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HOME AUTOMATION USING IoT

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Abstract: Availability of high speed mobile networks like 3G and Long Term Evolution (LTE) mobile industry has seen a tremendous growth in providing various services and applications at the fingertips of the citizens. Internet of Things (IoT) is one of the promising technologies which can be used for connecting, controlling and managing intelligent objects which are connected to Internet through an IP address. Applications ranging from smart governance, smart education, smart agriculture, smart health care, smart homes can use IoT for effective delivery of services without manual intervention in a more effective manner. IoT can be used for realizing smart home automation using a Wi-Fi module based Arduino Node MCU and Android mobile app. Home automation using Ethernet through which user can control their homes using an Android App is presented. Remote operation is achieved by any smart- phone/Tablet etc., with Android OS, upon a GUI (Graphical User Interface) based touch screen operation. Android application acts as transmitter and sends ON/OFF commands to the receiver where loads are connected. By operating the specified remote switch on the transmitter, the loads can be turned ON/OFF remotely through wireless (Cloud) technology. The cloud server is used to transmit and receive data through which user can control their homes. There has been a need of controlling electronic doors remotely for automation and security purposes. IoT technology implementation over the electronic door lock makes it a super advanced door opener cum locking system. In this way the automatization and security is achieved even when the authorized person is physically present at some remote location.

Keywords: Internet of Things (IoT), Android Application, Cloud server

I. INTRODUCTION

Homes of the 21st century will become more and more self- controlled and automated due to the comfort it provides, especially when employed in a private home. A home automation system is a means that allow users to control electric appliances of varying kind. Many existing, well-established home automation systems are based on wired communication. This does not pose a problem until the system is planned well in advance and installed during the physical construction of the building. But for already existing buildings the implementation cost goes very high. In contrast, Wireless systems can be of great help for automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks, wireless systems are used every day and everywhere.

By implementing this system, it is possible to explore a variety of different Engineering challenges, including software programming, PCB design, Wi-Fi, TCP/IP protocols, Web Server logic design, and other aspects. This automation system provides great insights to the challenges of software and hardware design.

In the present day, home automation is becoming essential for the purpose of improving one's life condition. Convenience and ease of using home appliances is what home automation is offering. Home automation offers a futuristic way of life in which an individual gets to control his entire house using a smart phone, from turning on a TV to locking/unlocking doors; it also offers an efficient use of energy. But to get or acquire such system installed will cost a lot of money and that is the major reason of why home automation has not received much demand and attention, adding to that also the complexity of installing it and configuring it.

Smart home is not a new term for science society however; it is still far more away from people's vision and audition. The field of home automation is growing exponentially as the electronic based technologies are converging day by day. Several smart systems have been

constructed where the control is through Bluetooth, internet, short message service (SMS) etc. Bluetooth system is one of the best wireless systems and also most of the current laptop/notebook, tablets and cell phones have in-built adaptor which results in reducing the cost of system indirectly. As it limits the control to within the range of Bluetooth environment while on the other hand most of the systems are not too possible to be implemented as a cost-friendly solution.

Proposed system is an Arduino based home automation done with Arduino connected to a Wi-Fi and controlled via android app or a social media network. This system deals with the safety in home and smart home technologies which will be cost efficient.

II. EXISTING MODEL

Home automation is the usage of information technology and computer for controlling home appliances and various other devices. Both Bluetooth and GSM are used to control the appliances. In wireless technology, several connections are introduced like Bluetooth, FPGA and ZIGBEE. Each of the connection has their unique specifications and applications. Among the four wireless connections, Bluetooth is chosen with its suitable ability to control appliances from indoor and GSM for outdoor. Also, most of the current laptop or cell phones are come with built-in Bluetooth adapter. It will reduce the cost of this system. Through GSM, the user can effectively control and monitor the appliances from remote places by sending SMS. The concept behind this is to receiving the sent SMS and processing it further as required to perform several operations. This type of the operation to be performed depends on the nature of the SMS sent.

The home automation system is developed using a pic microcontroller board with Bluetooth being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides most modern solution with smart phones.

In order to achieve this, a Bluetooth module is interfaced to the pic microcontroller board at the receiver end while on the transmitter end GUI application on the cell phone sends ON/OFF commands to the receiver where loads are connected. By touching the specified location on the GUI, the loads can be turned ON/OFF remotely through this technology.

