International Journal on Emerging Technologies 11(5): 389-396(2020)

ISSN No. (Print): 0975-8364
ISSN No. (Online): 2249-3255

Conceptual Design: A Novel Covid-19 Smart AI Helmet

Safaa N. Saud Al-Humairi, Muhammad Hafiz Zainol, Husniza Razalli, Lilysuriazna Raya, Muhammad Irsyad Abdullah and R. Junaidi Daud

Faculty of Information Sciences and Engineering, Management and Science University, 40100 Shah Alam, Selangor, Malaysia.

(Corresponding author: Safaa Najah Saud Al-Humairi)

(Received 21 July 2020, Revised 03 September 2020, Accepted 28 September 2020)

(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: COVID-19 is the biggest threat in the year 2020 so far, which it has dramatically changed human life and the world economy. The world has traumatized by the terrifying effect of this virus. Not only the under developed countries but also the most developed countries around the globe that have witnessed the devastating impact of this lethal virus. Furthermore, COVID-19 imposes a heavy burden and costs on the health sector, and consequently, providing continuous monitoring by modern technologies will lead to a reduction of health costs and improve control of people's health practices, management, and prevention of this pandemic.

Furthermore, most of the current monitoring researches were focused on the fix and limited monitoring features to detect the spread of COVID-19 virus. Therefore, the main objective of this paper is to develop and implement an adaptive monitoring system and model of a smart Artificial intelligence (AI) helmet, based on measuring variables that can be monitored continuously by thermal (Adafruit) and pi (impeded sensor) module camera with impeded sensors. The method of body temperature and face detections as proposed features will to be implemented and calibrated in real-time. Moreover, both the proposed features will be functioning based on AI algorithm. In conclusion, this system will serve the Malaysian community and society need by hindering the spread of COVID-19 virus.

Keywords: COVID-19, Monitoring Technology, Artificial Intelligence, Thermal body temperature, Smart Helmet.

I. INTRODUCTION

Coronaviruses (CoV) are a large family of viruses that causes illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV) [1]. In 2019, for example, the coronavirus rapidly spread to Wuhan, China. In 2020 it spread to many people worldwide, regardless of age, gender and race. In contrast, the majority of states face the spread of this virus and cannot publicly detect patients due to the lack of technology for scanning or tracking [2, 3]. Besides that, the equipment which is used is either a hand-held or a fixed mounted thermal imaging equipment which is unable to use anywhere with inconvenience and is for one user only limited. Loading scanning time may take longer particularly in a crowded environment [4].

Furthermore, fixed thermal imaging devices require high-cost initial investment and images in particular objects are challenging to interpret because erratic temperatures prevent precise surface temperature measurements, apart from differences in size and reflection [5, 6]. Conventional thermal imaging devices, such as hand-held and stationary systems, are typically to provide reading data from the device related to an object in the field of view of the device or to read data from an external stationary monitor. A thermal imaging device is a type of the thermographic camera used to measured temperature [7]. From other perspectives, it is patient recognition that most countries face in managing this pandemic. Most devices used are known as standalone systems, meaning that the technology of thermal imaging does not include face recognition, and it takes time to identify the identity of patients. Nowadays, technology in China has started to wear AI-powered smart helmets which can automatically take pedestrians temperatures as they patrol the streets amid the coronavirus crisis. The high-tech headgear has an infrared camera, which will sound an alarm if anyone in a radius of five meters (16 feet) has a fever that a common symptom of the disease. Furthermore, with the advancement in information technology face recognition (FR) has become an important research area due to its worth in the real world. There are many factors behind the rapid growth of development of face recognition system like active algorithm development, big database of facial images and a number of evaluation methods for performance measurements of face recognition algorithm are available. Due to these advantages, FR has appeared as an attractive solution to manage many obligatory requirements needed to give proof of identification and verification.

To be a focus on the current area of implementation, in Malaysia, every citizen has identification card as an identity and in the event of losing or forgetting the ID card that associated with severe conditional cases may cause a problem to the health inspector or officer to trigger the identity properly, a portable, affordable and accurate interface with a range of features device is, therefore, essential to be designed. The purpose of this project is to establish a proof of concept on an artificial intelligence smart monitoring system by designing AI Helmet to be implemented for multi-purposes, such as tracing COVID19 infected people through the police officers or health inspector, or for the fireman to locate the body temperature of incident people in case of severe fire as well as for immigration police to trace the suspects without approaching them closely in such pandemic discovered study its effectiveness in generating smart cities, in which it can quickly measure body temperature in crowds. Moreover, this intelligent helmet will also be designed with the facial-recognition technology with the help of WIFI module that can exceed a develop data science cloud and display pedestrian's personal information such as name, address and age. So, it will make it easy for the officer/inspector to control from outbreaks of the disease. Moreover, based on the current pandemic "COVID19", this project will enable Malaysia to face this pandemic with implementing the latest AI technology that has yet made available in the monitoring technologies out of china market.

