Temple Crowd Management and Elevation System Using IoT

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Abstract — In recent years, the need for effective crowd management systems has become increasingly important, especially in public spaces such as temples, shopping malls, stadiums, and transportation hubs. This system proposed smart automation using IoT to control high crowd effectively which reduce manual control for handling crowd at high density and enhance the public safety and efficiency in handling large gatherings of devotees. The system presents a comprehensive solution through a web-based portal designed to assist event organizers and citizens in overcoming the challenges associated with crowd management. The system integrates multiple advanced technologies, including IR sensors, automated walkway escalators, Automated slider gate systems. Conveyor belt move according time provided by timer control with respect to the crowd density. The MQ-135 sensor is primarily used to detect a range of gases, including co2 with high precision. Ultrasonic sensors are employed to measure crowd density, providing real time data on the number of people in specific areas. This information is processed and displayed on an LCD screen .The system also incorporates a servo motor to control barriers or doors based on crowd density, allowing for automated control of entry and exit points. The system is designed to be salable and adaptable, making it suitable for a wide range of applications, from small gatherings to large-scale events respect to the crowd density.

Keywords: IoT, Crowd Management, Conveyor belt, MQ-135 Gas Sensor, Ultrasonic Sensor, Servo Motor, LCD, Public Safety

I. INTRODUCTION

Crowd management has become a critical aspect of public safety, especially in areas with high foot traffic such as temples, stadiums, shopping centers, and transportation hubs. The risks associated with overcrowding, such as stampedes, air quality deterioration, and emergency situations, necessitate the development of advanced monitoring and control systems. Traditional methods of crowd control often rely on manual intervention, which can be slow and inefficient in responding to sudden changes in crowd density. In response to these challenges, this project proposes a smart crowd management system utilizing the Internet of Things (IoT) technology combined with various sensors to provide real-time data and automated control mechanisms. Temples, especially during festivals and special events, often experience significant overcrowding, posing serious risks to the safety and well-being of devotees. By utilizing a network of sensors and automated systems, an IoT-based crowd management system can monitor real-time conditions, provide immediate feedback, and control the movement of people within the temple premises. The proposed system integrates a walkway escalator, MQ-135 gas sensor, ultrasonic sensors, an emergency button, a servo motor, and an LCD display. The MQ-135 sensor monitors air quality by detecting the presence of harmful gases, ensuring a safe environment in crowded spaces. Ultrasonic sensors are employed to measure the distance between individuals, thereby assessing crowd density in real-time. In case of emergencies, a strategically placed emergency button allows for instant alerts, activating safety protocols. The servo motor is used to control physical barriers such as doors or gates, automatically regulating the flow of people based on crowd density data. The information gathered by the sensors is displayed on an LCD screen, providing security personnel with crucial insights for effective crowd management. This IoT-based approach not only enhances safety but also streamlines the management process by offering real-time, automated solutions.

II. LITERATURE REVIEW

1) The literature review on automatic passenger counting systems in urban transport explores the integration of technologies like infrared, ultrasonic, and video-based sensors. It highlights the accuracy and reliability of these methods, particularly video systems and infrared sensors, in providing real-time data on passenger flow. This data is essential for optimizing route planning, improving scheduling, and enhancing service efficiency. The review also discusses the potential for combining passenger counting data with other transit management systems to enable data-driven decision-making, ultimately improving public transport services and passenger experience.[1]
2) The literature review on intelligent condition-based monitoring techniques for bearing fault diagnosis examines advanced methods like machine learning and signal processing to detect faults in machinery. It highlights the effectiveness of these techniques in identifying early wear and misalignment, emphasizing the superiority of models like neural networks over traditional methods. The review also discusses integrating monitoring systems with real-time data analysis to enhance proactive maintenance, ultimately improving machinery reliability and longevity.[2]
3) The literature review on multi-sensory perception for intelligent vehicles examines the integration of radar, LIDAR, cameras, and ultrasonic sensors to improve situational awareness and decision-making. It highlights how sensor fusion enhances environmental modeling by overcoming individual sensor limitations, particularly in challenging conditions. The review emphasizes the need for robust algorithms to process and integrate data from various sensors, ultimately advancing the safety and navigation capabilities of autonomous and semi-autonomous vehicles.[3]
4) In emergency evacuations, crowds often become congested and stampeded because of extreme panic, resulting in injuries and fatalities. Safety officers can spread positive emotions and reduce crowd panic by issuing information or appeasement, which is an

effective way to ensure evacuation safety. In this article implement a simulation system for crowd evacuation to visualize the results of positive emotion contagion. The proposed method can provide guidance for emergency response management. Safety officers can spread positive emotions and reduce crowd panic by issuing information.[4]

