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IoT Based Face Mask and Body Temperature Detection System for Covid-19

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Abstract

Since the COVID-19 pandemic, it is required to wear a face mask in public areas. A correctly worn mask provides the most protection against the viral transmission of COVID. A person's body temperature has also become crucial in evaluating whether they are healthy or suffering from an issue. In this system, we develop a real-time model to meet the requirement for detecting a person's body temperature and the percentage of masks they are wearing before they reach a public area. With the aid of an Arduino and temperature sensor, we were able to determine the position of the mask by using the face detection approach. To record input photographs and gauge a person's temperature, we employed an ESP camera and temperature sensor, respectively. The result of these tests is a live video feed that provides precise information about whether or not someone is wearing a mask properly and whether or not their body temperature is within the proper range or falls below it. If it is either above or below, the door won't open, and a red indicator light will illuminate while a buzzer beeps; if it is at the proper level, the door will open.

Keywords

Arduino, ESP Camera, Neural network, Object detection.

INTRODUCTION

The respiratory system of individuals can be affected and infected by the corona virus family of contagions. The other commonly recognized influenza viruses including S.A.R.S. are all members of this corona virus group. However, the WHO (World Health Organization) declared a global epidemic in January 2020 due to the well-known COVID19 virus. It is predicted that it originated from the initial cases that appeared in Wuhan, the Chinese province of Hubei. The current COVID 19 script includes a number of Internet of Things (IoT) functions, including smart ventilators, masks, and foods designed to allow for sound insulation at home while still being protected by medical infrastructure. Protected data storage systems, cloud and edge computing, intelligent data processing and smart bias detectors are a few examples of ultramodern necessities. What started as a Chinese country position phobia that prompted inquiries regarding its origin from numerous businesses has now materialized as a global epidemic. While the state and central governments are taking various steps to address the issue, it has become urgent for the working population to leave the comfort of their homes in order to make a living and address the provident imbalance.

With these factors in mind, it is obvious that the proposed model, when implemented in the workplace associations, will contribute to ensuring the safety and wellbeing of all employees. This approach is specifically made for public spaces, assiduity, and services that will aid those who are constantly concerned about their own and other people's safety.

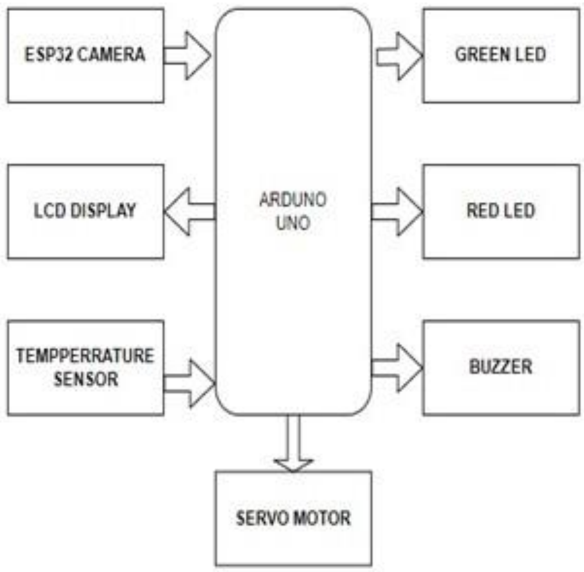

Figure 1. Block Diagram of Proposed System

LITERATURE SURVEY

The various systems used for the COVID 19 Face Mask and Body Temperature Detection Systems are covered in this section, along with some possible techniques. Vaishali Maheshwari, Utkarsh Chandna, and Shashank Singh [1] discuss several sensor and processor elements used for temperature monitoring and control. The PLCs and AT89S52 microcontroller are used in conjunction with the LM35 sensor. They use sensors to build an inexpensive, very accurate temperature management system with both analogue and digital parts. Sensors are classified according to how accurately they can measure actual or real-time parameters. The MAX30205 Temperature sensor is described in article

[2] as offering clinical temperature monitoring options. It has capabilities that make simple assessing of temperature sensing as a component of a comprehensive clinical patient monitoring system. This application demonstrates how to gather temperature data using a health sensor.