II. RELATED LITERATURE

A. Thermal Body Temperature Camera

Thermal body temperature cameras cannot detect a virus. Still, they can quickly non-invasively detect high body temperatures in public and private space to alert health and security teams to the need to scan scanned individuals for disease in such a way as to avoid slowness in their foot traffic [8, 9]. Challenges exist. It is critical in operational terms that BTM cameras can see the head or corner of the eye, which means that there are no hair or brass and that BTM cameras should be positioned only 2 meters from the subject. Security teams also need to ensure that the area does not have healthy light sources, sunlight or people that are not screened. Additionally, people who are asymptomatic and may include a large number of COVID-19 individuals cannot exhibit high temperatures. Because these cameras do not calculate core temperature, they assume the wrong positive and incorporate this hypothesis into procedures. Make sure the display system is sensitive enough for slight differences in temperature [10, 11].

Fig. 1. Thermal camera set up at the airport [12].

Fig. 1 shows the thermal cameras set up at checkpoints or by hand-held at the airport, at frontier and entry levels of companies, schools and other organizations to monitor the highly contagious virus triggered by COVID-19 are used to quickly and reliably screen a large number of people at high corporate temperatures. Among the devices being used are FLIR thermal imaging items for temperature monitoring, including hand-held and permanently installed systems. The same FLIR sensor, calibration features, and measuring functions are available in both formats, and the customer chooses to use the technology for the hand-held or fixed option. Because of the current situation, the market for its T-Series hand-held products, and for the A310 fixed-mount heat imaging camera has increased. FLIR is also growing, as displayed in Figure 2. The third category of product, the non-contact thermometer IR200, is also highly demanded and is aimed at scanning the person's forehead for signs of fever.' Traditional' thermometers are mercury in glass, ear or forehead thermometers and the drawbacks of the digital thermometer.

Fig. 2. FLIR thermal camera [13].

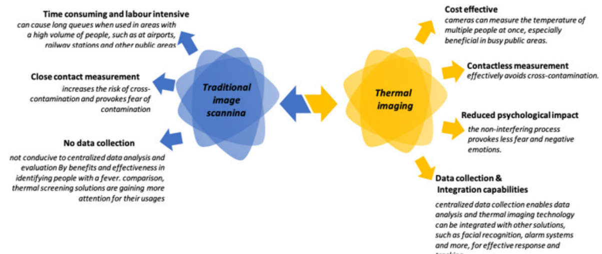


Fig. 3. Features comparison of the traditional image scanning and thermal imaging [15].

Fig. 3 illustrates the advantages of thermal imaging by using cameras to calculate skin temperature, which detects the infrared energy emitted by people and objects [13]. In addition, thermal screening solutions for temporary use are easily preliminary identified, firstly the place: the current entries in railway stations, bus stations, subway stations, and airports are placed with cameras installed on a trip or other temporary program. Furthermore, the solutions deployed at existing security gates considered to be equipment installed at existing entrances and gates, as well as the solutions that can be incorporated with alarm systems, can be deployed and removed quickly based on entries in use. At the same time, data may be stored locally on a central base. In South Korea, documents including credit cards, mobile location data and CCTV videos and interactions with other people were used by the government to create a system for tracking confirmed cases. The result was a map which could tell people if they were close to a carrier with a coronavirus. The government of South Korea has launched an updated tool to help patients track them further in almost real-time, in order to find out where the disease is going [14]. In China, government-based CCTV cameras point to those who do not leave at the apartment door of a 14-day quarantine, as shown in Fig. 4. Digital bar codes on mobile apps show people's health. These are only some of the ways in which its monitoring system has helped contain a coronavirus outbreak in the world' s second-largest economy. Individuals in China received either photographic evidence of CCTV equipment being installed in front of their house to implement quarantines or told CNBC in interviews.

CCTV health authorities required other methods of detection, such as the infaring ear thermometers used in some countries. And now, a company based in Austin says that its security cameras use thermal imaging and computer vision technology to detect people with the fever that may be linked to the virus, as shown in Fig. 5.

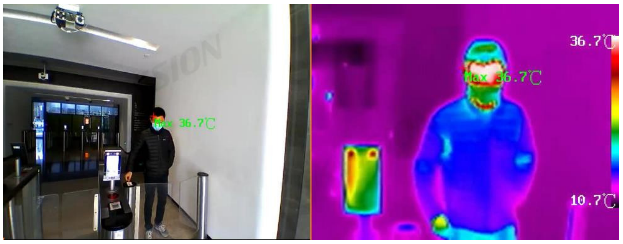


Fig. 4. CCTV thermal camera set up by the Korean government [16].

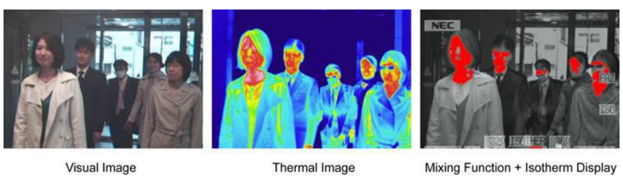


Fig. 5. Body temperature scanning in the public area [16].

