

NOVEL COVID-19 DETECTION AND DIAGNOSIS SYSTEM USING IOT BASED SMART HELMET

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Abstract--Coronavirus is the new virus that has not been identified in humans before which it causes the coronavirus disease called COVID-19. This disease was firstly discovered in Wuhan, China, on December 2019 and spread to the world until now. The virus can easily pass from person to person which make it spreaded rapidly. One of the common symptom of COVID-19 that can be easily identified is fever. Since the virus outbreak, thermal screening using infrared thermometers are used at public places to check the body temperature to identify the indicated infectee among crowd. This prevention still lacking because it spends a lot of time to check the body temperature from every person and the most importance is the close contact of the infectee might lead to spreading it to the person who do the screening process or from the one in charge of screening to the checked people. This study proposes the design of system that has capability to detect the coronavirus automatically from the thermal image with less human interactions using smart helmet with Mounted Thermal Imaging System. The thermal camera technology is integrated to the smart helmet and combined with IoT technology for monitoring of the screening process to get the real time data. In addition, the proposed system is Equipped with the facial-recognition technology, it can also display the pedestrian's personal information which can automatically take pedestrians' temperatures. This proposed design has a high in demands from the healthcare system and can potentially help to prevent for coronavirus spreading wider.

Keywords: COVID-19, Coronavirus, IoT Technology, Smart Helmet.

1. INTRODUCTION

A coronavirus is a sort of virus that can make ailment in animals [1] and individuals [2,3]. The function of normal body is disturbed by the action of such virus which breaks into cells within their host and exploits them to replicate itself. The name of Coronaviruses was taken from Latin term 'corona', that means crown, since they are encompassed by what look like royal crown of a spiked shell shape. The World Health Organization (WHO) officially announced that a new virus had been identified which then is called by 2019-nCoV on January 2020 [4]. The virus was recognized as part of the coronavirus group, which involves SARS and the other known colds [4,5]. The first reported case was from Wuhan, China and has infected 7,711 people and 170 reported deaths in China before coronavirus was declared as a global pandemic which produces a sickness authoritatively defined as COVID-19 that has diffused to a minimum 141 nations and regions, causing death over 5,700 individuals around the world [6]. Someone who infected by coronavirus will show common symptom such as fever, dry cough, and tiredness or some cases, infected person will feel pains & aches, runny nose sore throat, nasal congestion, or diarrhea [7–9]. However, some people infected with the virus do not show any symptoms and do not feel uncomfortable. Around 80% of individuals infected by COVID-19 can get recovery without acquiring particular treatment [6], but it is so dangerous for older people or someone with develop serious illness

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which the probability for them to get serious illness and develops difficulty breathing are higher. Right now, no effective vaccine for COVID 19 was produced or particular medication for treatment such virus was developed. However, potential vaccines and some particular medicine treatments are still under investigation and now being subjected to comprehensive test by leading medical research centres. Further, extraordinary efforts are coordinated by WHO to develop and produce effective vaccines and drugs to avoid and treat COVID-19. As the reported case of death and infected people keep increasing [6], many nations have performed lockdown to minimize the spread impact of coronavirus. They also try to identify the infectee among crowd by screening the temperature in public places using infrared thermometer. But the usage of the infrared thermometer gun itself is still lacking because it might not cover all of people and time-consuming. That way also can lead to the spreading virus widely because the health officer has to do it one by one through a lot of people queuing when one of them has probability to infect people around. To prevent this flaw, an alternative technology is needed. The internet of things (IoT) has been adopted in a smart city as infrastructure's key since the introducing the concept of a smart city. The big research efforts that are done presently are a confirmation on prosperity monitoring by remote sensing is based on IoT. The internet of things (IoT) is the interconnection between the physical objects or things that are attached with sensors and software to gather and deliver informations among them and primary servers with least human mediation [10]. IoT healthcare is modern worldview that conveys the services and medical data associated indeed farther areas. The IoT system in medical is now in an advance setup that contains so many varieties of mechanism like smart sensors, medical equipment, big data, cloud computing, telemedicine, clinical information system, and many more. IoT technique is categorized into; remote monitoring of patients, remote tracking and monitoring of health, sensor based devices for hand wash monitoring, and monitoring of interactive RFID activities [10–13]. It delivers best evaluation, better diagnosis, and maintains efficient treatment of patient. The main applications of IoT in the field of medical health care incorporate [14-16]: Therapeutic data administration, Telemedicine and portable medical care and management of health. With the IoT technology that has widely implemented in the health care sector, this study aims to design of system that has capability to detect the coronavirus automatically from the thermal image with less human interactions using smart helmet with Mounted Thermal Imaging System. The thermal camera technology is integrated to the smart helmet and combined with IoT technology for monitoring of the screening process to get the real time data.

