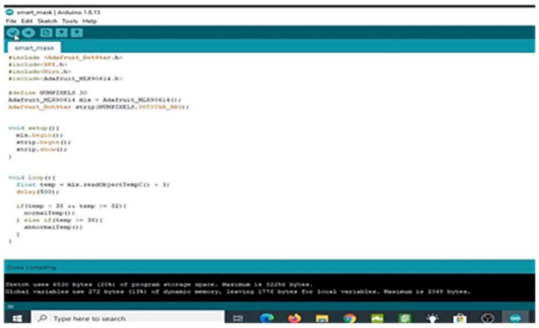

Fig. 4. Compiling the program

Compile the program of temperature sensor. Whether the code having any errors or not, if no errors proceed further.

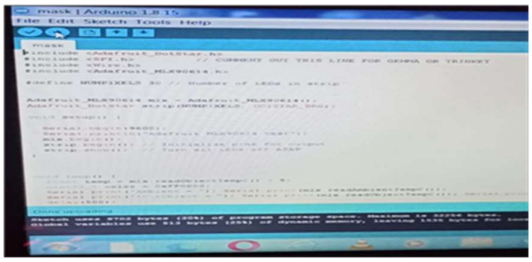

Fig. 5. Uploading the program

II. SOFTWARE CODING

Coding is done in the python environment as shown in the program below, where we save and run the program of face mask to check the person wearing a mask or not.

```
#include <Adafruit_DotStar.h>
#include <SPI.h>
#include <Wire.h>
#include <Adafruit_MLX90614.h>
#define NUMPIXELS 30 // Number of LEDs in strip
Adafruit_MLX90614 mlx = Adafruit_MLX90614();
Adafruit_DotStar strip(NUMPIXELS, DOTSTAR_BRG);
void setup()
{
Serial.begin(9600);
Serial.println("Adafruit MLX90614 test");
```

```
mlx.begin();
strip.begin(); // Initialize pins for output
strip.show();  // Turn all LEDs off ASAP
}
void loop() {
float temp = mlx.readObjectTempC() + 5;
uint32_t color = 0xFF0000;
Serial.print("Ambient = "); Serial.print(mlx.readAmbientTempC());
Serial.print("*C\tObject = "); Serial.print(mlx.readObjectTempC()); Serial.println("*C");
delay(500);
Serial.println();
if(temp < 38 && temp >= 31){
normalTemp();
} else if(temp >= 38) {
abnormalTemp();
}
}
void normalTemp(){
uint32_t color = 0xFF 0000;
for(int i = 0; i < 31; i++){
strip.setPixelColor(i, color);
strip.show();
}
delay(2000);
turnOff();
}
void abnormalTemp(){
uint32_t color = 0x00FF00;
for(int i = 0; i < 31; i++){
strip.setPixelColor(i, color);
strip.show();
}
//digitalWrite(buzzer,HIGH);
tone(A0, 100, 500);
delay(2000);
//digitalWrite(buzzer,LOW);
turnOff();
}
void turnOff(){
uint32_t color = 0x000000;
for(int i = 0; i < 31; i++){
strip.setPixelColor(i, color);
strip.show();
}
```

```
}
// Detection of  facemask
import cv2
# Load the cascade
face_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')
# To capture video from webcam.
cap = cv2.VideoCapture(0)
# To use a video file as input
# cap = cv2.VideoCapture('filename.mp4')
while True:
# Read the frame
_, img = cap.read()
# Convert to grayscale
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
# Detect the faces
faces = face_cascade.detectMultiScale(gray, 1.1, 4)
# Draw the rectangle around each face
for (x, y, w, h) in faces:
cv2.rectangle(img, (x, y), (x+w, y+h), (255, 0, 0), 2)
# Display
cv2.imshow('img', img)
# Stop if escape key is pressed
k = cv2.waitKey(30) & 0xff
if k==27:
break
# Release the VideoCapture object
cap.release ()
```

If no errors, upload the program to the Arduino Uno board once you upload the program it will works 128 times. Dump the program into the kit. Then check the output.

