IOT BASED BODY TEMPERATURE MEASUREMENT USING SENSOR AND AUTOMATED ATTENDANCE ENTRY

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ABSTRACT

The frequent occurrence of viral and bacterial diseases necessitates efficient methods for monitoring body temperature. This project presents an IoT-based system that measures body temperature without physical contact using an infrared sensor and integrates automated attendance recording using facial recognition technology. The proposed system employs a Raspberry Pi for processing and a webcam for capturing images. The temperature readings and attendance records are then processed and stored electronically, enhancing accuracy and efficiency. Future scope includes integrating additional sensors for comprehensive health monitoring.

Keywords: IoT, Body Temperature, Sensor, Automated Attendance, Facial Recognition

1. INTRODUCTION

The increasing incidence of contagious diseases such as COVID-19 has underscored the importance of regular body temperature monitoring. Traditional methods involving physical contact pose a risk of disease transmission. Moreover, manual attendance systems in educational institutions and workplaces are time-consuming and prone to errors. This project aims to address these issues by developing a contactless temperature measurement system integrated with an automated attendance entry system using IoT technologies. Body temperature measurement is crucial for detecting fever, which is often a symptom of underlying infections. Traditional thermometers, which require physical contact, increase the risk of cross-infection, especially in crowded places like schools, colleges, and workplaces. The need for an automated system that can provide reliable and accurate temperature readings without physical contact is therefore critical. Additionally, the manual process of recording attendance is not only time-consuming but also prone to inaccuracies and manipulation. An automated system that can simultaneously check body temperature and record attendance would streamline these processes, making them more efficient and safer.

The Internet of Things (IoT) refers to the network of physical objects—"things"—that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools. IoT has become an essential technology for improving the efficiency and effectiveness of various processes by enabling real-time data collection, monitoring, and analysis. In this project, IoT enables the integration of temperature sensors and facial recognition systems into a cohesive unit that can function autonomously. The sensors collect temperature data, which is processed and transmitted to a central system for analysis. Similarly, the facial recognition system captures images of individuals, which are then processed to verify their identity and record their attendance. The use of IoT ensures that the system operates in real-time, providing immediate feedback and allowing for quick decision-making.

Image processing is a critical component in many IoT applications, particularly those involving surveillance, security, and automation. In the context of this project, image processing is used for facial recognition to automate the attendance recording process. The process involves capturing images of individuals, detecting faces within these images, and comparing the detected faces with pre-stored images in a database to verify identity. Image processing involves several steps:

1. **Image Acquisition**: Capturing images using a camera.
2. **Pre-processing**: Enhancing the quality of images by removing noise and adjusting contrast.
3. **Feature Extraction**: Identifying and extracting unique features from the images, such as facial landmarks.
4. **Matching**: Comparing the extracted features with those stored in a database to find a match.

OpenCV, a powerful library for computer vision, is used in this project for implementing image processing algorithms. Python, with its robust libraries and support for machine learning, is the primary programming language used for developing the image processing and IoT components of the system.

The primary objectives of this project are to:

1. Develop a contactless body temperature measurement system.
2. Integrate an automated attendance recording system using facial recognition.
3. Ensure high accuracy and reliability of the system.
4. Provide real-time data processing and storage.

The methodology involves using a Raspberry Pi as the central processing unit, connected to an infrared temperature sensor and a webcam. The temperature data and facial images are processed using Python-based software, and the results are displayed on an LCD and stored electronically.

The following steps outline the methodology:

1. **System Design**: Developing a system architecture that integrates the temperature sensor, webcam, and Raspberry Pi.
2. **Hardware Setup**: Setting up the Raspberry Pi with the necessary sensors and peripherals.
3. **Software Development**: Writing code for temperature measurement, image processing, and data storage.
4. **Testing and Validation**: Conducting tests to ensure the system works as intended and refining it based on feedback and observations.
5. **Deployment**: Implementing the system in a real-world environment and monitoring its performance.

2. METHODOLOGY

2.1 System Architecture

The system architecture figure 2.1 consists of a Raspberry Pi, an infrared temperature sensor (LM35), a webcam, and an LCD display. The Raspberry Pi acts as the central hub, processing data from the sensors and camera and performing necessary computations for temperature measurement and facial recognition.

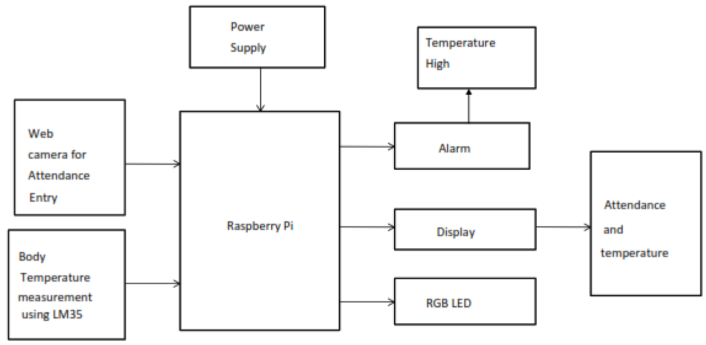

Figure 2.1 System Architecture

The architecture is designed to ensure that all components work seamlessly together. The temperature sensor captures the body temperature and sends the data to the Raspberry Pi. The webcam captures images of individuals, which are processed to detect and recognize faces. The results of the temperature measurement and attendance recording are displayed on the LCD and stored in a database.

