

Survey on IoT Technologies for Home Automation System

RADHIKA C¹, MENAKA M²

¹(Assistant Professor, Information Technology, Kingston Engineering College, Tamilnadu)

² (Assistant Professor, Computer Science, Kingston Engineering College, Tamilnadu)

Abstract:

Internet of things (IoT) is an emerging technology today that envisions all objects around us as a part of Internet. Automation of the devices, appliances at home and office is having extensive possibility of research with the innovation of technology in communication. Misuse of power energy can be shortened by automating the devices and appliances. Mobile communication is plays a major role in the automation domain. Android phones are designed with applications to automate the required devices. Creating a mobile app on a Smartphone device so that the user can control electronic devices; see the amount of flow, so the problem is the difficulty in saving electricity can be resolved. IoT includes variety of objects like smart phones, tablets, digital cameras and different sensors. When all these devices are connected together, they enable additional smart processes and services that support our basic needs, environment and health. Massive number of devices connected to internet provides enormous kinds of services and also produces huge amount of data and information. Cloud computing is an on-demand access to a shared pool of configurable resources that can be provisioned as infrastructures, software and applications. Cloud based platforms help to connect to the things around us so it is easy to connect any objects anytime at any place using in built applications. Applications that use devices like sensors have unique requirements of enormous storage to store big data and huge computation power to enable the real time processing of the data, information and high speed network is required for audio and video streaming. Wireless technologies like Bluetooth, WiFi, and ZigBee have been used in wide range of applications like modern home security systems using low cost, low power, less complexity RF module.

Keywords — IoT, Wireless technology, Smart phones, Sensors, Cloud.

I. INTRODUCTION

IoT (Internet of Thing) is extension of Internet services (all the devices are connected and controlled with internet connectivity).IoT is emerging topic in industry and engineering circles. Internet has changed human's life by providing anytime, anywhere connectivity with anyone. Internet helps us to bring in with immediate solution for many problems and also 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 device and new technology to simplify their day to day life. The innovators and researchers are

In 1990s, Internet connectivity began to proliferate in enterprise and consumer market, but was still limited in its use because of the low performance of the network interconnects. In the 2000s internet connectivity became the norm for many applications and today is expected as part of many enterprise, industrial and consumer products to provide access to information. However, these devices are still primarily things on the internet that require more human interaction and monitoring through apps and interfaces. For many years Home

automation is mainly used as features of science fiction writing, but it's become practical since the early of 20th century that is because of the introduction of electricity and rapid improvement in information technology [3].

II. INTERNET OF THINGS

IoT is generally a scenario where network connectivity and computing capability was extended to objects, sensors and all items normally not considered as computers can exchange, generate and consume data with minimal human intervention. Rapid growth in technologies enhanced the growth of IoT Environment and it was already developed in Industrial Wireless sensor Network. The concept of combining computers, sensors, and networks to monitor and control devices has existed for decades and the projections for the impact of IoT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than \$11 trillion by 2025 [1].

A. Objectives of Internet

The internet where the existing network of internet to the computer systems will connect to the real world objects or things. Things may include any objects, home appliances, devices, vehicles, etc. and when these things connect to the internet in specific infrastructure via standard protocols then the whole system is said to be internet of things [4]. The term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects. [IoT 2008] Figure shows the objectives of IoT [3].

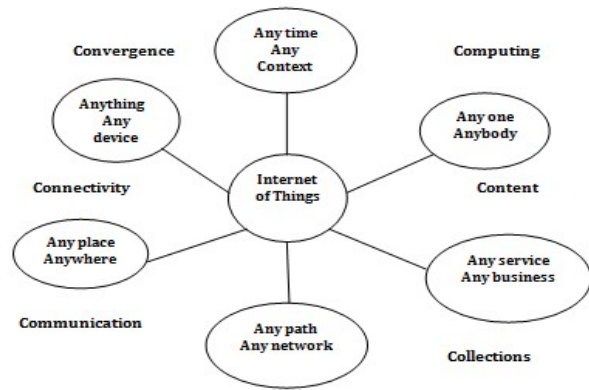
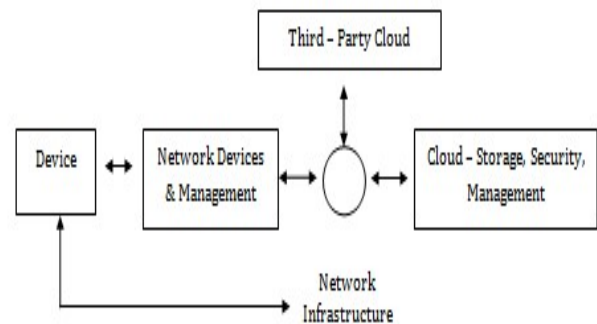


