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A Low-Cost Home and Industrial Automation System Using IoT and Cloud Computing

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***Abstract:** This paper describes a low-cost home and industrial automation system that utilises IoT and Blynk Cloud for real-time monitoring and control. The system automates a variety of devices, including lighting, motors, temperature controls, and environmental sensors, by incorporating IoT-capable sensors and actuators. Data from these devices is sent to the cloud via the Blynk platform, which offers a mobile interface for remote access and control. Blynk Cloud allows customers to monitor their systems from anywhere and seamlessly integrates with existing IoT devices and protocols. This cloud-based technique also facilitates data storage and additional analysis. The usage of Blynk Cloud makes the system more user-friendly and customisable, resulting in a cost-effective solution for both household and industrial automation.*

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I. INTRODUCTION

In recent years, advances in the Internet of Things (IoT) and cloud computing have transformed automation systems in a variety of fields, including household and industrial applications. The Internet of Things has enabled seamless connectivity between devices, allowing for real-time monitoring and control of a variety of appliances and processes. Cloud computing expands on this capabilities by offering a scalable, accessible, and cost-effective platform for data storage, processing, and remote access. The integration of these technologies has resulted in the creation of smart automation systems that increase efficiency, eliminate human interaction, and provide more control over devices.

Home and industrial automation have received a lot of attention as there is a growing desire for intelligent solutions that optimise energy use, improve security, and increase overall convenience. Traditional automation systems can require intricate wiring, expensive hardware, and specialised software, making them unsuitable for mass use, particularly in cost-sensitive contexts. However, IoT-based automation provides a more flexible, scalable, and cost-effective alternative by combining wireless communication, cloud-based data storage, and mobile applications for control and monitoring.

This project describes a low-cost home and industrial automation system that incorporates IoT-enabled sensors and actuators into the Blynk Cloud platform. The suggested system enables users to monitor and control a variety of electrical and environmental factors using a simple mobile interface. The Blynk Cloud enables real-time data transmission and remote access without the need for substantial infrastructure or advanced programming expertise. The system is meant to be extremely customisable, allowing for seamless interaction with existing IoT hardware and protocols to meet a variety of automation needs.

The primary benefit of this system is its low cost, making it accessible to small-scale companies and household users who may not have the resources to invest in typical automation solutions. The Blynk Cloud connection offers a robust and effective approach to manage automation activities, including data visualisation, remote control, and event-triggered automation. Furthermore, the system provides data storage, allowing users to analyse past trends, optimise resource utilisation, and make sound judgements.

The proposed automation system can be used in a variety of situations, including smart homes, factories, agricultural environments, and commercial structures. In residential settings, it may regulate lighting, heating, cooling, and security systems, improving energy efficiency and comfort. In industrial settings, it may automate machines, monitor environmental conditions, and improve safety measures, all of which increase productivity and efficiency. The ability to access and manage automation systems remotely provides flexibility and convenience, both of which are critical for meeting current automation requirements.

This study investigates the architecture, implementation, and advantages of the suggested automation system. It includes a thorough examination of the hardware and software components, data transmission protocols, and cloud-based features that enable smooth operation. In addition, performance evaluation and case studies are explored to demonstrate the system's applicability and usefulness in real-world circumstances.

II. EXISTING SYSTEM

Currently, most residential and industrial automation systems are either manually operated or semi-automated. In industrial settings, processes still require significant human participation for setup, monitoring, and modifications, but home automation systems, while more sophisticated, frequently rely on user inputs via mobile apps or voice commands. These systems lack complete automation and integration, necessitating manual operation or predefined conditions to function.

III. PROPOSED SYSTEM

The suggested system provides a low-cost solution for home and industrial automation by leveraging IoT and Blynk Cloud for real-time monitoring and control. It automates a variety of devices, including lighting, motors, temperature controls, and environmental sensors, by combining IoT-enabled sensors and actuators. Data from these devices is communicated to the cloud via the Blynk platform, allowing users to access and control the system remotely using an easy-to-use mobile interface. Blynk Cloud facilitates successful integration with existing IoT hardware and protocols, resulting in efficient data visualisation..

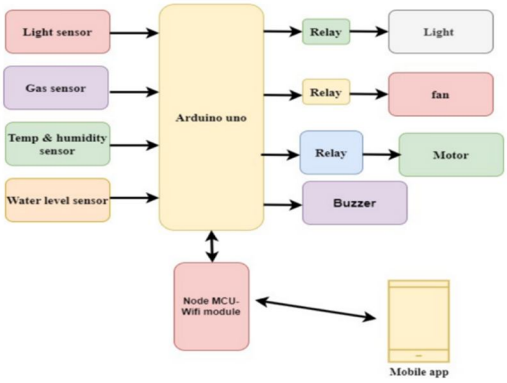

Fig.1. Architecture

IV. COMPONENTS USED AND DESCRIPTION

A. *Arduino UNO*

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board. Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package. Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

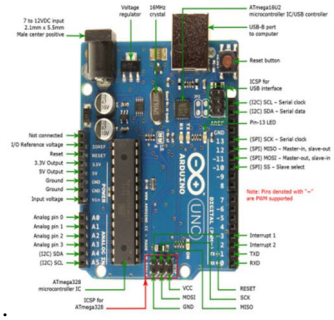

Fig.2. Arduino UNO Pin Description

B. *Node MCU*

NodeMCU is a low-cost open source IoT platform.[4][5] It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module.[6][7] Later, support for the ESP32 32-bit MCU was added.

