

IOT CONCEPT, TECHNOLOGIES & APPLICATIONS FOR SMART HOMES – A REVIEW

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ABSTRACT

Modern civilizations expect new devices and new technology to simplify their day to day Activities. IoT has great potential to improve the quality of life. IoT aims to coalesce everything under a common infrastructure, giving us not only control of things around us, but also keeping us informed of the state of the things. Present study addresses the concept of IoT, IoT related technologies, challenges and its application for future smart homes.

KEYWORDS: Home Automation system (HAS), IOT, Smart Homes, Zigbee.

I. INTRODUCTION

IoT is the major prospect and challenge today. IoT can be simply described as things which connect living and non-living things through internet. IoT can also be considered as a global network which allows communicating between things-to-things (T2T), human-to-human (H2H) and human-to-things (H2T) by providing uniqueness to every object. Formally computers, smart phones and tablets are devices which can be connected to the internet. But today every household thing can be taken online right from gas to vending machine to cars which can communicate and pass the message to other object.

Smart homes are also called Home Automation system or Demotic which involves the control and automation of all electronic equipment around us. With the advance in networking technology many projects of smart homes have been developed to provide safety security and quality of living. In addition to home automation system is supposed to save energy as large amount of electricity is wasted due to human negligence. Finally

home automation system should provide solution to all the problems which are faced by smart homes.

II. APPLICATIONS OF IOT FOR SMART HOMES

The IoT application related to smart homes are enormous. We can categorize them in following ways;

1. Functions based

- Alert and sensors – heat/smoke sensors, temperature sensors
- Monitoring – Regular feed of sensor data i.e. heat, CCTV monitoring
- Control – switching on/off appliances i.e. sprinklers, lightings
- Intelligence and Logic – Movement tracking i.e. security appliances

2. Security based

- CCTV based Surveillance
- Intrusion detection & alarming

3. Health & wellness based

- Application for physically handicapped
- Applications for old age / kids

- Applications providing information about medical history of family members

4. Energy management based

- Application controlling (turning On / OFF) home devices to conserve energy (e.g. control Air conditioning system, illumination / lighting control ...)
- Application of Solar energy management systems

Following picture gives different categorization

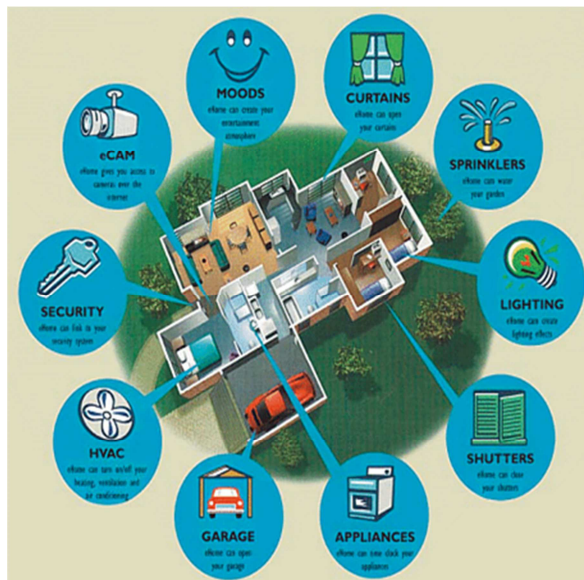


Figure 1: Different Application areas of Smart homes

III. IoT RELATED TECHNOLOGIES

The Internet of Things (IoT) enabled users to bring physical objects into the scope of cyber world. This was made possible by different tagging technologies like NFC, RFID and 2D barcode which allowed physical objects to be identified and referred over the internet. IoT, which is integrated with Sensor Technology and Radio Frequency Technology, is the ubiquitous network based on the universal hardware resources of Internet, is the Internet contents objects together.

a) Radio-Frequency Identification (RFID)

RFID is one of the important tools that plays vital role in IoT for solving identification issues of objects in a cost effective manner. Tag, reader, antenna, access controller, software and server are the main components of RFID. It is more reliable, efficient, secured, inexpensive and accurate. RFID has an extensive range of wireless applications such as distribution, locating, patient monitoring, military applications etc.

b) Wireless sensor network (WSN)

A WSN is a wireless network consisting of spatially scattered independent devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure or motion or at different locations. There is various application areas where WSN can be used for example military, home security, healthcare, agriculture monitoring, manufacturing, forest fire and flood detection etc.

c) Wifi

Now a day's entire city have become Wi-Fi corridors. Wireless fidelity Wireless Fidelity (Wi-Fi) technology allows computers and other devices to interconnect over a wireless signal. Today Wi-Fi provides high speed Wireless Local Area Network (WLAN) connectivity to almost millions of offices, homes, and public locations such as hotels and airports.

d) Bluetooth

is open wireless protocol which uses short range radio technology for exchanging data over fixed or mobile devices. This is cost effective solution for as it does not required permanent wiring.

e) Zigbee

is one of the protocols extensively used in IoT related applications because of its characteristics like flexible protocol

design, low cost and high data security and reliability and strong encryption capability. It is generally used in home automation, monitoring power management systems, Industrial controls system, and health monitoring power management systems. Zigbee is ideal & most preferred technology for research related activities. Zigbee is best solution for a wide range of Smart Home applications: lighting, security, thermostats, and remote controls.

- f) **INSTEON**- It is the most consistent and best-seller technology wireless home-control networking technology because of its features like simple to install, cost effective and highly reactive. Insteon can control & integrate electrical devices like illuminations, Heaters, air-conditioners to make home a smart home.
- g) **Barcode** – is an alternative method for data entry extensively used in retail stores. It uses different way of encoding numbers and letters by using combination of bars and spaces of varying width.
- h) **Actuator** - An actuator is device that converts energy into motion. It takes hydraulic fluid, electric current or some other source of power. They are typically used in manufacturing or industrial applications.
- i) **Z-Wave**– Z-Wave is the top wireless home Automation technology in the market. It offers more than 1700 certified product worldwide. Z-wave is the widely used most stable and reliable technology because of its features like flexibility and security.

