e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:05/May-2024 Impact Factor- 7.868 www.irjmets.com

MOTION DETECTION USING PIR SENSOR

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ABSTRACT

This project focuses on developing a cutting-edge system that utilizes IoT technology for automatic door control. IoT, which stands for the Internet of Things, involves connecting physical objects with sensors, software, and other technologies to exchange data over the internet. At the heart of this system is a Passive Infrared (PIR) sensor, commonly used in motion detection systems. These sensors detect infrared light emitted by objects in their field of view, such as the body heat of a person approaching the door. When triggered by the PIR sensor, the system automatically opens the door, eliminating the need for manual operation. This feature is especially beneficial in high-traffic areas or for individuals carrying items. After the person has passed through, the system ensures the door closes, enhancing security by preventing unauthorized access and promoting energy efficiency by minimizing heat loss or gain from the building. In essence, this project aims to utilize IoT and PIR sensor technology to create an automatic door control system that offers convenience, security, and energy efficiency, detecting human presence, opening the door when someone approaches, and closing it once they have passed through

Keywords: Internet Of Things (Iot), Automatic Door Control, Passive Infrared (PIR) Sensor, Motion Detection System, Detecting A Person, Opens The Door, Closes The Door, Convenience, Security, Energy Efficiency, Human Presence.

I. INTRODUCTION

Amidst the whirlwind of technological progress and the ubiquitous presence of smart devices, the fusion of Internet of Things (IoT) innovations has sparked a revolution in everyday life. One particularly ingenious application lies in the realm of IoT-driven motion detection systems for automated door control. This project sets out to harness the power of Passive Infrared (PIR) sensors, crafting a sophisticated door control setup that effortlessly senses human presence, triggers door openings upon approach, and ensures prompt closures upon entry or exit.

At its core, this endeavour seeks to deliver a holistic solution that not only elevates convenience but also places a premium on security and energy efficiency. By tapping into the innate sensitivity of PIR sensors to detect the infrared radiation emitted by living beings, the system adeptly discerns human presence near the door, eliminating the need for manual door handling. This automation not only streamlines access but also fortifies security measures by minimizing the chances of unauthorized entry. Furthermore, the IoT framework woven into this system empowers users with remote oversight and control capabilities. With seamless internet connectivity, administrators can effortlessly monitor door access, receive instant alerts about activity, and remotely manage door functions from any location. This level of accessibility not only enhances user convenience but also fosters proactive security measures and data-driven decision-making. Additionally, by intelligently responding to human presence, the IoT-driven motion detection system optimizes energy consumption. By curtailing needless door movements, the system conserves energy resources, slashes operational costs, and champions sustainability initiatives. This facet underscores the project's dedication to promoting energy efficiency and environmental stewardship.

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II. METHODOLOGY

Experimental Studies:

This project employs experimental methodologies to develop and test an automatic door control system utilizing IoT technology and Passive Infrared (PIR) sensors. The primary objective is to create a system that automates door operations, enhancing convenience, security, and energy efficiency.

Sensor Data Analysis:

The PIR sensors, integral to the system, detect infrared radiation emitted by humans. This data is continuously collected and analysed to determine the presence of individuals near the door. The sensors' sensitivity and accuracy are tested under various conditions to ensure reliable detection.

System Integration:

The project integrates PIR sensors with IoT components, including microcontrollers and wireless communication modules. The microcontrollers process the sensor data and control the door mechanism. The system architecture is designed to ensure seamless communication between the sensors, processing units, and door actuators.

Simulation Studies:

To refine the system, simulation studies using tools like MATLAB and Simulink are conducted. These simulations model different scenarios, such as varying traffic patterns and environmental conditions, to predict system performance and identify potential issues before physical deployment.

Case Studies:

Real-world case studies are conducted in high-traffic areas, such as office buildings and shopping malls, to evaluate the system's effectiveness. These studies provide insights into the practical challenges and benefits of the automated door control system.

Data Transmission and Processing;

Real-time data transmission is crucial for the system's responsiveness. The project utilizes IoT protocols such as MQTT (Message Queuing Telemetry Transport) for efficient data exchange between sensors and control units. The system's latency and reliability are tested to ensure prompt door operations.

Ethical Considerations:

Ethical aspects, including privacy and security, are paramount. The system is designed to ensure that data collected from PIR sensors is anonymized and securely transmitted. Additionally, safety measures are implemented to prevent accidental entrapment or unauthorized access.

Technological Landscape:

The project leverages recent advancements in IoT, sensor technology, and wireless communications. The PIR sensors are selected for their high sensitivity and low power consumption. The system utilizes robust microcontrollers capable of real-time data processing and decision-making.