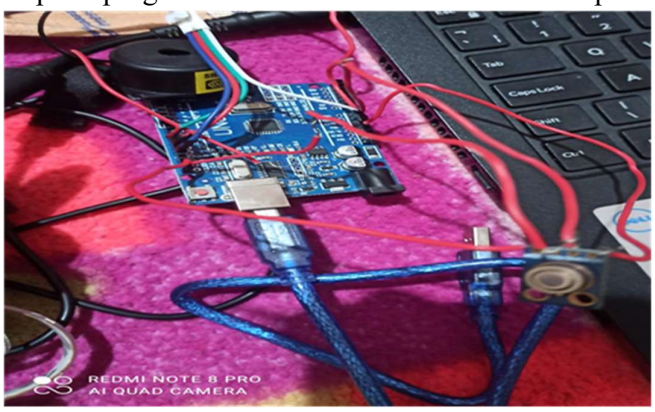

Fig. 6. Connecting the circuit

Make the connections as per the circuit diagram, then connect the circuit to the PC /Laptop

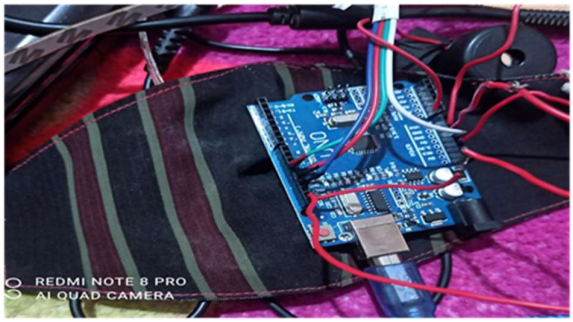

Fig. 7. Connecting to the mask

After the connection of the circuit than connect to the mask.

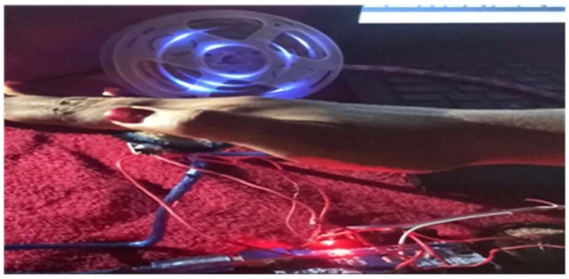

Fig. 8. Result showing that it is a normal temperature

When opposite person's have normal temperature, blue light is ON and no indication of the buzzer.

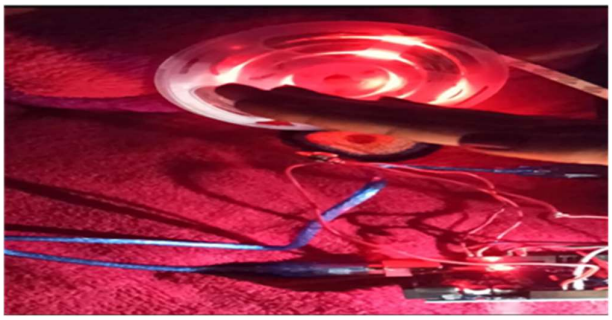

Fig. 9. Result showing it is an abnormal one

The opposite person has above normal temperature, so red light is ON with indication of buzzer as shown in the Fig. 19.

III. ADVANTAGES, APPLICATIONS AND LIMITATIONS

A. Advantages :

- Relieves Symptoms of Asthma.
- Eliminates Harmful Chemicals from Indoor Environments.
- Neutralizes Unpleasant Odors.

Reduces the Chances of Airborne Diseases.

B. Applications

The applications of the paper are this could be used for safety & security purposes for maintaining human health in good conditions and to prevent the coronaviruses from entering into the human body.

C. Limitations

There is no proper dataset available for mask detection and classification. The available datasets mostly have noisy data or are created artificially, which are not useful for creating a real-time mask detection system. In contrast, we consumed a lot of time collecting and pre-processing the proper face mask images. Further, we also used the Haar Wavelet technique to only select frontal face images from the noisy images.

IV. CONCLUSIONS AND FUTURE WORK

This research work aims at implementing in detail the design and implementation of a mask for the human beings. Before uploading your code make the connections and check the connections once before dumping. And next we will upload the code to dump the Arduino uno board. After uploading the code blue light is On Buzzer is OFF. When the high temperature person came to the front of to your buzzer is automatically beeps sound and red light is ON. In future work, we will propose a deep learning framework by using pre-trained deep learning models to monitor the physical interaction between individuals in a real-time environment as a precautionary step against the spread of the COVID-19.

The CDC (Center for Disease Control and Prevention) also states that anyone with a hearing impairment should consider a clear transparent face mask. Therefore, we will also focus on the detection and classification of transparent face mask type. According to the WHO guidelines, the sneezing and coughing are the major symptoms of COVID-19, in the future, we will work on analyzing the individuals who are coughing and sneezing by using the deep learning models, which will be helpful in controlling the spread of COVID-19.

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