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NodeMcu and Blynk for a Smart Garage Door Surveillance Controlling System

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ABSTRACT

This paper introduces a Smart Garage Door Surveillance and Controlling System, utilizing NodeMcu and Blynk. This system offers real-time monitoring, remote control, and intelligent notifications, providing users with convenience and peace of mind. The paper evaluates the effectiveness of integrating NodeMcu and Blynk in a Smart Garage Door Surveillance Controlling System, comparing it to conventional methods, and assesses its effectiveness in providing remote monitoring and control capabilities. The NodeMcu and Blynk IoT solution offers a cost-effective and efficient solution for garage door control. The NodeMcu microcontroller connects the garage door to the IoT, allowing users to remotely monitor its status. The Blynk platform provides a user-friendly mobile application for easy control from anywhere with an internet connection. The system also offers SMS notifications for instant alerts about the garage door's status, and a buzzer notification system for immediate notifications of any garage door activity. Smart integration addresses the security and convenience issues of traditional garage door control systems. The system enhances security by providing customizable alerts for specific events like unauthorized access attempts. It also introduces an intelligent auto shut-off feature, which automatically shuts off the garage door if it remains open for an extended period, reducing security risks and energy wastage; this feature is designed to be both smart and environmentally conscious, providing additional protection and energy efficiency. The paper discusses the use of NodeMcu and Blynk for smart garage door systems, highlighting their ease of installation and potential benefits, and demonstrates the cost-effectiveness and user-friendliness of integrating the NodeMcu microcontroller with Blynk's IoT platform for remote garage door monitoring and control. The study aims to transition from manual methods to IoT-enabled systems, enhancing security and convenience through real-time surveillance. The findings will guide the development of more efficient garage door control solutions, catering to the growing demand for smart home technologies.

1.0 INTRODUCTION

The Internet of Things (IoT) is a significant computing paradigm, connecting various systems and applications across various fields, including science, engineering, business, health, leisure, and everyday life. It has sparked interest in smart home systems, which automate household appliances using network technology, allowing users to perform tasks before arriving home with minimal human intervention. This has led to an unprecedented array of applications in various fields, including science, engineering, business, health, and leisure [1, 2]. IoT refers to the interconnected network system between everyday household objects, such as appliances, doors, and garage doors [3, 4]. Smart home technology offers a remote interface for home appliances, enabling control and monitoring through mobile applications via wireless transmission, internet, and Android, as per recent studies [5, 6]. The smart garage door concept enables remote operation using networking protocols and IoT sensors. It reduces manual operation by allowing users to access the garage from anywhere with a mobile application installed on their smart phone devices, thereby reducing the need for manual opening and closing of the garage door [7, 8]. Smart garage door systems reduce trespassing by allowing homeowners to control door opening and closing via a mobile application [9]. NodeMcu, a low-cost open-source IoT platform, coupled with Blynk, a versatile IoT platform, forms an ideal combination for a Smart Garage Door Surveillance Controlling System. NodeMcu's compatibility with Blynk enables seamless integration and remote monitoring of garage door status. The research explores this synergy, providing an affordable, user-friendly solution for users to monitor and control their garage doors remotely, enhancing security and convenience through IoT technology.

2.0 LITERATURE REVIEW

In paper presented by [10], the design and development of a smart garage door system using an Arduino microcontroller, a mobile application, and a Blynk cloud server. The application allows remote control and access to the door via Wi-Fi or 3G/4G networks. The system also functions using Google Assistant voice commands. Also in [11], the study aims to design a prototype of an automatic gate drive using a DC motor to control a house gate and open or close it using a smartphone application. The drive system uses a 12 V battery and requires serrations on the gate based on the size of the teeth (gear). The Arduino uno circuit utilizes the HC-05 Bluetooth module, Motor Driver l298n for polarity reverser, fence as load, and Bluetooth RC Controller application for DC motor movement. The study by [12], aim to develop an automatic rolling door for small-scale industrial companies using a DC motor drive and raindrop sensor. The research involved problem identification, design, implementation, testing, and conclusion. The system tested showed a 1.19 second response time for reading the rain sensor and 1.34 seconds delay time for closing the gate in rainy conditions. A smart Remote Garage Door system has been developed for residential and office use at a low cost and energy efficiency [13]. The prototype uses a low cost and energy efficient microprocessor, known as Arduino Uno to realize a smart function such as sending instruction through smartphone to open the door once the user is authorized. The study in [14], proposes an automatic door opening and closing system that detects human body movement near the door using an IR sensor. The system uses a mini door mounted on a threaded screw to transfer motor power for radial door motion. The switch controls the motor direction for both way motion. The work of [15] presents a simple approach to build an automatic garage gate access model using RFID using Arduino. This system provides effective security for authorized personnel and ensures a buzzer alerts when an unauthorized person tries to enter. The garage door opening system has numerous advantages, including energy conservation, reduced human effort, and time savings.

