

# Home and Industrial Automation with Real-Time Energy Metering & Monitoring using IoT based Technology

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*Abstract*— Advancement in automation organization is devising liveliness story simpleton and easy with respect made Cyberspace an essential component of life. With such influence of Internet in our daylight -to-day life, the present tense generation is seeing a emergence of a new technology known as the 'IoT: Internet of Things'. Internet of things is creating plexus of everyday objects ranging from industrial motorcar to consumer dwelling house contrivance that share information and complete tasks while you are managing other action. A Home Mechanization System uses computers or Mobile River devices to ascendance staple home functions and features automatically through internet from anywhere around the world leading to the smart home concept, which is meant to save the electric world power and homo energy . The prime focus in development such a system is to provide ease for human life with a high efficiency, along with reduced power consumption. Real time monitoring of energy consumption is main objective lens of the system. This newspaper publisher reviews different techniques of designing, developing and implementing IoT based Home Mechanization System to all the aspects. In the modern era, automated organisations are being favoured over conventional arrangement. Over the past times decade, the brisk addition in the number of net users has.

**Key words:** Internet of Things, Automation, Smart Home, Real-Time, Energy Consumption

## I. INTRODUCTION

The procedure of restraint or operating various equipment, political machineries, industrial processes, and other practical application using various control organisation of rules s, with less or no man intervention is termed as auto mation. Based on the application, automation can be further categorized as abode automation, industrial automation, building automation, etc. Home automation is the process of controlling home convenience automatically using various control organisation proficiency. The electrical and electronic appliances in the home such as fan, lights, outdoor lights, fire alarm, kitchen timer, etc., can be command using various control techniques. Technology is a continuously evolving and developing process, which requires upgrading of the system according to the technology. Nowadays, all the system data is available on net and the World Wide Web technology is growing very fast. Embedded system with web technology provides remote management and controlling of embedded twist via web interface following the Cyberspace of Things technology. The Internet of Things is a technology in which the actual physical entities (electronic 5 senses of device ) with data sensing, processing and self adoption capacitance are used to interact with similar devices and process the data to take an intelligent decision which easiness our day to day life. In IoT environment, the devices are given unique

identifiers, giving them the ability to transfer data over a network without having homo -to-human or human-to-machine interaction. IoT is a combination two words: internet and affair which way that any objective or person which can be distinguished by the real number cosmos can be connected to global system of interconnected figurer network , governed by standard protocols. IoT can be defined as "An open and comprehensive network of intelligent object that have the capacity to auto organize, share information, data and imagination , reperforming and acting to environmental changes in real time". IoT is a humanity, where real, virtual and digit IoT is a new era of intelligence computation and it is providing a privilege to communicate around the mankind. The target of IoT is anything, anyone, anytime, anyplace, any service and any network. The ultimate goal of IoT applications is to automate organization rather than using manual scheme s, to improve the timber of living. Common fig .1 Internet of Thing Construct IoT includes change of objects like smart sound, tablets, digital cameras and different sensing element. When these entire gimmicks are connected together, they enable additional smart appendage and services that support our basic needs, environment and health. Massive number of gimmick s connected to net provides enormous kinds of services and also produce huge amount of data and information. House mechanisation is a forward stride in "Internet of Things", where everything is configured with an Internet Protocol (IP) address, which monitors, ascendancy s and remotely accesses the organisation the help of web technology. From the end user's power point of view, Internet based Home Mechanization System is very convenient, easy flexible and cheap. Nowadays, most of the devices have local aesthetic region network (LAN) connectivity via Ethernet and / or are Wisconsin -Fi enabled, which can connect them to smart phones or computers. But these devices cannot communicate with each other or else need additional devices to do so. Thus, these devices need to be unified, such that they can be monitored and control condition using one unity program or device, e.g. controlling lights, devotee , breeze -conditioners, oven , icebox , TV etc. by using an application on the Smartphone. This gives the user more control of their house and can simplify many manual natural processes. [16] Fig.2 Home Automation Internet on Things devices are controlled by web accountant which is a software system of embedded system and software slew . This is the most popular practice for Web development using in the earth. Remote control login and monitoring can be done by building a distributed web control system.