Procedure for measuring temperature:

- After connecting the HSP to the system, the HSP will start directing you right away.
- To gather data with the default settings, click the temperature quick start link on the Home tab.
- The left-hand slider on the settings tab allows you to adjust the temperature, which is displayed in Celsius.
- When HSP is turned on, there is no need to start or stop the monitor because temperature data are taken automatically.
- Hold one of these slides close to your skin to simulate heat. When the thermometer is positioned close to a powerful heat source (such as the forehead or armpit), the temperature should increase by six degrees. Place HSP on the counter to let the heat reading dissipate in order to simulate cold, or blow cool air onto the platform to hasten coding.

Paper [3] A learning framework is presented by the authors Kaiming He, Xiangyu Zhang, Shao-qing Ren, and Jian Sun to make it easier for training officers to employ networks that are deeper than those previously used. Instead of learning unreferenced functions, they reformulate the layers to learn residual functions with reference to the layers' inputs. The author presents extensive data that demonstrates how these residual networks are simpler to optimize and can get more accurate as the depth is increased. They also present analysis on CIFAR-10 WITH 100 1000 Layers. In comparison to the COCO object detection data set, they achieve a 28% relative improvement. Ross Girshick, Jian Sun, Kaiming He, and Shaoqing Ren [4] developed the suggested method. In the published literature on object identification networks, Fast R-CNN has shortened the operating duration of this detection network. Faster R-CNN is a one-stage model that is completely trained. It uses a special region proposal network (RPN) to generate region suggestions, which is faster than other methods like selective search. This method can recognize a wide range of scales and aspect ratios.

According to Joseph Redmon and Ali Farhadi [5], the author presented YOLO 9000 as being state-of-the-art. It is a real-time object detection system with a 9000 object type detection range. The YOLO detection method underwent a number of fresh and innovative modifications, and the YOLOv2 is now state-of-the-art on common detection tasks like PASKAL VOC and COCO. Utilizing a distinct multiscale training methodology. The YOLO v2 model, which comes in a range of sizes, makes it simple to compromise between accuracy and quickness. Finally, authors present a method for integrating object detection and training in classification. By employing this method, they simultaneously train YOLO 9000 on the COCO detection dataset and the ImageNet classification dataset. This allows YOLO 9000 to predict object classes and validates their ImageNet detection task approach.

Single deep neural network is used by Wei Liu, Dragomir Anguelov, Dumitru Erhan, Christian Szegedy, Scott Reed, Cheng-Yang Fu, and Alexander C. Berg [6] to recognize objects in pictures. Even with reduced input image sizes, SSD is more accurate than the single-stage method.

There have been numerous attempts to build faster detection by focusing on each stage of detection, however doing so has only significantly increased detection speed at the expense of significantly decreased detection accuracy. For many categories, authors developed SSD (single shot detector), which is more accurate and thicker than the previous version of YOLO. The core of SSD uses tiny convolutional filters to forecast categories score and a box of the set for a provided set of default bounding boxes. which are utilised for training, features maps, and high accuracy even with input imagery of low quality. A non-contact measurement of human body temperature by automatically locating the inner-canthus on a thermal image, according to research by Hurriyatul Fitriyah, Aditya Rachmadi, and Gembong Edhi Setyawan [7]. Individually, both eyes' inner canthus was visible. Temperature determines where the inner-canthi is located, with the inner-canthi having the highest temperature in the facial region. Since the inner-canthus' blob must have a minimum of 9 pixels in area, a thresholding method based on the temperature with the highest nine values was employed to find potential possibilities.

The one-stage object detector shown in paper [8] by authors Tsung-Yi Lin, Priya Goyal, Ross Girshick, Kaiming He, and Piotr Dollar is comparable to the cutting-edge COCO AP for more complex two-stage detectors. Examples include the Mask R-CNN and the Feature Pyramid Network (FPN). To do this, they identify a class imbalance that precludes a one-stage detector from achieving the best accuracy possible and come up with a novel loss function that gets around the problems. In this study, they propose a novel loss function, which is more efficient than past approaches, for dealing with class imbalances. When the right class confinement increases, the scaling factor of the loss function, which is a scaled cross entropy loss, drops. To show the value of focus loss, they developed a straight forward one-stage object detector. RetinaNet was selected due to its thorough sampling of object locations throughout an input image.

