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MOTION SENSING LIGHT AUTOMATION SYSTEM

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Abstract: **The Motion Sensing Light Automation System using NodeMCU and an Ultrasonic Sensor is an effective solution to automate lighting control that can minimize energy consumption and add security to different environments. The ultrasonic sensor and the NodeMCU microcontroller based on ESP8266 Wi-Fi module collaborate in the system to detect movement in a range. The combination of NodeMCU and ultrasonic sensor technologies demonstrates a scalable approach towards smart automation, opening up the possibility of safe, energy-efficient smart building environments. This work aims at automating lighting control, without the use of relay modules or infrared sensors, by developing a motion-sensing light automation system that uses a NodeMCU with ultrasonic sensors. This technology makes use of ultrasonic sensors that detect the presence of humans by measuring distance to objects in real-time. Based on the ESP8266 Wi-Fi module, the NodeMCU has strong connectivity, which allows for remote control and monitoring through a mobile application.**

Key Words: **ESP8266, HC-SR04, Blynk, MOSFET**

1. Introduction:

This is possible without using a relay module by implementing an ultrasonic sensor-based Motion Sensing Light Automation System with NodeMCU [1]. It's very effective for energy-conscious areas like hallways, restrooms, or entrance ways as it senses movement within its range and activates lights accordingly based on real-time presence. The NodeMCU (ESP8266), a microcontroller with Wi-Fi functionality, is at the heart of the setup [2]. It utilizes ultrasonic waves to calculate the distance [3]. The HC-SR04 ultrasonic sensor will alert when it reaches a predetermined distance to measure something. In this case, the sensor is set between 1 to 2 meters in front. Upon hitting this distance, it gives feedback to the NodeMCU [4]. This system is specifically designed for low-power lighting applications and is directly controlled through the GPIO pins of NodeMCU rather than those traditional configurations that use a relay module for dealing with high power switching [5]. Such a system may light areas as and when required, without requiring additional hardware to connect small LEDs directly on these pins or using transistors or MOSFETs for slightly

higher-power LEDs. It allows one to include it in smart lighting control solutions using remote control by smart bulbs to switch on/off the lights based on any need for power consumption depending on the motion information. The feature is pretty useful in smart home configurations since NodeMCU will communicate with applications like Google Home, Blynk, or IFTTT, thus offering more personalization and flexible scheduling along with remote monitoring. At some point, the sensor will not be able to sense any movement, and then NodeMCU cuts off the lights for not wasting power and to save power. This delay can easily be set in such a manner that lights can remain ON even if a person momentarily fails to move. In addition to its main function of automating, the design of the system is relatively flexible and expandable for it to be ideal for additional purposes [6]. This is such that a larger area could be scanned with minimum change-over in modifications as more ultrasonic sensors and LEDs are added [7]. This means that there is the potential for increased flexibility when it comes to viewing or changing settings in the system, using the Wi-Fi offered by NodeMCU. This is based on the lack of a relay module, which reduces general cost and the physical size of the system. So, this makes the system relatively inexpensive to anyone interested in intelligent and effective automation.

2. Literature Review:

K. L. Raju, V. Chandrani, S. S. Begum, M. P. Devi, The Internet of Things is made up of objects with distinct identities that are linked to one another online. It's just using the Internet to connect and keep an eye on different sensors and gadgets. This opened the door for home automation and monitoring, which improves the security and comfort of people's lives. The general idea behind IOT-based monitoring and sensing systems for automated house implementation is explained in this paper. The suggested prototype makes use of a Node MCU board that can be remotely controlled via the internet using an Android OS smartphone. The core of this system is the Node MCU, which serves as an interface for a variety of hardware modules and can function as a mini web server. The relay system has switching features to regulate lights, fans, and other household appliances that are connected to it. Through the detection and analysis of temperature and humidity data, it is also utilized for environmental monitoring. Intrusion detection, which is provided by this system utilizing a motion sensor, is another alerting feature. The Blynk mobile app for Android is used to manage all of these activities [8]. Jasmine Pandini, Muhammad Asyrad Bin Zulkipli, Fenoria Putri, Smart systems have emerged as a result of the quick development of technology, with the goal of improving safety, convenience, and energy efficiency. In this paper, we describe the creation of a NodeMCU sensor-based automated door and light system. The technology is intended to automatically regulate internal illumination and door opening and closing. This experiment used the NodeMCU sensors' built-in Wi-Fi capabilities to create the system, allowing for remote control and monitoring through a