III. PROPOSED WORK

3.1 HARDWARE DESIGN

Nowadays development and changes of technologies is happening daily as well as continuous improvement of people's living standards are increasing. The mobile phones are the inspirable part of human lives today. The mobile phone is the most important part of human lives today. With the help of this smart gadgets human can do many works with or without internet like here one can make home as well as organization smarter or more luxurious. The proposed system is a new technology, so that mobile phones can be used to communicate with and control electrical appliances like Fans, A.C., Lights etc. using Android App and Wi-Fi module. The transmitter of Wi-Fi transmits the data given by the application using radio waves technology. The block Diagram is as shown in Fig.1. The Wi-Fi works on radio waves technology, as the data to be passed through Wi-Fi is converted into the electromagnetic signal which is then sent using the antenna. This signal is passed to the Arduino controller. The Arduino further operates the received information and performs operations. This controller can be connected to the Relays of different switches to pass the current after generating the magnetic field. New appliances can be added anytime to the system, which provides for the reliability of the system.

Internet of Things(IoT) deals with billions of intelligent objects which would be connected to sense & collect the data and also communicate with surrounding people using mobile, wireless and sensor technologies. Main objective of IoT is to manage and control physical objects around us in a more intelligent and meaningful manner and also improve quality of life by providing cost effective living including safety, security and entertainment. Smart objects gather useful contextual data autonomously and send to remote application servers for offering context aware or location based services. The word "context" can refer to any location information, surrounding environment, people &

objects that are nearby so that adaptive and personalized services can be provided to the user.

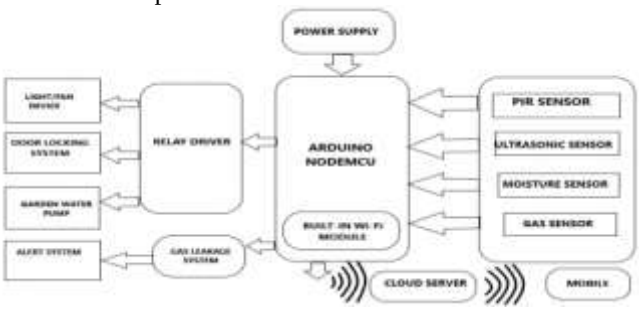

Fig 1 Block Diagram of Proposed System

3.2 Arduino Node MCU

Node MCU 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 as shown in Fig.2. 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 Espressif Non-OS SDK for ESP8266.

Fig 2 Arduino NodeMCU

3.3 Sensors

Sensors used are

i) Ultrasonic Sensor
ii) PIR Motion Sensor
iii) Gas Sensor
iv) Soil Moisture Sensor

3.3.1Ultrasonic Sensor

Ultrasonic sensors are essentially sound sensors, but they operate at a frequency above human hearing. The sensor sends out a sound wave at a specific frequency. It listens for the specific sound wave to bounce off of an object and come back. The sensor shown in Fig.3. keeps track of the time between sending the sound wave and the sound wave returning. The speed of sound can be calculated based on the variety of atmospheric conditions, including temperature, humidity and pressure. The ability of a sensor to detect an object also depends on the objects orientation to the sensor. If an object doesn't present a flat surface to the sensor then it is possible the sound wave will bounce off the object in a way that it does not return to the sensor.

Fig 3 Ultrasonic Sensor

3.3.2 PIR Motion Sensor

PIR sensors are used to sense motion and to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. PIR sensors are low power and low cost, pretty rugged, have a wide lens range, and are easy to interface with. This chip takes the output of the sensor and does some minor processing on it to emit a digital output pulse from the analog sensor.The PIR motion sensor is as shown in Fig.4.

Fig 4 PIR Motion Sensor

3.3.3 Soil Moisture Sensor

The Soil Moisture Sensor shown in Fig.5 is used to measure the volumetric water content of soil. A typical volumetric ratio would be 55% solid material and 45% pore

space. As water is added to the soil, the pore spaces begin to fill with water. Soil that seems damp to the touch might now have 55% minerals, 35% pore space and 10% water. This would be an example of 10% volumetric water content. The maximum water content in this scenario is 45% because at that value, all the available pore space has been filled with water. This soil is referred to as being saturated, because at 45% volumetric water content, the soil can hold no more water.

