IoT-Based Door Automation and Smart Health Monitoring System

Ruchi Chaurasiya
Department of Computer Science and Engineering
Amrita School of Computing, Bengaluru
Amrita Vishwa Vidyapeetham, India
bl.en.u4cse22278@bl.students.amrita.edu

Shakshi Yadav
Department of Computer Science of Engineering
Amrita School of Computing, Bengaluru
Amrita Vishwa Vidyapeetham, India
bl.en.u4cse22286@bl.students.amrita.edu

Swagata Malik
Department of Computer Science and Engineering
Amrita School of Computing, Bengaluru
Amrita Vishwa Vidyapeetham, India
bl.en.u4cse22252@bl.students.amrita.edu

Meena Belwal
Department of Computer Science and Engineering
Amrita School of Computing, Bengaluru
Amrita Vishwa Vidyapeetham, India
b_meena@blr.amrita.edu

***Abstract*—This project presents the design of an automated access control system that aims to enhance security through the use of an ultrasonic motion sensor and a live heartbeat check. This system makes use of an ultrasonic sensor which detects any motion within a certain radius directing a signal to the controller based on Arduino. The controller is able to communicate with a script written in Python that queries API for the pulse of the user in question. Using these parameters,the system compares the real-time heartbeat of the pulse taken against the thresholds set beforehand.When the parameters exceed the range ,the control unit within the Arduino will trigger the servo to unlock the door. Another scenario the parameters are within range ,the door will remain closed. Such a system is able to increase the control measures in biological information system as it enables people to open the door while maintaining their hands free. The outcome demonstrates that by combining simple hardware components with data processing techniques, a reliable and secure automated access system can be created with minimal manual intervention, improving security while ensuring ease of use.**

***Index Terms*—Arduino, API, Ultrasonic sensor, Python Script**

I. INTRODUCTION

Today's advanced in technology make it easy for the seiner develop coordinate experienced programmed and systems for automated monitoring.The aim of this project is to combined a door with an automated closure function and heart rate measurement capabilities as a means to optimize safety and accessibility. As spaces become more experienced and smarter, the need for strong solutions that enable healthcare delivery and automated decision making has increased. The most common,yet quite important,indicator of a person's physical state is the heart rate. The expansion of these possibilities to access control systems is a new way of increasing security while taking into account the welfare of users.

Access control has always been dependent on physical credentials such as key credentials,RFID as Biometric Scan,implemented in the traditional door automation systems. While these methods work well, there are health factors that tend to be ignored and they could prove to be of great importance in sensitive environments like hospitals, gyms, and workplaces which would benefit from adopting health monitoring. However, devices for heart rate monitoring typically operate independently of access control or automation systems, acting only as devices for health data collection. This project combines these two areas by creating a system that uses heart rates to automatically make access control decisions.

The system as designed provides an opportunity of detection as it employs a heart rate sensor which monitors the pulse of the user with the hope of determining if his or her heart rate is within acceptable limits and if it is not. A micro controller then,makes sense of this information and adjust the position of the servo motor. The movement can either be unlocking or locking the door. Where the heart rate is found to be outside the set limits,provision that allows access is off effectively providing a health minded security system. With this blend of technologies , the system is able to be quick, accurate, and user friendly-all drawbacks of existing such systems which choose to implement either automation or health monitoring.

The heart rate-based door automation system introduces a new dimension to access control by integrating health monitoring as a key feature. Such a system has wide-ranging applications, particularly in environments where health and security are equally critical. The innovation lies in its ability to evaluate both security and health-related parameters in real-time, providing an efficient, practical, and user-friendly solution. By addressing gaps in existing systems, this project sets the foundation for future advancements in intelligent automation and health-conscious technology integration.

Section II of this paper reviews similar studies and methods used for this workplaces and it helps to setting up the background for our work. Section III explains the steps used to build the system. Section IV explains the implementation details. Section V explains the result and their analysis parts. Section VI concludes the paper with key findings and potential future improvements.

