

A Review on Smart Plug

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Abstract:- As internet penetration is increasing around the world and more and more devices are getting connected to the internet technologies like IoT (internet of things)/Machine to Machine (M2M) communications are gaining popularity because of their ability to communicate with each other and take decisions based on set preferences or user patterns independently without any user interaction. The smart plug is aimed at converting regular power sockets into smart power sockets by having the ability to control the on/off status of the switch through a mobile app using the internet (IoT) or Bluetooth communication protocol and also provides advanced features like the ability to schedule the on and off time of the socket, monitor the current and power consumed by the appliances connected to the socket in real-time, an emergency kill switch to control on/off state when there is no connection to the smart plug through internet or Bluetooth and smart socket can also work in an extended mode where multiple appliances can be connected and monitored individually.

Keywords— Microcontroller, Firebase, IoT, Home automation, cloud, wifi, BLE, Power monitoring.

I. INTRODUCTION

Industry 4.0 refers to a new phase in the Industrial Revolution that focuses heavily on interconnectivity, automation, machine learning, and real-time data. Industry 4.0, also sometimes referred to as the Industrial Internet of Things (IIoT). The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Home automation gives you access to control devices in your home from a mobile device anywhere in the world. The term may be used for isolated programmable devices, like thermostats and sprinkler systems, but home automation more accurately describes homes in which nearly everything — lights, appliances, electrical outlets, heating, and cooling systems — are hooked up to a remotely controllable network. Smart home automation systems should be installed in your home while building the house or even

you can even get the home automation done by externally installing the device in latter time but it is a complex process where existing wiring and system will be disturbed and the other option what user have is to buy a smart plug. Smart plug is a layer/smart device which fits into the existing socket and converts the existing normal socket into smart socket into which you can connect any electronic appliance present in the home and they can be controlled that is turning on/off the appliance can be done from a remote location. And the appliance can also be monitored from a remote place via a mobile application. Mobile application is developed to control and monitor the appliance which is connected to the smart plug. As the entry point into the home automation is very high and integrating the home automation system into an existing electrical system is a tedious task and requires the entire rewiring of existing electrical systems in the home. Hence the smart plug helps to convert the existing power socket into a smart socket without changing any wiring of the socket, it's as simple as plugging in a wall adapter to the socket. As most of the smart plugs available in the market require a Wi-Fi connection to control the smart plug the proposed smart plug can be controlled using both Wi-Fi and Bluetooth hence it can attract a wider range of customers as the plug can be controlled even from basic features phones which include supports Bluetooth protocol, thereby reducing the cost and complexity involved in getting the home automation done.

The objective of the smart plug is to:

- To design a device that converts an existing socket into a smart socket using which any electronic appliance can be controlled remotely. And also extend the sockets whenever the user requires them.
- To make home automation technology accessible to a common person at an affordable price.
- To make the device portable and reduce the size of the device drastically.
- To design a device that can control the appliance remotely via internet.

- To design a device that works on Bluetooth protocol to control and monitor locally if the user doesn't have access to the internet connection.
- To measure the power consumed by the electronic appliance connected to the smart plug.
- To create a user interface that is intuitive to control and monitor the device.
- To provide a solution where the user can schedule the task to turn on/off the device.

II. METHODOLOGY

The smart plug is completely controlled through a mobile app that can connect to the smart plug either via a WIFI network or Bluetooth which gives a wider range of connectivity for all types of devices to control the smart plug. The mobile app communicates with the socket using google firebase database management system which is a NoSQL based database management system that uses key-value pairs to store the values of variables instead of traditional rows and columns used SQL based databases which results in poor performance due to the delay caused in fetching the data from the SQL tables. Hence using firebase gives a greater advantage and improves the responsiveness of the app. When the user doesn't have access to the internet then the smart plug can be controlled directly connecting to the socket using Bluetooth mode.

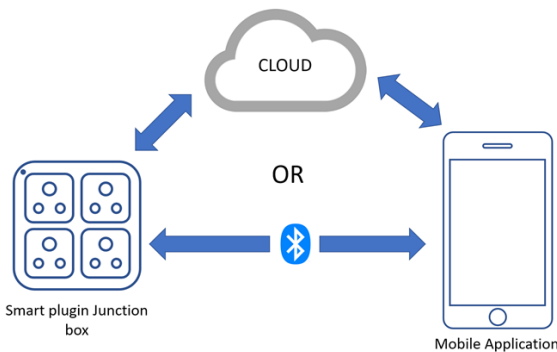


Figure 1: Basic working principle.

Smart plug consists of microcontroller and relay which is embedded into it and the microcontroller can connect to the internet so that it can be controlled remotely via mobile application through a cloud platform. When a user wants to change the on/off state of the appliance which is connected to the smart plug then it can be achieved with the help of a mobile application just by clicking a button. Now the mobile application communicates with the microcontroller through the cloud platform. Cloud acts as a mediator between the smart plug and the mobile application and it is a must that both the device should be connected to the internet. The data gathered by the microcontroller is updated to the mobile application via a cloud platform. If the user doesn't have access to the internet then the user can connect through Bluetooth and utilize all the features that are provided with the smart plug.