5) The literature review on road health monitoring systems explores the integration of sensor data and optimized deep neural networks (DNNs) for assessing road conditions. It highlights the use of sensors like accelerometers and laser scanners to gather data on road surface and vehicle interactions. The review emphasizes DNNs' advantages in analyzing complex data for accurate detection of road defects, such as cracks and potholes, and discusses challenges in training and optimizing these models. Overall, it underscores the potential of combining sensor technology with advanced deep learning to improve road maintenance strategies and safety.[5]

III. PROBLEM STATEMENT

The temple management faces challenges in ensuring the safety and security of devotees during peak festival seasons, resulting in overcrowding, accidents, and stampedes. To address this, a crowd management system using IoT sensors and devices is proposed. The system will utilize MQ-135 sensors to detect CO2 gas and monitor air quality, ultrasonic sensors to track crowd density, emergency buttons for instant alerts, servo motors to control entry points, and LCD displays for real-time updates. The system aims to provide a smart and efficient solution for crowd monitoring, management, and emergency response, ensuring a safe and peaceful experience for devotees while minimizing the risk of accidents and stampedes.

IV. OBJECTIVES

1) To ensure the safety of devotees by continuously monitoring air quality through the MQ-135 sensor, detecting harmful gases.
2) To implement an automated system for controlling the flow of people within the temple premises by using servo motors to manage gates and barriers based on real-time data, ensuring smooth and orderly movement of devotees.
3) To handle overcrowding effectively.

V. PURPOSE

The purpose of developing an IoT-based crowd management system for temples is to address the critical need for ensuring the safety and security of devotees in environments that are often subject to overcrowding, especially during peak times like festivals and special religious events. Traditional crowd management methods are often insufficient to handle the complexities of large gatherings, leading to potential dangers such as stampedes, poor air quality, and delayed responses in emergency situations. By integrating advanced IoT components like the MQ-135 sensor, ultrasonic sensors, emergency buttons, servo motors, and an LCD display, the system aims to provide real-time monitoring and automated control of crowd density, air quality, and emergency protocols, significantly reducing the risk of accidents and enhancing the overall safety of the temple environment. Additionally, this system is designed to streamline the management of large crowds by offering temple authorities precise and timely data that aids in making informed decisions.

VI. SCOPE

The scope of the IoT-based crowd management system for temples encompasses a range of functionalities designed to address the complexities of managing large crowds in religious settings. This system includes the deployment of MQ-135 sensors to monitor air quality and detect harmful gases, ensuring a safe and healthy environment for devotees. Ultrasonic sensors are used to measure crowd density in real-time, allowing for precise monitoring of visitor distribution and enabling timely interventions to prevent overcrowding. The system integrates emergency buttons that can be activated to trigger immediate responses, such as controlling gate operations via servo motors, thereby facilitating rapid adjustments to crowd flow during critical situations. An LCD display provides real-time information and alerts to temple authorities, aiding in quick decision-making and effective management of the crowd. The scope of this system extends to improving overall safety, enhancing visitor experience, and streamlining the management of large gatherings, making it a crucial tool for modern temple administration.

VII. MODULES

A. *Super Admin:*

1) Login
2) Add security admin
3) View security admin
4) Delete security admin
5) View current sensor data
6) View hourly footfall/crowd Report
7) Logout

B. *Security Admin:*

1) Login
2) Add Gate
3) Gate No
4) Gate Name
5) Gate Id
6) Hardware Id
7) View Gate
8) Delete Gate
9) View current sensors data(Gate wise)
10) View hourly footfall/crowd Report
11) View emergency log
12) logout

VIII. PROPOSED SYSTEM

The proposed IoT-based crowd management system for temples aims to create a highly efficient and automated solution for managing large gatherings and ensuring the safety of devotees. This system integrates several critical components to address various aspects of crowd control and

environmental monitoring. The MQ-135 sensor will be strategically placed to continuously monitor air quality and detect CO2 gas, detecting harmful gases and ensuring that the air remains safe for the worshippers. Ultrasonic sensors will be installed at key points to measure crowd density and provide real-time data on the number of people in different areas of the temple. The data collected by these sensors is processed by a central control unit, which uses this information to make informed decisions about crowd management. In case of emergencies, an emergency button allows temple authorities to trigger immediate actions, such as activating servo motors to open or close gates and manage crowd flow effectively. The system will feature an LCD display that provides real-time updates on air quality, crowd density, and system status, enabling quick decision-making by temple staff. By integrating these components, the proposed system aims to enhance the safety, efficiency, and overall experience for temple visitors, addressing the challenges of overcrowding and ensuring a secure and orderly environment.

