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SMART SWITCHER - AN INTELLIGENT REMOTE CONTROL SYSTEM FOR HOME APPLIANCES

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Abstract- Implementation of a home automation system has been a desire of every young mind. With the advancement of technology, people now have more convenient systems which will be a big help for them, for example - switching a device by sitting on the sofa. The Internet of things (IoT) is an emerging technology today that envisions all objects around us as a part of the Internet. Automation of the devices, appliances at home and office is having extensive possibility of research with the innovation of technology in communication and can bring up a big difference in the livelihood. Misuse of power can be reduced by automating the devices and appliances. Mobile communication plays a major role in the automation domain. Android mobile devices are designed with applications to automate the required devices.
Index terms - IoT, wireless technology, smart phones, triac

I. INTRODUCTION

IoT (Internet of Things) is an extension of Internet services (all the devices are connected and controlled with internet connectivity).IoT is an emerging topic in industry and engineering circles. The Internet has changed human's life by providing anytime, anywhere connectivity with anyone. The Internet helps us to bring in immediate solutions for many problems and also is able to connect from any of the remote places which contributes to overall cost reduction and energy consumption. Every day the modern people expect new devices and new technology to simplify their day to day life.

In the late 90s, Internet connectivity began to proliferate in the enterprise and consumer market, but was still limited in its use because of the low performance of the network interconnects. Today internet is expected as part of many industrial and consumer products to provide access to information. For many years Home automationhas mainly been used as a feature of science Century because of the introduction of electricity and rapid improvement in information technology.

II. INTERNET OF THINGS

IoT [1] is generally a situation where network connectivity and computing capability is extended to articles, sensors and all items can exchange, generate and consume data with negligible human intervention. Rapid growth in technologies enhanced the growth of the IoT Environment and it was already developed in the Industrial Wireless sensor Network. The concept of combining computers, sensors, and networks to controlling devices has existed for decades and the projections for the impact of IoT on the Internet and economy are impressive, with some expecting as many as 200 billion connected IoT devices and a global economic impact of above $11 trillion by 2025[2].

A. Objectives of Internet

The internet where the existing network of internet to the computers will connect to the real world objects. Things may incorporate any objects, home appliances, vehicles, etc. and when these things connect to the internet in specific infrastructure by means of some standard protocols then the whole system is said to be IoT. The term "Internet of Things" has come to portray a variety of technologies and research disciplines that enable the Internet to reach out into this present reality of physical objects. Figure shows the objectives of IoT.

B. Internet of Things Connectivity model

IoT uses four common communication models

1. Device to device communication
   Two devices communicate directly between one another via a wireless network like Bluetooth, zigbee etc., without using an intermediate server.

2. Device to cloud communication

The IoT device interfaces directly to an Internet cloud like an application service provider to trade data and control message traffic.

3. Device to gateway model

There is an application software operating on a local gateway device, which act as an intermediary between the device and the cloud service and provides security and other functionality such as data or protocol translation.

4. Back end data sharing model

The back-end data sharing model alludes to a communication architecture that enables clients to transfer and check smart object data from a cloud administration in combination with data from different sources.

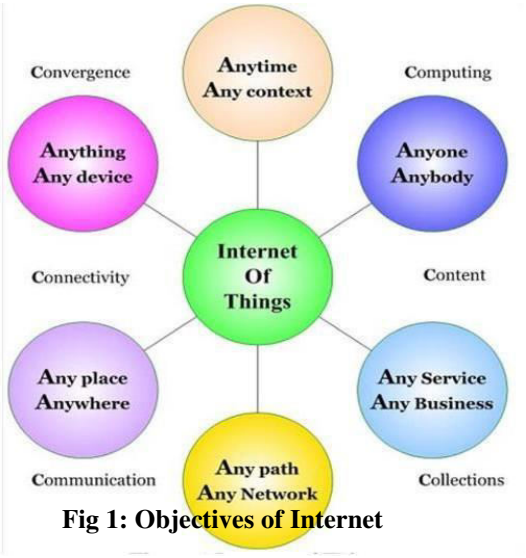

Fig 1: Objectives of Internet

III. SMART HOME AUTOMATION

Smart Home [4], ranks the highest IoT application on all computed channels. More than 60,000 people search for the term “Smart Home” every month. This is not a surprise. The IoT Analytics company database for Smart Home includes 256 companies and entrepreneurs. The total funding for Smart Home entrepreneurs now goes beyond $2 billion, which includes popular startup names such as Nest or Alert Me as well as a number of MNCs like Philips, Haier, or Belkin.