Figure 1: Objectives of Internet of Things

B. IoT Reference Architecture



C. Internet of Things Connectivity Model

IoT uses four common Communication models [1]

i. Device to Device Communication

Two Devices Communicate directly between one another through a wireless network like Bluetooth, zigbee etc. without using an intermediate server.

ii. Device to cloud Communication

The IoT device connects directly to an Internet cloud service like an application service provider to exchange data and control message traffic. This approach frequently takes advantage of existing communications mechanisms like traditional wired Ethernet or Wi-Fi connections to establish a connection between the device and the IP network, which ultimately connects to the cloud service.

iii. Device to Gateway Model

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

iv. Back End data sharing Model

The back-end data-sharing model refers to a communication architecture that enables users to export and analyze smart object data from a cloud service in combination with data from other sources.

D. Challenges

Different key challenges was discussed by Dhananjay Singh et al., and Sarita Agrawal et al., in [4] [5].

- i. Standards*
- ii. Identification*
- iii. Authentication*
- iv. Security*
- v. Integration*
- vi. Coordination*
- vii. Data Storage*
- viii. Network Self-Organization*

E.Applications of IoT

- i. Smart Homes*
- ii. Wearable*
- iii. Smart City*
- iv. Smart grid*
- v. Industrial Internet*
- vi. Connected Car*
- vii. Connected Health*
- viii. Smart retail*
- ix. Smart Supply chain*
- x. Smart farming*

III. SMART HOME AUTOMATION

Smart Home clearly stands out, ranking as highest Internet of Things application on all measured channels. More than 60,000 people

currently search for the term “Smart Home” each month. This is not a surprise. The IoT Analytics company database for Smart Home includes 256 companies and startups. More companies are active in smart home than any other application in the field of IoT. The total amount of funding for Smart Home startups currently exceeds \$2.5bn. This list includes prominent startup names such as Nest or AlertMe as well as a number of multinational corporations like Philips, Haier, or Belkin. [6]

Smart homes are those where home appliances are remotely controlled. Wireless Smart home automation system is one of the applications of IoT (Internet of Things) it is a system that uses physical devices like computers, Mobile to control basic home functions and features automatically through internet from anywhere outside the world. The main purpose of IoT based Home automation system is to save electrical power and human efforts. Smart Home Automation is the process of operating and controlling various equipments using control system techniques with no human intervention. The electrical and electronic home appliances can be operated and controlled using various control system techniques. Massive Growth in technologies and architecture enhancement comes out with many security problems. 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 internet.

IV. LITERATURE SURVEY

A Survey on an Efficient IOT Based Smart Home [3] proposes an efficient implementation for IoT for monitoring and automation system and it uses the portable devices as a user interface. Portable devices can communicate with home automation network through an Internet gate, by means of low power communication protocols like zigbee, Wi-Fi etc. This project aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol and arduino uno. The user here will move directly with the system through a web-based interface over the web whereas home appliances like lights, fan etc. are remotely controlled through easy website. This paper also describes how to provide fully smart environment

condition monitoring by various sensors (Temperature, Humidity, Light and Level) for providing necessary data to automatic detection and resolution of any problem in the devices. Controlling the home appliances via World Wide Web.

Based on the idea of “A Survey on Internet of Things Based Home Automation System” [7]. A Remote Password Operated Home Appliances Control Project Algorithm was designed to read the data from Bluetooth module, Initialize the LCD and UART protocol and display the status of the electrical loads on LCD. The system is installed beside the conventional electrical switches on the wall. The risk of dangerous electric shocks can be avoided by using low voltage switches. The system uses two GUIs- one on the personal computer and the other on Smartphone. The status of the appliances i.e. whether it is on/off can be known by using this GUI. Any changes in the status of the appliances, immediate intimation is shown on the GUI. The window GUI will act as a server to forward or transmit any data to/from the Smartphone and the main control board, after the Smartphone’s Bluetooth is connected to the Bluetooth of the computer. In case, the Bluetooth connection between the PC or laptop and the control board fails, then connection can be re-established by using USB cable. The user can monitor and control the devices from any remote location at any time using IOT.

This paper describes “Smart Home Automation using IOT” [8]. A System hardware is divided into three parts i.e. PCB, humidity sensor, and Arduino controller. Relay, LPT port, transistor, diode resistor are integrated on PCB. They have connected two devices to the PCB i.e. fan and light. Humidity sensor is connected to Arduino. It will sense humidity and temperature as well. Arduino and PCB are connected to PC. Arduino and PCB will interact with each other through PC. They have measured temperature and humidity. They have set time by which it continuously senses temperature and humidity. In the screenshot, it continuously senses temperature and humidity after every 5 seconds.

ADVANTAGES (a) Adds Safety Through Appliance and Lighting Control (b) Secures Home Through web control Increases Convenience through Temperature Adjustment (c) Save time (d) Save money and increase convenience (e) Allow to appliances control when out of town [8].