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specific mobile application. The application gives customers the option to alter a number of system characteristics to suit their unique needs. This innovation provides a useful and integrated way to automate doors and lights, improving comfort, safety, and energy efficiency in any structure, whether it be a home or a business. It offers simplicity and flexibility by allowing users to remotely control the door and light. This system is very effective because it makes it easier for users to open and close the door and turn on and off the light without extra effort. The user can unlock the system by sending commands through the Blynk application on their smartphone. A microcontroller called a NodeMCU sensor will then confirm the command and send data to other components to move the sliding door and turn on the light [9].

3. Design:

A motion-sensing light automation system can be made using a NodeMCU, ultrasonic sensor, and LED. The ultrasonic sensor will detect distance, that is, the presence or absence of any human or objects. The NodeMCU is an embedded device which has Wi-Fi connectivity; when the distance changes within its range it means that some motion is going on, and this change is signified to the NodeMCU via the signal received by the NodeMCU. The NodeMCU checks the input if it detects movement. The LED turns on after this process. Connect the ultrasonic sensor trigger and echo pins with the NodeMCU's GPIO pins as an illustration. Write now the software capturing the response by the sensor and calculate its distance based on how long does it take the noise to bounce back to the sensor. If it is less than a threshold level, then turn on the LED. The system is easily mounted, energy-efficient, and does not use infrared sensors since it only applies the ultrasonic detection technology. It can be used on energy-saving or home automation projects.

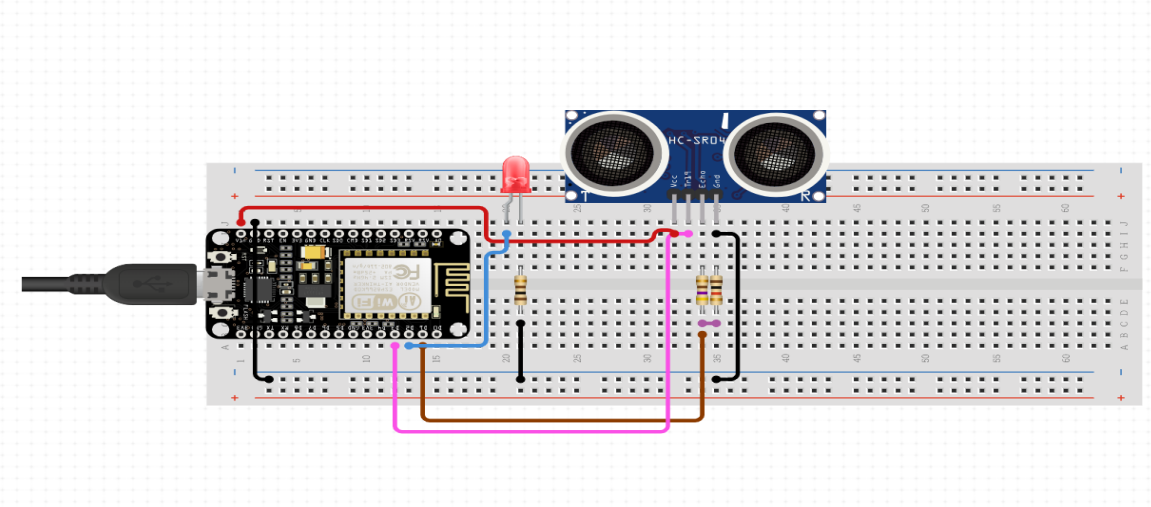

Figure 1: Design on Motion Sensing Light Automation System

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4. Result Analysis

The motion-sensing light automation system analyzed is with an LED, an ultrasonic sensor, and a NodeMCU. The findings of this research are dependable and effective to operate. An ultrasonic sensor uses the sound waves and measures the distance changes by detecting the changes in distance. The NodeMCU lights up the LED to provide automatic lighting whenever movement is detected in a defined range. This technology avoids infrared sensors, which are highly high in dependence on temperature and illumination conditions, thereby assuring consistent performance in numerous contexts. Because the NodeMCU communicates with the ultrasound sensor seamlessly and is capable of controlling the LED precisely, the system responds and is energy-efficient. Sharp power consumption reduction was observed from manually operated lights while instantaneous activation of the LED on motion detection was also identified as one of the important findings. The system is affordable, easy to install, and appropriate for use in smart homes without dependency on infrared technology. It allows users to save energy and has convenience.

