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EMPLOYABILITY OF AN INTERNET OF THINGS (IOT) BASED SYSTEM FOR MONITORING AND CONTROLLING OF ELECTRICAL DEVICES

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ABSTRACT

As the speed and capacity of the Internet increase, the Internet of Things (IOT) is introducing new nodes to the market and opening doors for new invention opportunities. This study describes an Internet of Things (IoT)-based surveillance and control system for energy-saving electrical devices. Because lighting appliances use a lot of energy, improving efficiency and speeding up defect detection is a big challenge. Depending on the type of application, this work uses two distinct model techniques. IEEE 802.11 wireless technology is utilised in compact spaces or cramped buildings, with every equipment linked to a single Wi-Fi network. Wired configuration is employed in the second model, similar to the street lamp pole, where the number of appliances rises only in one direction.

INTRODUCTION

IOT is a global network of interconnected sensors, computers, and digital devices that are connected via the internet. These devices can communicate with one another and exchange and transfer information by assigning unique identifiers, or UIDs, to each item. The emphasis on automating these spaces has sharply expanded as diverse business spaces and cultures expand. Additionally, everyone is moving towards a better and more dependable electrical control system as a result of the growing traffic chaos in urban areas. For further energy conservation and early defect identification resolution, an intuitive web application and a mobile-based monitoring and control system linked to an IOT cloud server are employed here. The search has intensified for the best energy-based traffic signal and light control system in this rapidly expanding era of smart cities. In order to make using and monitoring electrical devices easier, effort has been made to develop a dependable and user-friendly program.

APPLICATIONS OF IOT

IOT is very applicable in numerous fields, such as:

1) Smart Exam based on IOT to determine exam question difficulty and disability for students [1]. This technique makes it possible to assess a student's comprehension of a particular topic or subject.

2) An IOT-based remote patient health monitoring program [2].

3) Modern vehicle monitoring systems are designed to track a vehicle's performance and get real-time input on its movement [3].

Due to the fact that IOT transfers data into an open cloud system, it has also provided critics with a forum for an open discussion on security issues. IOT implementation requires careful consideration and prudence [4].

SYSTEM OVERVIEW

The entire system is separated into two categories, as was previously described. Within the system: The suggested ESP module-based surveillance and control system's block diagram is displayed in Figure 1.

It is made up of street lights, current-sensing sensors, a relay that turns the device on and off, a 5 volt power supply converter, and an MCU node at the slave end (an electrical device). Sensors are used to operate electrical appliances, provide analogue environmental signals to systems, and carry out associated tasks. The Raspberry Pi 3 controller, which is linked to the Internet, makes up the master end. The microcontroller's job is to use a wireless connection to gather data from every street lamp and transform it into serial communication.

The signal travels via the sensors to the NodeMCU, which then wirelessly sends it to the master control terminal. The master controller recognises the signal and takes the necessary action when it detects a street light failure. At the electrical device end of the gearbox system is a NodeMCU that gathers data from the device's sensors. The master controller, a Raspberry Pi, is located on the other end and is responsible for wirelessly receiving data and sending it to a central monitoring system. The graphical depiction of the data collected from the electrical devices is displayed by the web application.

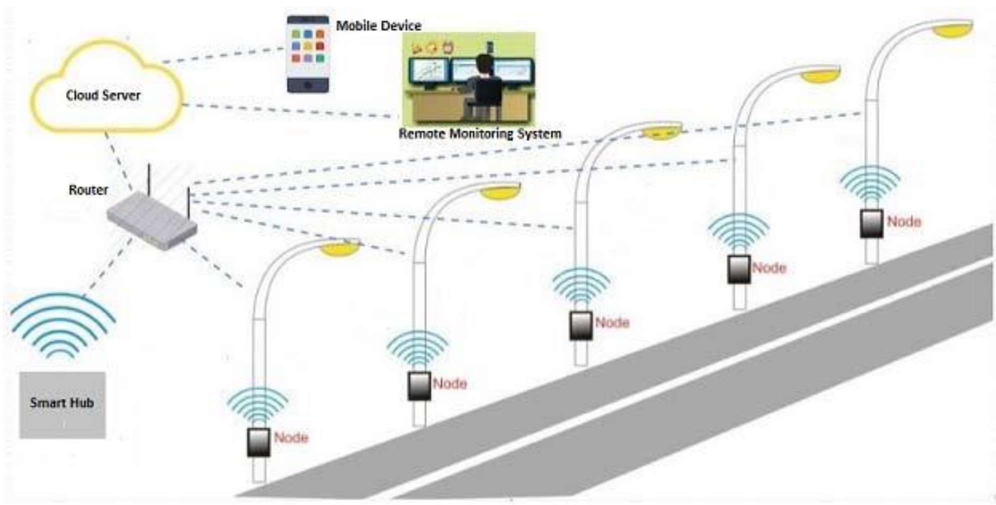

Fig. 1. Block diagram of Wi-Fi based surveillance and control system (On Premise)

