Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 7, No.3, July : 2024

IOT-BASED SMART GATE OPERATOR

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Abstract
The advancement of Internet of Things (IoT) technology has enabled the development of innovative solutions for enhancing security and convenience in various domains. This paper presents the design and implementation of an Automatic Smart Gate System employing ESP8266, a DC motor driver, and a custom MIT App interface. The proposed system aims to automate the operation of gates, providing users with seamless control and monitoring capabilities. The core components of the system include an ESP8266 microcontroller for IoT connectivity, a DC motor driver for actuating the gate mechanism, and a MIT App developed using MIT App Inventor for user interaction. The ESP8266 facilitates communication between the gate system and the MIT App via Wi-Fi, enabling users to remotely control the gate from their smartphones. The system architecture comprises three main modules: the ESP8266 module responsible for interfacing with the motor driver and handling communication with the MIT App, the motor driver module for controlling the DC motor that operates the gate, and the MIT App module providing a user-friendly interface for gate control and status monitoring. Key features of the Automatic Smart Gate System include remote gate operation, real-time status monitoring, and user authentication for access control. The MIT App allows users to open or close the gate remotely, check the current status of the gate (open or closed), and receive notifications for gate activities. Additionally, the system supports multi-user access control, where authorized users can be granted or revoked access privileges. The proposed system offers numerous benefits, including improved convenience, enhanced security, and efficient gate management.

INTRODUCTION

Automated gate systems have become increasingly popular due to their convenience and enhanced security features. Traditional manual gate operation can be cumbersome and inefficient, especially in scenarios where frequent access is required. To address these challenges, this project presents an innovative solution: an Automatic Smart Gate System utilizing ESP8266, a DC motor driver, and a custom MIT App interface.The proliferation of Internet of Things (IoT) technology has revolutionized the way we interact with devices and systems in our environment. By integrating IoT capabilities into gate automation, we can create smart gate systems that offer remote control, real-time monitoring, and advanced access management features.The primary objective of this project is to design and implement an Automatic Smart Gate System that provides users with seamless control and monitoring capabilities. The system leverages the ESP8266 microcontroller for IoT connectivity, enabling wireless communication between the gate system and a smartphone application developed using MIT App Inventor.In this introduction, we will provide an overview of the project, highlighting its significance, objectives, and key features. We will also outline the structure of the paper, detailing the organization of subsequent sections.By the end of this project, we aim to demonstrate the effectiveness and practicality of the Automatic Smart Gate System in improving gate operation efficiency, enhancing security, and offering greater convenience to users. Through a combination of hardware and software components, this system represents a promising advancement in the field of gate automation, catering to the evolving needs of modern users.

LITERATURE SURVEY

1. "Smart Gate Automation Using IoT" by V. Sowmiya, R. R. Mohan, and S. Suganya: This paper explores the implementation of a smart gate automation system using IoT technology. It discusses the integration of sensors, microcontrollers, and wireless communication modules to enable remote gate control and monitoring. The study focuses on the benefits of IoT-based gate automation in terms of convenience, security, and energy efficiency.
2. "Design and Implementation of Automatic Gate Control System Using Microcontroller" by J. Ajit and S. Arumugam: This research presents a microcontroller-based automatic gate control system designed for residential and commercial applications. The study discusses the hardware components, such as sensors and actuators, used for gate operation and obstacle detection. It also evaluates the system's performance in terms of reliability and responsiveness.
3. "Development of a Smart Gate Control System with Security Features Using Raspberry Pi" by K. Ramanaiah and K. Srinivas: This paper proposes a smart gate control system based on Raspberry Pi, a popular single-board computer. The system incorporates features such as face recognition, RFID authentication, and remote access via a web interface. The study investigates the feasibility of using Raspberry Pi for intelligent gate automation and evaluates its performance in real-world scenarios.
4. "Wireless Control System for Automatic Gate" by M. F. Ahmed, A. S. Noraziah, and M. S. Sabri: This study presents a wireless control system for automatic gates using RF (Radio Frequency) communication technology. The research discusses the design 13 and implementation of the system's hardware and software components, including the RF transmitter- receiver modules and microcontroller-based control unit. It evaluates the system's effectiveness in providing reliable and secure gate operation.
5. "Development of a Smartphone-Based Gate Control System" by N. N. Nguyen and H. D. Phan: This research focuses on developing a smartphone-based gate control system using Bluetooth Low Energy (BLE) technology. The study discusses the design and implementation of the mobile application for gate operation and status monitoring. It evaluates the system's usability, energy efficiency, and security features, highlighting the advantages of smartphone integration in gate automation. These literature sources provide valuable insights into the design, implementation, and evaluation of automatic gate control systems, offering guidance for the development of the proposed Automatic Smart Gate System utilizing ESP8266, DC motor driver, and MIT App interface.