Smart homes are those where home appliances are remotely controlled. Wireless Smart home automated system is one among the best applications of IoT. It is a system that uses devices like computers, mobile to control basic home functions automatically through the internet from anywhere outside the house. The main purpose of IoT based Home Automation systems is to save electrical power and human efforts. Smart Home Automation is the process of operating and controlling various equipment using control system techniques with no human intervention. The electrical and electronic home appliances can be operated and controlled using various control system techniques. Enormous growth in technologies and hardware enhancement comes out with many security issues. Electrical devices are linked and combined with each other and connected through a home network to allow the device control by smart phones and computers with access to the internet. [6]

IV. LITERATURE SURVEY

In Bluetooth based home automation systems [3] the home appliances are connected to the Arduino BT board at input output ports using relays. The program of Arduino BT board is based on high level interactive C language for microcontrollers; the connection is made via Bluetooth. The password protection is provided so only authorized users are allowed to access the appliances. The Bluetooth connection is established between the Arduino BT board and phone for wireless communication. In this system the python script is used and it can install on any of the Symbian OS environments, it is portable. One circuit is designed and implemented for receiving the feedback from the phone, which indicates the status of the device.

The pros of this system are wireless control, monitoring can be done at every level and status checking is possible. The cons are low Bluetooth range, connection issues and configuration of the application software

The SMS based home automation [5], GPRS based home automation and dual tone multi frequency (DTMF) based home automation, these options we considered mainly for communication in GSM. The system uses a transducer which converts machine function into electrical signals which goes into microcontrollers. The Sensors of the system convert the physical qualities like sound, temperature and humidity into some other quantity like voltage. The microcontroller analyzes all signals and converts them into commands to understand by GSM module. Select appropriate communication methods among SMS, GPRS and DTFC based on the command which received the GSM module.

The devices can be controlled from long distances and has an economical design it can be easily implemented in homes. The system is network dependent, so network congestion can reduce the reliability of the system. If any mistake occurs while typing the message format, the message will not be acknowledged by the arduino and the device will not work.

Home Automation using cloud based system [9] focuses on design and functioning of home interface to collect data about data from home appliances and then send to the cloud data server to get saved on Hadoop Distributed File System. It is a process using MapReduce and use to implement a monitoring tasks to Remote user Presently Home Automation System is persistently developing its resilience by assimilating the current characteristics which gratify the rising interests.

This paper presents the design and development of home automation systems that use cloud computing as service. The current system consists of three important units: the first part is cloud server, handles and controls the data and information of client and users and the status of devices the hardware circuitry module is the second part which works the required main connection to the actuators and sensing devices which give the physical service. Last part is Home Server, which constructs the hardware device and gives the user interface. This paper focuses on building web services using the cloud which is needed for security and storage and availability of the data. The current system is cost efficient, much more reliable and comfortable which also gives a safe automation system for the whole family. The system is made up of various user service modules for different platforms.

This system has continuous improvement and is suitable for handling multidimensional and multi variety of data. The drawbacks are data acquisition and interpretation of results is tough.

V. IMPLEMENTATION

TOOLS USED

Software Tools

1. Android Studio

Android studio provides a platform to develop applications that are based on java or Kotlin. The language used is Java. The platform provides method for coding and testing the final application on a real as well as a virtual device. The ability of the software to emulate the possible outcomes of the application in a virtual environment helps developers to understand the mistakes if any and to make the required corrections to rectify any shortcomings in the application.

2. Proteus 7

The Proteus Design Suite is a software tool suite used primarily for electronic design. The software is used mainly by electronic engineers to create schematics and electronic prints for manufacturing printed circuit boards. It can emulate the behavior of a circuit in real life through simulation. The components are dragged and dropped into a virtual space where they are connected and tested. The simulation allows the user to identify potential flaws in the circuit design before construction. This avoids loss of material, time and effort.

Hardware Tools

1.ESP32

ESP32 is a series of low cost, low power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth.