Fig.3. Node MCU

C. Light Sensor Module

The light sensor module is a crucial component of the proposed IoT-based automation system, responsible for detecting ambient light levels and automating lighting control accordingly. It enhances energy efficiency by ensuring that artificial lighting is only used when necessary, reducing power consumption.

- Light Dependent Resistor (LDR): The core sensing element that changes resistance based on the intensity of light falling on it.
- Operational Amplifier (Op-Amp) Circuit: Used for signal conditioning and converting the LDR output into a readable voltage signal.
- Microcontroller (ESP8266/ESP32): Processes the sensor data and transmits it to the cloud.
- Relay Module: Controls the switching of lights based on sensor input.

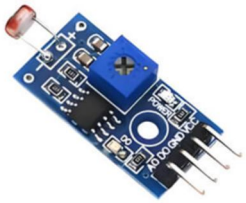

Fig.4 Light sensor

D. Gas Sensor Module

A The MQ-2 gas sensor module is a key component of the automation system designed to detect gas leaks and monitor air quality. It is highly sensitive to various gases, including LPG, methane, carbon monoxide, and smoke, making it an essential safety feature in both residential and industrial environments.

Fig.5 Gas Sensor Module

E. Temperature Sensor Module

The DHT11 temperature and humidity sensor is a key component of the automation system, providing accurate temperature and humidity readings for environmental monitoring. It is widely used in IoT-based applications due to its low cost, reliability, and ease of integration.

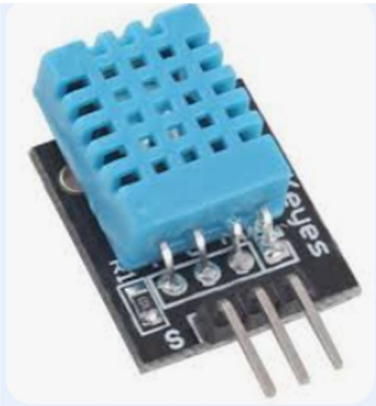

Fig.6. Temperature sensor

F. Water level Sensor Module

The Water Level Sensor module is an essential component in automation systems, particularly for water management in residential, industrial, and agricultural applications. It helps monitor and maintain optimal water levels in tanks, reservoirs, and pipelines

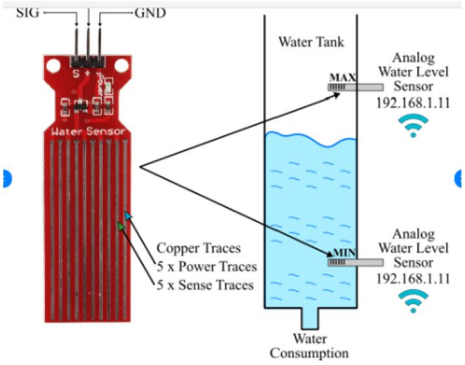

Fig. 7. Water level Sensor Module

G. Buzzer

It is an active buzzer that works from frequency range of 2000Hz to 2600Hz. It is made up on 2 pins that are used to attach it to ground and power source. Once the current flows through it, it will expand the ceramic disk inside it which will result in making the disc vibrate. The sound that will be heard is the result of the vibrations occurring with the disk.

Fig 8: 5V Buzzer.

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V. RESULTS

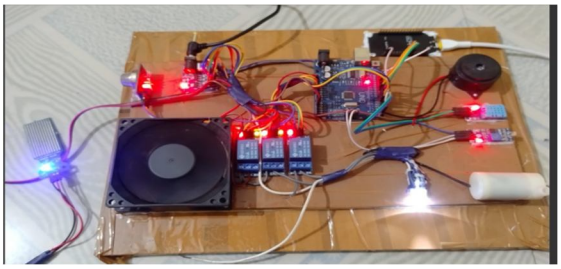

Fig 8: Working

The suggested IoT-based home and industrial automation system uses both hardware and software components. The following sections describe the system's primary hardware components and workflow. Serves as the primary processing unit, managing sensor data and communicating with the cloud. Included are temperature sensors (DHT11/DHT22), motion sensors (PIR), gas sensors (MQ-2), and humidity sensors. Relays, motors, and smart switches control devices in response to user orders or predefined situations. Provides internet connectivity for real-time data transmission. Provides the voltage and current required to keep the system's components running smoothly.

- Step 1: Data Acquisition: Sensors collect real-time data on temperature, humidity, motion, and other environmental factors.
- Step 2: Data Processing: The microcontroller processes sensor data and determines the appropriate control actions.
- Step 3: Cloud Communication: Data is transmitted to the Blynk Cloud for storage and analysis.
- Step 4: User Interaction: The user accesses the Blynk mobile app to monitor sensor readings and send control commands.
- Step 5: Device Control: Actuators respond to user commands or automated triggers to adjust device states.