Internet on Things devices are controlled by web controller which is a package of embedded system and software stack. This is the most popular practice for Web development using in the world. Remote login and monitoring can be done by building a distributed web



application is less effective since the use of headphones and Smart phones is increasing rapidly.[3]

Hasan B. and Serkan I. have designed and implemented a telephone and PIC remote controlled device for controlling the home electrical devices. In this Pin check algorithm has been introduced where it was with cable network and not wireless communication. The system ensures safety as it cannot be used by unauthorized users as the system uses Pin-check system. The architecture is very complex, but it gives an idea of remote handling of home automation system.[4]

Hoque S. E., Akbar M. M., Sohan S., and Naim I. presented a GSM based communication and control for home appliances. Different AT commands are sent to the Home Mobile for controlling different appliances. The drawback of this system is that a Graphical User Interface (GUI) is not provided to the user. Different AT commands have to be remembered by the users to control the connected devices. Also, the system supports Java enabled mobile phones. The system thus becomes less functional as now-a-days the use of Java enables phones are reducing and the use of Android phones are increasing tremendously.[5]

Rana J. R. and Pawar S. N. have implemented a Zigbee based home automation system. Zigbee is a high-level communication protocol used to create personal area network. It supports any kind of micro-controller. The system eliminates the complications of wiring. Considerable amount of power saving is also possible. Operating range is more than Bluetooth. But the system does not allow remote monitoring and controlling of appliances.[6]

Piyare R. and Tazil M. have presented design and implementation of a low cost, flexible and wireless solution to the home automation. The system uses Bluetooth technology where cell phone is used for interaction between the host server and the client modules. This system can be used by any appliances that require On-off switching applications without any internet connection. The drawback of this system was that the wireless communication system was found to be limited to a range less than 50m in a concreted building and maximum of 100m range in an open range. The system supported only the symbian OS cell phones.[7]

Jadhav A., Anand S., Dhangare N., and Wagh K. S. developed a system which uses operating systems for implementation of the Home Automation System. An XML document is created and placed over the server, which can be used by any other mobile device without any platform issue. The layout of the screen is controlled by a common XML format. Downloading of XML file from the server and its parsing needs to be coded on every platform. As the design part is coded only once, a lot of coding effort is reduced. The same file is used by every other platform. The main objective of the paper was to develop a system without operating system platform limitations for Universal Mobile Applications.[8]

Javale D. and Nandanwar S. have used Android ADK for implementing a home automation and security system. In this system, the devices are connected to a Bluetooth sub controller physically. It does not require internet connectivity. Smart phone is used to access and control the devices using built-in Bluetooth connectivity. Communication is established between android mobile

device and the ADK. However, the system restricts mobility and can only be controlled within the specified boundary due to limited range of operation up to 100 m. Thus, the system does not support remote monitoring and controlling of appliances.[9]

Syed Anwaarullah presents the design and implementation of a low cost, compact and secure Android smart phone based home automation system. A single chip microcontroller real time operating system is integrated to the system, to improve the responsiveness of the system and make it more dynamic. The system uses Bluetooth technology. The Bluetooth module that is used is based on the Bluetooth V2.0 protocol and has a range of 10m operating at frequency of 2.4GHz with a maximum data exchange rate of 2.1Mbps. Similar to most of the existing systems, this system also does not support remote monitoring and controlling of devices.[10]

Sirsath N. S., Dhole P. S., Mohire N. P., Naik S. C and Ratnaparkhi N.S developed a Home Automation system that employs the integration of multi-touch mobile devices, cloud networking, wireless communication, and power-line communication to provide the user with remote control of various lights and appliances within their home. This system uses a consolidation of a mobile phone application, handheld wireless remote, and PC based program to provide a means of user interface to the consumer.[11]