B. Temperature Screening Device

A new temperature monitoring equipment is now being piloted, which uses artificial intelligence (AI) to locate febrile individuals. Even though they wear spectacles, protective masks or headgear, a real-time screening system-which simply uses smartphones with 3D and thermal laser cameras-detests the front temperature of individuals who walk along. It could address the current situation, where some places have long queues due to the time needed for temperature testing, which can take time and work. This is the result of a 7 February 2020 outbreak in Singapore. Under the state of the Disease Outbreak Response System (Dorscon), code orange refers (in Fig. 6) to a mild to high public health impact which requires organizers to cancel or postpone large-scale non-essential events and carry out temperature screenings for group events [17]. The breakthrough in Singapore, known as iThermo, was created by Integrated Health Information Systems (IHiS), a public health technology agency and the local KroniKare medicines company. It is currently piloting in Serangoon North and the St Andrews Community Hospital, Simei in IHiS's headquarters

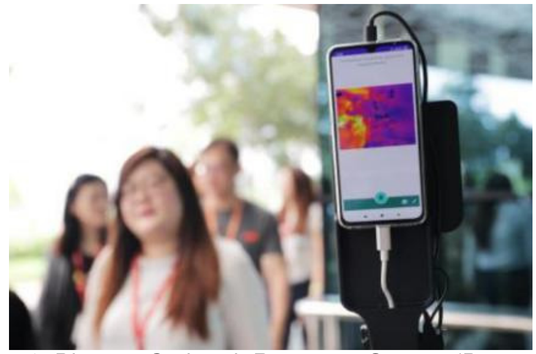


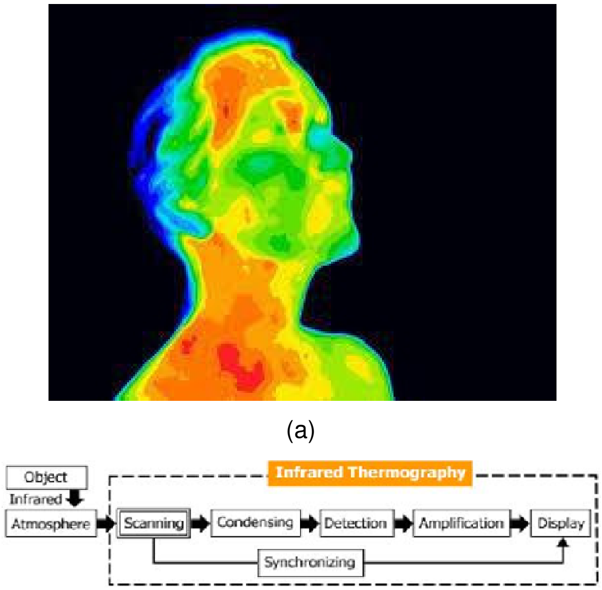
Fig. 6. Disease Outbreak Response System (Dorscon) app [18].

C. Infrared Thermography

Most of the equipment used to track COVID-19 now uses thermography infrared. The thermograph of this infrasound reads the body's temperature. Therefore, people can quickly know whether these people screened throughout infrared technology have a symptom, as shown in Fig. 7. However, it offers many types of thermal and thermal imaging devices. In many fields as airport and hospital, its system has also been used. In reality, the system shows someone's temperature tested. It means that a person may have a symptom if the temperature is above 37℃. This is essentially the determination of these thermometer arms as well as other similar measuring devices for infrared body temperature. With the latest COVID-19 coronavirus outbreak, you may have noticed an increased use of such equipment at airports and in other control points. These instruments aim to calculate the body temperature a bit away, if it's inconvenient, uncomfortable and possibly quite gross to stick a thermometer in everyone's mouth or rear ends.

Fig. 7. Thermal imaging technologies [19].

Infrared emission of objects is cantered with a unique lens. A phased array of infrared detector components is used for scanning the concentrated light. The detector elements produce various thermogram models. It takes 33 seconds to get the temperature data for the thermogram immediately to the detector array, as shown in Fig. 8(a-b). This data is collected from several thousand points in the detector array field of view. Via electrical impulses, the thermogram produced by detector elements is translated. The signals are transmitted to a signal processing device, a circuit card with a passionate chip, which converts information from the elements to show data. In compliance with the strength of infrared radiation, the signal processing unit sends out the data to the monitor wherever it may seem as various colours. The picture is formed by integrating all the pulses of the elements.



(a)

(b)

Fig. 8. Infrared thermography (a) scanning image and (b) block diagram [20].

III. DESIGN CONFIGURATIONS

The design of the system covers the details explanation of methodology that is being used to make this project well-functioning, as shown in Fig. 9. This method is used to achieve the objectives through the accomplishment of the perfect result. In this section, the block diagram, flowchart and design aspect of the independent component are discussed to ensure overall features and ideas could be realized using the correct methodology.

