

IoT-Based Contactless Temperature Monitoring System with Facial Identification for Automated Healthcare Screening

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Abstract— In modern healthcare environments, preliminary screening procedures such as body temperature measurement are essential but often inefficient when performed manually. Conventional contact-based temperature monitoring requires significant human involvement, consumes time, and makes large-scale data recording and management difficult, particularly in high-traffic medical and public settings. To address these limitations, this paper proposes a contactless temperature monitoring and recording system integrated with face recognition and server-based data management. This work aims to offer automatically measured body temperature without physical contact, identify individuals using facial recognition technology, and securely record the corresponding data on a centralized server through a communication module. This system significantly reduces manual effort, minimizes human error, and enables efficient storage and retrieval of large volumes of visitor and patient data in real time. This proposed model is suited for hospitals, clinics, and public access points where rapid and reliable health screening is critical. The proposed model increases operational efficiency, scalability, and traceability in healthcare screening applications. As future work, the system can be extended with an emergency alert mechanism, such as an automated buzzer or notification system, to immediately flag abnormal temperature readings for prompt medical attention.

Index Terms— IoT, Contactless Temperature Measurement, Facial Recognition, Health Screening, Hospital Automation.

I. INTRODUCTION

Health screening is an important step in checking patient and public safety, body temperature measurement is most widely used preliminary indicator of illness. During global health emergency like COVID-19 pandemic, the need for fast, reliable, and mass temperature screening was strongly highlighted during public health crises. Contact-based screening methods, including hand-held temperature, time consuming and manual record keeping, needs lot of physical involvement and depend on healthcare personnel, it does not work well in crowded places includes hospitals, offices, and colleges. It puts both staff and patients at risk, as close physical interaction can spread infections. The manual screening methods are inefficient, unsafe in crowded environments, and lack real-time data handling, making automated, contactless, and intelligent screening solutions.

To overcome these problems, this work proposes an IoT-based contactless screening system integrated into a robotic platform designed specifically for hospital environments. The robot automatically detects the person approaching near it and measure their body temperature without having a physical contact. This robot also has a facial recognition technology where it identifies the person with their name and the patient id for patients and designation for the staff of the hospital. New patients can register their name by interacting with robot where they give the information like name, reason to visit hospital, the symptoms. Based on symptoms it allocates the doctor they need to meet for the specific illness. It reduces the human involvement at initial screening stage, the robot reduces the infection risk, improves operational efficiency, and standardized patient intake process. All

collected data is secured and transmitted to a centralized server for real time storage and monitoring.

The methodology applied in this work includes an infrared temperature sensor for non-contact temperature measurement, a camera for facial image acquisition, and embedded processing unit to execute face recognition and data handling algorithm. Once a patient is identified, the robot will record the temperature along with personal and clinical inputs such as name, visit purpose and symptoms. Based on this information system will assign the doctor by mapping patient needs to available medical specialists. The robot is further integrated with hospital information system through IoT framework, the hospital information includes the resource of hospital for patient's emergencies and resource allotment the data is updated in backend server managing patient data, appointment routing, access control. This modular design allows the system to function as a standalone screening unit or as part of a fully autonomous hospital robot.

The expected outcome of the proposed robotic system is fast, reliable, and scalable healthcare screening and assistance solution health screening and assistance solution capable of handling large data with minimal human intervention. Apart from temperature screening and identification it also maintains the real time awareness of hospital resource, including bed availability, including bed availability, doctor schedules, ICU capacity, and nurse and staff availability. Using this information, the robot can guide patients through the hospital, reducing waiting time, and smooth patient flow by directing them to appropriate department or doctor. The system enhances tracing feature via automated digital records, supports efficient resource utilization, reducing administrative workload, and

minimizing human error in patient triage and entry management.