II. Literature Survey

Akshay Duth et al. [1] set the stage for the paper by outlining the challenges posed by COVID-19 and introducing the smart door system as a potential solution to enhance safety and hygiene in public areas. Yusi Cheng et al. [2] proposed advocates for a smart lighting system based on the use of LED and wireless sensor technology to optimize usage with client comfort through digital control dependent on the presence of the dwellers and available sunshine. C.lasya et al. [3] presented a vision of a experienced home automation system that leveraged modern technology to improve the quality of life for users by automating everyday tasks and enhancing home security. Shih-Chin LO et al. [4] proposed a smart lighting system known as "Light speaks to light (L2L)." This system was designed to prevent adverse effects of smartphone use in bed by offering the compatibility of display screen and ambient light.

V. Baby Shalini [5] had demonstrated the viability of a healthcare monitoring system based on IoT technology that offered continuous quiet watching along with timely alarms to the care providers. Ananth S et al. [6] contemplated the continuous monitoring of patients' health through wearable devices such as smartwatches, mounting various sensors to communicate with the cloud for analysis and sending alarm requirements. Mrunal Fatangare et al. [7] focused monitor essential signs and health-related information, facilitating early detection of possible well being issues and preventive interventions. Shou Tian et al. [8] discussed the shift from traditional medication to smart healthcare, fueled by advancements in technology and a shift towards patient-centered care.

Sakshi Sahu et al. [9] discussed the importance of computerization in daily life and its role in increasing efficiency through smart domestic frameworks that incorporate IoT technology. Rathina Raj et al. [10] presented a model utilizing the Constrained Application Protocol (CoAP) to monitor and control physical parameters in IoT-based systems. Logeshwaran M. et al. [11] automated the process of temperature checking and hand sanitization to prevent the spread of COVID-19, reducing the risk of cross-infection and providing an efficient way to monitor body temperature. Mohammad Asyraf et al. [12] implemented a pneumatic door automation system for access control in smart homes, using a PIC 16F877A micro-controller and a pneumatic actuator based on a double acting cylinder.

C. Pathania et al. [13] introduced an Arduino-based heat sensing and visitor alert system which was developed mainly to mitigate difficulties brought about by the COVID-19 pandemic. Poorani R et al. [14] proposed temperature observing with door system using Arduino, it detected the human's temperature and face mask. It prevented the increase of Covid-19. V. Venkataramanan et al. [15] proposed a door opening system that uses a PIR sensor, MLX90614 temperature sensor, and servo motor to detect human presence, measure temperature, and open the door if the temperature is within a specified range. Alfred Antonius et al. [16] presented the design of an automatic door lock system using a micro-controller called ESP32, which could be controlled via a smartphone, providing a practical solution for home security.

Suhashini Awadhesh Chaurasia et al. [17] discussed various projects and research papers focused on developing innovative solutions using Arduino micro-controllers, sensors, and other technologies to address real-world problems. Nusrat Jahan Farin et al. [18] conceived an idea of using intelligent self-controlled Micro-controller Unit (MCU) based heart monitoring system for track of disabled peoples and heart patients through real-time heart rate detection. Dr. S. M. Mowade et al. [19] explored an automatic door control system with a human body temperature sensor to prevent the spread out of covid-19 and it decreased the physical touch it helped to overcome the disease. B Varshini et al. [20] created a smart door which with detected the face mask and used a machine learning model. This can be used for entry positions in various mall, hotels and public places.

However, existing works often fail to integrate health metrics, like heart rate with access control systems. While systems utilizing traditional methods like RFID, temperature checks, and face recognition are effective in ensuring safety, they neglect user health status, particularly in sensitive environments like hospitals and gyms. Additionally, health monitoring devices are typically separate from automation systems and don't influence access control decisions. This research aims to bridge this gap by combining heart rate monitoring with automated door control, creating a more personalized, real-time, and health-conscious security system that adapts to individual health conditions, offering an innovative solution for environments where both security and health are critical.

