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IoT Based Home Automation using PIR Motion Sensor and Node MCU

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Abstract: ***This paper depicts a unique home automation system where its efficiency and accuracy can be improved by integrating the PIR motion sensor and google voice assistant. It comprises of Node MCU (esp8266) which is a Wi-Fi module used to transmit data over internet, electromagnetic relays, and the PIR sensor. This developed system works when there is any motion within the defined sensor range and it can also be controlled through the mobile application. Blynk application has been configured with the system so that it works flawlessly on both iOS and android devices. The developed microcontroller has been configured with the Blynk server which makes the home appliances work remotely and eliminates the need for a dedicated PC server. The final prototype is also configured with google assistant so that the relays can be triggered with the voice too and this system has been successfully developed, and the working prototype has been tested with various test cases.***

Keywords: ***Node MCU, PIR, Wi-Fi, relays.***

I. INTRODUCTION

Internet of Things (IoT) is a concept which helps to build a wireless network among the different devices accessed through internet and various IP protocols. Basically IoT creates an ecosystem among devices which makes it accessible remotely and things in IoT represents the devices like sensors, microcontrollers, and mobile phones that's connected to a wireless network. The resulting network is usually referred to Internet of things (IoT) [1]. Evolution of IoT has solved plethora of real time problems and have improved the flexibility of various existing systems. Evolution of technology have always encouraged the use of Wi-Fi which eradicates the need of wired connection and thus reducing the cost and complexity of the system. In this case the Wi-Fi module, Node MCU (esp8266), act as a gateway to connect the home appliances to the Blynk server and those appliances can be triggered remotely through the Blynk mobile app. Additionally, this Internet based home automation system has been integrated with passive infrared sensor (PIR sensor) which makes the system work when there is any physical movement. With all these in mind the system has been designed.

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Fig. 1. Smart Home

II. METHODOLOGY

Mainly the project is a concept to bring automation in the home. All the home appliances will be controlled via Blynk mobile app and also by detecting any physical movements across the room. The appliances in the home will be interfaced with centralized micro controller Node MCU for the organized working. The controller also interfaced with WIFI to receive the control commands from Wi-Fi shield (Wi-Fi hotspot) and through Blynk servers those appliances can be triggered. The operator will be provided with the Blynk app on a Wi-Fi enabled smart phone. If an operator wants to switch the appliances to on or off, he needs to switch the button provided in Blynk app. Once he's done, the Blynk app will send the data to the Blynk servers and receives the response back to the microcontroller accordingly and when the request is received by the microcontroller it activates the specific appliance. In the same way all other appliances can be controlled. In addition to that a PIR motion sensor has been added to the Node MCU which detects the motion within a defined range and controls the appliances based on the detected inputs.

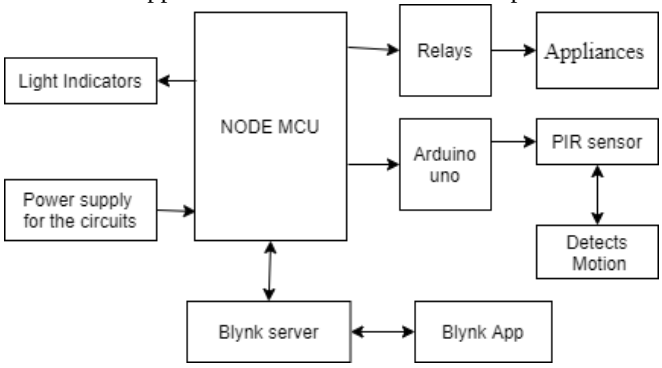

Fig.2. Block Diagram

III. HARDWARE SPECIFICATION

The components used are,

- NODEMCU esp8266
- PIR Motion Sensor
- LED
- Relay
- Arduino UNO

- NODEMCU (esp8266) has been selected as the controller for this system due to its compact size, compatibility, stress-free interfacing over several other type of controller including Programmable Integrated Circuit (PIC), Programmable Logic Controller (PLC) and others.
- ESP8266 is an open source Wi-Fi enabled module that is built on top of manufacturer's proprietary SDK. The firmware provides a simple programming environment, which is a very simple and fast scripting language which makes the ESP8266 stand out. The board has a built-in micro USB port, a hard reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plugged into our designed board. Figure-3.1 shows the diagram of NODEMCU (ESP8266). It has a Processor called L106 32bit RISC microprocessor core based on the Tensilica Xtensa Diamond Standard 106Micro running at 80 MHz and has a memory of 32 Kbit instruction RAM. IEEE 802.11 b/g/n Wi-Fi module comes in handy with this module which accepts most of the bandwidth.

Fig.3.1.Node MCU

- A light emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it.Fig-3.2 shows the diagram of LED.