This implementation offers an efficient and scalable automation system that ensures remote access, energy efficiency, and cost effectiveness. The suggested low-cost home and industrial automation system, which uses IoT and Blynk Cloud, is an efficient, scalable, and user-friendly solution for real-time monitoring and control. By combining wireless connection, cloud storage, and a mobile interface, the solution improves convenience, security, and energy efficiency while remaining cost-effective and customisable. IoT-based automation improves resource utilisation, reduces operational costs, and boosts productivity in both residential and industrial settings. With the ongoing improvements in cloud computing and IoT technology, this strategy has the potential to radically revolutionise smart automation solutions, making them more accessible and effective for a variety of applications.

VI. CONCLUSION

To summarise, the suggested low-cost home and industrial automation system based on IoT and Blynk Cloud offers an efficient, scalable, and user-friendly solution for real-time monitoring and control. By combining wireless connection, cloud storage, and a mobile interface, the solution improves convenience, security, and energy efficiency while remaining cost-effective and customisable. IoT-based automation improves resource utilisation, reduces operational costs, and boosts productivity in both residential and industrial settings. With the ongoing improvements in cloud computing and IoT technology, this strategy has the potential to radically revolutionise smart automation solutions, making them more accessible and effective for a variety of applications.

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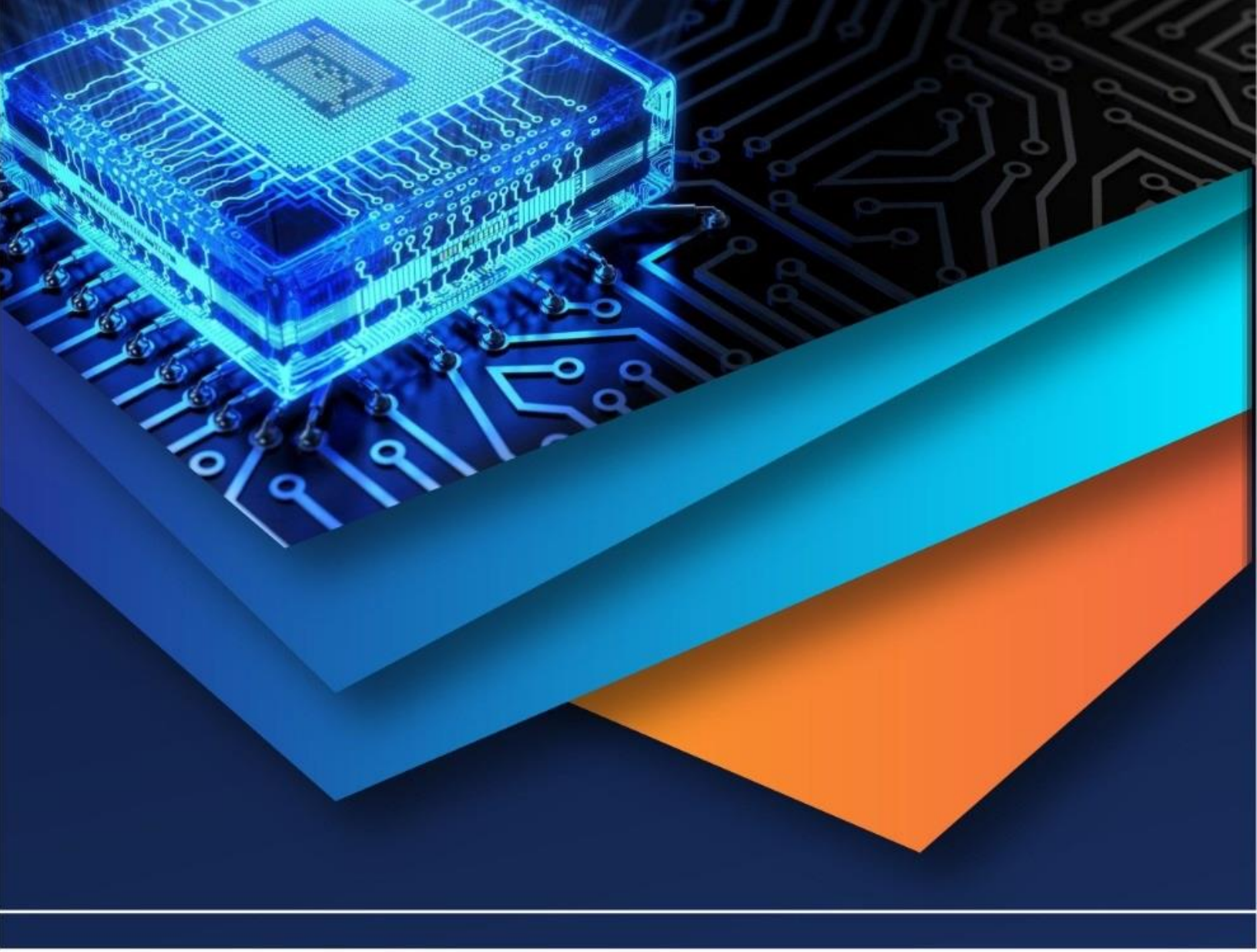

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