Basil Hamed designed and implemented a control and monitor system for smart house. Smart house system consists of many systems that controlled by LabVIEW software as the main controlling system in this paper. Also, the smart house system was supported by remote control system as a sub controlling system. The system is also connected to the internet to monitor and control the house equipment's from anywhere in the world using LabVIEW. [12]

Basma M. Mohd, Sherine M., Abd El-kader and Fakhreldin M. A. proposed a new design for the smart home using the wireless sensor network and the biometric technologies. The proposed system employs the biometric in the authentication for home entrance which enhances home security as well as easiness of home entering process. The structure of the system is described and the incorporated communications are analyzed, also estimation for the whole system cost is given which is something lacking in a lot of other smart home designs offers. WB-SH is designed to be capable of incorporating in a building automation system and it can be applied to offices, clinics, and other places. The paper ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form. The paper ends with an imagination for the future of the smart home when employs the biometric technology in a larger and more comprehensive form.[13]

Delgado A. R, Picking R. and Grout V. in their paper, describe an investigation into the potential for remote controlled operation of home automation systems. It considers problems with their implementation, discusses possible solutions through various network technologies and indicates how to optimize the use of such systems. The home is a heterogeneous and distributed computing environment which certainly requires a careful study before developing any suitable Home Automation System (HAS)

that will accomplish its requirements. Nevertheless the latest attempts at introducing Home Automation Systems in actual homes for all kinds of users are starting to be successful thanks to the continuous standardization process that is lowering the prices and making devices more useful and easier to use for the end user. Even so several important issues are always to be handled strictly before developing and installing a Home Automation System; factors like security, reliability, usefulness, robustness and price are critical to determine if the final product will accomplish the expected requirements. [14]

Thus, there are various techniques to control home appliances such as IOT based home automation over the cloud, home automation under Wi-Fi through android apps from any Smartphone, Arduino based home automation, home automation by android application based remote control, home automation using digital control, RF based home automation system and touch screen based home automation. Wireless home automation using IOT is an innovative application of internet of things developed to control home appliances remotely over the cloud.

### III. PROBLEM STATEMENT

The idea about home mechanization expects with bring the control about operating your consistently home electrical appliances of the tip for your finger, Therefore providing for client competitive lighting solutions, exceptional vitality preservation with ideal utilization of vitality. Separated from exactly lighting solutions, the idea also further extends will bring a in general control In your home security and also Fabricate a brought together home excitement framework Also much a greater amount. The IoT built home mechanization system, similarly as the name prescribes means with control every last one of gadgets about your advanced mobile home through web conventions or cloud based registering. Home mechanization frameworks face four principle tests. These are helter shelter cosset from claiming ownership, inflexibility, poor manageability, What's more trouble clinched alongside accomplishing security. There need aid a couple All the more way tests that need will be acknowledged same time configuration & Creating those system:.

- Measures.
- ID number.
- Organize affiliation toward oneself.
- Combination.
- Information stockpiling.
- Confirmation.

Those IoT based home mechanization framework comprises of a servers Furthermore sensors. These remote servers found around web which assistance you on deal with and transform the information without the requirement from claiming customizes workstations. Those web built servers cam wood make arranged on control and screen different sensors introduced in those wanted area. Control utilization of servers will be getting to be an enormous issue in the server operation group keeping. The support expense about servers will be respectably high; likewise it additionally obliges a cooling framework. Hence, Vitality utilization Also cosset advertised need turned a real issue to vast information focuses What's more servers. A controller for

low control utilization camwood unravels this issue, consequently upgrading the execution. Electrical vitality or control is a critical component for person survival these days. Separated starting with these efforts, mechanization is necessary on vitality appropriation to upgrading compelling reason of the people. Nowadays, mankind's meter perusing is giving work to insufflate will adapt up for future private require. So, the interest to programmed meter perusing (AMR) frameworks may be expanding rapidly, which measures energy utilization readings electronically. [17].