Table 1: Summary of smart garage door systems.

Author(s)	Systems used/methodology	Drawback
[16]	The PIC16F84 module and trigger circuitry	The system lacks wireless communication methods.
[17]	Uses Arduino Uno	The garage door can be opened and closed remotely.
[18]	The system comprises an RFID tag, RFID reader, GSM module, and a PIC16F877A microcontroller.	Misplacement of RFID cards can pose a significant security threat.
[19]	A microcontroller equipped with Wi-Fi, Bluetooth/BLE support.	The implementation of the system incurs higher costs compared to traditional gate control methods.
[20]	The device utilizes GSM technology integrated on a microcontroller.	The system may not be suitable for high-traffic areas due to its need for a delay time after opening the gate.
Proposed	Uses GSM/Wi-Fi technology on a Nodemcu microcontroller	The proposed system avoids aforementioned drawbacks mentioned with the additional features of security surveillance and users notification

Table 1 provides a structured summary of the identified gaps in existing smart garage door systems, offering a clear overview of the areas that the research aims to address and improve upon.

3.0 METHODOLOGY

The methodologies used in this study are divided into two parts: software and hardware. The software component involves circuit simulation, and algorithms, while the hardware part includes constructing the prototype and testing the system to verify correct functionality. This paper emphasized the method used to monitor the garage door activities via mobile app remotely, thereby enhancing security. The paper is designed to develop an automated smart garage door system that switches the door ON/OFF and send messages to user mobile app on any motion detected around the garage door. The system responds appropriately through the microcontroller and the control information system is conveyed to the user via the Internet (IoT) Blynk Mobile App.

3.1 Hardware and software Requirements

3.1.1 Hardware Requirements

a. NodeMcu Microcontroller

NodeMCU (Figure 1), also known as Devkit 1.0, is an open-source hardware platform for building IoT projects based on the ESP8266 microcontroller. It offers an easy-to-use firmware and development environment compatible with Arduino IDE, combining "node" and "MCU" in a single system-on-chip.

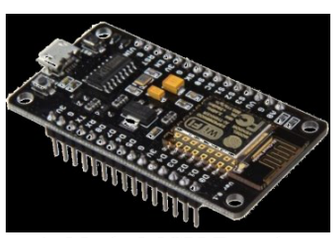

Figure 1: Node MCU Development Board [21]

b. Servo Motor

A servomotor (Figure 2) is a precise control mechanism for angular or linear position, velocity, and acceleration, consisting of a motor and a feedback sensor that sends and receives signals to the Blynk.

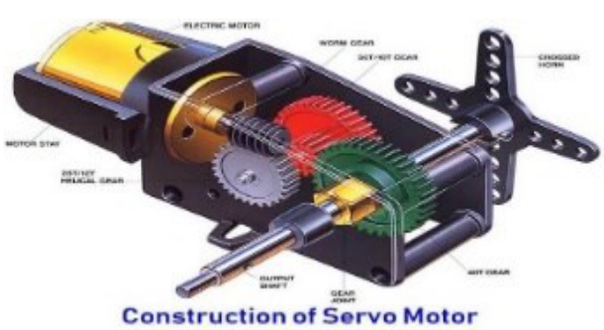

Figure 2: Servo Motor [22]

c. Light Dependent Resistor (LDR)

A Light Dependent Resistor (LDR) is a device with a resistance that changes with light falling on its surface, commonly used in circuits to detect the presence of a car in a garage, as shown in Figure 3.

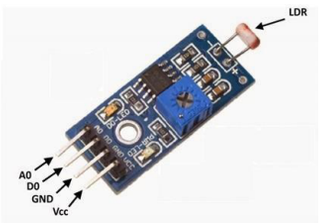

Figure 3: Light Dependent Resistor (LDR) [23]

d. GSM Module

The GSM module (Figure 4) is a device that alerts users of any detected illegal movement by notifying them via phone. It operates at either the 900 MHz or 1800 MHz frequency band and is provided by a mobile service provider, sending messages to the authorities as per programmed.

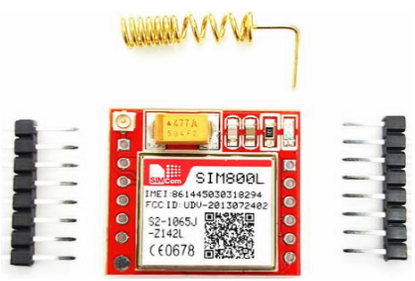

Figure 4: GSM Module [24]

e. PIR (Passive Infrared) sensor

PIRs (Figure 5) are pyroelectric sensors that detect infrared radiation levels. They are divided into two halves in motion detectors to detect motion changes, rather than average IR levels. The sensor is wired to cancel each other out, ensuring accurate detection of motion. The sensor's design allows for efficient use of infrared radiation.