Wenhong Yu, chenlu Luo and Kuanwang [9] study provides a system with non-contact temperature measurement and automatic data collection capabilities, as well as a system with body temperature detection and data collection capabilities. To accomplish more automated and intelligent temperature measurement and data gathering during COVID-19, they developed a human temperature measurement and data collection system in this work. This is economical and makes it possible to acquire temperature data without contact.

Mohammad Marufur Rah-man, Md. Motaleb Hossen, Manik, Md. Milon Islam, and Saifuddin Mahmud [10] propose a method for preventing the spread of covid-19 in a network of smart cities where all public spaces are watched over by closed-circuit television (CCTV) cameras by identifying people who are not wearing any facial masks. The appropriate authority is alerted via the city network when a person without a mask is found.

To train an architecture, a collection of pictures of people wearing and not wearing masks that were gathered from various sources. Singh et al. [11] concentrate on how IOT might address

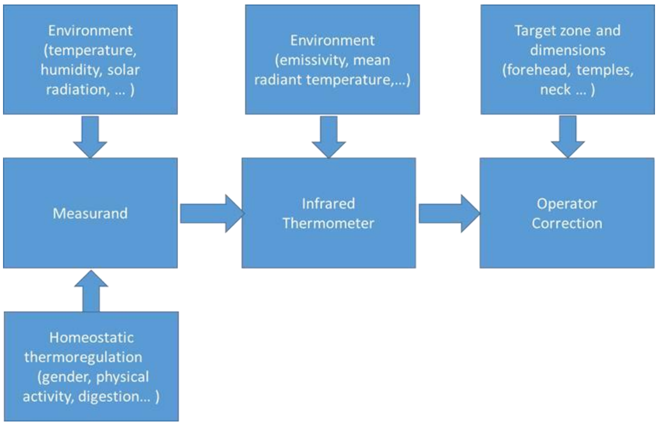

Figure 2. Measuring chain of non-contact body temperature measurement

COVID-19 by developing a system that uses connected devices to track patients and notify authorities in emergency situations.

According to Elena Cosentini, Laura Canale, Giorgio Ficco, and Marco Dell'Isola [12], during a covid pandemic, infrared thermometers, thermal imaging cameras, and scanners were frequently used as an alternative to the conventional contact clinical thermometer. The author of this article uses clinical and metrological perspectives to investigate workers' non-contact body temperatures at the entrance to the workplace. 1. To improve the precision of readings of body temperature. 2. To minimize the field's dependency on the precision of body temperature. 3. Offers screening decision criteria to prevent the COVID-19 virus from propagating. The study adopts the strategy of taking into consideration measurement subjectivity in clinical medicine as well as conventional instrumental uncertainty sources. A detailed screening strategy for body temperature measurement is required to select the threshold temperature value and measuring method for reaching critical areas during the COVID-19 pandemic. Xiangjie Kong, Kailai Wang, Shupeng Wang, Xiaojie Wang, Xin Jiang, Yi Guo, Guojiang Shen, and Xin Chen [13] put forward an edge computing-based mask (ECMask) identification system to support public health initiatives by ensuring real-time performance on low-power camera devices on buses.

The three main steps of this ECMask are as follows: 1. Video restoration: With this realization, the super resolution of images and movies improves. 2. Face Detection: To ensure accuracy with accelerating speed, this technique is commonly used in object detectors. 3. Mask Identification: Following the detection of faces, their goal is to ascertain, based on the cropped faces (i.e., masked and non-masked), whether or not a mask is being worn. Infrared thermographs (IRTs) were utilized in research by Quanzeng Wang, Yangling Zhou, Ghassemi, David McBride, Jon P. Casamento, and T. Joshua Pfefer [14] on spotting elevated body temperatures. (EBT) is a kind of antibiotic that can be applied both to treat infectious diseases and in therapeutic settings. How optical IRT calibration stacks up against other common non-contact infrared thermometers, though, is unclear. In order to obtain temperature readings, the author performed clinical thermographic imaging research on more than 1000 people.

