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Design & Development of IOT based Home Automation System

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Abstract: With the amazing power of the latest wireless communication & internet technology, life is becoming much easier. With a single touch on the cell phone, we are able to access large amount of information & data due to latest computes & internet. These advanced technologies not only give the information, but also gives us the ability to control, communicate, organize and manage the many resources, devices etc. Among which the Internet of Things is the latest one. The IOT is sort of vision which has penetrated into our day today life through a network of wireless devices which can be controlled & monitored by a cell phone. The IOT based home automation is one of the interesting field. In this paper we present IOT based home automation system, wherein we can control some electrical appliances like light, door etc. by using our smart phone.

Keywords: Internet enabled PC/Laptop/Cell phone, Node MCU, ESP8266 Microcontroller, Relay & Buzzer

I. INTRODUCTION

Automation or automatic is a word that is used to control systems such as machinery, processes in factories, boilers and heat treating ovens, switching in telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. The present century will be more self control and automated due to the comfort it provides especially when this automation technique is applied to a personal home. Home automation system means that allow the users to control various electrical, safety & monitoring devices automatically & wirelessly. Earlier such devices are controlled with wired circuit. With advancement of wireless communication & automation technology, life is getting simpler and easier in all aspects. In today's world Automatic systems are being preferred over manual systems. With the rapid increase in the number of users of internet over the past decade internet has made a part and parcel of life, and IoT is the latest and emerging internet technology. Internet of things is a growing network of everyday object-from industrial machine to consumer goods that can share information and complete tasks while you are busy with other activities. Wireless Home Automation system (WHAS) using IoT is a system that uses computers or mobile devices to control basic home functions and features automatically through internet from anywhere, anytime around the world. An automated home is sometimes called a smart home. The home automation system differs from other system by allowing the user to operate the system from anywhere around the world through internet connection.

II. RELATED WORK

The literature survey shows that, this modern wireless communication, cloud computing and internet of things technologies for control various electrical & electronics devices have been used by various researchers. Vinay Sagar et al used IOT technology for home automation in which Intel Galileo that has the integration of Cloud networking, wireless communication etc for remote control of various electrical appliances like fans, lights [1]. Tejal Deshpande et al proposes the home automation using IOT, smart phone and Arduino mega ADK for controlling Temperature, lights and mood lighting etc [2]. Prof B.P Kulkarni et al adapted the Raspberry PI method for home automation system with IOT [3]. Home automation & Security of smart home is being established by the use of multiple technologies like RFID, SMS, Email & real-time algorithm based IOT by Khushal Shingala [4]. Again the application of Raspberry PI method along with android smart phone for home automation is reported by Kalyani Pampattiwar et al [5]. Apart form home automation, the IOT is now being used for Women's safety, wherein various methodologies like transmitter, receiver, GSM, GPS, temperature sensor, heart beat sensor with ARM-7 microcontroller is reported by R.A.Jain et al [6]. As the IOT is a very vast domain so its area of application is also vast. Here is a IOT based theft detection using raspberry PI, in which image processing, camera, motion sensing etc used and reported by Umera Anjum et al [7]. Anandkrishanan S et al used IOT for LPG gas leakage & monitoring along with SMS alert by applying GSM technique [8]. Other researchers have applied the IOT methodology for smart city underground water leakage & theft detection, Vehicle theft detection,

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smart parking system and smart agriculture system [9][10][12][13]. The other important filed of application of IOT is healthcare. Prashnat Salunke et al proposed IOT driven healthcare system for remote monitoring of patients [14]. Electromyogram (measurement of electrical activities of muscles) is one of the important physiological parameter of human. Gaurav Raj et al reports measurement of this EMG by using sensors & IOT [15].