EXISTING METHOD

The existing methods for IoT-based smart gate operators involve a variety of technologies and approaches.Here are a few examples:

These systems use RFID modules to automatically collect talls from moving vehicles as they pass through a toll plaza.The system can also identify vehicles against which stolen and accident cases are registered,using RFID technology.

IoT based smart home system ,like qToggle,use sensors or actutators with network connections implementing a specific API for communication such systemcan be adapated for gate operation,allowing for remote control and monitoring.

Secure Smart City Frameworks are the frameworks ensure secure access to smart city application via the IoT environment, including mutual authentication between users and gateways.This can be applied to gate operators to enhance security.

PROPSED SYSTEM

PROPOSED SYSTEM:

Proposed Model:

1. Requirement Analysis: Define the specific requirements of the smart gate operator system based on the intended application (e.g., residential, commercial, industrial). Identify key functionalities such as remote access control, security features, integration capabilities, and data analytics.

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2. Hardware Selection: Choose suitable hardware components including microcontrollers, sensors (e.g., motion sensors, proximity sensors), actuators (e.g., motors for gate operation), and connectivity modules (e.g., Wi-Fi). Consider factors such as reliability, power consumption, scalability, and compatibility with the desired features.
3. System Design: Design the architecture of the smart gate operator system, including the hardware layout and communication protocols. Define the software components such as firmware for microcontrollers, server-side applications for data processing, and user interface for remote control and monitoring.
4. Connectivity Setup: Establish connectivity between the smart gate operator system and the internet for remote access and monitoring. Configure communication protocols such as MIT, Google firebase for Cloude data storage between the gate controller and remote servers or mobile devices.
5. Authentication and Access Control: Implement authentication mechanisms to control access to the gate mobile based authentication. Develop user management functionalities for 31 adding/removing users, assigning access permissions, and managing authentication credentials. 6.User Interface Development: Design and develop user interfaces for remote control and monitoring of the gate operator system. Create mobile apps, web portals, or desktop applications for users to interact with the system, view gate status, and manage access permissions.