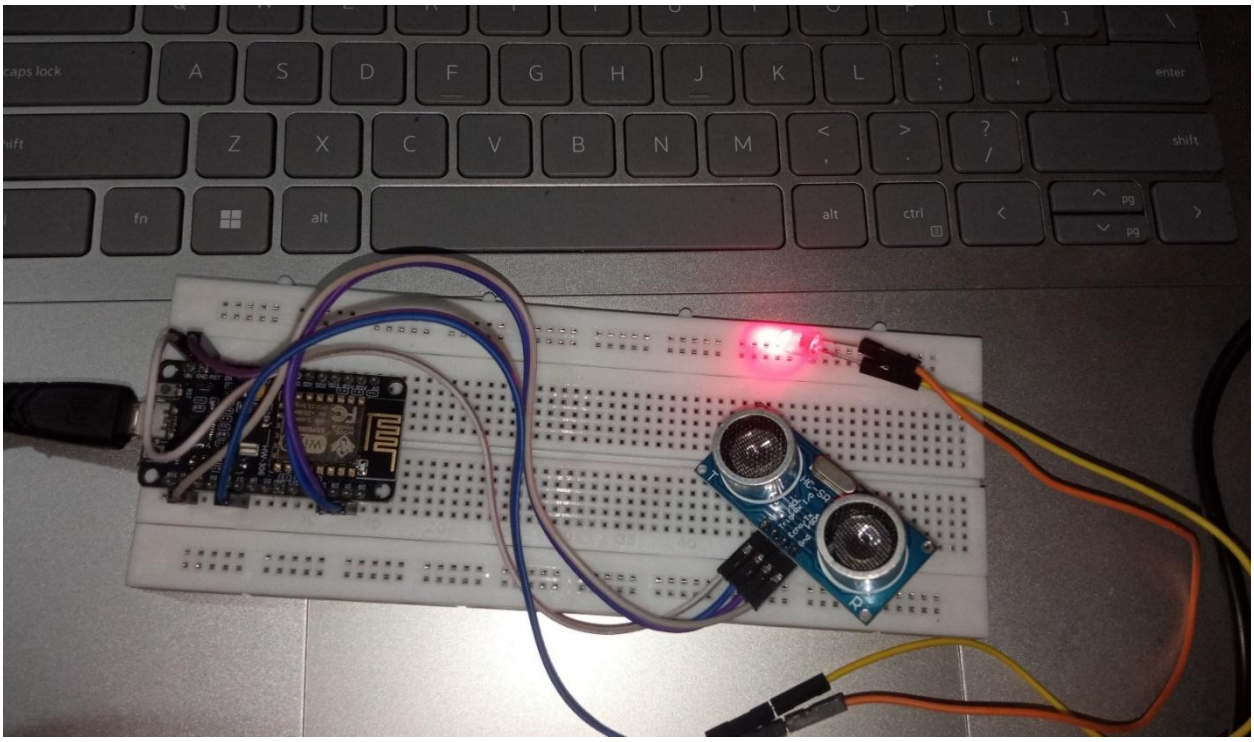

Figure 2**:** Result on Motion Sensing Light Automation System

5. Conclusion:

They basically improve convenience and economy in multiple ways by saving energy, bringing security, and prolonging the life of lighting fixtures because they automatically turn the lights on when motion has been detected and off once no motion has been felt after a period of inactivity. This is especially advantageous in rooms that keep their lights on for much longer hours than they would need to, week-in and week-out - halls, bathrooms, garage and outdoor areas. Taking all of this into consideration, motion-sensing light control automation systems offer a cornucopia of advantages in it: it's cheaper regarding the cost of energy, it provides improved security and convenience and much more approachable lighting approaches as well. Such systems are a smart way to go about increasing safety efficiency while being practical for any public or commercial and even domestic setting in mind. Motion-sensing light automation systems have several disadvantages, including the possibility of false activations, discomfort in low-traffic areas, greater initial costs, and maintenance needs. Before installing it, you must analyze the restrictions of the system and the particular requirements of your space. Benefits, especially energy saving, security, and convenience outweigh disadvantages for most users though highly dependent on the intended usage and surroundings of the benefit of the system.

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