III. Methodology

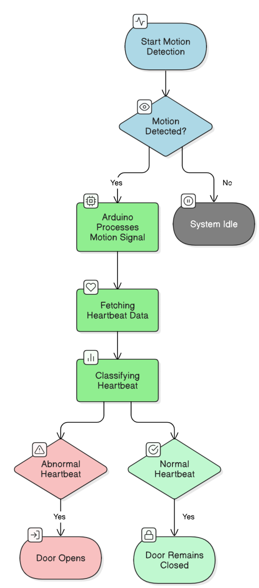

Fig. 1. Frame Work of Proposed Work Door Automation and Smart Health Monitoring System

Fig. 1. explains the development of this automated access control system following a structured methodology that outlines the operational sequence of a system to monitor motion and responds accordingly. Upon detecting motion, the system processes the signal and then acquires and classifies heartbeat data. If the heartbeat is classified as abnormal, the system triggers a door to open; otherwise, the door remains closed. In the absence of motion, the system transitions to an idle state, awaiting further motion detection events. This system effectively integrates motion detection with heartbeat classification to execute a specific action based on the health status inferred from the heartbeat.

A. System Overview

The system revolves around the integration of hardware components and software programming to develop an automated access control system that opens and closes a door based on motion detection and real-time heartbeat data.

1) System Design: First, the system requirements as well as the objectives of the project were defined, and suitable hardware elements were selected. The architecture was elaborated with a view to allow the operation of the system where an Arduino is controlled with a Python script which retrieves and controls a heartbeat and a door device respectively.

The design choices included:

Using Arduino as the core controller: The purpose for its selection was to oversee the process of motion detection and also to control a servo motor which in turn operates the door device.

Utilising Python as a software to retrieve heartbeat data at the cloud based level: The designed python script was able to interact with the graphical user interface computerized system known as the Googie sheets interface feeding consistence between the commands used to decide whether to grant access to the door or not Embedded in the shape of voice control.

Having mounted the hardware components, attention was now turned on to the software aspects of the system. This phase included:

The process of programming the Arduino: In these pages, the Arduino code was indeed written which facilitated performing various roles such as handling the ultrasonic sensor meant for motion detection, controlling the servo motor to rotate clockwise or anticlockwise for opening and closing of the door respectively and enabling the course for serial communication with the Python script.

The script allows connecting with the Google sheets API to download the heartbeat information stored online and send this data to Arduino boards using serial communication. This would ensure that the door mechanism works according to the data retrieved.

2) System Integration: In this phase, both the hardware and software were integrated. The ultrasonic sensor and servo motor were connected to the Arduino, and the Python script was tested with the Arduino to ensure that communication was functioning correctly.

B. Motion Detection

Motion detection is carried out using an ultrasonic sensor, which measures the distance between the sensor and an object. The sensor sounds off ultrasonic through and then bounces back the sound waves. The time taken for the sound waves to return is utilized to calculate the distance. If the distance is less than a pre-defined threshold (presence of a person or object near the door), it triggers the next events in the system.

- This ultrasonic sensor can trigger a pulse and measure the time taken by its reflection.
- This data is then read by the Arduino in order to confirm a distance less than threshold indicating motion.

C. Heartbeat Data Fetching

An Arduino, on detecting motion, sends a signal saying, ”motion detected, to the Python script. In turn, that Python script tries to get the latest heartbeat from the remote server through an API. The heartbeat data, however, comes wrapped in a JSON object.

- An API endpoint should return a JSON object with a heartbeat value.
- Then, the Python script fetches this from the API and parses it for further processing using HTTP requests.

D. Servo Motor Control Based on Heartbeat

The Python script receives heartbeat data and then the Arduino checks if the heartbeat value is in borderline level between safe range. It does the control through a servo motor which is connected to the door as follows:

- If the heartbeat is above 100 or below 60, it is read as emergency and the door gets opened automatically.
- The door remains closed if heartbeat falls within normal range.