Fig. 3.2. LED

- Relays, the main component of our project, are nothing but a switch which works electromagnetically to trigger the appliances that are connected to this prototype. Typically they are available in various volt options like 5v, 12, 24v and so on to support plethora of appliances which makes this system more versatile and affordable. Relays are capable of triggering devices which works on higher volts. For instance, a 40 watts bulb can be triggered to on\off condition using a 5v relay. They usually take an input and an output where the coil inside it is magnetically charged when an input voltage is given to it. They comprises of three contactors: Normally open (NO), Normally closed (NC) and common (COM) where by using subtle combination of these contactors, home appliances can be turned on and off.

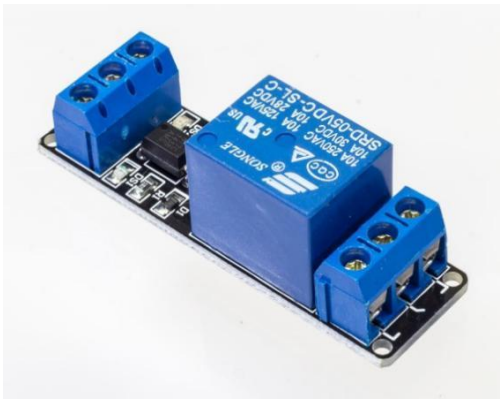

Fig. 3.3. Relay

- A passive infrared sensor (PIR sensor) is an electronic sensor which measures infrared (IR) radiation in its field of view from objects. They are most widely used in motion-detectors based on PIR. These sensors are widely used in safety alarms and automatic lighting. PIR sensors sense general movement, but don't have information on who moved or what. An active IR sensor is necessary for this purpose. PIR sensors are generally referred as "PIR" or sometimes as "PID" for "passive infrared detectors." The term passive refers to the fact that PIR devices for detection purposes don't radiate energy, instead they work entirely by detecting infrared radiation (radiant heat) emitted by objects or reflected from them.

Fig. 3.4. PIR motion sensor

IV. WIFI MODULE

Expressive Systems Smart Connectivity Platform (ESCP) of high-performance wireless SOCs for mobile platform manufacturers has an unsurpassed ability to incorporate Wi-Fi features into other applications at the lowest cost and the best flexibility.

V. SOFTWARE DEVELOPMENT

A program has to be developed with an efficient logic to run and execute the designed wireless home automation system where it's easy to verify and compile after writing the code.

The complete flowchart which gives the whole operation of system is shown in figure-5.The complete flowchart which indicates the whole operation of the system and controlled by a mobile app. The focus of this project is to automate the process of triggering the home appliances. The program developed through Arduino's IDE has been used as an interface between Blynk app and microcontroller, node MCU, of this project to improve its accuracy. The developed program have been uploaded into the node MCU via Arduino's IDE and configured to connect the module to Blynk server. The Unique ID provided by the Blynk has been configured with the Blynk app to communicate with the specific remote Wi-Fi module and the Blynk app is modified by including on\off switches as per our need to trigger the relays connected to the input pins of the node MCU module remotely. Additionally, the program to calibrate the PIR sensor has been fed into the Arduino and also the PIR sensor has been connected to the node MCU module via Arduino UNO using its I\O pins. To improve the flexibility the relays are configured with google assistant using IFTTT, a free web-based service that creates chains of simple conditional statements, so that the relays can be triggered google voice assistant. Finally, this process continues the operation and the system forms a loop to its initial condition.

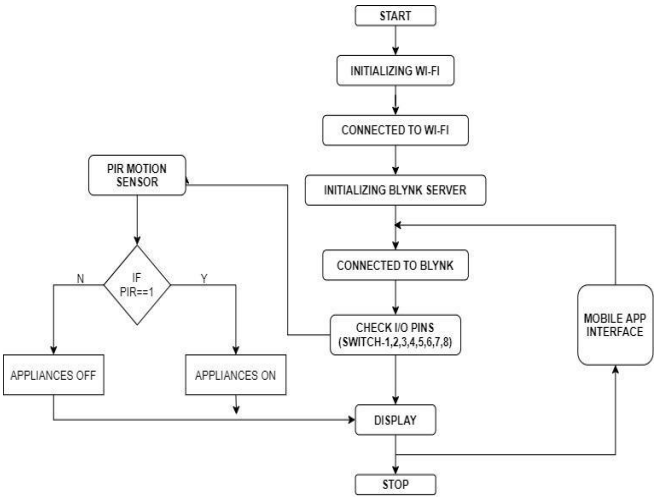

Fig. 5. Flow Chart

VI. RESULT AND DISCUSSION

Images of Output:

Fig. 6.1. Node MCU Integration

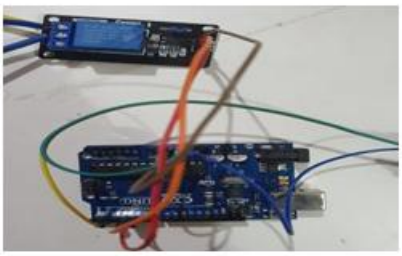

Fig. 6.2. Arduino UNO connection

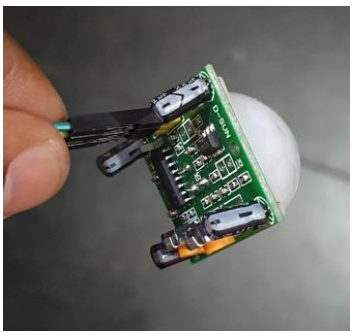

Fig. 6.3. Passive Infrared Sensor

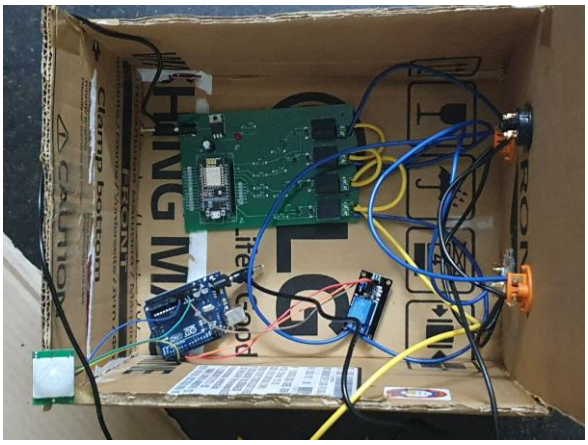

Fig. 6.4. Integration of all the components

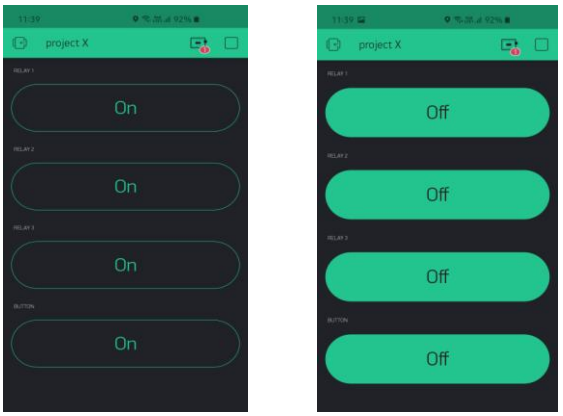

Fig. 6.5. Blynk app Screenshots.

VII. CONCLUSION

However, the working prototype of our home automation system has been tested and implemented. Since it comprises of PIR sensor, the appliances work only if there is any physical motion with the defined range. All the appliances connected to the board can be monitored remotely with the Blynk mobile application which works flawlessly on both the android and iOS devices as well. This prototype can be used to solve plethora of real world problems, automating the street lights, For instance and substantial amount of electricity can be saved by switching off the appliances/devices when there is no any physical motion. As a future enhancement, we are also working on configuring the ultrasonic sensor (HC-SR04) with this prototype which would allow us to elicit data such as distance to and from an object/human and with those data the precision of human motion detection can be improved. To sum it up all, perhaps this prototype might sound simple yet the concept behind this is such a game changer.

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AUTHORS PROFILE

Ranjithkumar. R is an undergraduate computer science student pursuing his studies at Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu. Despite working on many projects, this is his first paper after his several days of research on IoT and he is so curious about Android app development which led him to complete the Internshala’s Android app development course successfully. As a team leader, his solution for the real-time problem, Reverse Logistics for Retailers, got selected in Smart India Hackathon 2019 and he presented it for Hindustan Unilever Pvt Ltd which he contemplates as his biggest accomplishment.

Rathish Ganesh. S is a student who is currently pursuing computer science engineering at Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu. He has worked on many projects and this is his second paper. He is somewhat good at mobile application development in both native and react components. The first paper was on Paper Presentation in International Conference on “Recent Advances in Engineering and Technology - ICRAET 2019” and has been awarded the best paper of all. The paper presented was about Virtual ICU.

Ram Vikash. K who is currently an undergraduate computer science Engineering student pursuing at Sri Krishna College of Engineering and Technology, Coimbatore, Tamil Nadu. He has done several projects with respect to his field and this is his first paper. In addition to that he has participated in in Smart India Hackathon 2019.

Mr.M.Manikandan is currently an Assistant Professor in Dept. of Computer Science and Engineering, Krishna College of Engineering and Technology, Coimbatore. He has completed his B.E in Computer Science and Engineering in 2013, M.E in Computer Science and Engineering in 2016 and Pursuing his Ph.D. He has around 4 years of teaching experience and 1 years of research experience. His area of research includes Cloud Computing Techniques, Machine Learning. He has published around 5 papers in International journals and has published 2 patents. He was the Junior Research Fellow for the project titled “Compilation Skill Requirements for IT-Professionals” worth 15 lakhs sponsored by DST/NSTMIS. He is a life member of Institution of Engineers, Indian Society for Technical Education. He has published 2 books in his area of interest.