2. METHODOLOGY

This section describes the working flow of three subsystems due to the interrelationship between each other to perform the entire application. In addition, the necessary system's element, excluding module of decision making, are image processing module that is in charge of data processing of optical and thermal cameras. Furthermore, the task of the required data collection is assigned to the smart helmet when needed. The interfacing of a modular system that is based on IoT communication link and GSM is done. This system delivers a notification if detecting temperature higher than normal temperature. The GPS module determine the position coordinates after tagging it and a notification is sent to assigned smart mobile through a GSM. The officer will get the data of people's face and temperature to identify someone who is indicating as infectee of COVID-19 as shown in figure 1. The proposed smart helmet is integrated into three segments. The first segment of the system involves the input source of the mechanism that consists of the thermal camera, optical camera and mobile phone application. The processor development was the second segment of system development. In this segment, the microcontroller processor was integrated using the Arduino IDE software to perform coding of the source code. The software enables compilation of the necessary commands and source code into the NODEMCU V2 processor. Meanwhile, the third segment of the system focused on the output source for the mechanism.

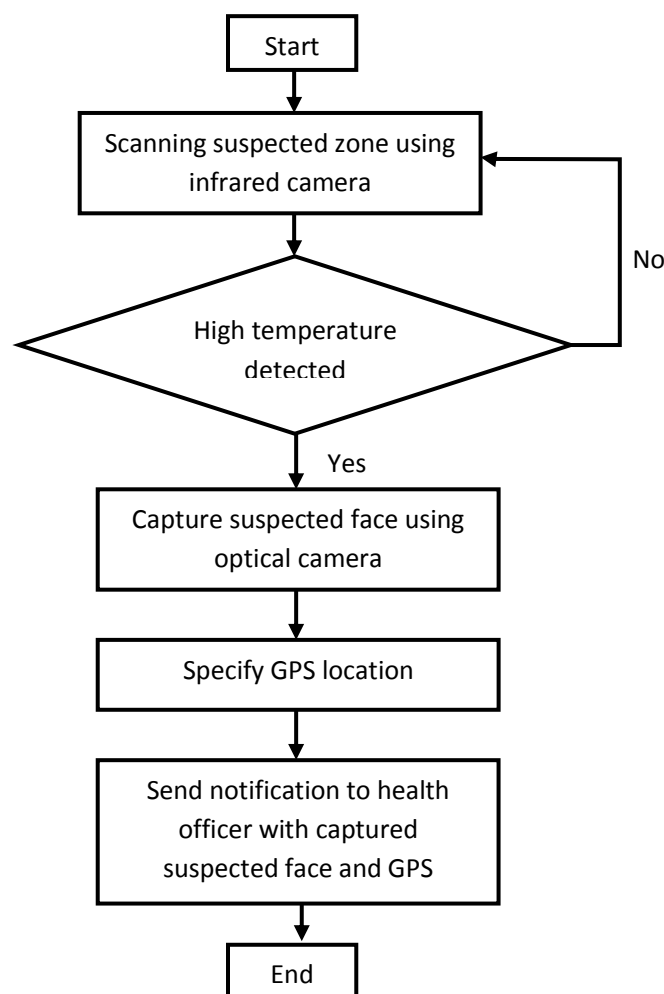
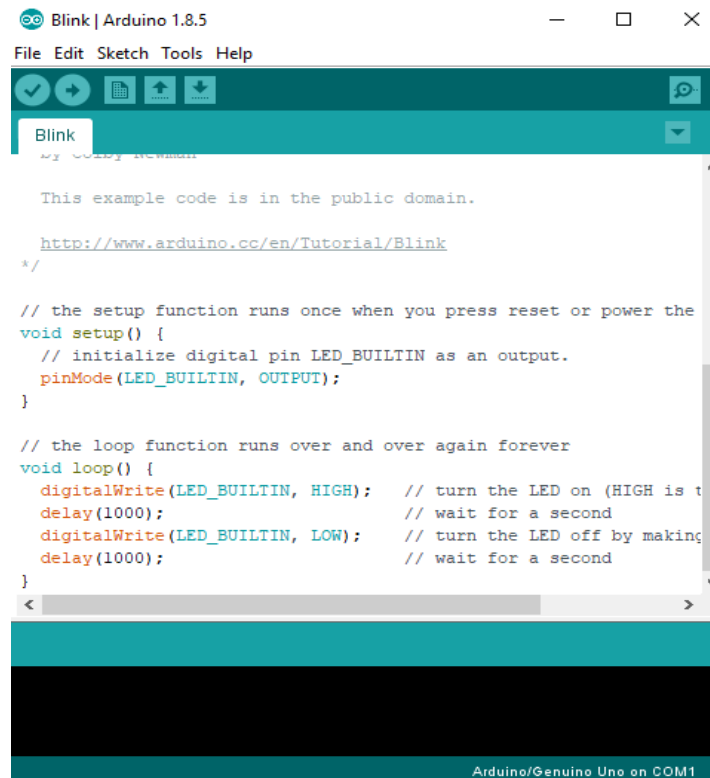