Based on the calculated decision, moving between two states: 90 degrees (open) and 0 degrees (closed), servo motor is responsible for physically opening and closing of the door

E. System Workflow

1) The ultrasonic sensor continuously measures the distance.
2) If motion is detected, the Arduino signals the Python script to fetch the latest heartbeat data.
3) The Python script fetches the heartbeat and sends it back to the Arduino.
4) Based on the received heartbeat value, the Arduino opens or closes the door using the servo motor.

IV. Implementation

The implementation phase of the automated access control system follows a clear path that integrates both hardware components and software programming. The system makes use of an Arduino Uno, an ultrasonic sensor, a servo motor, and a Python script to fetch and process heartbeat data. Below is the step-by-step explanation of how the system was implemented.

A. Hardware Setup

The ultrasonic sensor was wired to the Arduino, with the trigger and echo pins connected to the respective input/output pins on the Arduino. The sensor was tested to ensure it could detect distances accurately and reliably. The servo motor was connected to Pin 7 of the Arduino and tested to make sure it could open and close within the desired range of motion.

Fig. 2. elaborates the hardware components and connection of the proposed system.

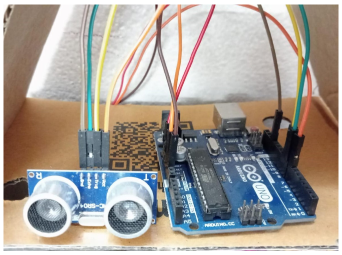

Fig. 2. Hardware Setup of Door Automation and health Monitoring System

Fig. 3. Whole setup of Door automation and health monitoring system

Fig. 3. further elaborates the model for complete door automation using ultrasonic sensor and servo motor.

1) Ultrasonic Sensor Setup: The ultrasonic sensor (HC-SR04) is responsible for detecting motion. It has two primary pins: the Trigger Pin (to send the pulse) and the Echo Pin (to measure the returned pulse). The sensor is connected to the Arduino via digital pins:

- Trigger Pin connected to pin 9
- Echo Pin connected to pin 8

The sensor operates by emitting a pulse and calculating the time it takes for the pulse to return after reflecting off nearby objects.

2) Servo Motor Setup: The servo motor is used to physically open and close the door. It is connected to pin 7 of the Arduino and is programmed to rotate between two positions:

- Open: 90 degrees
- Closed: 0 degrees

The servo motor's position is controlled through PWM signals generated by the Arduino board.

3) Arduino Board Setup:: The Arduino Uno is the central microcontroller that manages the sensor readings and motor control. It is programmed using the Arduino IDE to handle the following:

- Measure distance using the ultrasonic sensor
- Send motion detection signals to the Python script
- Control the servo motor based on the heartbeat data

B. Software Development

The software implementation consists of two parts: the Arduino code and the Python script. Each of these works together to manage the hardware components and achieve the desired functionality.

1) Arduino Code:: The Arduino code is responsible for the following tasks:

- Motion Detection: It continuously measures the distance using the ultrasonic sensor. If the distance is below the threshold (indicating motion), it sends a "motion detected" message to the Python script.
- Heartbeat Processing: Upon receiving a heartbeat value from the Python script, the Arduino decides whether to open or close the door based on the specified heartbeat thresholds.
- Servo Control: Based on the decision, the servo motor is moved either to the open or closed position to physically control the door.

The Arduino code is structured as a continuous loop that keeps measuring distance and responding to the heartbeat data.

2) Python Script: The Python script serves as the intermediary between the Arduino and the external API that provides the heartbeat data. The script performs the following tasks:

- API Request:When motion is detected, the Python script sends an HTTP request to the API to fetch the latest heartbeat data.
- Serial Communication: Once the heartbeat data is fetched, the script sends the value to the Arduino over serial communication for further processing.
- Continuous Monitoring: The script continuously checks for motion detection signals from the Arduino and ensures the real-time heartbeat data is sent when required.

The Python script uses the requests library to interact with the API and the serial library to communicate with the Arduino.

C. System Workflow

The system runs in a cycle where the ultrasonic sensor is triggered first. Stressing on movement, the system grabs the most recent heartbeat information from the API, sending it to the Arduino. After this, the Arduino determines whether the heartbeat level is normal and accordingly decides whether the servo motor should turn the door open or closed.