### IV. SYSTEM IMPLEMENTATION OBJECTIVES

The main objectives of this research work is to design and implement a home automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable web interface. The system can attain great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will definitely decrease the deployment cost and will increase the ability of upgrading, and system reconfiguration. The objectives of implementing an IoT based home automation system can be defined as follows:

- To reduce power consumption in the web applications.
- To make energy metering easy by creating web application.
- To make an automated and intelligent home, and provide comfort to every consumer.
- Also the application is real time means the user can monitor real-time data and takes a particular action.

### V. PROPOSED SYSTEM

This paper proposes a smart home with intelligence and provides e-metering system as a smart grid to overcome the discussed issues. The web application enabled system controls smart devices in home and also, all billing features from web application work as a cloud application. The main objective of this project is to design energy consumption metering and control system for all service providers. As per this technology, a user can login and check usage of electricity in real time, while controlling various devices. Most of the energy providers can use same application for service management or controlling. No need to use separate application. Figure 3 shows a block diagram of the proposed system.

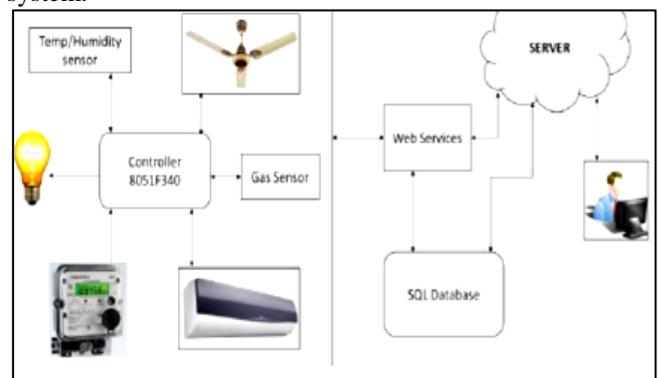


Fig. 3: Block Diagram

Microcontroller is the heart of the system, being a high speed SMD. It contains a server which is having a web application working as a cloud application, where we can monitor or control the devices connected to the

microcontroller. Temperature and humidity is measured by the sensor and displayed on web application. The gas sensor detects of leakage of gas. The SQL database contains all the data and values and these values are provided to application by web services. The system actually works on the principal of “Tri-Level Context making Model”[12]. The role of this model is to generate context after data acquisition. To maintain a quality of service in different service domains, the models consist of three levels of working: Simple monitoring, Automatic controlling and user centric services. Data acquisition and signal processing are the low level context, whereas high level context is used to generate situation awareness. Hardware contains main controller board with various sensors. Firstly all the sensors detect its current status and this status is sent towards the main controller. The current status values are stored into the database and these values are fetched and displayed on application. If status is updated by consumer, exact opposite procedure takes place. Updated values are stored in database and are also forwarded to the controller via internet connectivity by http request. Finally, the controller sends the updated value to transducers and they start working accordingly. Figure 4 shows flowchart of the proposed system.

## VI. ADVANTAGES OF HOME AUTOMATION SYSTEMS

There are many advantages of incorporating IoT into our lives, which can help individuals, businesses, and society on a daily basis. For individuals this new concept can come in many forms including health, safety, financially and every day planning. In recent years, wireless systems like Wi-Fi have become more and more common in home networking. In home and building automation systems, the use of wireless technologies gives several advantages that could not be achieved using a wired network only.

The home automation systems possess the advantages as described below:

### A. System Scalability and Straightforward Expansion

Deploying a wireless network is especially advantageous when, due to new or changed requirements, extension of the network is necessary. In contrast to wired installations, in which cabling extension is tedious. This makes wireless installations a seminal investment.

### B. Integration of Mobile Devices

With wireless networks, associating mobile devices such as PDAs and Smartphone's, automation system becomes possible everywhere and at any time, as the devices' exact physical location is no longer crucial for a connection (as long as the device is in reach of the network). For all these reasons, wireless technology is not only an attractive choice in renovation and refurbishment, but also for new installations.