This paper is organized as follows. Section I introduces the background and motivation of the study. Section II reviews the related work and highlights existing research gaps. Section III describes the proposed methodology and system architecture adopted in this work. In section IV demonstrates the experimental setup, results, and performance evaluation analysis. This concluding section summarizes the key findings and layout future research directions.

II. LITERATURE REVIEW

Contactless temperature screening systems received attention during COVID-19 pandemic as an effective measure to reduce physical contact to improve public safety. Kumar et al. [2] developed a solar powered kiosk that integrates an Infrared temperature sensor with an automatic hand-sanitizer dispenser to monitor and control disease spread in public spaces. Their system automatically checks the body temperature automatically and decides whether to allow entry by opening or closing a gate, depending on whether the temperature is normal or high which shows that temperature building system can be built with low cost and less human intervention. Similarly, Thoong et al. [3] proposed a system that measure temperature without physical contact for smart campus environment using an MLX90614 IR sensor, RFID identification, and cloud based data storage. Their system uses an infrared temperature sensor, RFID cards to identify people, and cloud storage to store the collected data online.

Beyond temperature sensing alone, multiple studies have explored the integration of thermal measurement with facial recognition for enhances identification and safety. Tsai et al. [4]. presented an integrated system capable of performing masked face recognition along with contactless temperature measurement using convolutional neural networks. Their system achieved a facial recognition accuracy of 94.1% under real world conditions, emphasizing that face recognition can operate efficiently without physical interaction. Boonsong et al. [6] exhibited an IoT based contactless body temperature monitoring system deployed in a hospital ward, highlighting the effectiveness of the Melxis MLX90614 sensor for medical screening application. These studies confirms that combining thermal sensors with computer vision techniques on embedded platforms such as Arduino Uno enables accurate reliable contactless screening systems.

IoT technologies has been widely applied in the sector of healthcare and management. Bollineni et al. [1] rendered a encompassing survey on IoT for next generation smart healthcare, emphasizing the role of interconnected sensors and real time data analytics in improving patient monitoring and clinical decision making. Extending these concepts,

Arun et al. [7] developed an intelligent screening system that combines temperature measurement with additional healthcare indicators, allowing automatic screening in healthcare environment. Furthermore, Devi et al. [8] demonstrated how IoT and machine learning techniques can elevate hospital resource management, including equipment maintenance and staff utilization, leading to reduced operational costs and improved efficiency.

Overall, existing research had successfully addressed specific components such as contactless temperature sensing, facial recognition, and IoT based data logging [1]-[8]. However, most systems focus on isolated functionalities and lack on integration with hospital workflow automation and resource awareness. There is limited work on unified robotic platform that combine contactless temperature screening, facial identification, patient data acquisition, real time hospital resource management within a single intelligent system. The proposed work addresses this gap by integrating these components into a unified IoT-enabled robotic solution for automated healthcare screening and patient guidance.

III. METHODOLOGY

The proposed robotic contactless screening system integrates multiple functional modules to automate patient entry screening, health data collection, and hospital workflow assistance. Figure 1 demonstrated this system architecture consists of sensing, processing, display, and communication units working together to perform contactless operation. Key functional modules include a vicinity detection mechanism to identify patient presence, it uses facial recognition to identify the registered patients and staff members and registration is required for new comer where it as the details like name, purpose for visit and symptoms. The system measures the body temperature without touching using IR temperature sensor, it gives feedback on screen and sound as message or alert. The system shows whether the person is recognized, their temperature result, and whether they are allowed to check in or need attention. It helps in managing patient details, assigns the correct hospital department, and checks availability of hospital resources. This helps guide patients smoothly to the right location inside the hospital. On the software side, the system uses deep learning models and IoT communication protocols to enable intelligent and autonomous decision making. Facial recognition is implemented using a Convolutional Neural Network (CNN), which captures the patients image during their first visit and stores the encoded facial features in the hospital database. During subsequent visits, the system will compare the live facial input with the stored embedding to accurately recognize and retrieving their previous medical id and report. The contactless temperature monitoring module is implemented using an infrared temperature sensor (MLX90614) interfaced with robot's microcontroller. The