2. 4 way capacitive touch sensor

This is a 4 switch digital touch sensor with capacitive sense technology, the TTP 224 IC offers capacitive sense input feed designed for touchpad control, followed by a 4-finger-sized touchpad. The board has a jumper's arrangement to change the key press output mode in Timed or Toggle, Active High or Active Low.

3. NodeMCU ESP8266 v3

NodeMCU v3 is a development board which runs on the ESP8266 with the Espressif Non-OS SDK, and hardware based on the ESP-12 module. The device features 4MB of flash memory, 80MHz of system clock, around 50k of usable RAM and an on chip Wi-Fi Transceiver.

4. Arduino Nano

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that Diecimila/Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack

5.MOC3041

The MOC3021 is a Zero-Crossing TRIAC driven Optocoupler. Meaning it has an Infra-red Light Emitting Diode (LED) inside it coupled with a TRIAC. When the LED is triggered the TRIAC is also turned on.

Interface modules:

Login: Login is done through the app with the appropriate username and password. The app connects to the server. The server updates the application with the current status of the devices (i.e. ON/OFF).

On first use of the app, the user is prompted to give labels (names) for the devices connected. The measurements are also to be entered. Upon completing this task, the user reaches the home page.

On reaching the home page, the user has 3 options

1. Device Control
2. Device Readings
3. Logout

Fig. 2 Main Layout

1. Device Control: On selecting active devices the user is sent to a page where all devices that are connected to the system is displayed. There is color besides the button indicating the current status of the device (GREEN for ON, RED for OFF). When the user selects an option, the app sends data to the server via internet. The status of the device is updated and command send to the device to implement.

Fig 3. Device Control

2. Device Readings: The app displays the power consumed during the working of the device. This will give the user an idea of the amount of power being consumed by the device.
   Primary readings to be displayed are:
   1. LV – Line voltage
   2. LP- Line power
   3. LC- Line current
   4. Energy

   The readings are received from the current sensor located within the device. It mesures the total current that has been used.

Fig. 4 Device Readings

3. Logout: To logout of the device control profile from the current device.

Hardware implementation:

1. Node MCU: it is used to connect the board to the internet. This is the component that transfers the data received from the server to the Arduino board.
2. Arduino Nano: the board controls the functionality of the system. It receives the instructions from the server via the Node MCU and implements it.
   a. If the command is to turn on a device, then the Nano will switch the pin to which the control lines of that device is connected to high.
   b. If the command is to turn off a device, then the Nano will switch the pin to which the control lines of that device is connected to low.
3. The circuit is powered by stepping down the current to 12V, using a step-down transformer. This is to ensure that the devices (MCU and Nano) does not get damaged due to excessive current.
4. The device runs on the principle of TRIAC, the Optocoupler controls the circuit. It monitors.
5. A physical touch pad is also included with the device in the aim of providing a physical means of control to the user. The touch pad has buttons that are mapped to certain devices connected to it, so when the touch pad is pressed, the signal is relayed to the server, the status of the device is updated and the command is executed within the device.

VI. CONCLUSION

The mobile application and the automation device was successfully implemented. The mobile app was able to be paired with the hardware via Wi-Fi making the functionalities of the app to be performed on the hardware device, i.e., the switch board. 3 switches were made in the switchboard, a fan, a light and a plug point. All the 3 switches worked successfully. Both the ON and OFF functionalities were performed and the

Corresponding line voltage was noted in our mobile application. The test results were more accurate based on the connectivity range compared to the Bluetooth based and GSM based home automation devices. The manufacturing cost is much lesser than that of the currently used devices.

VII. FUTURE SCOPE

The smart switcher project may emerge as a technological advancement in the field of home decor and IOT. The product can deal with multiple connections in and out bound. The latest technology of Artificial Intelligence can be integrated with the product to learn certain user patterns and automatically power the user's house/office accordingly. The product can be developed in low cost and does not need much of a maintenance. Installing this product in a user's home/office would make his life easier. This product is developed in such a way that there would not be any inconveniences for any user and hence it can integrate into the daily life of a user such as the smartphones. Everyone in the world would want to own such a device which updates the user about his electricity usage and how much would he want to control so that he can meet his monthly budget. As a whole, this product would become a companion for the mankind and would make his life easier.

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