A. Phase 1: Requirement gathering of the project

Identify all the knowledge and requirement, such as hardware and software, and design should be done correctly. During this section, data on the scope, objectives, current scenario and complication of the project have been appropriately acknowledged. The design for the whole project is completed during this part. Project schedule throughout the entire process will be recorded all the time.

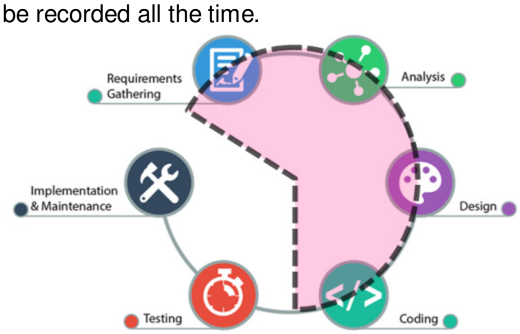


Fig. 9. Project methodology development that covered until coding as conceptual design.

B. Phase 2: Body Temperature Analysis

Following an aspect of the present invention, an infrared sensor, including the infrared sensor configuring to detect a wavelength including an absorbent band by at the atmosphere, is provided with a radiation temperature measurement device to measure the surface temperature of an object with no contact. A measuring instrument designed for measuring the infrared sensor output. A measuring rate estimate involves the measurement of the object's surface temperature by the atmosphere at a wavelength of the absorption band. Storing means that the infrared sensor output is pre-configured for conversion to the object's surface temperature; surface measurement means that the object's surface temperature is determined from the infrared sensor output measured employing the measured absorption rate, computed by the rate of absorption calculation; an absorption rate storage means that, according to the convertibility information, the absorption rate is configured to store in advance the absorption by the atmosphere at the wavelength of the absorption strip and the means of correction configured to correct the surface temperature of the object calculated utilizing the absorption rate stored by the storage medium.

Approach to black-body radiation using Stefan-Boltzmann Fourth-Power act is the most theoretical and precisely accurate calculation of the first phase. The following equation, indicated in equation 1, is currently linked to the output measuring value V, the measuring instrument temperature Tr and the surface temperature Tb.

$$V = b \times (T_b - T_r) + c \tag{1}$$

In this case, b and c are pre-stored coefficients on Output Storage Unit in Eqn. 1. b is equal to the sensitivity of the infrared sensor 1, and c to an infrared sensor offset 1. By solving the equation with Tb, the surface temperature Tb can be achieved. In particular, not only the infrared unit but also all wavelength bands are aimed with the Stefan - Boltzmann formula of the fourth-order equation indicated in equation 1. Nevertheless, an infrared sensor with the previous detection band cannot be made real, and the band has to be limited. Still, when limiting the band, the equation does not necessarily have the fourth-order equation.

Analysis phase could be a stage in any of study, in which in this stage, the project's resources and requirement, literature review and schedule were analyzing. Within the analysis time, the research regarding COVID 19: An AI-Smart and Affordable Helmet system has been found on the internet and analysis regarding the project related is studied. Once the project requirement was obtained, some analysis on the function for electronic components and a few of apparatus must be used to complete this project. While planning, analysis regarding the project related are done, which includes with study regarding electronic component corresponding to Raspberry Pi, Adafruit Thermal Camera, Pi Module and 3.5 Inch RPI Display.

C. Phase 3: Design of the project

This phase is to create or design the new circuit for the project and defines the stable hardware that may use in the project. This phase also requires to understand on how to combine the Raspberry Pi system to data cloud, thermal camera and raspberry pi camera. After all the process of designing the schematic circuit, then the designing process of the layout was done where it requires steps until the layout can be done correctly. The body temperature monitoring system will be divided into two parts, and the first part will a wearable smart helmet attached to two types of cameras; Adafruit thermal with 24 × 32 array of IR thermal sensors and Pi module cameras. The second part will be a mobile application for the tracing purpose. The block diagram of the monitoring system is shown in Fig. 10.

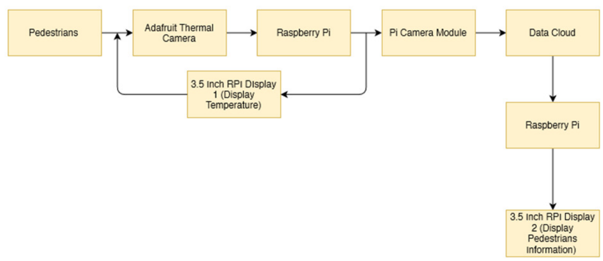


Fig. 10. Block Diagram of the proposed System.

The design of the smart helmet will be in adjustable adult sizes as presented in Fig. 11, in which is a rechargeable lithium battery IC KF5056 and an LDO MIC5366-3.3YC5, RPI display screen, as well as two microcontrollers, type Raspberry Pi4. Furthermore, the AI helmet will be provided with WIFI module to transmit the detected data to the cloud and mobile application.