III. THE SYSTEM OUTLINE

This paper proposes an IOT based home automation system for monitoring, & control of electrical appliances & prototype door operation by the use of Node MCU & ESP8266 microcontroller. Node MCU is an open source IoT platform. It includes firmware which runs on the ESP8266 WI FI SoC from Espressif system, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the non OS SDK Epressif. It uses many open source projects, such as lua-cjson, and spiffs. It is a low-cost Wi-Fi chip with full TCP/IP stack and MCU capability produced by Chinese manufacturer, EspressifSystem. Apart from the main microcontroller, we have some other electronics components like Relay, Buzzer, DC geared motor, a AC bulb and a prototype Door assembly. There are two power supply units. One 230v AC mains to a bulb through a relay. The bulb can be turned ON & OFF as and when the relay is turned ON & OFF. The second power supply unit of 9v DC is to controller.

IV. METHODS AND MATERIALS

The developed IOT based home automation system block diagram is shown in the fig 4.1.This consists of following blocks

1) Wi-Fi enabled system/laptop/PC
2) Node MCU
3) ESP8266 Microcontroller
4) Relay
5) Buzzer
6) L293D Motor
7) AC Bulb
8) Prototype Door
9) Power Supply

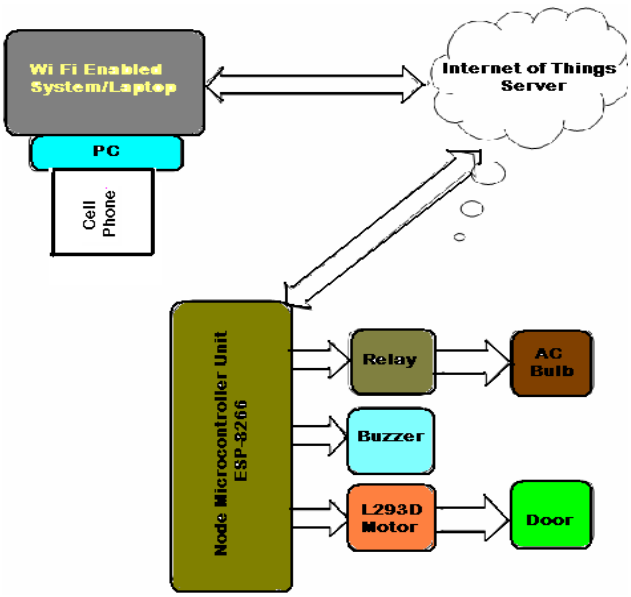

Fig. 1 System Block Diagram

4.1 Wi Fi Enabled system/laptop/PC:

The main essential requirement of this work is the internet connectivity, this can be done by using a internet connected PC or laptop. This facility can also be accomplished by using a mobile phone. The mobile phones internet data can be shared with the IOT system by using a mobile app shareit.

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4.2 NodeMCU:

NodeMCU is an open source IOT platform. It includes firmware which runs on the ESP8266 wi fi SOC from Espressif systems, and hardware which is based on the ESP-12 module. The word "NodeMCU" by default refers to the firmware. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non SDK. It uses many open source projects, such as lua-cjson, and spiffs.

4.3 ESP8266 Microcontroller:

Espressif Systems' Smart Connectivity Platform (ESCP) is a group of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the low cost, and small space requirement. ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to off load Wi-Fi networking functions from another application processor. When ESP8266 executes the application, it boots up directly from an external flash. It has integrated cache to improve the performance of the system in such applications. Also, working as a Wi-Fi adapter, wireless internet access can be added to any microcontroller based design with simple connectivity.

Fig. 2 Image of ESP8266 Processor (curtesy)

4.4 Relay:

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

Fig. 3 Images of SPDT Relay (curtesy)

4.5 Buzzer:

It is a electromechanical device, which converts electrical signals in to sound signals. It is incorporated into the proposed home automation system to alert the people around in case of any eventuality.

4.6 L293D Motor driver circuit (IC):

The L293D is a driver IC for geared DC motor which is connected to prototype door assembly. The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

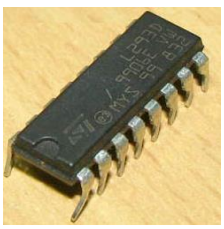

Fig. 4 Image of L293D Driver IC (curtesy)

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Iinputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

Working of L293D Driver: There are 4 input pins for l293d, pin 2, 7 on the left and pin 15 , 10 on the right. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

4.7 230v AC Bulb:

It is a load to the relay. We have used the controlling of an AC bulb through IoT. It has a separate power supply of AC 230 v, but it is connected through the relay. As and when the relay is made ON & OFF so the bulb will be ON & OFF accordingly.