Mouth temperature and data from various facial regions to calibrate the IRT system utilizing seven different registration techniques. Wearing a face mask is one of the best and most effective ways to stop the spread of COVID, according to Sunil Singh, Umang Ahuja, Munish Kumar, Krishan Kumar, and Monika Sachdeva [11]. In this article, two object detection models—YOLOv3 and faster R– CNN—are used to accomplish this task. The author trained both models using a data set that included images of people in two categories—those with and those without face masks. This project suggests a method that marks people's faces with bounding boxes (red and green) depending on whether or not they are wearing masks and keeps track of how many people do so each day. [A] You Only Look Once, Version 3 (YOLOV3) It is a real-time object detection technique that can recognize particular items in pictures, videos, or live feeds. In order to find an object, YOLO employs a CNN.

The YOLO algorithm comes in two flavors. 1. CNN image categorization 2. Object detection with CNN [B] faster R-CNN It is a deep convolutional network used for things that are better suited to the user as a single, end-to-end, unified network. The network can predict the locations of various objects accurately and quickly. Object detection utilizing RPN and a detector network (FAST-RCNN) and the Region Proposal Network (RPN).

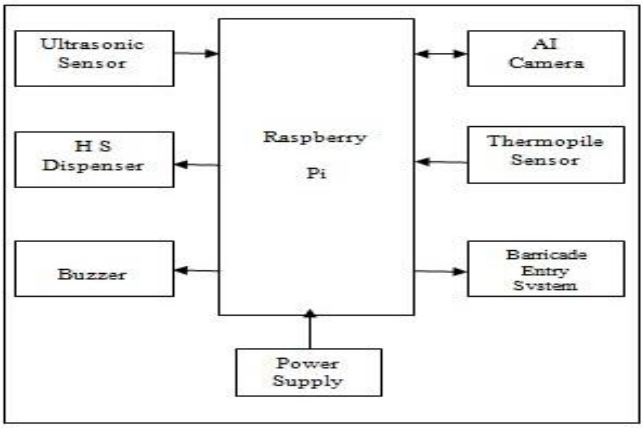

Figure 3. Object Detection Model for Deep learning approach

In [15], authors Ashlesha D. Mahalle, Rahul Nawkhare, and Ashish Bandre introduced the artificial face mask detection approach in a straight forward, affordable device. In this study, deep learning is introduced. The authors of this study used a computer vision and machine learning system built on Open-CV to identify someone wearing a face mask in a picture or video stream. Their use of OpenCV was advantageous. The models were examined using screenshots and live video feeds.

Model optimization may involve a continuous process of fine-tuning the hyper parameters to provide a very accurate outcome once the model's precision has been obtained. The bulk of the photographs were improved with Open-CV, according to the study. The images had previously been captioned with the word's "mask" and "without mask." Due to the wide range of image sizes and resolutions, accurate face recognition is possible. Syed Danish Pasha, Maaz Suhail, V Madhumitha, Archana Sas, B Varshini, HR Yogesh [16], Wearing a face mask in public settings is the most efficient means of prevention for COVID-19, which poses a significant risk to global health.