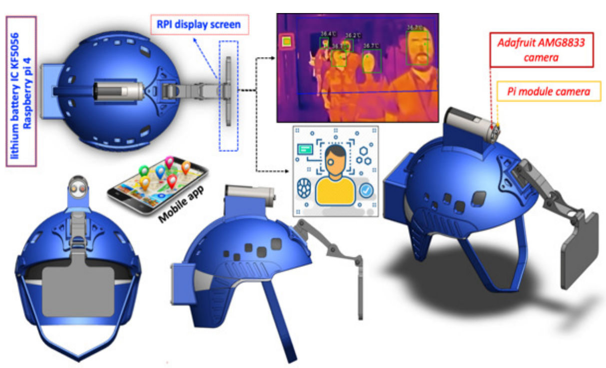


Fig. 11. 3D design of the proposed system.

Fig. 12 shows the flow chart of the functioning procedure that will be based on the thermal camera with continues display on RPI screen, once it detects a presence of positive gesture or high body temperature > 39°C, the Adafruit thermal will be feedback to Raspberry Pi4. It will start operating the facial recognition process instantly. The detected information will be encoded and sent to data cloud and alerting push message to the mobile application through a Wi-Fi module to be sent to the medical crew station nearby and allocate the infected person through GPS provider module (longitude and altitude coordination). This data flow from the smart helmet to the cloud could be visualized in Fig. 12, that represents the data flow diagram of the implemented system.

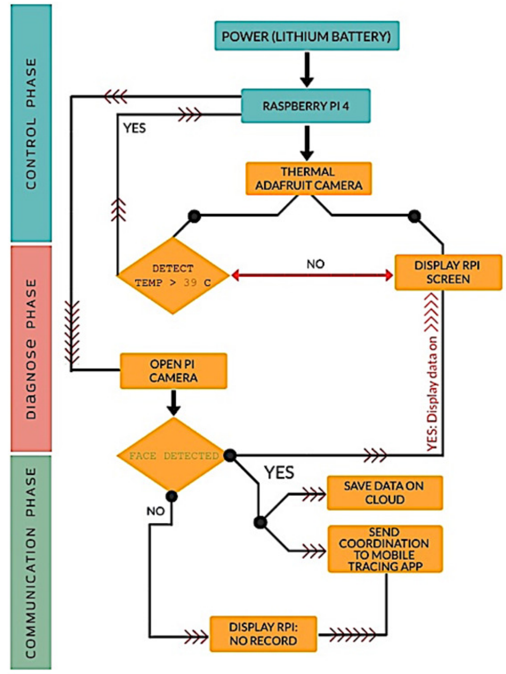


Fig. 12. Flow Chart System Architecture.

G. Phase 4: Project Coding Algorithm

(1) IR image processing Algorithm for the body temperature capture

In order to determine the temperature from the Adafruit camera and its corresponding sensors, only images with the temperature above the threshold will be recorded, as shown in Fig. 13. The following sequence of image processing algorithm will be performed for each image:

a) The first frame, which will start to collect data and proceed for the next framework for further processing, is recorded and extracted by Adafruit Camera Video.

b) The temperature scale is estimated for each pixel according to colour gradient distribution, which is explained below.:

c) The temperature is measured from the right side of the captured frame to be divided into absolute interval numbers (n), with the endpoints (Tmin and Tmax) used to estimate the body temperature of j-th point as:

$$T_j = T_{min} + \frac{T_{max} - T_{min}}{n} j \quad (2)$$

d) Then a j-th pixel from the temperature scale is associated with exact temperature values and corresponding RGB values.

e) In the next step, each pixel has an RGB value compared with the pixel-scale values of the RGB. The thermal pixel is assigned to a temperature which is equal to the pixel at a minimum Euclidian distance of these values.

f) Selecting the region of interest (ROI): In the analyzed frame rectangular region with the human body, thermal image inside is distinguished. To do so, we use two assumptions:

g) Temperature of the scanning bodies on the thermal image at least 3°C higher than the 36°C.

h) There is more than one scanned body in the field of view.

i) Selecting specific points (*spi*) in the i-th frame for further tracking: we used minimum eigenvalue algorithm developed by Shi and Tomasi [21, 22], which is realized to find specific corner points in ROI.