EnOcean –Is the latest technology mainly aims at zero energy consumption through energy harvesting. These devices needs less maintenance as they are self-powered

IV. LITERATURE REVIEW

This technical paper [1] explains use of different hardware and software devices for developing Temperature logging system for the Smart home. This system makes use of ATmega 16 microcontroller, Wi-Fi, Think speak which is an open source IOT application for storing, retrieving data over the internet. This paper further explains how to collect, store, analyze, visualize finally retrieved data over the internet. Authors have proposed a smart module which is the brain of the system

This paper [2] explains how IOT and Solar based system can be used in Home automation with the objectives to improve the efficiency, accuracy & economic benefit. The authors have integrated all types of power consuming devices i.e. bulbs, television, Refrigerator with IOT which will effectively balance power generation & energy usage. To demonstrate the use of solar based electronic power system the authors have wrote and design the simulator in which has 3 basic things are considered.

AmpHour Meter – to know the first level charge on battery backup Solar Amps Meter – amount of charging power coming in AC Amps Meter – amount of power used Different case studies are conducted with the appliances like TV, Refrigerator, computer, house lighting and microwave is on with sun intensity. This paper [3] describes IoT based simulation environment which will switch on/off house-hold devices remotely using web based application through mobile or laptops. The current status of device would be saved in database along with time and calculator will calculate power consumption of devices and time of on and off. Matlab, Sqlserver, visual studio and .net framework were used to develop the simulator.

This paper [4] suggests a Home Automation system that works the combination 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 for their home. This system uses Smart phones, wireless remote, and PC based program to provide a means of user interface to the consumer.

This paper [5] the key objective of this paper is to help out handicapped/old aged people. It gives basic idea of how to control various home appliances and provide a security using Android phone/tab.

The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the android phone and send control signal to the Arduino ADK which in turn will control other embedded devices/sensors.

This paper [6] addresses a numeral of issues concerned in designing a home automation system (HAS). HAS should provide a user-friendly interface on the host side so that various devices/sensors can be easily setup, monitored, and controlled. Lastly the system should be cost effective. This project integrates locally and remotely controlled systems based on of Cloud data network.

This allows the system to operate without the dependence of a mobile provider. Cloud networking and data communications allow individuals to monitor, manage, and control their personal data points through the Internet.

This paper [7] Zigbee based home automation techniques are very popular due to high data rate no sort of latency issues. This paper proposes Zigbee based system which makes communication between user and household equipment. User can use system through Web page and SMS for monitoring and controlling the electronic equipment's such as heater, lamps and air-condition.

This paper [8] provides review on different definitions of IoT, its origin and Architectures. It also studies different technologies, its comparison and application in different areas. Finally author concludes some of the key observation like need of worldwide standardization, standard protocol for better governance.

This paper [9] gives us a gist about use of digital camera as a motion detector. These are used in areas where no one is allowed to enter as well as detecting motion in restricted areas. In Intelligent monitoring sensor (digital camera) and software work in tandem with each other. The camera will be used for capturing images while the motion will be detected by the software. On such motion detection an alert signal will send to the designated PC.

This ensures security in the restricted area. Traditionally CCTV's were used for monitoring but it is expensive due to huge hardware cost and significant manual efforts. But web-cam based surveillance system with motion detection ability would be more effective and economical.

This paper [10] compares various popular home automations technologies like X10, Zigbee, Z-wave, Insteon and EnOcean on the basis of performance, affordability, flexibility, data security and reliability. Author finally concludes that there are some plus and minuses for each of technology like Z-wave is the cheapest technology but it is absolute so Zigbee can be considered as ideal. This paper will help to choose best possible technology for smart homes.

V. KEY CHALLENGES OF SMART HOMES

- **Reliability and acceptance** – The major issue in case of Smart homes is Reliability. A reliable system is must for any technology.

- **Data Privacy** – Confidentiality of data need to be maintained. Data must be kept safe from external intervention.
- **Integration** – IoT for smart homes in a collection of heterogeneous devices so integration of such devices is complex task.
- **Coordination** – There must be proper coordination between connected devices and process etc. so that system would work efficiently.
- **Cost of smart-ness** - Since in the smart home technology is new technology, the products are quite expensive. Thus production of the devices is a hard work.
- **Data storage** - Since the use of different IOT applications are ever increasing this results into requirements of large amount of data storage.

VI. NEED

Smart homes need energy efficient, flexible system which will automatically detect the fault in the devices and initiate a recovery process to resolve the problem. As in many cases some people are not able move much from one place, it is essential for them to develop a system which requires less human interaction. Also to improve standard of living it is needed to change home condition according to the mood of the user without any disruption. So we need a much smarter system which provides all the above facilities in low price and less energy consumption.

VII. CONCLUSION

IoT has been bringing an ocean of technological changes in our daily lives, which in turn helps to making our life simpler and more comfortable, through various technologies and applications. This paper has discussed the various technologies and tools that can be integrated for future smart homes.

IoT applications are very useful in all the domains including medical, manufacturing, industrial, transportation, education, governance, mining, habitat etc. Though IoT has abundant benefits, there are some inefficiencies / flaws in the IoT governance and implementation level. The key observations in the literature are that

- There is no standard definition in worldwide
- Universal standardizations are required in architectural level
- Technologies are varying from vendor-vendor, so needs to be interoperable
- For better global governance, we need to build standard protocols.

Finally this paper presents need to understand applications and technologies to gain future direction for the implementation of IOT application for smart homes.

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