### C. Aesthetical Benefits

Apart from covering a larger area, this attribute helps to full aesthetical requirements as well. Examples include representative buildings with all-glass architecture and historical buildings where design or conservatory reasons do not allow laying of cables.

### D. Reduced Installation Overheads

First and foremost, installation costs are significantly reduced since no cabling is necessary. Wired solutions require cabling, where material as well as the professional laying of cables (e.g. into walls) is expensive. Another advantage of IoT is the ability to track individual consumers and targeting these consumers based on the information supplied by the devices. In a way, it provides a more “personalized” system that could potentially increase business sales and increases their demographic. Additionally, with the increased amount of devices connected to the Internet the Smart Grid expands, conserving more energy. Devices can make decisions and adapt without human guidance to reduce their energy usage. IoT can also function as a tool that can save people money within their households. If their home appliances are able to communicate, they can operate in an energy efficient way. Finally, IoT can assist people with their everyday plans. Thus, IoT is certainly advantageous to businesses, individuals, consumers, the environment, and society.

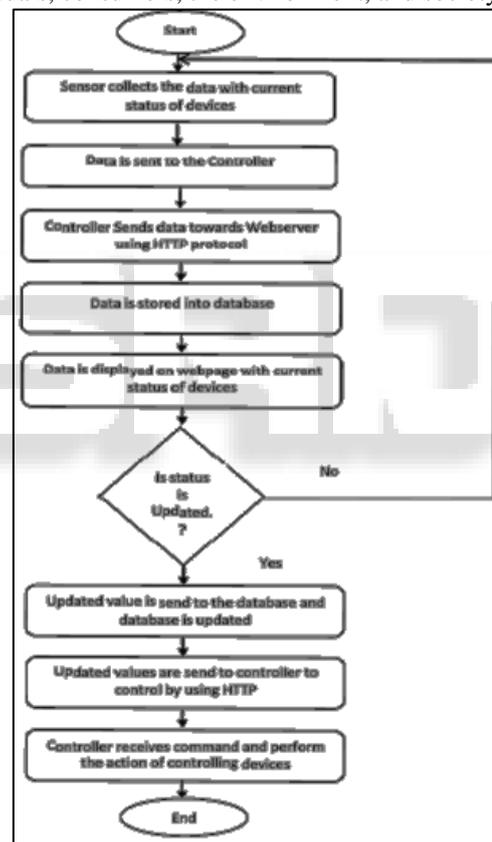


Fig. 4: Flowchart

## VII. CONCLUSION

Internet is a means of Communication which is easily available and affordable nowadays. Android Phones and Android applications are already a part of human life. Thus, a combination of these technologies will make life more simple and easy to live. The paper reviews various techniques and systems having both, the facilities of Home automation and Real Time Energy controlling and monitoring, which is available in single web application. Multiple Energy service providers can use same web application by changing admin login and it depends upon the size of database. The potential of the system can be

improved to a greater extent by combining technologies such as cloud computing, big data, robotics etc. Even though these technologies are not new to the Industry, combination of these technologies with the Internet of Things (IoT) will do miracles in human life.