PROTOTYPE OF SMART GATE

Fig.1. Front view

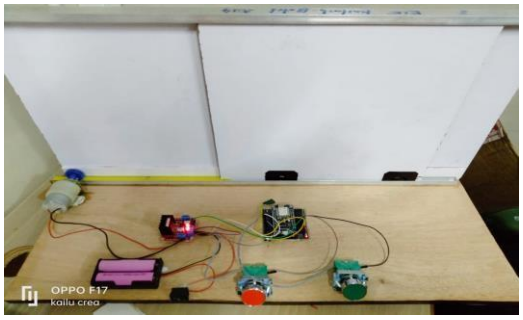

Fig.2. Back view

BLOCK DIAGRAM FOR SMART GATE

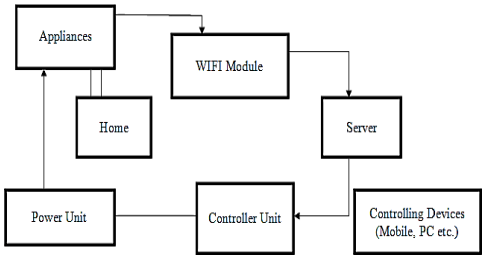

Fig.3

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WIRING DIAGRAM

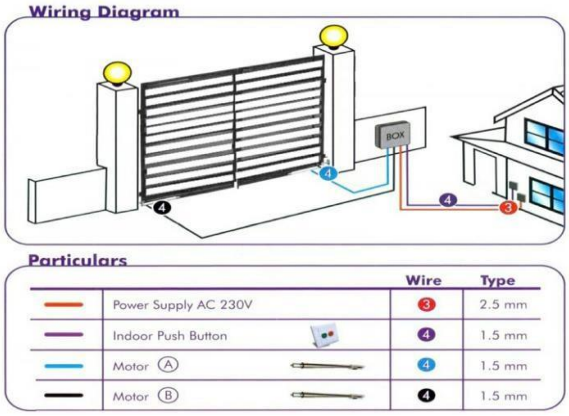

Fig.4

CIRCUIT DIAGRAM

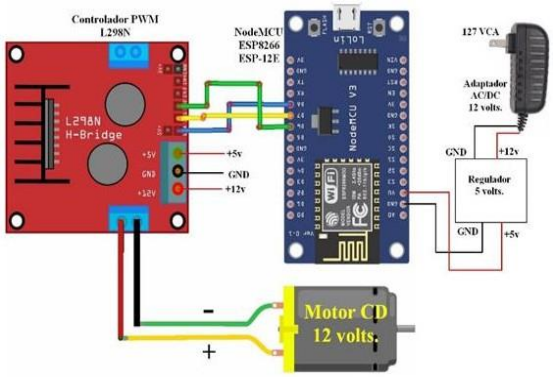

Fig.5

SOFTWARE SPECIFICATION

MIT App Inventor is an intuitive, visual programming environment that allows everyone – even children – to build fully functional apps for Android phones, iPhones, and Android/iOS tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes. And what's more, our blocks-based tool facilitates the creation of complex, high-impact apps in significantly less time than traditional programming environments. The MIT App Inventor project seeks to democratize software development by empowering all people, especially young people, to move from technology consumption to technology creation.A small team of MIT CSAIL staff and students, led by Professor Hal Abelson, forms the nucleus of an international movement of inventors. In addition to leading educational outreach around MIT App Inventor and conducting research on its impacts, this core team maintains the free online app development environment that serves more than 6 million registered users.Blocks-based coding programs inspire intellectual and creative empowerment. MIT App Inventor goes beyond this to provide real empowerment for kids to make a difference – a way to achieve social impact of immeasurable value to their communities. In fact, App Inventors in school and outside of traditional educational settings have come together and done just that With over a million unique monthly visitors from 195 countries collectively creating almost 30 million apps, MIT App Inventor is changing the way the world creates apps and the way that kids learn about computing.

MIT App Inventor (App Inventor or MIT AI2) is a high-level block-based visual programming language, originally built by Google and now maintained by the Massachusetts Institute of 39 Technology. It allows newcomers to create computer applications for two operating systems: Android and iOS, which, as of 25 September 2023, is in beta testing. MIT App Inventor (App Inventor or MIT

AI2) is a high-level blockbased visual programming language, originally built by Google and now maintained by the Massachusetts Institute of Technology.

It allows newcomers to create computer applications for two operating systems: Android and iOS, which, as of 25 September 2023, is in beta testing. It is free and open- source released under dual licensing: a Creative Commons Attribution ShareAlike
3.0 Unported license and an Apache License
2.0 for the source code. Its target is primarily children and students studying computer programming, similar to Scratch.

Step 1: Go download MIT A12 COMPANION application in play store and scan with your mobile phone

Fig.6: Ui of MIT APP

Step 2: Scan with the QR code and code with the three buttons as OPEN,CLOSE,STOP button functions.

Fig.7 : Block code of button

GOOGLE FIREBASE

Firebase, Inc. is a set of backend cloud computing services and application development platforms provided by Google. It hosts databases, services, authentication, and integration for a variety of applications, including Android, iOS, JavaScript, Node.js, Java, Unity, PHP, and C++. Firebase is Google's mobile application development platform that helps you build, improve, and grow your app. Here it is again in bigger letters, for impact: Firebase is Google's mobile application development platform that helps you build, improve, and grow your app.

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Fig.8: Cloud based system configuration

Firebase Cloud Messaging (FCM) provides a reliable and battery-efficient connection between your server and devices that allows you to deliver and receive messages and notifications on iOS, Android, and the web at no cost.