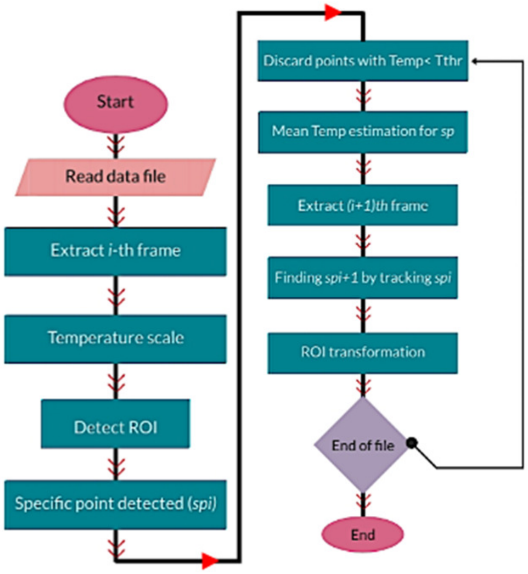


Fig. 13. IR image processing Algorithm.

j) To check whether each point corresponds and estimate the mean temperature to the scanned bodies: all ends are discarded with a temperature value lower than the T_{thr} threshold. The value of Tthr is empirically chosen for all ROI points plus 3℃ as a median temperature. The mean temperature of the scanned frame bodies for the remaining specific points is calculated as a mean temperature value.
k) Analyzing the following (i+1)th frame: if the file is not over, the next video frame is extracted.
l) Tracking sp_i: A Kanade-Lucas-Tomasi (KLT) algorithm [23] will be used to track sp_i and find sp_{i+1}.
m) ROI transformation: the geometric processes are estimated and implemented at ROI borders between sp_i and sp_{i+1}.
n) Mean temperature estimation for selected points: return to the particular point check stage.

(2) Face recognition Algorithm for the suspected/infected bodies

The flow diagram in Figure 14 starts by capturing the data from the Pi camera. Based on the input data, the method needs to find the region that detected as a Face by applying face detection method. Face Detection is the first and essential step for face recognition, and it is used to detect faces in the images. There are many techniques to recognise faces, with the help of these techniques, we can identify faces with higher accuracy. These techniques have an almost same procedure for Face Detection such as OpenCV, Neural Networks, Matlab, etc. The face detection work to detect multiple faces in an image.

Based on detected faces, we continue the process by applying a face recognition process. As a general view, this algorithm extracts the relevant information of detected face that convert to an image and encodes it as efficiently as possible. For this purpose, a collection of images from the same person is evaluated to obtain the variation. This variation will store in the face database for a training dataset. Mathematically, the algorithm calculates the eigenvectors of the extracted features of the set of face images. Each image from the set contribute to an eigenvector, and these vectors characterize the variations between the images. When we represent these eigenvectors, we call it eigenfaces. Every face can be represented as a linear combination of the eigenfaces. The basic idea of the algorithm is developing a system that can compare not images themselves, but these features extracted features data. The algorithm can be reduced to the next simple steps: -

i. Acquire a frame of input camera and convert as an image.
ii. Find the region that considers as a face area, and this is a continuing step until the program found the face area.
ii. Once the face is detected, calculate the eigenfaces and determine the face space by extracting the features of the detected face. It will be necessary for further recognitions. This step will be in the duplication process where it is also applicable for training method.
iv. The extracted data will be used to compare the eigenfaces data that already exist in the database with a specific face identity to determine if the face image belongs to a particular stored identity.
v. Then, it will be determined if the image corresponds to a known face of the database of not.
vi. Finally, the detected face image will be saved in the database for collection.

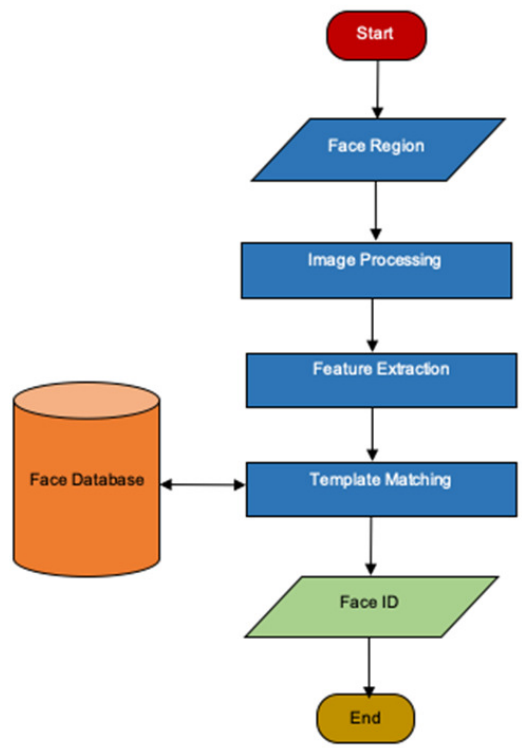


Fig. 14. Face recognition algorithm flow chart.

IV. COMPONENTS USED AND SPECIFICATIONS IN SMART HELMET

There are several components listed in this section in order to build a working prototype. The parts have been selected in order to be able to be produced quickly, bearing in mind cost-effectiveness, compactness, current consumption, and developer friendliness.

