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IOT-BASED SMART HELMET FOR COVID-19 DETECTION

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Abstract
Among the pandemics that have shocked the world is COVID-19. The virus, which had its origins in China, quickly spread to many other nations. It was necessary to devise strategies to control the virus's spread. In addition to being time-consuming, the conventional techniques of taking temperatures using thermal handheld gun thermometers also exposed the officers to the same virus. Thus, with the development of smart devices, the Internet of Things has become widely used as a result of technological advancement. The smart helmet proposed in this study is Internet of Things (IoT) enabled. It uses a thermal camera to scan people for high temperatures, an optical camera to identify people, and an alert system to send information and alerts to authorized officers so they can take appropriate action. For example, they would inform the designated person and provide instructions on how to self-manage in accordance with COVID-19 management guidelines, including self-distance, exercise, handwashing, sanitizing, and nutritional requirements. The smart helmet application's technological integration is advantageous for improving patient monitoring and safety protocols. For example, manual testing can be difficult in crowded areas, which is why contactless screening is necessary. Operation and decision-making have been improved by the implications in real-time data analysis, concurrency, HCI, remote monitoring, data security, and interdisciplinary collaboration. After being put to the test, the information will serve as the foundation for cutting-edge study and applications in a variety of fields, including the manufacturing industries. Three steps were involved in the methodology: data input, processing, and output. The Arduino IDE, GSM and Google location applications, thermal and optical cameras for data input, and mobile phone applications are among the materials used. The temperature of eight people was recorded using a simulation at the entrance to a mall. Three of the eight people had fevers, while the other seven had normal temperatures. Healthcare professionals confirmed temperature readings using an additional thermometer.

Keywords: COVID-19 Management, IoT Platform, Smart Helmet, Image Processing

Introduction
The first COVID-19 case was reported in Wuhan, China, in December 2019. Over 200 countries have seen the virus's global spread (Hageman, 2020). Additional coronavirus types include the Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012 and the severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002–2004 (Abeler et al., 2020). The symptoms of the coronavirus for its extremity include mild to moderate cough, fever, sore throat, production of sputum, chills, and headache, and the incubation period is 1–14 days; or critical acute respiratory distress syndrome (ARDS), secondary infection, acute heart injury, and multiple organ dysfunction syndrome (MODS); or severe (shortness of breath) (SOB), myalgia, diarrhea, nasal congestion, and conjunctival congestion (WHO, 2021). Additionally, underlying medical conditions like diabetes, asthma, hypertension, and heart conditions put people over 60 years old at higher risk (Hageman, 2020).

The Covid-19 pandemic has brought about a new normal in the way things are done on a daily basis in offices, businesses, and social settings. The pandemic presented numerous difficulties. Among these difficulties is pressure on healthcare systems to fully accommodate the patients; a high rate of transmission that makes it difficult to establish control and management measures; the closure of businesses during lockdowns reduces economic gain; education is disrupted; families experience increased mental health as a result of losing contact with loved ones due to quarantine and cessation of travel; negative stereotypes surrounding the use of vaccines impede the widespread acceptance of vaccine usage; healthcare personnel experience burnout from emotional and physical exhaustion; and there is a high risk to vulnerable populations due to the escalation of underlying illness (Maison et al., 2021). Early identification and social distancing reduce or eliminate the effects of such difficulties.

Objective

The emergence of COVID-19 has caused fatalities and hampered interpersonal relationships. Because the virus spreads quickly from one person to another, control and management of its spread are therefore necessary. There have been initiatives, like the installation of thermal screening at public and commercial entrances. Unfortunately, this preventive measure takes a lot of time and exposes the screening staff to the same virus. As a result, a more effective method of conducting the screening at an early stage is required. of contamination. In light of this, we present a smart helmet that maintains social distance while automatically detecting the virus.

Related Work

Through early diagnosis, patient monitoring, workplace safety, quarantine monitoring, preventive alerts, contact tracing, smart metering, and fitness, IoT platforms could be used to stop the spread of COVID-19 (Siddiqui et al., 2021). The many IoT application areas for controlling the COVID-19 pandemic's effects are compiled in Figure 1. According to Nasajpour et al. (2020), these include early virus diagnosis, patient symptom monitoring, quarantine monitoring through individual mapping, preventive alerts to advise people against visiting specific areas, contact tracing of infected individuals, smart metering, and improved fitness and lifestyle to boost immunity to fight the virus.Institutions have made extensive use of digital technology platforms like Zoom and Microsoft Teams for social media connectivity with loved ones, education, online work, and meeting sessions (Armitage and Nellums, 2020). According to Siddiqui et al. (2021), the Internet of Things (IoT) provides effective services such as remote health monitoring and automation facilities, which in turn encourage social distancing. IoT platforms, which include wearables and health monitors, can be used to remotely monitor and transmit patient data from their surroundings to clinicians for assessment, diagnosis, and treatment interventions—all without the patient having to physically visit the hospital. This makes face-to-face interactions less likely. Drones for telemedicine that are managed by an Internet of Things framework can be used to transport medical supplies. As stated by Srinivas and colleagues (2022), Robots like Autonomous Delivery Robots (ADRs) are used by IoT platforms to transport goods, including medical supplies, to areas that are inaccessible to people. In order to screen patients for Ebola symptoms at airports during the pandemic, the US government employed non-invasive IRT (Chen et al., 2020).