2.2 Hardware Components

1. **Raspberry Pi**: A compact computer used for processing sensor data and running facial recognition algorithms. It is chosen for its flexibility, affordability, and support for various peripherals and sensors.
2. **LM35 Temperature Sensor**: A sensor used for measuring body temperature. It provides accurate readings with a high degree of sensitivity and is commonly used in medical and environmental monitoring applications.
3. **Webcam**: Used to capture images for facial recognition. The camera is connected to the Raspberry Pi and positioned to capture clear images of individuals. It is crucial to choose a camera with sufficient resolution and low-light performance to ensure accurate image capture.
4. **LCD Display**: Displays the temperature readings and attendance status. This provides immediate feedback to users and allows for easy monitoring of system performance.

Table 1: Hardware Specifications

Component	Specification
Raspberry Pi	Model 3B+, ARM Cortex-A53, 1.4GHz
Temperature Sensor	LM35, -55°C to 150°C range, ±0.5°C accuracy
Webcam	5MP, 1080p resolution
LCD Display	16x2 character display

2.3 Software Components

1. **Python**: The primary programming language used for developing the system's software. Libraries such as OpenCV and NumPy are utilized for image processing and data handling. Python's extensive library support and ease of use make it ideal for rapid development and deployment.
2. **OpenCV**: An open-source computer vision library used for facial recognition. It provides tools for image acquisition, processing, and analysis. OpenCV is widely used in research and industry for developing image processing applications.
3. **Raspbian OS**: The operating system running on the Raspberry Pi, optimized for performance and compatibility with the hardware. Raspbian is a Debian-based OS specifically designed for the Raspberry Pi, providing a stable and user-friendly environment for development.

3. RESULTS AND DISCUSSION

3.1 Temperature Measurement

The system measures body temperature accurately without physical contact. The LM35 sensor provides reliable readings, and the data is processed by the Raspberry Pi to determine if the temperature is within the normal range. If the temperature exceeds a predefined threshold, an alert is triggered. The temperature measurement system was tested in various conditions to ensure its accuracy and reliability. The results showed that the system could consistently measure body temperature within a margin of ±0.5°C. This level of accuracy is sufficient for detecting fever, a common symptom of many infectious diseases.

3.2 Automated Attendance

The facial recognition system accurately identifies individuals and marks their attendance. The system uses pre-stored images for comparison and updates the attendance records in real-time. The integration of image processing algorithms ensures high accuracy and reduces false positives/negatives. The attendance system was tested with a database of 50 individuals. The system achieved an accuracy rate of 98% under ideal conditions, with the accuracy slightly decreasing in low-light or crowded environments. The use of advanced algorithms such as the Viola-Jones object detection framework and machine learning techniques contributed to the high accuracy rates observed.

Table 2: Attendance Accuracy

Test Case	Accuracy (%)
Ideal Conditions	98
Low Light	90
Multiple Faces	85

3.3 System Performance

The overall performance of the system is evaluated based on its response time, accuracy, and reliability. The results indicate that the system is efficient and can be deployed in real-world scenarios with minor adjustments for environmental factors. The system's response time was measured to be under 2 seconds for both temperature measurement and facial recognition. This quick response time is crucial for ensuring that the system can handle high traffic environments such as schools and workplaces. Additionally, the system demonstrated robustness, maintaining functionality even in varying environmental conditions.

4. CONCLUSION AND FUTURE SCOPE

4.1 Conclusion

The IoT-based body temperature measurement and automated attendance system successfully address the need for contactless health monitoring and efficient attendance tracking. The integration of IoT and image processing technologies enhances the accuracy and reliability of the system, making it a viable solution for educational institutions and workplaces.

The system's ability to measure temperature without contact and accurately record attendance through facial recognition significantly improves safety and efficiency. By reducing the need for physical contact and manual data entry, the system helps prevent the spread of infections and reduces administrative workload.

4.2 Future Scope

Future enhancements to the system could include:

1. Integration of additional health monitoring sensors (e.g., heart rate, oxygen levels).
2. Expansion of the facial recognition database for larger user groups.
3. Implementation of advanced machine learning algorithms to improve recognition accuracy in diverse conditions.
4. Development of a mobile application for remote monitoring and control of the system.

These enhancements would further increase the system's utility and applicability, making it a comprehensive tool for health monitoring and attendance tracking. The addition of more sensors would provide a more holistic view of an individual's health, while improvements in facial recognition algorithms would enhance accuracy in various lighting and environmental conditions.

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