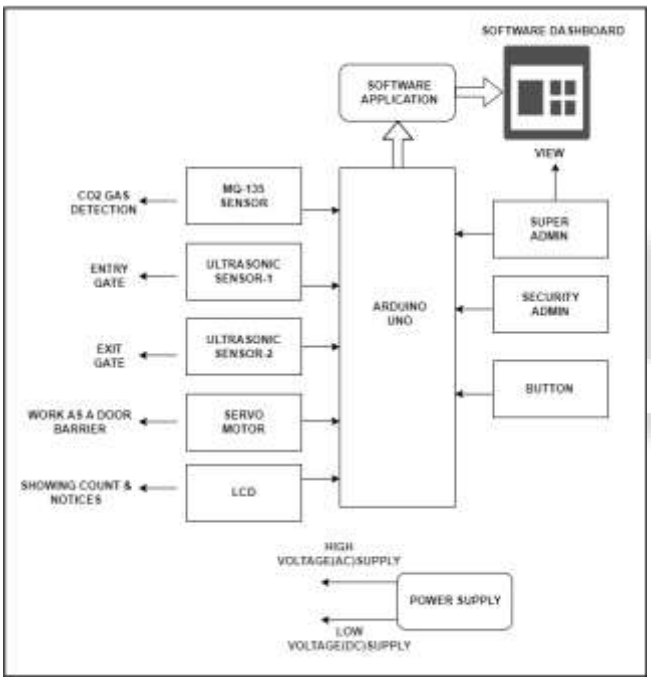

Fig. 1: Block Diagram

IX. System Architecture

The system architecture for the IoT-based crowd management system for temples is designed to provide comprehensive monitoring and control of crowd dynamics and environmental conditions. At its core, the system consists of several key components integrated into a cohesive framework. The MQ-135 sensor continuously measures air quality by detecting harmful gases and sending this data to a central processing unit. Concurrently, ultrasonic sensors are deployed at strategic locations to assess crowd density by measuring the distance between individuals, which helps in evaluating the level of overcrowding. The central processing unit, which can be a microcontroller or a more advanced processor, aggregates and analyses data from both the MQ-135 and ultrasonic sensors. The MQ-135 sensor is primarily used to detect a range of gases, including carbon dioxide (CO2) with high precision. Its primary function is to measure the concentration of gases in the environment to assess overall air quality rather than providing specific quantitative readings for individual gases like CO2.The MQ-135 can still be useful in providing general air quality indicators, which can help in identifying potential issues related to air pollution or hazardous conditions in environments like temples based on this data, the system makes real-time decisions and triggers responses as needed. The emergency button feature allows for manual activation of emergency protocols, sending immediate alerts to the central unit to initiate predefined actions. Servo motors, controlled by the central unit, manage the opening and closing of gates or barriers, facilitating controlled crowd movement and access management. An LCD display is integrated into the system to provide real-time updates and alerts to temple authorities, enabling them to monitor conditions and respond promptly. This architecture ensures that all components work together seamlessly to enhance safety, streamline crowd management, and improve the overall experience for temple visitors.