4.8 Prototype Door assembly:

It is a mechanical prototype assembly which replicates the Door. We have used a CD driver socket for this purpose. It is connected to a geared DC motor which is driven by the L293D driver IC to open and close the door assembly. As and when there is a signal from IOT server to the Node MCU, the controller sends the signal to the driver IC to drive the motor in clock wise or anti clock wise direction so as to facilitate opening and closing of the Door assembly.

4.9 Power Supply:

The developed system works on two different power supply modes. One is a direct AC 230v supply to turn ON & OFF the load bulb thorough relay. The second one is a regulated power supply.

V. SYSTEM SOFTWARE

The software for this work is written by using ARDDUINO Integrated Development Environment (IDE). The flow of the system program is as shown in fig.5

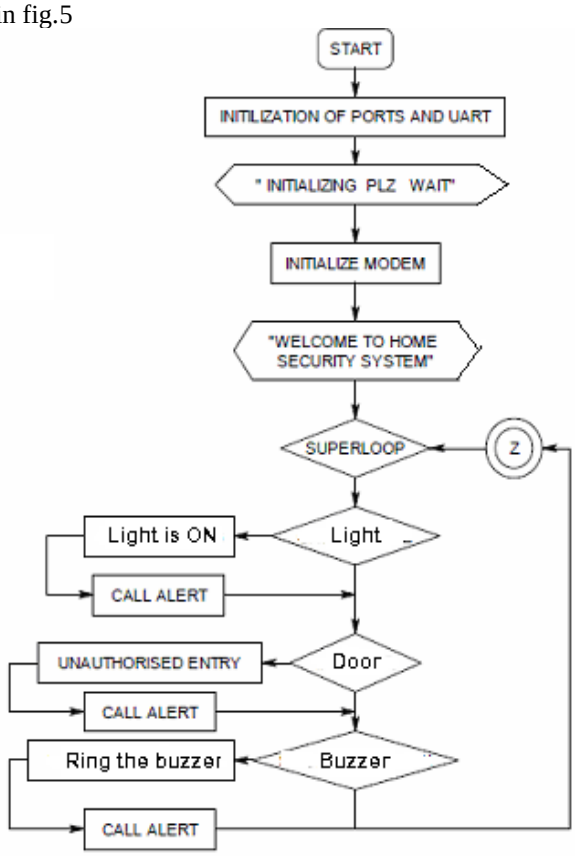

Fig.5 Flow of the System software

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VI. SYSTEM OPERATION

As soon as the system is powered ON, the processor automatically executes the system program stored in EPROM. As the developed system is IoT based, hence, it is essential to establish the network connectivity. Once the network connectivity is established by using wi-fi enabled system/laptop or cell phone, go to particular IoT web page, and open the virtually designed switches. The system has three virtual switches, 1) for buzzer, 2) for opening and closing of the door and the 3) one is for light. Simply ON/OFF the particular switch, the IoT server sends the signal to the microcontroller of the system which in turn sends the signal to relay to turn ON/OFF the particular device connected to it.

VII. EXPERIMENTAL RESULTS & DISCUSSIONS

The designed system was tested in the laboratory and shown satisfactorily results. As the system is totally automatic, there is no need of personal presence. The system is built on ESP8266 microcontroller hence it uses low power consumption. The developed system is compact, portable and can readily be used in real time applications.

VIII. CONCLUSION

In this work an attempt is made to design & develop an internet of things based home automation system. In this system the home automation is equipped with three automation units like opening & closing of door, turning ON & OFF of a bulb and a Buzzer. As and when any virtual button in the IoT is activated through the cell phone, the appliances like light, buzzer and door etc accordingly the corresponding device are activated. The necessary hardware & software is developed for interfacing. The developed software is stored in the flash memory of the ESP8266 microcontroller which reduces the hardware of the system. The three home automation modules/applications have been monitored with simple circuits. So the developed system is very compact, reliable & low cost system.

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