Fig 5 Soil Moisture Sensor

3.3.4 Gas Sensor

The Grove - Gas Sensor module shown in Fig.6 is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

Fig 6 Gas Sensor

3.4 SOFTWARE DESIGN

3.4.1 Cloud Storage

Cloud computing is the practice of using remote servers on the internet to manage, store and process data instead of using a personal computer.

Cloud computing is a general term that is better divided into three categories: Infrastructure-as-a-Service, Platform-as-a-Service, and Software-as-a- Service. IaaS (or utility computing) follows a traditional utilities model, providing servers and storage on demand with the consumer paying accordingly. PaaS allows for the construction of applications within a provider's framework, like Google's App Engine. SaaS enables customers to use an application on demand via a browser.

3.4.2 Firebase Storage

Firebase Storage provides secure file uploads and downloads for Firebase apps, regardless of network quality. It is used to store images, audio, video, or other user-generated content. Firebase Storage is backed by Google Cloud Storage.

3.4.3 Software Development Kit

There are several platforms for developing smart phone applications such as Windows Mobile, Symbian, iOS and Android. In the proposed system, the Android platform app is developed as most of the phones and handy devices support Android OS. Java programming language using the Android Software Development Kit (SDK) has been used for the development and implementation of the smart home app. The SDK includes a complete set of development tools such as debugger, libraries, and a handset emulator with documentation, sample code and tutorials. The designed app for the smart home system control and monitors the electrical devices and provides security.

IV. WORKING OF PROPOSED SYSTEM

The proposed system consists of an app which is developed using Android platform and by using Arduino Ethernet based micro web-server. Using the smart home app, from a remote location it is possible to control and monitor the smart home environment. The app will communicate with the micro web-server via the internet. Any internet connection via Wi-Fi or 3G/4G network can be used on the user device.

Proposed project is of low cost efficient system. This system has two main modules: the hardware interface module and the software communication module. At the heart of this system is the Arduino NodeMCU microcontroller which is also capable of functioning as a micro web server and the

interface for all the hardware modules. All communication and controls in this system pass through the microcontroller.

From user side, user can select the option, which switch he/she wants to switch ON/OFF or set timer from their Android smart phone Application. This command goes to the Wi-Fi module which is inbuilt in Arduino NodeMCU. Wi-Fi module transmitter converts it into signals and sends that command to the receiver of the Arduino NodeMCU. After that controller activates that particular I/O pin on the board and send input to the Relay. In that Relay, which has 230V power supply, after receiving current it

Fig 7 Prototype

generates electromagnetic field in coil and passes the 12V current to switch ON the light. User can select the option from anywhere in remote access area network, which is near about 100 m from Wi-Fi module placed in Arduino NodeMCU.

In proposed model various sensors are used to detect the

i) User's motion,
ii) Water content in soil,
iii) To ensure security and
iv) Detecting gas leakage.

The Passive Infra-Red (PIR) sensors allow one to sense motion, almost always and are used to detect whether a human has moved in or out of the sensors range. The PIR sensor is a pyroelectric device that detects motion by measuring changes in the infrared level emitted by surrounding objects. This motion can be detected by checking for a high signal on a signal I/O pin .When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection.

When a person comes to home in absence, it can be sensed by using an Ultrasonic sensor and by detecting the bounced back sound waves. Ultrasonic sensor is placed in door facing downwards by which it can sense and detect the person standing and an alert message will be given to user's mobile through app. And thus everything can be controlled and monitored the security of home even in absence.

Soil moisture sensor is used to measure volumetric water content in soil .And if there is no water content in soil, an alert message will be send to user through app thus indicating to switch on the motor and to water the plants and reverse process can also be done with the help of this sensor.

The gas sensor used is MQ4 sensor. It is a semiconductor type sensor, which can appropriately sense the presence of smoke, LPG, methane, butane, propane and other hydrocarbon combustible gases. The sensitive material in this sensor is tin-dioxide(SnO2). When it comes in contact with the gas to be monitored, the electrical resistance of the sensor decreases; enabling the microcontroller to respond to the situation.

When it detects the concentration of combustible gas in the air it outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V. The prototype is shown in Fig.7.

The sensor data are sent to the web server and stored in the cloud. The data can be analyzed anywhere any time. If the sensor parameters are greater than the threshold level then the respective alert messages will be raised and the required actions are done for the controlling of the parameters.