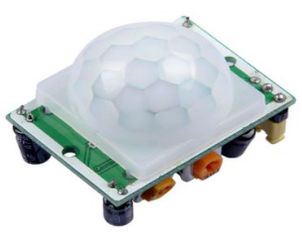

Figure 5: PIR Sensor [25]

f. Camera (ESP32-CAM) Module

The ESP32-CAM (Figure 6a & 6b) is a popular development board with a camera module, enabling projects capturing images or videos. It's dual-mode with Wi-Fi and Bluetooth capabilities, and can function as a standalone system with PCB antennas and ESP32 chip-based cores. It's suitable for home security cameras and IoT projects.

Figure 6a: ESP32-CAM [26]

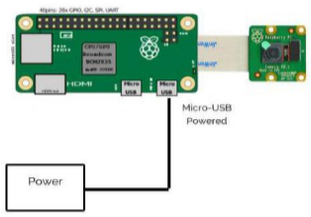

Figure 6b: Camara Setup[27]

3.1.2 Software Requirements

g. Arduino IDE

The Arduino IDE is a Java-based cross-platform application for Windows, macOS, and Linux, used for writing and uploading programs to Arduino compatible boards and other vendor development boards, with the aid of 3rd party cores.

h. Blynk

Blynk is an IoT platform for iOS or Android smartphones that allows users to control Arduino, Rasberry Pi, and NodeMCU via the internet, creating a graphical interface or HMI by compiling and providing appropriate addresses on available widgets.

4.0 SYSTEM DESIGN

The circuit was built on a breadboard (Figure 7) to confirm that everything worked properly, and then transferred to the PCB for permanent soldering. The sensor, the relay unit, and all other components in the system were interfaced with the NodeMCU and Arduino board.

Figure 7: Constructed Smart Door

4.1 Implementation

The Garage Door Security System comprises numerous components that work together to create a fully functional system. Each component was individually tested during development and testing to ensure proper communication and interface before being introduced to the system.

4.1 Result

Figure 8a shows the prototype of the design smart door. When the user swap the “close door” switch from the blynk mobile App, the label closed will turn yellow from black (Figure 8b), and the garage door will be closed (Figure 8a),

likewise, when the user swap the “open door” switch from the blynk mobile App, the label open door will turn purple (Figure 9b), and the garage door is open (Figure 9a). In this paper, the security functionality of the system is that if there is any intruder at the garage, the PIR (passive infrared) detect the person and send 'Motion Detected' to user (Figure 10), and at the same time calling the user phone through the use of GSM module (Figure 11). The GSM module has a sim card. The PIR system uses a light dependent resistor (LDR) and laser to communicate, with a 1023 signal between them. If an obstacle occurs, the signal is low, indicating a car is parked. The servo motor (Figure 2) rotates from 0-180° degrees for opening and closing doors, with a 0-90° degree setting for flip doors. Instructions for opening or closing are sent to the cloud and Node MCU, which control the motor based on code in the Arduino IDE. The system can be enabled or disabled.

Figure 8a. Prototype of the garage (closed view)

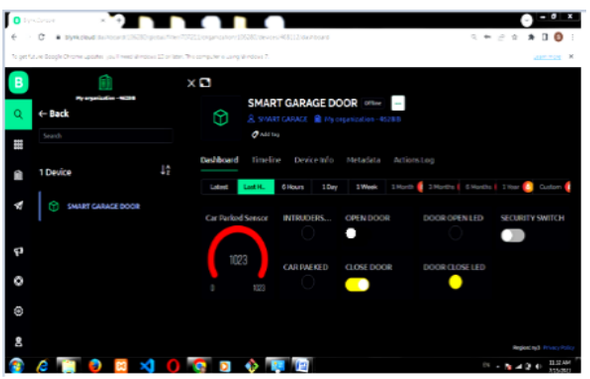

Figure 8b: Mobile App showing closed view)

Figure 9a. Garage door prototype (open view)

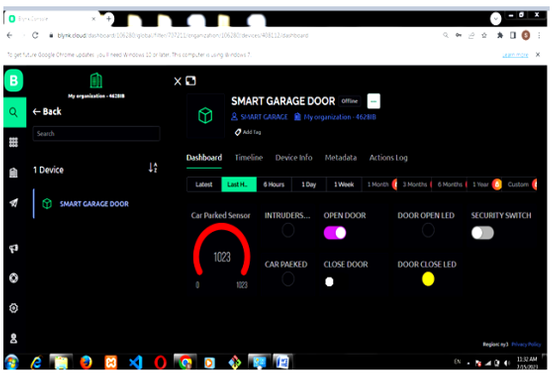

Figure 9b. View of the Blynk (Open view)

Figure 10: Result showing SMS Messages to the user.