This paper [9] describes that the Home automation or automation of an office is done so with electronics and communication advancement. Platforms based on cloud computing help to connect to the things surrounding everyone so that one can find it easy to access anything and everything at any time and place in a user friendly manner using custom defined portals. Hence, cloud acts as a front end to access IoT. The exciting opportunities yet to increase the connectivity and relationship of home devices for home automation purposes to the internet.

The model [10] consists of different sensors like temperature, gas, motion and LDR. Initially the Intel Galileo connects to the internet through WiFi. When the connection is established it will start reading the parameters of sensors like p1, p2, p3 etc. The threshold levels for the required sensors are set as t1, t2, t3 etc. 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 alarm a1, a2, a3 etc. will be raised and the required actuation is done for the controlling of the parameters. In the proposed model the temperature, gas leakage, motion in the house is monitored. The temperature and the motion detection is stored in cloud for analysis. If the temperature exceeds the threshold level then the cooler will turn on automatically and it will off when the temperature comes to control. Similarly when there is a leakage of gas in the house alarm is raised giving the alert sound. The required lights are turned on/off automatically by detecting the light outside the house. The user can also monitor the electric appliances through the internet via web server. If the lights or any electrical appliances are left on in hurry can be seen and turned off remotely through simply typing the IP address of the web server.

This paper [11] was an attempt to introduce ideas, movements, technical approaches and considerations for strategic planning for the Internet of Things. It was a simple review of research in IoT models, privacy issues and considerations for businesses to include in their way forward for IoT. Attempts are being made to harness the seismic shift caused by the IoT movement. While unification or standardization is lacking it seems like it may be left to economic competition on what moves forward. This paper was a very small fraction of what IoT literature provides and was meant to educate individuals as it has done for the author in order to initiate discussions at their organizations.

This paper [12] describes The Internet of Things (IoT) is an atmosphere in which objects, animals or people are made available with distinct identifiers and the capability to transfer data through a network without requiring human-to-human or human-to-computer interaction. 'Internet of Things' defines a number of skills and research disciplines that allow the Internet to reach into the real world of physical objects. Technologies like short-range wireless communications, RFID, ad hoc and wireless sensor networks (WSNs) which is the part of Internet of Things (IoT). The home automation using Internet of Things and wireless sensor network work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. This paper describes the concept of WSN, IoT and architecture of Home Automation.

Based on surveyed study the comparison of home automation systems [13] Microcontroller, user interface, a communication interface and their performance factor are compared. There are a number of do-it-yourself (DIY) platforms available that allow to create Home Automation system quickly and easily with low cost and high performance e.g. Raspberry pi, Arduino, other microcontrollers, etc. In this review explained different home automation system e.g. Web based, email based, Bluetooth-based, mobile-based, SMS based, ZigBee-based, Dual Tone Multi Frequency-

based, cloud-based and Internet based. In future home automation will more smart and fast. It would be extended to the large-scale environment such as colleges, offices and factories etc.

This paper [14] is based on Findings and Analysis on Services for IoT, They have reviewed the services offered by IoT, and presented the opportunities and challenges:

1. The data generated from the different devices are analysed with new big data techniques to make easier the decision-making process. Data mining (DM) and machine learning (ML) techniques can be used.
2. Real-time analytics is possible through big data services over the Cloud.
3. The data are generated by a huge amount of 'things' all the time (in a city environment for example: weather stations, traffic cameras, metering devices, smart urban furniture, street lights, etc.). Depending on their characteristics, different techniques will be used:
 - (a) Natural language processing techniques (for example information extraction or question answering) to extract relevant information from textual unstructured information;
 - (b) DM and ML techniques to make predictions about collected data;
 - (c) Visualization techniques (dashboards or Google Analytics) to view graphically the data in order to facilitate the decision-making process.
4. Data from multiple sources in several formats are accessible via cloud services (data as a service, DaaS). The data are collected and stored into the Cloud and can be used/rented by other organizations to perform analysis, graphs, maps, etc.
5. Integration of information. It is a big challenge. The major idea is to integrate structured and unstructured information from different sources. Moreover, general/domain ontologies and reasoning techniques to match equivalent concepts among all the collected information can be used.

This paper describes [15] Various Home Automation Methodologies Analyzed from a Security Standpoint and Challenges in Home Automation Security. It shows how the concept of

security and meaning of the word “intruder” has changed in modern homes. Various home automation technologies considered in this work include context-aware home automation systems, central controller-based home automation systems, Bluetooth-based home automation systems, Global System for Mobile communication or mobile-based home automation systems, Short Messaging Service-based home automation systems, General Packet Radio Service-based home automation systems, Dual Tone Multi Frequency-based home automation systems, and Internet-based home automation systems.