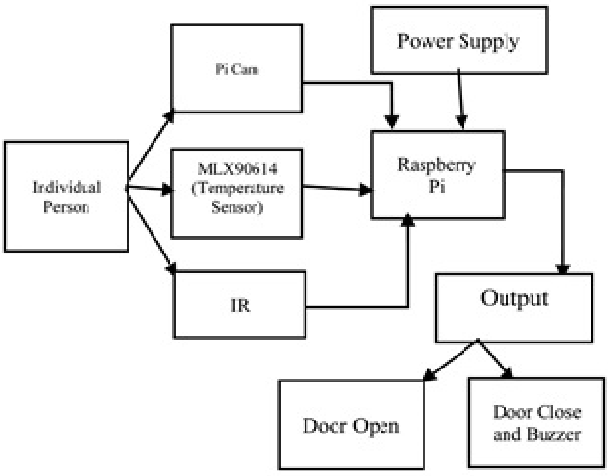

Figure 4. Open-CV-based computer vision and machine learning system

To stop the spread of COVID, the government has imposed a lockdown. To prevent economic harm, the administration needs to lift the lockdown. Wearing a face mask reduces the possibility of an illness transmitting from one person to another in public places. As a result, the author created an internet-connected smart door that uses machine learning to identify face masks and measure body temperature. The proposed framework is built using the face mask recognition method and the TensorFlow software library, and the temperature is tracked. Different classifications in this study, including support vector machines and symbolic classifiers, are the topic of [17] by G. K. Jakir Hussain et al. The project is being created as a prototype for tracking individual body temperatures and identifying masks. The first technique includes automatically spraying sanitizer while using a temperature sensor to gauge the body's current temperature. The second choice offers them a safety net to protect them from COVID-19. The suggested deep learning-based continuous monitoring of people's conditions and storage of the data on a server and the results of their training and testing percentage experiment, which involved 10 random trails, demonstrate that the symbolic approach outperforms the conventional approach. Table1 shows brief summary of presented methods.

SIMULATION RESULTS

Table 2. Simulation Results

Sr. No	Temperature	Mask Wearing Percentage	Results
1	35	100%	Entry Allowed
2	32.90	80%	Entry Allowed
3	36	60%	Entry Not Allowed
4	41.86	90%	Entry Not Allowed
5	39	100%	Entry Allowed
6	35.08	50%	Entry Not Allowed
7	47.20	70%	Entry Not Allowed

Table 3. Performance Analysis of the system

No of Persons	No of Persons Truly Detected	No of Persons Falsely Detected	Accuracy of Device	Detection time
100	80	20	80%	125sec

In this endeavor, we created a tool with an accuracy rate of 80% that can work admirably. It greatly aids in reducing the likelihood of the spread of COVID in public areas. Only those who have worn masks that are 80% or above and have body temperatures below 39 are permitted entry into this apparatus, indicating that they are safe from COVID.

Table 1. Short Recap of the Literature Survey

Sr. No	Methodology	pros	cons
[1]	Using microcontroller and PLC	Easily Accessible, Reliable Used for monitoring in pre- and post-operative time	Difficult for monitoring.
[2]	Here future Pyramid nature mask R-CNN Faster R-CNN is used to archive results	System is Simple and highly effective Accuracy is more	Lambda &Y are hyper parameter

[3]	Thermometer issued for measuring humans body temperature	-Avoid strong Lightning	-Waiting at least 15 min in the measurement room or 30 min after exercising. -Does not have higher & lower Face temp.
[4]	Multi-temp sensor such as DS18820 issued to capture body temp signal and SCMA789C52 to processed signal	-Can enhance Public Safety -This helps to reduce manpower	-There is human Error in reading values -Not suitable for larger crowds
[5]	YOLOV3 and faster R-CNN technology issued for face mask detection	-Detection speed and accuracy -High hardware performance	-Struggles to Detect small object -micro localization Error compared to faster R-CNN
[6]	In this system open-CV technique issued to check people wearing mask or not	Fast detecting method, low cost, easy to used	-Many objects are fairly low
[7]	CCTV issued for capturing real Time video footage and convolution neural CNN is used for feature extraction from image	Trained Architecture with 98.7% accuracy	-Difficult to classify Faces covered by hand since it almost looks like peoples wearing mask -Difficult to locate person correctly
[8]	Temperature screening Protocol issued for	-Simplicity of use -High Accuracy -No Risk of injuries	-Risk of injuries -low accuracy

CONCLUSION

New advancements and the dearth of smart technologies drive the development of new models that will aid in meeting the needs of developing nations. In this work, an IoT-based system is created to monitor body temperature and describe face masks that can improve public safety. In addition to providing a redundant sub caste of protection against the spread of the Covid-19 virus, this will aid in police force reduction. The model makes use of an ATmega328p real-time deep literacy system to describe face masks, determine temperature, and cover the number of persons present at any one time. When it comes to temperature dimension and mask location, the device performs quite well; the trained model was able to produce a result of 97%. The test findings show a high level of sensitivity in recognizing people wearing and not wearing face masks, so authorities will able to respond right away in accordance with epidemic safety rules.