#### REFERENCES

- [1] Sriskanthan N. and Karand T., "Bluetooth Based Home Automation System". *Journal of Microprocessors and Microsystems*, Vol. 26, pp.281-289, 2002.
- [2] Alkar A. Z. and Buhur U., "An Internet Based Wireless Home Automation System for Multifunctional Devices", *IEEE Transactions on Consumer Electronics*, vol. 51, pp. 1169-1174, 2005.
- [3] Mohd. Izhar Ramli, Mohd. Helmy Abd Wahab, Nabihah, "Towards Smart Home: Control Electrical Devices Online", *Nornabihah Ahmad International Conference on Science and Technology: Application in Industry and Education (2006)*.
- [4] Yavuz E., Hasan B., Serkan I., and Duygu K., "Safe and Secure PIC Based Remote Control Application for Intelligent Home", *International Journal of Computer Science and Network Security*, Vol. 7, No. 5, May 2007.
- [5] Shahriyar R., Hoque E., Sohan S., Naim I., Akbar M. M., and Khan M. K., "Remote Controlling of Home Appliances Using Mobile Telephony", *International Journal of Smart Home*, vol. 2, pp. 37-54, 2008.
- [6] Rana J. R. and Pawar S. N., "Zigbee Based Home Automation", April 10, 2010.
- [7] Piyare R. and Tazil M., "Bluetooth Based Home Automation System Using Cell Phone", *Consumer Electronics (ISCE)*, 2011 IEEE 15th International Symposium on, 2011, pp. 192-195.
- [8] Jadhav A., Anand S., Dhangare N. and Wagh K.S., "Universal Mobile Application Development (UMAD) On Home Automation", *Network and Complex Systems ISSN 2224-610X (Paper) ISSN 2225-0603 (Online) Vol 2, No.2, Marathwada Mitra Mandals Institute of Technology, University of Pune, India 2012*
- [9] Javale D., Mohd. Mohsin, Nandanwar S., and Shingate S., "Home Automation and Security System Using Android ADK", *International Journal of Electronics Communication and Computer Technology*, vol. 3, pp. 382-385, 2013.
- [10] S. V. A. Syed Anwaarullah, "RTOS Based Home Automation System Using Android", *International Journal Of Advanced Trends In Computer Science And Engineering*, vol. 2, pp. 480-484, 2013
- [11] Sirsath N. S, Dhole P. S, Mohire N. P, Naik S. C & Ratnaparkhi N.S, "Home Automation using Cloud Network and Mobile Devices".
- [12] Basil Hamed, "Design & Implementation of Smart House Control Using LabVIEW", *International Journal of Soft Computing and Engineering (IJSCE)* ISSN: 2231-2307, Volume-1, Issue-6, January 2012.
- [13] Basma M. Mohammad El-Basioni, Sherine M. Abd El-kader and Mahmoud Abdelmonim Fakhreldin, "Smart Home Design using Wireless Sensor Network and Biometric Technologies" at Volume 2, Issue 3, March 2013.
- [14] Delgado A.R., Picking R. and Grout V., "Remote-Controlled Home Automation Systems with Different Network Technologies", *Centre for Applied Internet Research (CAIR)*, University of Wales, NEWI, Wrexham, UK.
- [15] Khatu M., Kaimal N., Jadhav P. and Syedali Adnan Rizvi, "Implementation of Internet of Things for Home Automation", *International Journal of Emerging Engineering Research and Technology*, Volume 3, Issue 2, February 2015, PP 7-11.
- [16] Pawar P. N., Ramachandran S., Singh N. P., Wagh V. A., "A Home Automation System using Internet of Things", *International Journal of Innovative Research in Computer and Communication Engineering*, Vol. 4, Issue 4, April 2016.
- [17] Bhilare R. and Mali S., "IoT Based Smart Home with Real Time EMetering Using E-controller", *IEEE INDICON*, 2015.
- [18] Singh S. and Ray K. K., "Home Automation System Using Internet Of Things", *International Journal of Computer Engineering and Applications*.
- [19] Radhika C., Menaka M., "Survey on IoT Technologies for Home Automation System", *International Journal of Engineering and Techniques - Volume 2 Issue 6, Nov - Dec 2016*.
- [20] Vinay Sagar K. N. and Kusuma S. M., "Home Automation Using Internet of Things", *International Research Journal of Engineering and Technology (IRJET)*, e-ISSN: 2395 -0056 Volume: 02 Issue: 03 | June-2015.
- [21] Aarti and Pooja Mittal, "Review Paper On Home Automation Using Internet Of Things", *International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)*, Volume 5, Issue 4, July - August 2016.