In this paper [16], they have proposed a protocol standard for home automation system called Home Automation Device Protocol (HADP). This protocol standard aims for the interoperability of home automation devices across different platforms. Based on the IFTTT (IF-This-Then-That) model, defined a set of device communication protocols where devices’ triggers and actions are combined to generate and manage interactions through a central node. The proposed protocol standard offers low power consumption and low bandwidth requirements using the minimum data packets to trigger an action on a home automation device. The protocol supports various communication mediums such as Wi-Fi, Bluetooth 4.2, ZigBee IP, 6LoWPAN, IEEE 802.15.4 standards, and Ethernet or any network layer supporting IPv6 protocol.

In this paper [17] they have described about Artificial Intelligence which refers to electronic environments that are sensitive and responsive to the presence of people. In an ambient intelligence world, devices work in concert to support people in carrying out their everyday life activities in easy, natural way using Information and Intelligence that is hidden in the network connected devices. It is characterized by the following systems of characteristics (1) Embedded: Many Networked devices are integrated in to the environment (2) Context Aware: These devices can recognize you and your situational context (3) Personalized: They can be tailored to your needs (4) Adaptive: They can change in response to you (5) Anticipatory:

They can anticipate your desires without conscious mediation.

V. CONCLUSIONS

IoT technology has great impact in everyone’s everyday life. This survey describes various methodologies used in home automation system to control and access the home appliances remotely through Internet services anywhere anytime. Several unlock issues related to privacy and security needs to be focused for future Internet of Things. Securing data, data management and privacy of every user plays a key role in the challenges of Internet of Things.

REFERENCES

1. *Internet Society; Internet of Things Overview; [online] Available: www.internetsociety.org*
2. *The Intel IoT Platform reference architecture specification white paper.[online] Available: <http://www.intel.in>*
3. *Twinkle Gondaliya ,”A Survey on an Efficient IOT Based Smart Home”, International Journal of Review in Electronics and Communication Engineering Volume 4, No 1 February 2016.*
4. *Gaurav Tripathi, Dhananjay Singh, and Antonio J. Jara, "A survey of Internet-of-Things: Future Vision, Architecture, Challenges and Service", IEEE World Forum on Internet of Things (WF-IoT), 2014, pp. 287-292*
5. *Sarita Agrawal, and Manik Lal Das, "Internet of Things – A Paradigm Shift of Future Internet Applications", International Conference on Current Trends in Technology, December, 2011.*
6. *IOT Analytics: Market Insight for Internet of Things, <https://iot-analytics.com/10-internet-of-things-applications>.*
7. *Pooja N.Pawar1, Shruti Ramachandran2, Nisha P.Singh3, Varsha V.Wagh4, "A Survey on Internet of Things Based Home Automation System",International Journal of Innovative Research in Computer and Communication Engineering, Vol. 4, Issue 1, January 2016.*
8. *Dhakad Kunall, Dhake Tushar2, Undegaonkar Pooja3, Zope Vaibhav4, Vinay Lodha5," Smart Home Automation using IOT", International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 2, February 2016.*
9. *H. Santhi, Gayathri.P , "A Review of Home Automation using IoT Applications", International Journal of Computer Science & Engineering Technology, ISSN : 2229-3345 Vol. 7 No. 07 Jul 2016.*

10. Vinay sagar K N, 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.
11. *Literature Review of the Internet of Things: Anticipating Tomorrow's Challenges for Privacy and Security.*
12. Prof S A Jain, Stevan Maineka, Pranali Nimgade, "Application Of IoT-WSN in Home Automation System: A Literature Survey", *Multidisciplinary Journal of Research in Engineering and Technology*, Volume 3, Issue 1, Pg.916-922.
13. Vaishnavi S. Gunge, Pratibha S. Yalagi, "Smart Home Automation: A Literature Review", *International Journal of Computer Applications (0975 – 8887) National Seminar on Recent Trends in Data Mining (RTDM 2016)*.
14. David Gil 1,*, Antonio Ferrández 2, Higinio Mora-Mora 1 and Jesús Peral 2, "Internet of Things: A Review of Surveys Based on Context Aware Intelligent Services", *Sensors* 2016, 16, 1069; doi:10.3390/s16071069.
15. Arun Cyril Jose¹ and Reza Malekian², "Smart Home Automation Security: A Literature Review", *Smart Computing Review*, vol. 5, no. 4, August 2015.
16. Thomas Gonnot, Won-Jae Yi, Ehsan Monsef, Jafar Saniie, "Home Automation Device Protocol (HADP): A Protocol Standard for Unified Device Interactions", *Advances in Internet of Things*, 2015, 5, 27-38.
17. Somayya Madakam, R. Ramaswamy, Siddharth Tripathi, "Internet of Things (IoT): A Literature Review", *Journal of Computer and Communications*, 2015, 3, 164-173.