A. Raspberry Pi 4

Raspberry Pi 4 is today 's key model. The 1.2GHz 64-bit Quad-core CPU and 1 GB RAM are packed super-fast. This is quicker than many modern smartphones and is utterly equivalent to many computers on your desktop. It is also more feature-rich, not only faster than the Raspberry Pi 4. It now has Wi-Fi and Bluetooth has been installed. It's much easier to access and use a wireless mouse and keyboard. Ethernet and four USB sockets are also supported. It is therefore easy to connect it and link any wired devices to your network router. It has the complete 40-pin GPIO sockets, equivalent to all versions. Hardware and computer devices with a Raspberry Pi 4 can be easily attached. It's somewhat cheaper than other models, and typically can choose a board for around £ 30. It's worth the extra money and is the board that most newcomers follow [24].

B. RPI Display

Raspberry Pi is a crucial touch screen with a 4D System display quickly and easily. Different dimensions available: 3.2 (RS 909-4105) and 3.5 inches (RS 909-4108), both attached via header 40-way. The Raspberry Pi provides power for the device, so an external power supply is not required. The software is available for download on the 4D Systems website, and installation with Raspberry Pi can be completed in only a few minutes [24].

C. Adafruit Thermal Camera

This Panasonic sensor is a thermal IR sensor scale of 8x8 [25]. When connected to the microcontroller (or Raspberry Pi), a total of 64 infrared temperature readings will be given by I2C. It's like the cool, but lightweight, easy-to-integrate thermal cameras. This component will calculate 0℃ to 80 ℃ with precision from ±2.5 ℃ (4.5 ℉) to ±2.5 ℃ (32 ℉ to 176 ℉). A human can be marked up to 7 meters (23) feet away. It is ideal for creating the human sensor or mini thermal camera with a maximum frame rate of 10Hz. We have code that is compatible with the Arduino (sensor transmits via I2C) or Raspberry Pi with Python for using this performance.

D. Raspberry Pi Camera

The Raspberry Pi Camera v2 has been designed for the Raspberry Pi, featuring a solid focus lens and a high-quality 8-megapixel Sony IMX219 image sensor [24]. It can accommodate static images of 3280 × 2464 pixels and supports video 1080p30, 720p60 and 640x480p60/90. It connects to Pi via a small socket on top of the board and uses the dedicated CSi interface, which is specially designed for cameras interfacing. The panel itself is tiny with approximately 25 mm × 23 mm × 9 mm. It also weighs a little over 3 g and is appropriate for mobile or other applications with necessary sizes and weights. It is connected via a short ribbon cable to Raspberry Pi. The high - quality image sensor Sony IMX219 itself has an eight-megapixel native resolution and has a fixed focus lens. With regard to images still, the camera can produce static images of 3280x 2464 pixels, and supports 1080p30, 720p60 and 640 × 480p90.

E. Raspbian Operating System

Raspbian is a Raspberry Pi Debian-based machine. Raspbian is available in several versions including Raspbian Buster and Raspbian Stretch. The Raspberry Pi Foundation has been the primary operating system for the Raspberry Pi family of single-board computers since 2015. Raspbian was developed as an independent project by Mike Thompson and Peter Green. In June 2012, the initial construction was completed. The operating system continues to be active. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs. Raspbian uses PIXEL, Pi Improved X-Window Environment, Lightweight as its main desktop environment as of the latest update. The LXDE desktop environment is revamped, and the Openbox stacking window manager has a new theme and few changes. A copy of the algebra software Wolfram Mathematica, Minecraft Pi and a lightweight Chromium version is included in this distribution. The latest version is available Minecraft Pi [26].

V. CONCLUSION

The smart AI helmet has been conceptually designed, and proposed algorithms were successfully programmed to meet the main objectives of this research as a monitoring and detection system for COVID-19 virus spread. This paper was discussed four elements from the design development scheme with taken into consideration the hardware and software required, while the other two aspects of testing and implementation followed by maintenance will be carried out in the next continued research paper.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the supported facilities provided by Management and Science University (MSU).

REFERENCES

[1]. Al-Humairi, S. N. S., Mazlan, N., Tarofder, A. P. D. A. K., & Razalli, H. (2020). *COVID-19 PANDEMIC: Monitoring Technologies, Healthcare and Panic buying behaviour*: White Falcon Publishing.

[2]. Ali, R., Zeng, J., Kavgic, M., & Cha, Y. J. (2020). *Heat loss detection using thermal imaging by a small UAV prototype.* Paper presented at the Smart Structures and NDE for Industry 4.0, Smart Cities, and Energy Systems.

[3]. Cascella, M., Rajnik, M., Cuomo, A., Dulebohn, S. C., & Di Napoli, R. (2020). Features, evaluation and treatment coronavirus (COVID-19). In *Statpearls [internet]*: StatPearls Publishing.

[4]. Findlay, M., Loke, J. Y., Remolina, N., & Tham, B. (2020). Ethics, AI, Mass Data and Pandemic Challenges: Responsible Data Use and Infrastructure Application for Surveillance and Pre-emptive Tracing Post-crisis. *SMU Centre for AI & Data Governance Research Paper Forthcoming*.