V. CONCLUSION

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a

process according to the requirement, for example switching on the light when it gets dark. The user can monitor and control all the home appliances through their mobile phones from any parts of the world or even in home by using Wi-Fi communication. To verify the reliability of the system a hardware implementation of the system was carried out. Using wireless sensor technologies a future improvement can be added to the proposed system. It also stores the sensor parameters in the cloud in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime anywhere.

FUTURE SCOPE

Using this system as framework, the system can be expanded to include various other options which could include home security feature like capturing the photo of a person moving around the house and storing it onto the cloud. This will reduce the data storage than using the CCTV camera which will record all the time and stores it. It stores the sensor parameters in the cloud which helps the user to analyze the condition of various parameters in the home anytime anywhere.

The home automation system involves making homes even smarter. More energy can be conserved by ensuring occupation of the house before turning on devices and checking brightness and turning off lights if not necessary. The next step would be to extend this system to automate a large scale environment, such as offices and factories. Home Automation offers a global standard for interoperable products. Standardization enables smart homes that can control appliances, lighting, environment, energy management and security as well as the expandability to connect with other networks.

REFERENCES

[1]M L Sharma, Sachin Kumar, Nipun Mehta, ”Smart Home System Using IoT” in International Research Journal of Engineering and Technology (IRJET), volume: 04 Issue: 11, Nov -2017, pp 123-130.
[2]DhakadKunal, DhakeTushar, Degaonkar Pooja, ZopeVaibhav, Vinay Lodha,” Smart Home Automation using IOT” in International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 2, February 2016, pp 101- 116.
[3]Surinder Kaur, Rashmi Singh, Neha Khairwal and Partyk Jain, “Home Automation and Security System” in Advanced Computational Intelligence: An International Journal (ACII), Vol.3, No.3, July 2016
[4]Pooja Patel, Mitesh Patel, Vishwa Panchal and VinitNirmal, “Home Automation using Internet of Things” inImperial Journal of Interdisciplinary Research (IJIR),Vol-2, Issue-5, January 2016.
[5]Pooja N.Pawar, Shruti Ramachandran, Nisha P.Singh and Varsha V.Wagh,“A Survey on Internet of Things Based on Home Automation” in International Journal of Innovative Research in Computer and Communication Engineering, Vol2, Issue-1, January 2016.
[6]G.Mahalakshmi and N.Vigneshwaran,” IOT Based Home Automation Using Arduino” in International Journal of Engineering and
Advanced Research Technology (IJEART) ISSN: 2454-9290, Volume-3, Issue-8, August 2017
[7]R. Piyare and M. Tazil, "Bluetooth based home automation system using cell phone," in IEEE 15th International Symposium on Consumer Electronics, Singapore, May 2011, pp. 192 - 195.
[8]Bhavik Pandya1, Mihir Mehta, Nilesh Jain, “Android Based Home Automation System Using Bluetooth & Voice Command”in International Research Journal of Engineering and Technology (IRJET) ,Volume: 03 Issue: 03 | Mar-2016.
[9]Ganesh Prabhu .S, “IOT Based Home Automation and Security System”in SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE),Volume 4, Issue 3, March 2017.
[10]Kumar Mandula, RamuParupalli, CH.A.S.Murty, E.Magesh, RutulLunagariya “Mobilebased Horne Automation using Internet of Things(IoT)” inInternational Conference on Control, Instrumentation, Communication and Computational Technologies (lCCICCT), June 2015.
[11]S. Kumar, "Ubiquitous Smart Home System Using Android Application," International Journal of Computer Networks & Communications, vol. 6, pp. 33-43, January 2014.
[12]R. Piyare, "Ubiquitous Home Control and Monitoring System using Android based Smart Phone," International Journal of Internet of Things, vol. 2, pp. 5-11, March 2013.
[13]M. S. H. Khiyal, A. Khan, and E. Shehzadi, "SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security," Issues in Informing Science and Information Technology, vol. 6, pp. 887-894, August 2009.
[14]K. P. Dutta, P. Rai, and V. Shekher, "Microcontroller Internationl Journal of Electrocal, Electronics & Communication Engineering”, vol. 2, pp. 642- 649, December 2012.
[15]M. R. Kamarudin, M. A. F., and M. Yusof, "Low Cost Smart Home Automation via Microsoft Speech Recognition," International Journal of Engineering & Computer Science, vol. 13, pp. 6-11, June 2013.

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