sensor measures body temperature without physical contact when a person approaches the robot. The obtained data is processed locally to determine abnormal temperature and wirelessly transmitted data to dashboard of the robot, where it is automatically updated in the patient’s record. This approach ensures hygienic, real time, and efficient temperature screening. The software uses programmed rules to imitate how real sensors and face recognition systems work. The results are immediately put across to the patient via visualization and auditory feedback. The processed data is transferred through a wireless communication interface, mimicking Internet of Things (IoT) connectivity simultaneously. This enables real time data to transfer to a hospital server or cloud platform, supporting digital data storage, monitoring, and analytics. The integration of screening results with hospital workflow logic allows the system to assist in assigning appropriate medical personnel and checking availability of hospital resources such as beds, ICU units, and staff. To validate the proposed methodology prior to physical deployment, a complete software simulation was developed using the Tinkercad virtual prototyping platform. The simulation presents logical behaviour of the robotic screening system and replicates real-world interactions using buttons, LEDs, a buzzer, and a display module. While the actual system would rely on camera-based facial recognition and infrared temperature sensing, the simulation substitutes these functions and the inputs are carefully chosen so that the system can still make correct decision. The Tinkercad-based validation confirms that contactless screening, identity association, IoT-enabled data communication, and hospital resource coordination can be effectively integrated into a single automated robotic platform, ensuring reduced human involvement, improved operational efficiency, and enhanced safety in healthcare environments.

Table. 1 shows this model is first initialized by activating all essential components, including sensors, motors, and alert devices, and setting the system to an idle state. This robot system then waits for a start command to begin operation. Once it activated then continuously monitors the surrounding environment to detect the presence of a person or any obstacles. Face recognition is simulated, and the identified face is associated with the current session when a person is detected. This system measures the distance to nearby objects to identify obstacles, If an obstacle is detected within a predefined threshold distance, the robot stops, moves backward, and changes its direction to avoid collision, it continues moving forward. Throughout the operation, visual or audio feedback is provided to indicate face detection and system status. This process is continuously while the system remains active, and all operations are safely terminated when a stop command is issued.

Table 1: Classification of Proposed model

Label	Components	Description
1	Arduino Uno	Main microcontroller used for control logical execution and peripheral interface.
2	Ultrasonic Sensor (HC-Sr04)	Detects human presence using ultrasonic distance measurement.
3	Push buttons	Stimulate face recognition, temperature detection and switching on/off the robot.
4	DC Motors	Enabling robotic locomotion.
5	Motor Driver(L293D)	Provides bidirectional motor control and current amplification.
6	Servo Motor	Controlled mechanical movements
7	Buzzer	Generates audible alerts for abnormal conditions.
8	LED	Visual status indicator
9	Resistors	Ensure current limiting and circuit protection.
10	Jumper wires	Provide electrical interconnections.

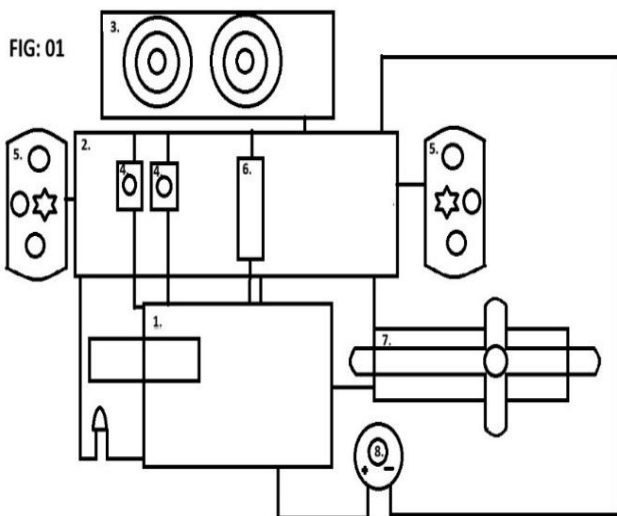


Figure 1. Diagram of Proposed model.