One-directional: This is the situation with traffic street lamps [11], which only have one direction of growth. This is distinct from the on-premise scenario because of the communication range difficulty here. Since the routers or Node MCU's wireless connection range is measured in meters, it cannot be used in situations where a connection measured in kilometres is needed. Additionally, a cable connection is utilised to link the Master Controller Raspberry Pi to the street light gadget in order to ensure the system's dependability. This Pi in turn is linked to a web application and cloud server. - The block diagram for the suggested surveillance and control system for a one-way system is displayed in Fig. 2.

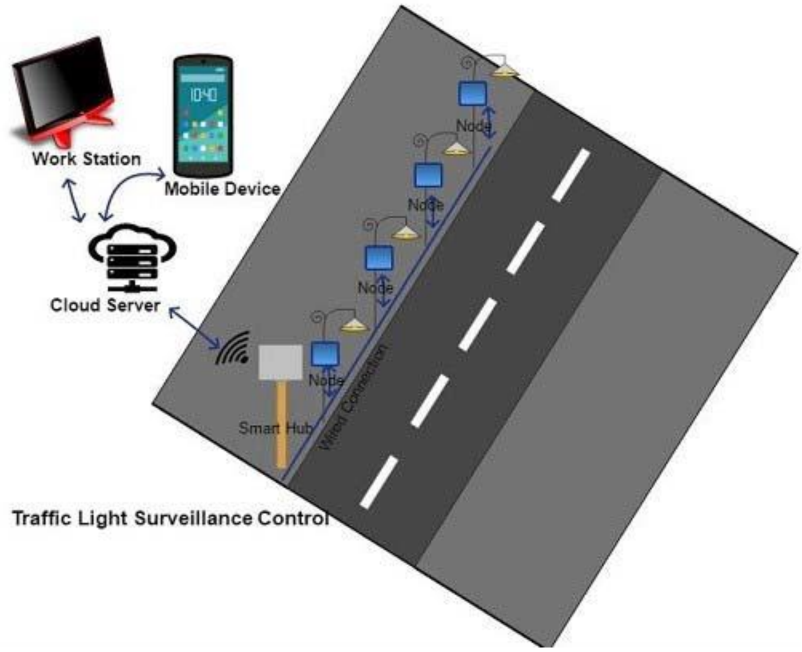

Fig. 2. Block diagram of Wi-Fi based surveillance and control system (One directional)

A. Master Controller: This device controls and monitors the entire system, functioning as its brain. Through a connected connection, the Raspberry Pi sends and receives signals to and from slave nodes. In parallel, it transmits the feedback to a central monitoring program so that various electrical devices' statuses can be seen visually.

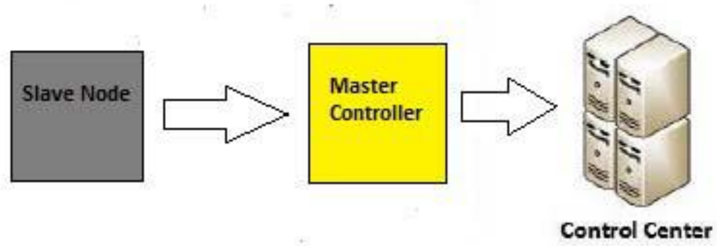

Fig. 3. Receiver Block Diagram

B. Slave Node: To transmit and receive data on the device's state, each lamp controller is linked to the master controller. A signal about the device's operational condition is sent to the master controller via the current sensor detector that is linked to the electrical device. In the event that the master sends a signal to the slave, the slave acts appropriately based on the information received.