Figure 1. Work Flow of Smart Helmet

The smart helmet was equipped with two different types of cameras, allowing the gathering of detailed information of the face detection details and temperature measurements. Optical camera and infrared thermal camera which provided information about the temperature at which the different focuses of interest were found. A thermographic camera, which sometimes named by thermal imager, thermal imaging, or infrared cameras, is a device using infrared radiation to create image similarly to traditional camera that utilize visible light to produce image. This module regards segmentation approach of an image according to the recorded temperature and captured colour images by both thermal and optical cameras. Thermal camera is utilized for hot body detection and recognizing by adopting the variability of high temperature compared with other objects within the scanned zone. If thermal camera visualizes high temperature body, then it creates high intensity levels of infrared spectra.

In this project, the Arduino IDE (Arduino integrated development environment) is adopted which is written in Java language and represents a cross-platform App. It involves many features code editor such as syntax highlighting, auto-indentation, and brace matching. The IDE additionally uploaded an Arduino board by compiled and uploaded programs using essential one-click mechanism. It also supports C and C++ languages in using special rules to order code. Further, it utilize wiring project that produces several input-output method to provide software library known by Wiring as depicted in Figure 2. In addition, Proteus software includes schematic, simulation and circuit design. It is mainly used for drawing several schematics and performing real time circuit simulation that empowers human to get access during running phase, and thus creating real-time simulation [17-18]. For face detection process, this prototype uses EmguCV cross platform. Net wrapper to the Intel OpenCV image processing library and C# .Net. The normal APIs are generated during programming by Open CV library. Arduinio UNO board is used with a computer stick driven by Intel processor. The face detection is done by using Cascade Classification algorithm which is based on Hair feature. It is presented by Paul Viola and Michael [14]. Further, Machine learning algorithm is used with a cascade function for training both of positive and negative images. The open CV library already has the Cascade object detection that recognizes the face of

the captured image. Many common features are extracted from the human Face to make a standardized size rectangle to enable image preprocessing algorithm to grayscale image as well as histogram equalization [14].



```
Blink | Arduino 1.8.5
File Edit Sketch Tools Help
Blink
This example code is in the public domain.
http://www.arduino.cc/en/Tutorial/Blink
*/
// the setup function runs once when you press reset or power the
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}
// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the
  delay(1000); // wait for a second
  digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making
  delay(1000); // wait for a second
}
Arduino/Genuino Uno on COM1
```

Figure 2. Arduino Coding

3. RESULT AND DISCUSSIONS

The presented design should be checked at the beginning by simulation to look at its achievability and confirm the unwavering quality of a control technique that was said over. A basic model of the created system is designed by Proteus software as appeared in Figure 3. For approving the system tentatively, the testing stage was focused on logical interims of the software to guarantee that all statements are tried and a functional interim is carried out within the tests to identify the errors. It also keeps up that the defined input will create real outcomes that are coordinated with the required ones. Each of Program and models level testing have been integrated and performed. The circuit simulation imitated the performance of the real electronic device and circuit on the cell phone-aided software.