1) The ultrasonic sensor detects motion and notifies the Arduino.
2) The Arduino requests the heartbeat value from the Python script.

3) The Python script fetches the heartbeat data from the API and sends it to the Arduino.
4) The Arduino processes the heartbeat and controls the servo motor accordingly.

D. Testing and Debugging

Several tests were conducted to ensure the system functions as expected:

- Motion Detection Test: The ultrasonic sensor correctly detects motion within the specified distance threshold.
- Heartbeat Test: The Python script successfully fetches heartbeat data from the API and sends it to the Arduino.
- Test for Servo Motor It operates the servo motor without a hitch and easily opens and closes the door following Arduino commands. The system is wholly functional and can descry stir, collect twinkle data, and autonomously manage the door.

A servo motor test indicates that a servo motor will operate easily, opening and closing a door according to its commands. The system is completely functional, able of detecting stir, costing twinkle data, and controlling a door autonomously.

V. Result & Analysis

The automated access control system was successfully implemented, demonstrating the desired functionality. Below are the key results observed during the testing phase:

A. Motion Detection

The ultrasonic sensor accurately detected motion within the set threshold. When an object or person came within 9 cm of the sensor, it triggered the system to take further action.

Threshold Sensitivity: The system responded to any object placed within the 9 cm threshold, ensuring reliable motion detection. Accuracy: The sensor effectively detected motion in real-time, with minimal delay.

B. Heartbeat Data Retrieval

The system fetched heartbeat data from the API correctly each time motion was detected. The Python script communicated with the API, processed the response, and transmitted the heartbeat value to the Arduino.

```
motion_detected
Motion detected! Fetching heartbeat data...
Heartbeat value fetched: 75
Received Heartbeat: 75

Heartbeat is normal. door remains closed.

motion_detected
Motion detected! Fetching heartbeat data...
Heartbeat value fetched: 50
Received Heartbeat: 50

Heartbeat is abnormal . Opening door.

motion_detected
Motion detected! Fetching heartbeat data...
Heartbeat value fetched: 195
Received Heartbeat: 195

Heartbeat is abnormal . Opening door.

motion_detected
Motion detected! Fetching heartbeat data...
Heartbeat value fetched: 80
Received Heartbeat: 80

Heartbeat is normal. door remains closed.
```

Fig. 4. Output of Motion detection and heartbeat-based door automation system

As shown in Figure 4, the system detects motion and fetches heartbeat data. If the heartbeat is abnormal, the door opens.

- API Response: Heartbeat data was fetched with minimal delay, allowing the system to react quickly.
- Data Consistency: The heartbeat values retrieved from the API were consistent and accurate.

C. Door Automation

This section evaluated the effectiveness of the door automation system under two distinct scenarios based on health parameters derived from the heartbeat sensors:

Case 1 : Health Parameter Within Threshold (Door remains Closed)

```
motion_detected
Motion detected! Fetching heartbeat data...
Heartbeat value fetched: 80
Received Heartbeat: 80

Heartbeat is normal. door remains closed.
```

Fig. 5. Heartbeat within normal range (80 bpm). Door remains closed

As shown in Figure 5, the system detects motion, fetches the heartbeat data, and determines that the heartbeat is normal, so the door remains closed.

Fig. 6. Door Closed: System keeps door closed as heartbeat is normal

As shown in Figure 6, the system demonstrates the door remaining closed when a normal heartbeat is detected.

Case 2 : Health Parameter exceeds Threshold (Door opened)

```
motion_detected
Motion detected! Fetching heartbeat data...
Heartbeat value fetched: 175
Received Heartbeat: 175

Heartbeat is abnormal . Opening door.
```

Fig. 7. Heartbeat abnormal (175 bpm). Door opening

As shown in Figure 7, the system detects motion, fetches the heartbeat data, and determines that the heartbeat is abnormal, so the door opened automatically.

Fig. 8. Door Opened: Automated system activated by motion and heartbeat detection

As shown in Figure 8, a practical implementation of the system demonstrates the door opened automatically when an abnormal heartbeat is detected.