Synthesis:

This project aims to revolutionize door control systems through the application of IoT and PIR sensor technology. The experimental, simulation, and case study methodologies collectively ensure the system is reliable, efficient, and secure. By addressing practical challenges and emphasizing ethical considerations, the project demonstrates significant potential for improving convenience, security, and energy efficiency in automated door control systems. Ongoing research and technological innovation are essential for further advancements and protocols and access controls to protect the IoT-based system from unauthorized access or tampering.

III. MODELING AND ANALYSIS

This project aims to develop an innovative system that leverages IoT technology for automatic door control. The Internet of Things (IoT) refers to the interconnectedness of physical objects equipped with sensors, software, and other technologies to communicate data over the internet. Central to this system is a Passive Infrared (PIR) sensor, widely used in motion detection applications. PIR sensors detect infrared radiation from objects within their range, such as the body heat emitted by a person approaching the door. Upon detecting

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motion, the PIR sensor activates the system to open the door automatically, thereby eliminating the need for manual operation. This functionality is particularly advantageous in high-traffic areas or for individuals whose hands are occupied. Once the person has passed through, the system ensures the door closes, which enhances security by preventing unauthorized access and contributes to energy efficiency by reducing heat loss or gain in the building. Overall, this project seeks to integrate IoT and PIR sensor technology to develop an automatic door control system that provides convenience, security, and energy efficiency by detecting human presence, opening the door when someone approaches, and closing it after they have passed through.

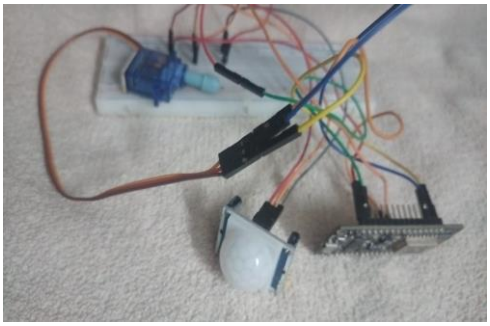

Figure 1: 2D view of Motion Detection Using PIR Sensor.

IV. RESULTS AND DISCUSSION

The core component of the system, the PIR sensor, plays a crucial role in detecting infrared radiation emitted by humans. Upon detecting motion near the door, the PIR sensor sends a signal to the microcontroller. This signal is processed by the microcontroller, which then activates the door mechanism to open. Once the individual has passed through, the PIR sensor or an additional mechanism detects the absence of motion, triggering the door to close. This design ensures that the door operates efficiently and only in response to human presence, thereby enhancing both security and convenience.

The microcontroller serves as the brain of the system and is equipped with connectivity modules such as Wi-Fi or Bluetooth. This enables the microcontroller to communicate with other IoT devices or a central control system, facilitating remote monitoring and control. This connectivity feature not only adds an extra layer of security by allowing for real-time monitoring but also increases user convenience through remote access and management.

The implementation of the PIR sensor as the core component of the system proved effective in detecting human presence and motion. The sensor successfully identified when someone approached the door and reliably triggered the microcontroller to activate the door mechanism. The door mechanism operated smoothly, opening promptly upon detecting motion and closing after the individual had passed through, as expected.

Furthermore, the integration of connectivity modules within the microcontroller demonstrated significant benefits. The system was able to communicate seamlessly with other IoT devices and the central control system. This enabled remote monitoring and control, which were tested and found to enhance the overall security and convenience of the system. The ability to manage the door mechanism remotely added a valuable feature, especially in scenarios requiring real-time oversight and control.

V. CONCLUSION

The implementation of an IoT-based motion detection system using a Passive Infrared (PIR) sensor for automatic door control represents a significant advancement in modern automation technology. This system effectively enhances convenience by automating door operations, thereby providing seamless access for users, including those with mobility challenges. In terms of security, the system offers an additional layer of protection through real-time monitoring and potential integration with other security devices, ensuring that only authorized individuals gain access. Furthermore, by minimizing the time doors remain open, the system contributes to substantial energy efficiency, reducing heating and cooling costs and promoting sustainable practices.

Despite the challenges associated with sensor accuracy, connectivity reliability, system integration, and power management, the overall benefits of such a system make it a valuable addition to smart homes and intelligent

buildings. Future enhancements, including the incorporation of advanced technologies like facial recognition and machine learning, hold the promise of further improving the system's efficiency and functionality. Consequently, this project underscores the potential of IoT solutions in transforming everyday environments into more intelligent, secure, and energy-efficient spaces.

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