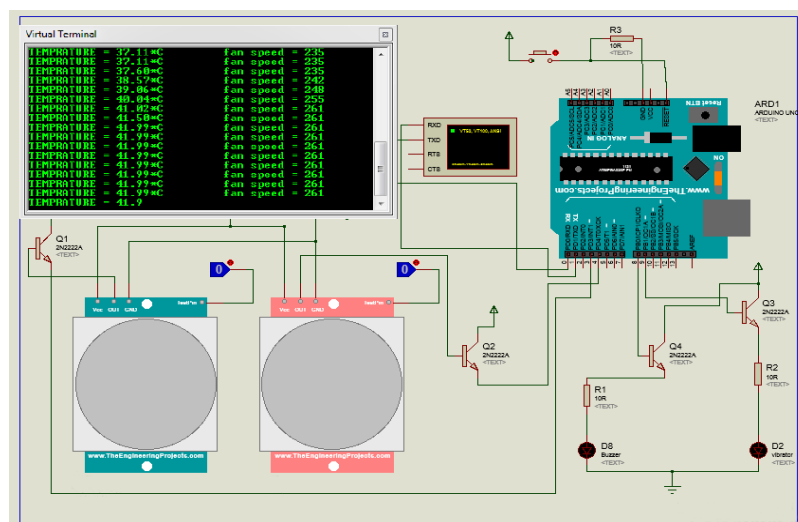


Figure 3. Proteus Circuit Simulation

Figure 4 shows the configuration of the system. The current innovation concerns with applicable kind of thermal imaging frameworks for detection an increase of body temperature as well as surveillance process, and more especially to an enhanced helmet-fixable camera system which may be promptly deployed and utilized to visualize thermal image with high resolution for the infected site coordinated to either user's eye whereas keeping up directed and coordinated visual contact of the client with the location to supply superior perceivability of the encompassing zones. An important indicator for an infection is increased body temperature (compared to other people in the immediate surroundings), generally known as fever. Thermography is the ideal method for scanning not just individuals, but also large flows of people. To do this, the temperature is measured, and an alarm triggered if it deviates. This allows persons with increased body temperature to be identified quickly and reliably, and to be isolated for more exact testing. Beyond checking body temperature, artificial intelligence is being used to diagnose COVID-19. Infection, software that automatically detects symptoms via screening images, and can make diagnoses quicker and reduce the risk of human error. The Figure 5 illustrate how the smart helmet work generally.



Figure 4: configuration design of the system (a) Over all system, (b) System Controller, (c) Thermal Camera and (d) Optic Camera.

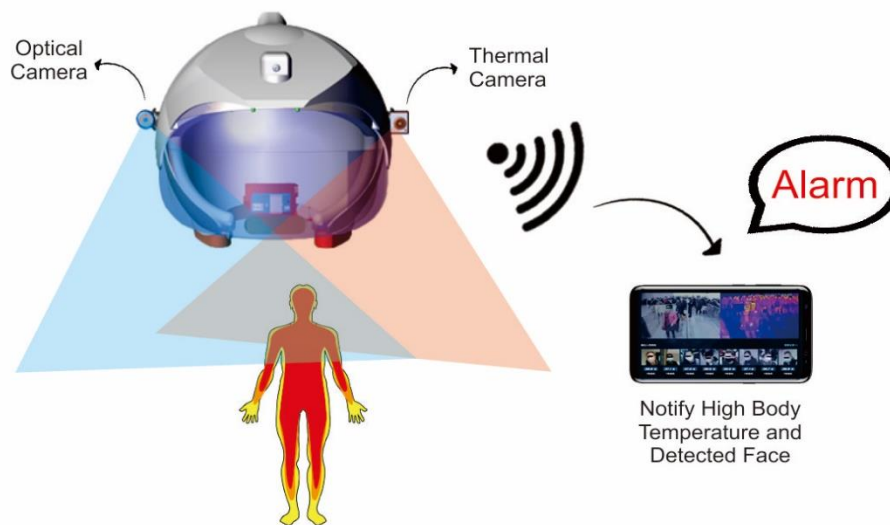


Figure 5. Smart Helmet System Work

Face recognition has been broadly examined since few decades. With the quick progresses in processing performance and memory, the online and live video processing of computer vision in portable devices became reachable. The algorithms of conventional computer vision like the Viola–Jones and deformable part methods and related extensions have really advertised great performance in the context of restricted conditions. In addition, to detect the history of visited place made by a person suspected as infectee, the Google Location History (GLH) can give the system the detail of places that have been visited by the infectee until now (Figure 6). GLH itself is Google service that saves where user go with every mobile device. The user experience can be improved by using any Google App or services which adopt Google Location History & Reporting. Like most Google services and features, the entire history and management is completely connected with user’s Google account, like most Google features and services. GLH has been used on assessing user’s habit [15], and user’s mobility [16] as well to provide visions, involving planning of infrastructure, control of infection diseases, and suitable reaction to disastrous occasions.