D. System Performance

The system demonstrated consistent reliability during testing. Communication between the Arduino micro controller and the Python script functioned seamlessly, with no data loss or transmission errors observed.

- Data Communication: The interaction between the Arduino and the Python script was flawless, enabling accurate and real-time data exchange.
- Servomotor function: The servo motor responded as designed, efficiently opening and closing the door based on the processed heartbeat data.

E. Comparison Summary Table

TABLE I
COMPARISON SUMMARY OF KEY TEST RESULTS

Test Case	Heartbeat Status	Door Status
Motion Detection	Object detected within 9 cm	Activated system to process heartbeat data
Heartbeat Retrieval	Normal (80 bpm)	Door remains closed
Heartbeat Retrieval	Abnormal (175 bpm)	Door opens automatically
System Performance	Seamless communication and processing	System functions reliably with no errors

Table I summarizes the key test results for the automated access control system. It demonstrates the system's functionality across various test cases, starting with motion detection, where the system accurately detected objects within a 9 cm range and triggered the processing of heartbeat data. When a normal heartbeat (80 bpm) was retrieved, the door remained closed, indicating the system's ability to distinguish between normal and abnormal conditions. On the other hand, if an abnormal heartbeat (175 bpm) was detected, the door automatically opened, showing the system's ability to respond to health-based parameters. Finally, the system performed reliably, with seamless communication between the Arduino microcontroller and the Python script, ensuring smooth operation of the door automation with no errors during testing.

Overall, The system successfully detected motion, retrieved heartbeat information, and controlled the door mechanism according to predefined thresholds. In general, the system proved to be robust, efficient, and capable of achieving its intended objectives with high reliability.

VI. CONCLUSION

This paper presents an innovative access control system that includes an ultrasonic sensor for motion detection and an inbuilt heart beat check. Real-time data processing and application of health based parameters is possible through the integration of the Arduino technology, python programming and APIs, ensuring appropriate restriction of access. Access control is made faster by opening or closing doors based on movement detection and heartbeat without a lot of manual efforts. Basic hardware components can effectively be used together with intelligent software to provide strong and effective security systems as demonstrated in this work. While the system functions effectively in controlled environments, scalability and adaptability to larger, more complex settings remain a challenge. For instance, extending the system to larger environments with multiple entry points requires robust network infrastructure and efficient data handling to prevent delays and ensure seamless integration. The system's reliance on heartbeat monitoring could also be impacted by inaccuracies or environmental factors, requiring further validation and calibration to ensure reliable access control decisions. Looking forward, there are numerous opportunities for enhancing the system. The integration of biometric sensors, such as fingerprint or facial recognition, would significantly enhance security and reduce the potential for unauthorized access. Additionally, the ability to operate the system remotely and store data in the cloud opens the door for greater flexibility and scalability, enabling real-time monitoring and remote management. Such modifications could allow the system to serve a wider range of applications, from smart homes and offices to commercial facilities, where multiple access points are common. These improvements present an exciting opportunity for expanding the reach and functionality of the system, making it more adaptable and secure for diverse use cases.

REFERENCES

[1] A. Duth, A. A. Nambiar, C. B. Teja, and S. Yadav, "Smart door system with covid-19 risk factor evaluation, contactless data acquisition and sanitization," in *2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS)*. IEEE, 2021, pp. 1504–1511.

[2] J. Agarkhed and R. Ankalgi, "Energy efficient smart home monitoring system in wireless sensor network," in *2016 International Conference on Circuit, Power and Computing Technologies (ICCPCT)*. IEEE, 2016, pp. 1–7.

[3] C. Lasya, N. M. Sai, N. G. Reddy, N. M. Reddy, S. Lekshmi, and S. Syama, "Hardware integration of sensors for automating smart homes," in *2022 International Conference on Automation, Computing and Renewable Systems (ICACRS)*. IEEE, 2022, pp. 202–206.