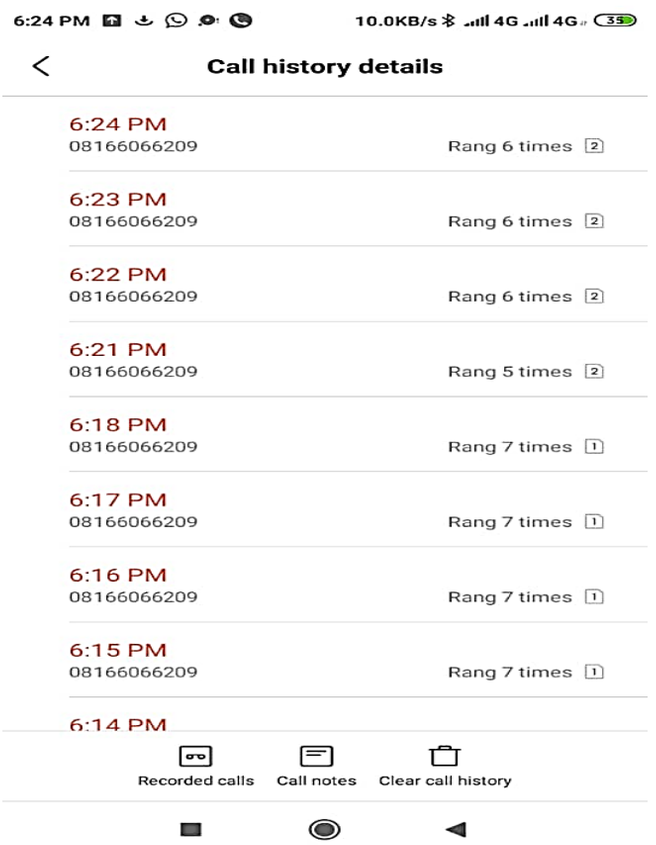

Figure 11**:** Result of call logs to the user

8. Advantages of the Smart Garage Door

i. Users can open or close their garage doors remotely using their smartphones, eliminating the need for physical keys or remotes

ii. promotes security as only authorized residents can enter the premises

iii. The auto mode will shut down if the garage door is left open for a specific duration.

iv. With SMS notifications, users can receive real-time updates on the status of their garage door, allowing them to monitor and control it from anywhere with cellular connectivity.
v. Smart garage doors enhance security by providing immediate notifications when the door is opened or closed
vi. users can receive notifications if the garage door is left open, prompting them to close it and maintain a more energy-efficient home.
vii.

5.0 CONCLUSION

This paper focuses on designing and developing a smart garage door using a mobile application. The system uses a Nodemcu micro controller for IoT wireless connection and the Blynk App for control. The mobile app makes garage door access more convenient and faster. This system provides homeowners with security, energy efficiency, and convenience. If the door is left open for too long, a buzzer sounds and a notification is sent to the user's smartphone. The implementation of NodeMcu and Blynk in the Smart Garage Door Surveillance Controlling System yielded positive outcomes. The integration facilitated efficient remote monitoring, real-time surveillance, and heightened security features compared to traditional systems. Users experienced enhanced control and monitoring capabilities, contributing to a more secure and user-friendly smart garage door system.

5.1 Recommendations

By implementing the recommendations below, the NodeMcu and Blynk Smart Garage Door Surveillance Controlling System can not only maintain its current positive outcomes but also adapt to evolving user expectations and technological advancements.

i. Encourage comprehensive user education programs to familiarize users with the capabilities of NodeMcu and Blynk, enabling them to maximize the benefits of the smart garage door system.
ii. Conduct further research and development to strengthen the security features of the system, ensuring robust protection against potential cyber threats and unauthorized access.
iii. Explore opportunities to enhance compatibility with other smart home devices and platforms, allowing for seamless integration within broader home automation ecosystems.
iv. Investigate ways to optimize costs associated with the implementation, making the NodeMcu and Blynk solution more accessible and affordable for a wider user base.
v. Stay attuned to emerging IoT and smart home technologies, ensuring that the NodeMcu and Blynk integration remains aligned with the latest industry advancements.
vi. Evaluate the scalability of the system to accommodate potential growth in user numbers and additional functionalities, ensuring a robust and responsive solution for diverse user needs.

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