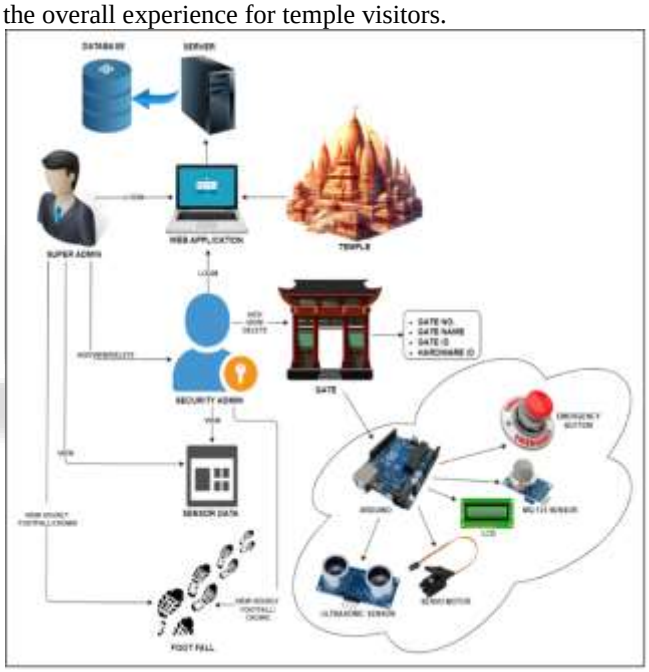

Fig. 2: System Architecture

X. Existing System

Existing crowd management systems in temple settings often rely on traditional methods, such as manual supervision and basic crowd control measures, which can be insufficient for handling large gatherings, especially during peak events. These systems typically lack the real-time monitoring and automation capabilities needed to effectively manage crowd density and environmental conditions. Air quality is generally monitored sporadically or not at all, which can lead to unsafe conditions if harmful gases accumulate unnoticed. Crowd density is usually assessed through visual observation rather than precise measurement, making it challenging to accurately gauge and manage overcrowding. Emergency response protocols are often manually activated, leading to potential delays in addressing urgent situations. Existing systems may not provide real-time data to temple authorities,

relying instead on static signs or verbal communication to convey important information. The lack of automated control mechanisms for gates and barriers means that adjustments to crowd flow are often reactive rather than proactive. The existing systems face limitations in terms of efficiency, safety, and responsiveness, highlighting the need for a more advanced IoT-based solution that integrates real-time monitoring, automated controls, and immediate data updates to enhance crowd management and ensure a safer environment for temple visitors.

XI. SYSTEM NECESSITY

A. *Hardware:*

1) Processor – i3
2) Memory- 1GB
3) RAM
4) Hard Disk 5GB
5) Arduino
6) Ultrasonic
7) Servo Motor
8) LCD
9) Button
10) MQ-135Sensor

B. *Software:*

1) Operating System: Windows XP and Later versions.
2) Frontend: HTML, CSS, JavaScript, XML.
3) Backend: Java
4) Database: MySQL
5) Domain: IoT

XII. ADVANTAGES

1) By continuously monitoring air quality with the MQ-135 sensor, the system ensures that harmful gas levels are kept in check, protecting the health of devotees.
2) The integration of ultrasonic sensors and an LCD display allows for real-time tracking of crowd numbers and environmental conditions.
3) Servo motors automate the control of gates and barriers based on sensor data, facilitating smooth crowd movement. This reduces the need for manual crowd control and minimizes human error.
4) The LCD display provides up-to-date information on crowd counts, air quality, and system status, enabling temple authorities to make informed decisions and implement effective crowd management strategies.

XIII. DISADVANTAGES

1) The integration of various sensors and control mechanisms can be complex, requiring a robust understanding of both hardware and software. This complexity may necessitate training for temple staff or the hiring of technical personnel.
2) Sensors, particularly those like the MQ-135, may be affected by environmental factors such as humidity, temperature, and dust, potentially impacting their accuracy and reliability.

XIV. APPLICATIONS

1) Temple Authorities and Management
2) Religious Institutions and Organizations
3) Event Organizers
4) Facility Managers
5) Local Government Agencies
6) Technology Integrators and Consultants
7) Safety and Security Personnel
8) Community Leaders and Stakeholders
9) Research and Development Teams
10) Donors and Sponsors
11) Festival and Event Management
12) Daily Operations.
13) Visitor Flow Management
14) Health and Safety Monitoring
15) Crowd Density Analysis

XV. FUTURE WORK

Future work for the IoT-based crowd management system for temples should focus on several key areas to enhance its functionality and impact. Advanced analytics and machine learning algorithms could be integrated to predict and manage crowd patterns more effectively, allowing for proactive rather than reactive measures. Upgrading to more precise sensors and expanding the system to include additional environmental and safety parameters will improve the accuracy and reliability of the data collected. Scalability and modularity should be considered to adapt the system for various sizes and types of religious sites, ensuring its applicability across different settings. Enhancements in user interfaces, such as mobile app integration and interactive displays, will facilitate better access and control for temple authorities. Furthermore, incorporating energy-efficient technologies and exploring renewable energy sources will contribute to the sustainability of the system. Enhanced emergency features, including automated notifications and integration with local emergency services, will improve response effectiveness.

XVI. CONCLUSION

In conclusion, the IoT-based crowd management system for temples represents a significant advancement in ensuring the safety and efficiency of managing large gatherings. By integrating MQ-135 sensors for air quality monitoring, ultrasonic sensors for real-time crowd density measurement, emergency buttons for immediate response, servo motors for automated control of gates, and an LCD display for real-time information, the system provides a comprehensive solution to address the challenges of overcrowding and environmental hazards. The system not only improves operational efficiency but also contributes to a better overall experience for visitors, making it a valuable tool for modern temple management and a model for integrating IoT technology in public safety and crowd control.

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