[4] M. E. Morris, *Left to our own devices: Outsmarting smart technology to reclaim our relationships, health, and focus*. Mit Press, 2024.

[5] V. B. Shalini, "Smart health care monitoring system based on internet of things (iot)," in *2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS)*. IEEE, 2021, pp. 1449–1453.

[6] S. Ananth, P. Sathya, and P. M. Mohan, "Smart health monitoring system through iot," in *2019 International Conference on Communication and Signal Processing (ICCSP)*. IEEE, 2019, pp. 0968–0970.

[7] M. Fatangare, H. Ohal, and V. Rathod, "Smart health monitoring system using pulse and temperature sensor (sensor-based health observer)," in *2023 7th International Conference On Computing, Communication, Control And Automation (ICCUBEA)*. IEEE, 2023, pp. 1–5.

[8] S. Tian, W. Yang, J. M. Le Grange, P. Wang, W. Huang, and Z. Ye, "Smart healthcare: making medical care more intelligent," *Global Health Journal*, vol. 3, no. 3, pp. 62–65, 2019.

[9] S. Sahu, R. Singh, P. Arya, and R. Nirala, "Smart home automation lighting system and smart door lock using internet of things," in *2022 4th International Conference on Advances in Computing, Communication Control and Networking (ICAC3N)*. IEEE, 2022, pp. 1320–1325.

[10] V. K. Rathina Raj and M. Belwal, "Design of coap based model for monitoring and controlling physical parameters," in *Ubiquitous Communications and Network Computing: 4th EAI International Conference, UBICNET 2021, Virtual Event, March 2021, Proceedings*. Springer, 2021, pp. 105–115.

[11] M. Logeshwaran and J. J. J. Sheela, "Contactless door system with temperature detection for covid-19," in *2022 4th International Conference on Smart Systems and Inventive Technology (ICSSIT)*. IEEE, 2022, pp. 1269–1274.

[12] M. A. N. B. M. Tamron, Z. S. Attarbashi, M. A. Abuzaraida, N. Atitallah, S. Iftikhar, D. O. D. Handayani, and A. B. B. Basri, "Iot-based heartbeats monitoring system," in *2023 IEEE 9th International Conference on Computing, Engineering and Design (ICCED)*. IEEE, 2023, pp. 1–5.

[13] C. Pathania, J. Vijay, R. Mahalakshmi, and V. Sailaja, "Arduino based touchless temperature sensing visitor notification system," in *2023 International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT)*. IEEE, 2023, pp. 96–100.

[14] A. UNO, "Temperature monitoring and automatic door opening system using," 2022.

[15] V. Venkataramanan, D. Shah, I. Panda, S. Shah, R. Davawala, K. Shah, and K. Salot, "Smart automatic covid door opening system with contactless temperature sensing," *e-Prime-Advances in Electrical Engineering, Electronics and Energy*, vol. 6, p. 100284, 2023.

[16] A. Antonius *et al.*, "Automatic door lock using microcontroller," *International Journal of Application on Sciences, Technology and Engineering*, vol. 1, no. 1, pp. 361–364, 2023.

[17] S. A. Chaurasia, S. A. Chaurasia, G. Kaur, P. Shobhane, P. Agrawal, and D. O. Bhende, "Design of a sensor-based door opening and closing system using arduino for women's safety," in *AI Tools and Applications for Women's Safety*. IGI Global, 2024, pp. 74–90.

[18] N. J. Farin, S. Sharif, and I. Mobin, "An intelligent sensor based system for real time heart rate monitoring (hrm)," 2016.

[19] D. Iskandar, E. W. Nugroho, D. Rahmawati, and I. Rozikin, "Automatic door control system with body temperature sensor," *International Journal of Computer and Information System (IJCIS)*, vol. 2, no. 4, pp. 131–134, 2021.

[20] B. Varshini, H. Yogesh, S. D. Pasha, M. Suhail, V. Madhumitha, and A. Sasi, "Iot-enabled smart doors for monitoring body temperature and face mask detection," *Global Transitions Proceedings*, vol. 2, no. 2, pp. 246–254, 2021.