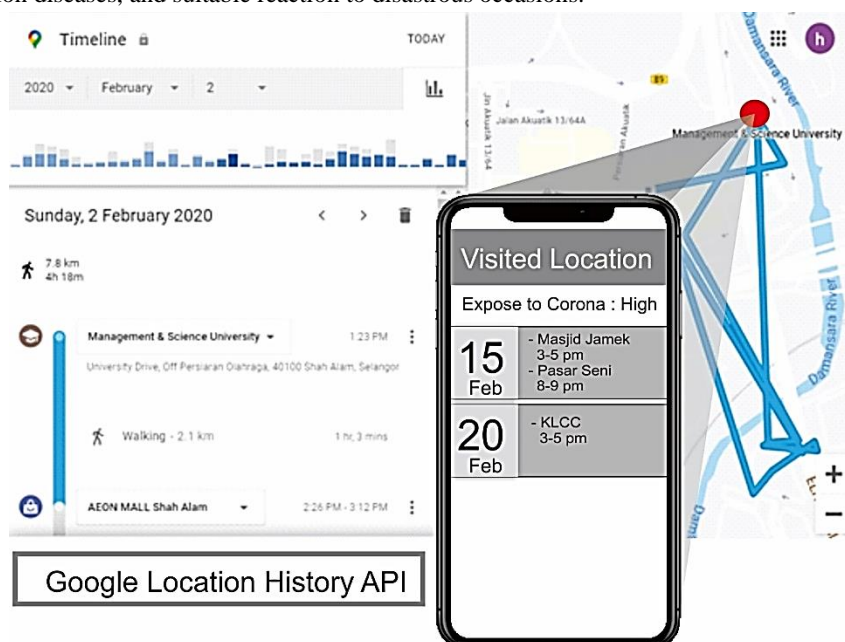


Figure 6. Google Location History System

After getting information incorporating the recognized face, body temperature, and GPS position delivered by Arduino through sequential communication, the micro-controller (type NodeMcu) had these values transferred to it over the Web to supply independent online worldwide access to of this information. For this reason, an exterior server called Blynk was utilized. When the thermal camera detects high temperature body as shown in Figure 7, the system notifies the authorities to alert them about the threat. At the same time the system will take a picture and sent to the health officer.

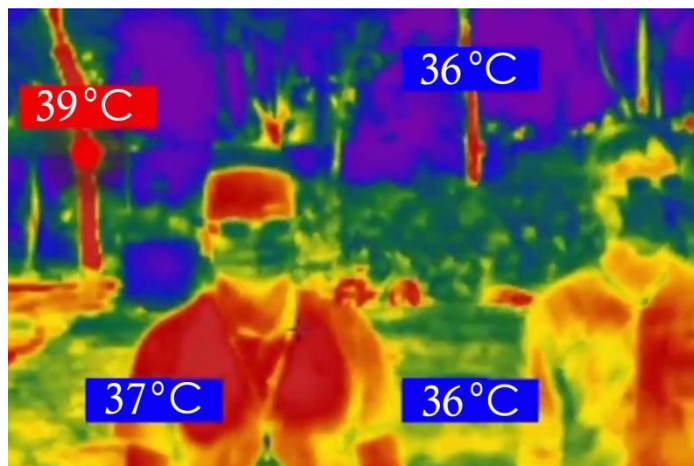


Figure 7. Thermal Image that detect variety of temperature

4. CONCLUSION

An innovative real-time early detection of coronavirus and monitoring system using smart helmet which integrated with thermal imaging system has been developed. The smart helmet can also detect high body's temperature in the crowds and send the measured data to be displayed on a phone application. As the latest big issue nowadays that happened across the world, the spreading of coronavirus give so much attention and awareness among people. Early detection of the coronavirus symptoms will be one of the suitable ways to prevent the spreading of coronavirus. As the high body temperature of people is one of the very common symptoms, a real time monitoring system of the screening process that automatically appearing the thermal image of temperature of people is needed. So the diagnosis of the screening process will be less time consuming and less human interactions that might cause the spreading of the coronavirus faster. It can be concluded that the remote sensing procedures, which provide an assortment of ways to identify, sense, and monitoring of coronavirus, give an awesome promise and potential in order to fulfil the demands from the healthcare system.

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