[5]. Guzik, T. J., Mohiddin, S. A., Dimarco, A., Patel, V., Savvatis, K., Marelli-Berg, F. M., D'Acquisto, F. (2020). COVID-19 and the cardiovascular system: implications for risk assessment, diagnosis, and treatment options. *Cardiovascular research*.

[6]. Havens, K. J., & Sharp, E. J. (2016). Chapter 7 - Thermal Imagers and System Considerations. In K. J. Havens & E. J. Sharp (Eds.), *Thermal Imaging*

Techniques to Survey and Monitor Animals in the Wild (pp. 101-119). Boston: Academic Press.
[7]. Howser, G. (2020). Raspberry Pi Operating System. In *Computer Networks and the Internet* (pp. 119-149): Springer.
[8]. Jeelani, R., & Jeelani, R. (2019). Thermal imagery for monitoring livestocks. *International Journal Of Life Sciences and Applied Sciences, 1*(1), 58-69.
[9]. Jiang, Z., Hu, M., Fan, L., Pan, Y., Tang, W., Zhai, G., & Lu, Y. (2020). Combining Visible Light and Infrared Imaging for Efficient Detection of Respiratory Infections such as COVID-19 on Portable Device. *arXiv preprint arXiv:2004.06912*.
[10]. Jiang, Z., Hu, M., & Zhai, G. (2020). Portable Health Screening Device of Respiratory Infections. *arXiv preprint arXiv:2004.01479*.
[11]. Khalik, S. (2020). Change in response if status moves from Yellow to Orange. Retrieved from https://www.straitstimes.com/singapore/health/change-in-response-if-status-moves-from-yellow-to-orange
[12]. Meyer, D. (2020). COVID-19 Pushes Microsoft, Dell, Red Hat to Virtualize Events. Retrieved from https://www.sdxcentral.com/articles/news/covid-19-pushes-microsoft-dell-red-hat-to-virtualize-events/2020/03/
[13]. Mstafa, R. J., & Elleithy, K. M. (2016). A video steganography algorithm based on Kanade-Lucas-Tomasi tracking algorithm and error correcting codes. *Multimedia Tools and Applications, 75*(17), 10311-10333.
[14]. Naudé, W. (2020a). Artificial Intelligence against COVID-19: An early review.
[15]. Naudé, W. (2020b). Artificial intelligence vs COVID-19: limitations, constraints and pitfalls. *Ai & Society*, 1.
[16]. Nguyen, D., Ding, M., Pathirana, P. N., & Seneviratne, A. (2020). Blockchain and AI-based Solutions to Combat Coronavirus (COVID-19)-like Epidemics: A Survey.
[17]. Organization, W. H. (2020a). *Management of ill travellers at points of entry–international airports, seaports and ground crossings–in the context of COVID-19 outbreak: interim guidance, 16 February 2020*. Retrieved from
[18]. Organization, W. H. (2020b). *Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19): interim guidance, 19 March 2020*. Retrieved from
[19]. Priest, P. C., Duncan, A. R., Jennings, L. C., & Baker, M. G. (2011). Thermal image scanning for influenza border screening: results of an airport screening study. *PloS one, 6*(1).
[20]. Sajjad, M., Nasir, M., Muhammad, K., Khan, S., Jan, Z., Sangaiah, A. K., Baik, S. W. (2020). Raspberry Pi assisted face recognition framework for enhanced law-enforcement services in smart cities. *Future Generation Computer Systems, 108*, 995-1007.
[21]. Shaw, R., Kim, Y. K., & Hua, J. (2020). Governance, technology and citizen behavior in pandemic: Lessons from COVID-19 in East Asia. *Progress in Disaster Science*, 100090.
[22]. Shi, J., & Tomasi, C. (1994). *Computer vision and pattern recognition*. Paper presented at the 1994. Proceedings CVPR'94., 1994 IEEE Computer Society Conference on.
[23]. Shi, J., & Tomasi, C. (1994). Good features to track (pp. 593–600). Paper presented at the Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition.
[24]. Times, T. S. (2020). Coronavirus: New AI-driven temperature screening device to save time and manpower. Retrieved from https://www.ihis.com.sg/Latest_News/News_Article/Pages/Coronavirus-New-AI-driven-temperature-screening-device-to-save-time-and-manpower.aspx
[25]. Wang, C. J., Ng, C. Y., & Brook, R. H. (2020). Response to COVID-19 in Taiwan: big data analytics, new technology, and proactive testing. *Jama, 323*(14), 1341-1342.
[26]. Wolfson, J. (2020). Why We Use Thermography Body Heat Thermal Scans. Retrieved from https://thedrswolfson.com/use-thermography-body-heat-thermal-scans/

How to cite this article: Al-Humairi, S. N. S., Zainol, M. H., Razalli, H., Raya, L., Abdullah, M. I. and Daud, R. J. (2020). Conceptual Design: A Novel Covid-19 Smart AI Helmet. *International Journal on Emerging Technologies, 11*(5): 389–396.