III. LITERATURE REVIEW

In this paper the Santhoshsivan N V, Senthilkumar S, Arunkumar K, Umasankar S, Jagadeeshraja M [1] present an economical and easiest way to monitor and control the electric

appliance remotely via internet. Designing a device that fits into existing socket and converts the existing normal socket into smart socket. The main concern of author is to install home automation device to a home without disturbing the existing wiring or system. Proposed smart plug is capable of controlling the on/off state of the electronic appliance that is connected to a smart plug. The paper also mentions about various sensors such as current sensor to measure the current and explains the advantages of using Triac with optocoupler over relay for switching application.

In this paper Yaowaluk Thongkhao and Wanchalerm Pora [2] have proposed a unique way of designing the smart plug which can be monitored and controlled locally via web application. Internet may not be accessible to everyone so here smart plug is designed in such a way that it communicates with user locally via Wi-Fi protocol. Micro controller is embedded into the smart plug and microcontroller acts as local server and it hosts a html page where user can interact and control the smart plug using the IP address provided by the Microcontroller. Limitation of this method is that both the microcontroller and mobile / laptop should be connected to same network. And the initial setup is difficult compared to Bluetooth.

One of the key features of home automation is automating the daily routine of the user, where repeated routine will be taken care by the smart intelligent system. In this paper Murad Khan, Bhagya Nathali Silva and Kijun Han [3] has proposed the concept of scheduling task which leads to automation and the process is carried out smoothly without human intervention and scheduling of household appliances will minimize the overall energy consumption. Authors have also explained about static and dynamic scheduling. In static scheduling whether forecasting report and user daily routine is used to define the model and profile for the day. But some parameters may vary from the predicted report, and based on this variation static scheduling profile is updated and the author calls the new scheduling method as runtime scheduling which is very much necessary to setting up the profile.

In this paper Nikola Lukac, Roman Pavlovic, Violeta Vukobrat and Nikola Teslic [4] monitors about smart plug where user communicates via Bluetooth protocol. Bluetooth low energy is an ultra-low power communication protocol. So in this paper author explains about the advantages of using Bluetooth protocol to communicate locally. Bluetooth is available in all the mobile application therefore using this protocol to communicate locally is more advantageous than other protocol. Author has also given comparison between various protocol that can be used to communicate and the conclusion is that BLE is more advantageous for this purpose.

In this paper Lei Wang, Dunlu Peng and Ting Zhang [5] proposes a user interface to monitor and control smart plug which is capable of controlling the smart appliance in an entire home. Author uses RESTful web services which are applied to communicate between the user and home devices. Then author explains two ways to access smart plug, that is either connecting it directly to Wi-Fi Ad-HOC mode or connecting it to a router in Wi-Fi infrastructure mode.

In this paper Rung-Shiang Cheng, Chia-Peng Lin and Jiun-Yu Zhou [6] mentions that to change the on/off state of electronic appliance. It requires physical presence the user. To

overcome this limitation the authors have designed a smart home automation using wireless technology using which the devices can be controlled and monitored remotely. The author has implemented a technique where status of the devices can be altered, only if the device present in specified range/location. To achieve this author has used GPS technology present in the Smart phone. In this method initially certain parameters are set and smart plug will constantly check the GPS location of the user, and when user location is in specific Range, then actions linked to that profile will be executed.

In this paper Maytham S. Ahmed, Azah Mohamed, Raad Z. Homod, Hussain Shareef, Ahmad H. Sabry and khairuddin bin Khalid [7] mention that to measure the power consumed by the electronic appliance, additional hardware such as power meter/oscilloscopes are required. To overcome this limitation the author has proposed an Idea of Integrating current and voltage measuring device into the smart plug. So that user can get the real time data of power consumed by the appliances connected to the smart plug. It is the economical way to measure the power consumed by the appliance. By measuring the power user can be aware of wastage of power that is occurring through the appliance and schedule the things accordingly.

In this paper Altaf Hamed Shajahan and A.Anand [8] talk about implementing smart plug with advanced energy system. Authors have proposed two methods of power measurement: Invasive type and Non-invasive. In Invasive type the wires need to be cut and passed through the sensor in order to get the power reading. And in Non-invasive type wires need not to be disturbed. Current flowing through the wires can be measured by using a current transformer through which the wires are passed. The data collected from the sensor will be stored in the microcontroller and updated to the cloud. Author also proposes various graphing and plotting techniques to extract more information/insight from the stored data.

In this paper N. Prayongpun and V. Sittakul [9] proposes master and slave concept among smart plug devices. Master device connects to the internet through Wi-Fi Router and slave devices connects to the master through Zigbee protocol. Authors suggest this concept because connecting multiple devices to the internet and monitoring at the same time is less convenient then connecting one device to internet and monitoring all slave devices through the master.

In this paper Ahmed S. Musleh, Mahdi Debouza and Mohamed Farook [10] mentions about using cloud platform as a bridge between the smart plug and the mobile application. When the user intends to change the on/off status of the electronic appliance then it can be achieved by just clicking a button and the data is updated to the cloud platform and the various data which are measured through sensor is updated to

cloud platform and mobile application displays the updated information to user.

IV. CONCLUSION

By Referring above papers, it can be outlined that home automation can be implemented easily using the smart plug which converts existing normal socket into the smart socket and it is possible to integrate current and voltage measuring sensors into the smart plug and the real-time data is updated to the mobile application and it is possible to integrate Bluetooth protocol into the smart plug so that people who don't have access to the internet can also communicate with the smart plug and all the data is updated to the mobile application via Bluetooth protocol. It is possible to automate certain processes/daily routines of the user using the scheduling concept and this project aims at the more intuitive way of implanting smart home automation in an economical way.

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