RESULT

The results and discussion section of a study on an IoT ESP8266 DC motor-controlled smart gate using PID (Proportional-Integral- Derivative) control, integrated with a MIT App and Google Firebase, would typically cover several key aspects:

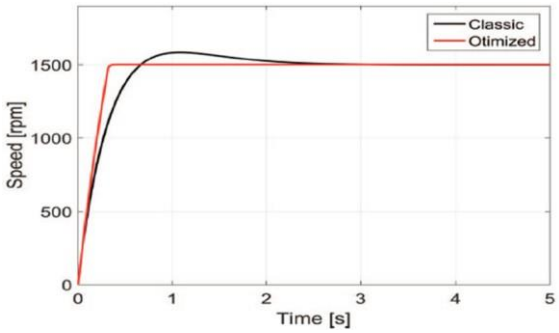

Fig.9

1. System Performance Evaluation: This part would involve analyzing how well the system performed its intended function. For instance, did the gate open and close smoothly? Did it respond promptly to commands from the MIT App via Firebase?
2. PID Controller Tuning: Since PID control is crucial for achieving smooth and efficient motor control, this section would discuss the process of tuning the PID parameters. It might include details on how the proportional, integral, and derivative gains were adjusted to optimize performance, such as minimizing overshoot, reducing settling time, and improving steady-state accuracy.
3. Response to Disturbances: How did the system respond to disturbances, such as variations in motor load or external forces acting on the gate? This could involve testing the system under different conditions to assess its robustness and stability.
4. Energy Efficiency: Evaluate the energy efficiency of the system, particularly important for IoT applications where energy consumption is a concern. This could involve measuring the power consumption of the ESP8266, the motor, and any other components to assess overall efficiency.

CONCLUSION

The proposed project will enable remote and automated control of a smart gate using an ESP8266 microcontroller, a DC motor for gate movement, a mobile app for user interaction, and a cloud platform (like Google Firebase) for real-time data management and potential remote-control capabilities. PID control will be implemented to ensure smooth and precise gate movement. A conclusion for an IoT- based smart gate operator project could highlight the significance of the technology in enhancing security, convenience, and efficiency. It might also discuss the potential for further innovation and integration with other IoT devices to create smarter and more connected environments. Additionally, emphasizing the benefits such as remote access, real-time monitoring,

and automation can reinforce the value proposition of the solution. Finally, acknowledging any limitations or areas for future improvement can provide directionfor continued development and refinement of the smart gate operator system.

REFERENCES

1. Beniwal, G., & Singhrova, A. (2022). A systematic literature review on IoT gateways. Journal of King Saud University- Computer and Information Sciences, 34(10), 9541-9563.
2. Sheikh, R. U., Kale, P. A., Sarfaraj, S., Sukhdeve, S., Sherekar, K., & Faruqui, S. (2021). A Review Paper on IoT Based Smart Security and Home Automation.
3. Ajay, K., Sivasankar, T., Raghava, T., Raj, E. S., Babu, Y. D., Aktar, S. M., & Mansoor, A. (2023). AUTOMATION OF RAILWAY GATE SYSTEM USING IOT.
Journal of Engineering Sciences, 14(05).
4. Ghareeb, A. Y., Gharghan, S. K., Mutlag,
A. H., & Nordin, R. (2023). Wireless Sensor Network-Based Artificial Intelligent Irrigation System: Challenges and Limitations. Journal of Techniques, 5(3).
5. Kurniawan, M. F. (2023). KUNCI PINTU BERBASIS INTERNET OF THING (IoT).
Jurnal Teknologi Terkini, 3(1).
6. Abdallah, S. (2021). Intelligent Navigation Service Robot Working in a Flexible and Dynamic Environment. Rochester Institute of Technology.
7. Abdallah, S. (2021). Intelligent Navigation Service Robot Working in a Flexible and Dynamic Environment. Rochester Institute of Technology.
8. Hammoodi, S. J., Flayyih, K. S., & Hamad, A. R. (2020). Design and
implementation speed control system of DC motor based on PID control and matlab simulink. International Journal of Power Electronics and Drive Systems, 11(1), 127-
134.
9. Suseno, E. W., & Ma'arif, A. (2021). Tuning of PID controller parameters with genetic algorithm method on DC motor. International Journal of Robotics and Control Systems, 1(1), 41-53.
10. Khalifa, M., Amhedb, A. H., & Al Sharqawi, M. (2021). Real time DC motor position control using PID controller in LabVIEW. Journal of Robotics and Control (JRC), 2(5), 342-348.