Fig 1 Application of IoT in Managing Impact of the Covid Pandemic

Contribution

The following are this study's primary contributions:

a. The study backs the smart helmet's use of IoT to manage COVID-19, restricting direct communication between the parties

b. The research demonstrates how various modules can be combined to create a single unit that accomplishes a shared objective

c. It offers the foundation for further research can be used to think about wearing smart helmets on robots to perform domain detection instead of compared to healed

Materials and Methods

The resources and techniques used in the discussion of the smart helmet will be covered in this section. In essence, the framework consists of three segments: the microcontroller processor integrated with the Arduino IDE for coding purposes; the output segment; and the input source, which includes a thermal camera, optical camera, and mobile phone app. The input segment operates the system's initial function. It uses optical and thermal cameras, respectively, to take pictures of people and measure their temperature. The optical camera is equipped with image processing capabilities that enable it to identify a person. After the identity has been established, the information is sent to the microcontroller, which then sends it to the central database and system, where the decision-making authorities are located.

Thermal Camera

An individual's temperature is screened using a thermal camera. This camera takes a picture by detects abnormalities in temperature using infrared (IR) waves. According to Irshad et al. (2018), the maximum normal body temperature is 37°C. Any body temperature above that causes the sensors to produce intense infrared spectra. The front side of the helmet is where the camera is installed.The CrowdTempPro T-500 model, as recommended by this study, has the following features: an uncooled microbolometer sensor, 640 x 480 px resolution, <50 mK sensitivity, 30-45°C temperature measurement range, +-0.3°C accuracy, 1-8 m measurement distance, and 45–35°C field view. The camera should also be able to detect up to 30 people's faces at once using multiple face detection.

Optical Camera

The primary goal of an optical camera is to take a picture of a specific person so that image processing can subsequently be utilized to identify the person. Authorities have a lead in identifying red zones since the camera also records the containment zones. On the front side of the helmet, the camera is installed. The specifications for the optical camera that will be utilized in the suggested study are as follows: 33 mm full-frame CMOS sensor with 30 megapixels of resolution, an ISO range of 100-32000, a DIGIC 8 image processor, 10 frames per second of simultaneous shooting, dual CMOS autofocus, Bluetooth, and Wi-Fi connectivity. The camera should also have an in-camera raw conversion feature.

GSM and GPS

Notifications are sent through a GSM whenever an abnormally high temperature is detected. According to Ahlawat and Krishnamurthi (2022), a GPS uses position coordinates to determine a person's geolocation, and the GSM then notifies the appropriate authorities.

Data Transmission Protocol

Wi-Fi protocols for data transmission will enable data transmission between the devices. As Wi-Fi enables data transfer over long distances, it is most suitable for this kind of technology (Pahlavan and Krishnamurthy, 2020). After a high temperature is detected and an image is taken and processed, the system will use Wi-Fi to send alerts to the appropriate authorities.

Arduino

Libraries, brace matching, syntax highlighting, and multiple file compilation are all included in the Arduino integrated development environment for electronic communication and response (Ahlawat and Krishnamurthi, 2022).

Google Location history

Based on the user's visitation patterns, the system stores their location using their Google location history. An individual's Google account manages this data and keeps track of their movements and regular locations.

Result and Discussion

A series of simulations are run through the design to verify that it is achievable. This is accomplished using a Proteus software model, in which the testing stage is predicated on the logical interims to validate the modules' integration and functionality. Finding errors and determining whether the results satisfy user requirements and established standards are further goals of the testing. To test the system as a whole, however, testing is done on each module independently before integration. The simulation mimics how the actual infrastructure would function. The three distinct flickering lights—red LED for high temperature, yellow for normal temperature, and green for low temperature—are displayed

The prototype was put to the test at the entrance to a mall, where security guards wear helmets and face the incoming crowd. To ascertain the variations in temperature within the crowd, the crowd was scanned.

The eight participants in the simulation provided the following outcomes:

Individual 1: 36.7°C
2nd person: 38.1°C
Person 3: 38.3°C
Individual 4: 37.1°C
Individual 5: 37.0°C
Individual 6: 38.3°C
7th person: 36.5°C
Individual 8: 36.9°C

Conclusion

As a result of the COVID-19 pandemic, nations developed systems for containing and managing the virus's spread. There was no way for this to succeed. without the aid of technology—ideally the Internet of Things. This An IoT-based smart helmet has been employed in research as a gauge. identify and assist in COVID-19 decision-making oversight. The research has assessed the effectiveness of the smart helmet's ability to identify symptoms of high temperatures of COVID-19 infection in a sizable gathering concurrently. The findings make it clear that the The application is quick, easy to use, and accurate. Furthermore, it educes direct patient contact and improves early identification, contact tracing, and lessens the strain on healthcare facilities because of its integrated, remote use technology

Limitations of the Study

- The cost of the sophisticated technology included in the smart helmet may prevent it from being widely adopted.
- Users experience weariness and discomfort as a result of the components' increased weight when using them for extended periods of time.
- The cameras' field of view may be restricted, making it difficult to capture some fine details or every person who needs to be scanned.
- Concerns about privacy and ethics may surface when people agree to have their data scanned and shared.
- The research is constrained to a moving crowd, especially at exit and entry points

- Using materials that are lighter, more flexible, and stretchable, as well as cameras with a wide field of view, data encryption, and creating a framework for ethical and privacy concerns are some possible areas that require improvement (Su et al., 2020).

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