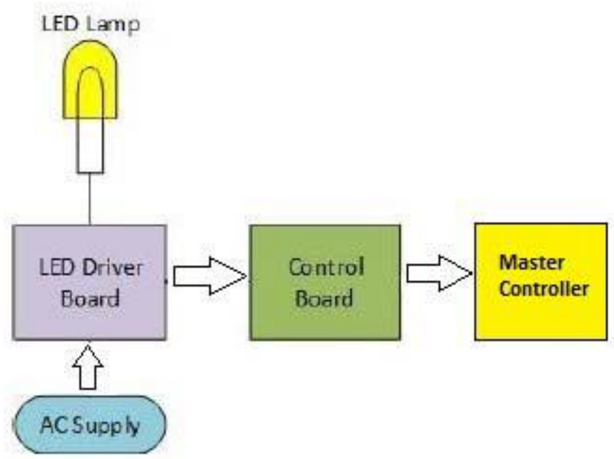

Fig. 4. Transmitter Block Diagram

C. Web Application: A user-friendly web application is utilised to show the electrical device's status.

Additionally, this web application allows the user to transmit signals to the gadget, enabling remote control of it. The HTTP protocol can be used by this application to communicate with the master controller.

D. Software utilised: The two development tools utilised in this project are AVR studio and Node Red. AVR Studio is used for embedded level programming, whereas Node Red is utilised for web application development.

ALGORITHM

Algorithm 1: Controlling Electrical device from Web application

Notation

Pub: Publisher

Sub: Subscriber

Trigger: Switch on the lamp from web application

1. MQTT server on Raspberry Pi controller receives message

from web application through Subscriber (Sub) message.

2. Pi reads the message for the client id of the target

electrical device

3. Node Red (pub) finds the client id of the target device and

Algorithm 2: Sending fault alert from Device to web application

Notation

Pub: Publisher

Sub: Subscriber

Trigger: Send fault signal from device

1. ACS712 current sensor senses the fault in electric current flow and alerts the Node MCU (Pub) to publish message to Subscriber for the fault.

2. Master Controller Pi receives this message from device over HTTP protocol using MQTT message.

3. Controller then sends the fault signal to other Subscriber over HTTP protocol.

4. Web application receives this fault signal and displays on the web portal.

Flowchart of the algorithm for the system is as depicted in Figure 5:

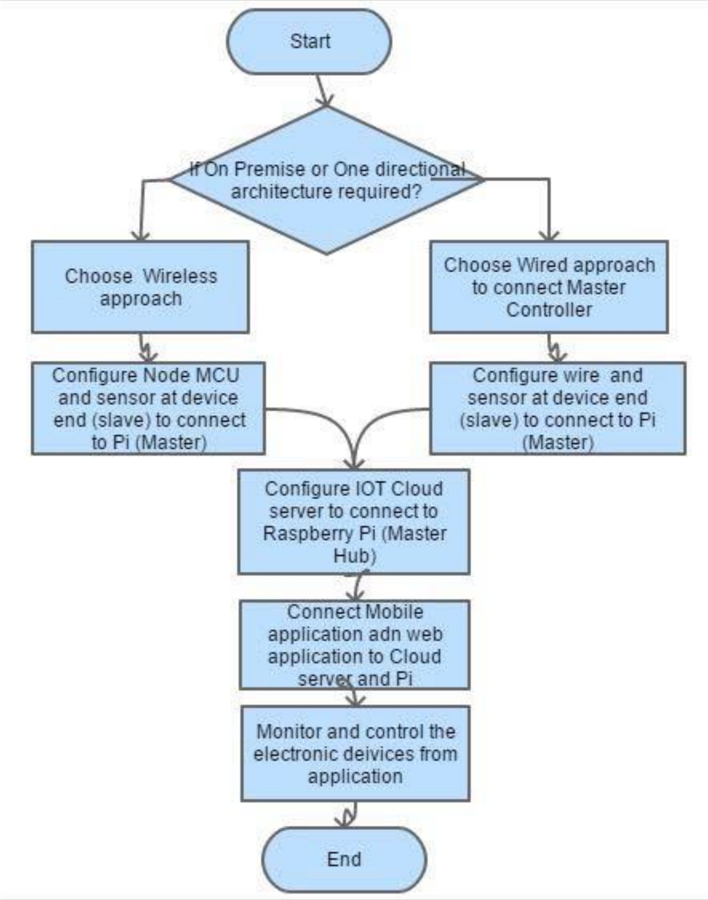

Fig. 5. Flowchart of the algorithm

CONCLUSION

The only purposes of this Internet of Things (IoT) based device surveillance and control system are to monitor the operational state of electrical equipment and to remotely regulate their on/off functionality from a central location. The system's architecture facilitates effective indoor and outdoor illumination. It significantly lowers the amount of electric energy used by offering central control over the appliances, while also increasing system efficiency by sending out alerts in the event of a malfunction. The user-friendly and conveniently available mobile controlling platform is provided by the graphical application. This system can be implemented to manage street lamps that use a lot of energy and require manual intervention. It is an energy-efficient solution.

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