IV. EXPECTED OUTCOMES

Fig. 2 shows the proposed robotic contactless screening system is expected to perform automated patient detection, identity association, and navigation with minimal human intervention. When a person approaches the robot, the system should detect presence and begin the screening workflow automatically. Facial recognition is expected to identify the detected individual with a stored identity, allowing accurate record creation and traceability. Table. 2 demonstrated this system is expected to move autonomously while

continuously monitoring its surroundings to avoid obstacles. When the robot detects the obstacle in a distance it stops to avoid collision. It performs obstacle avoidance function life turning left, right moving forward, backward without any human intervention. The system uses light and sound to inform user about the events like face recognized, input is taken, temperature is detected. Additionally, the system is expected to demonstrate smooth integration between sensing, control, and alert mechanisms. The overall response time from detection to feedback is expected to be low, ensuring real-time operation suitable for hospital environments. This model expected outcome includes improved screening efficiency, reduced human involvement, and safer patient-robot interaction.



Figure 2. Performance analysis of proposed model

Table 2: Comparison summary table

Ref	Existing Work	Gap/Limitation	Contribution of the Proposed System
[1]	Survey on IoT based smart healthcare	No real time implementation or robotic screening	Implementation of practical robot screening system and validated through simulation.
[2]	Solar powered temperature and sanitizer kiosk	No identity tracking; limited to temperature and sanitizer control	Introduces facial recognition, patient data association and hospital workflow.
[3]	IoT based campus temperature screening	RFID dependency and cloud upload latency	Enables fully contactless face recognition with edge processing
[4]	Masked face recognition with temperature sensing	Accuracy affected by lighting and occlusion	Designed for controlled hospital environments to ensure stable recognition
[5]	IoT based temperature data collection	No Decision-making mechanism	Adds identity association, and patient guidance
[6]	Hospital ward temperature monitoring	No link between patient identity and temperature	Links identity with screening results and hospital assistance logic
[7]	Multi parameter health screening	No hospital resource allocation.	Includes resource allocation and staff availability support
[8]	IoT based hospital resource management	Focused on maintenance, not entry screening	Combines both entry screening and resource allocation
[9]	ML based COVID-19 screening	High computational and cloud dependency	Uses light weight edge processing for real time screening and monitoring
[10]	Automated screening and contact tracing	No robotic mobility or patient interaction	Allows robotic navigation and autonomous patient screening
[11]	IoT based temperature measurement	No identity recognition	Includes facial recognition for monitoring and traceability
[12]	Smart hospital monitoring using IoT ML	Focused on monitoring, no pre entry screening	Provide automated entry level screening
[13]	IoT based healthcare monitoring	It continuously monitors not entry screening	Extends functionality to active pre-access screening
[14]	Healthcare systems	Limited automation and patient interaction	Enhances automation through robotic guidance and patient interaction.

V. CONCLUSION

The proposed IoT-based contactless screening system demonstrate a successful combination of automated temperature measurement, facial identification, and centralized data storage to improve of entry level screening in hospital or healthcare environment. It reduces the need for physical contact and reducing dependence on manual checks, it helps to reduce the risk of infection transmission and ensures a safer experience for both patients and healthcare staff. The system improves operational efficiency, accountability, traceability, allowing hospitals to maintain accurate health records and reports. The integration of IoT connectivity allows real time data transfer and monitoring, making the system suitable for high traffic area such as hospital entrances and outpatient departments. In addition, the use of affordable and widely available hardware components make this proposed solution cost effective and practical for deployment in resource constrained healthcare setting. Overall, the proposed model provides reliable, scalable and efficient solution for automation in health screening.

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