REFERENCES

[1] Bhupesh Aneja, Shashank Singh, Utkarsh Chandna, Vaishali Maheshwari, "Review of Tempertaure Measurement and Control", PP.1-10, January2014.

[2] Maxim Integrated Products inc, "How to Measure Body Temperature using the Health Sensor Platform", PP.1-7.

[3] Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun, "Deep Residual Learning for Image Recognition", PP.1-12, 10 Dec 2015.

[4] Shaoqing Ren, Kaiming He, Ross Girshick, and Jian Sun, "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks", PP.1-14, 6 Jan 2016.

[5] Joseph Redmon, Ali Farhadi, "YOLO9000: Better, Faster, Stronger", PP .1-9,25 Dec 2016.

[6] Wei Liu, Dragomir Anguelov, Dumitru Erhan, Christian Szegedy, Scott Reed, Cheng-Yang F u, Alexander C. Maxim Integrated Products incorporation, "How to measure body temperature using the health sensor platform", PP.1-7.

[7] Hurriyatul Fitriyah, Aditya Rachmad, Gembong Edhi Setyawan," Automatic Measurement of Human Body Temperature on Thermal Image using Knowledge-Based Criteria", Journal of Information Technology and Computer Science, PP.92-99, Volume2, Number 2, 2017.

[8] Tsung-Yi Lin, Priya Goyal, Ross Girshick, Kaiming He, Piotr Dollar "Focal Loss for Dense Object Detection", PP.1-10, 7 Feb 2018.

[9] Wenhongyu, chenluluo and kuanwan, "Body Temperature detection and data collection during COVID-19" E3S Web of science conference 233, PP.1-4, 2020.

[10] Mohammad Marufur Rahman, Md. Motaleb Hossen Manik, Md. Milon Islam, Saifuddin Mahmud, Jong-HoonKim, "An Automated System to Limit COVID-19 Using Facial Mask Detection in Smart City Network", PP.1-5, March 2020.

[11] Sunil Singh, Umang Ahuja, Munish Kumar, Krishan Kumar & Monika Sachdeva, "Face mask detection using YOLOv3 and faster R-CNN models: COVID-19 environment", PP. 19753–19768, Multimedia Tools and Applications (2021), DOI:1 March 2021.

[12] Giovanni Battista, Dell'Isola, Elena Cosentini, Laura Canale, Giorgio Ficco and Marco Dell'Isola, "Non-contact Body Temperature Measurement: Uncertainty Evaluation and Screening Decision Rule to Prevent the Spread of COVID-19", PP.1-20, 6 January 2021

[13] Xiangjie Kong, Senior Member, IEEE, Kailai Wang, Shupeng Wang, Member, IEEE, Xiaojie Wang, Xin Jiang, Yi Guo, Guojiang Shen, Xin Chen, and Qichao N, "Real-Time Mask Identification for COVID-19: An Edge-Computing-Based Deep Learning Framework", IEEE internet of things journal, pp.1-10, vol.8, no.21, November 1, 2021

[14] Quanzeng Wang, Yangling Zhou, Pejman Ghassemi, David McBride, Jon P. Casamento and T. Joshua Pfefer, "Infrared Thermography for Measuring Elevated Body Temperature: Clinical Accuracy, Calibration, and Evaluation", PP.1-25, 6 January 2021.

[15] Ashlesha D. Mahalle, Mr. Rahul Nawkhar and Mr. Ashish Bandre, "Artificial Intelligence Based Mask Detection With Thermal Scanning and Hand Sanitization Based Entry System", PP.299-304, Turkish Journal of Computer and Mathematics Education, Vol.12 No.13 (2021), DOI: 4 June 2021.

[16] B Varshini, H R Yogesh, Syed Danish Pasha, Maaz Suhail, V Mad-humitha, Archana Sas "IoT-Enabled smart doors for monitoring body temperature and face mask detection", Global Transitions Proceedings 2(2021) PP.246–254

[17] GK Jakir Hussain, R Priya, S Rajarajeswari, P Prasanth, N Niyazuddeen, "The Face Mask Detection Technology for Image Analysis in the Covid-19 Surveillance System", Journal of Physics: Conference Series, PP.1-8, 23 February 2022.