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A Conceptual Review on Smart Homes

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***Abstract* -** Internet of Things (IoT) is the one of the most trending topic for research which had made its spurt emergence in the industry with breathtaking implementations. Internet of Things applications are like a big blue ocean covering plenty of devices leading to a whole new ecosystem. Nowadays, one of the most enlightened applications of the Internet of Things is Smart Homes. This concept has made our homes more secure and smarter resulting in judicious use of resources as well as leading to a smarter sustainable development. Smart homes are one of the most reliable applications of Internet of Things making one's surrounding easy to deal with. This paper covers conceptual study on Smart Homes with offered utility, features and potency.

***Keywords*—**Internet of Things, Home Automation, Wireless Sensor Network, MEMS

I. INTRODUCTION

In past few decades, researchers at Carnegie Mellon University developed the world's first IoT-enabled Coke Machine. The concept of IoT developed in the early 90s by Mark Weiser and Kevin Ashton coined the term 'Internet of Things[1] . IoT has unleashed the world with life changing applications. According to present scenario, IoT has been successfully implemented in wide range of sectors from automation to logistics and analytics. IoT applications have taken the technology as well as research to new heights. Nowadays, this concept is prominently used in home automation that will make them safer and smarter. This wave of creating smart homes will not only be limited to the connection of small objects, it will make the interconnection and interoperability between multiple heterogeneous devices and networks. This new innovation has made the production of industry more efficient and faster. As the ideas and innovations are trending now at a faster pace, IoT is being used in all the technologies which are being developed. It will also support the various applications running simultaneously along with the enabling the receiving of data among CGI's and android app user. Cloud-based applications are the key to using leveraged data [1]. The Internet of Things doesn't function without cloud-based applications to interpret and transmit the data coming from all these sensors. The cloud is what enables the apps to go to work for you anytime, anywhere.

II. EVOLUTION

IoT trends have seen tremendous changes since the year of its evolution [2]. The figure 1.1 shows the various areas where the IoT has its breakthrough implementations and the smart homes are taking over all the applied field areas than all other domains.

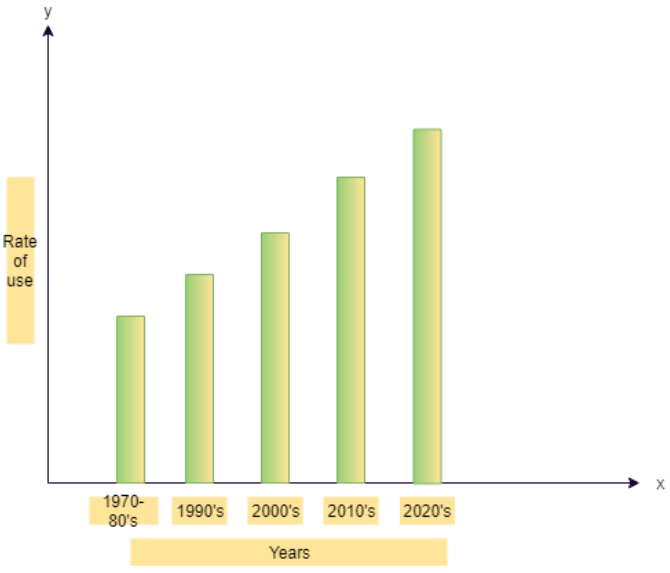

Figure 2: Evolution of IoT

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III.TECHNOLOGY

Technological evolution in digital electronics gives birth to micro-electro-mechanical systems (MEMS). A drastic change has come in the field of micro-sensors. Micro-sensors are now advanced at a greater extent having capabilities of low-cost and less energy consumption. The internet of things refers to wireless network between object, usually the network via smart sensors (device that takes input from the physical environment). In addition to this, objects are provided with unique identifiers and the ability to transfer data over a network without human-to-human or human-to-computer interaction. The sensor network basically describes the linking of sensor nodes either wired or wireless with one another. Usually sensors work over real world phenomena and coverts this into the form that can be stored, processed and manipulated as a digital form. Individually, sensor is not a single chip or microprocessor but it is also integrated with memory, sensing equipment, radio transmitter and receiver.

Sensor nodes conjointly make a network called sensor network. These may be connected with wired or wireless medium which depends on the requirement of specific applications. Wired sensors have proved to be helpful in various getting cut or damaged. Wireless sensor networks (WSNs) can enable independent monitoring and avoids entangling or damage of wires. From technological prospective, immense advancement has been done in wireless sensor technology after introduction of very large scale integration (VLSI), micro-electromechanical system (MEMS) and wireless communications further used in distributed sensor systems. The miniaturization of computing and sensing technologies enables the development of tiny, low-power and inexpensive sensors, actuators and controllers. Sensors are widely acceptable in numerous part of physical world applications. Wireless sensor architecture can be easily adapted for other applications such as home automation, environment monitoring, ship hull monitoring, underwater acoustics and biomedical diagnosis. With the rise in development of mobile applications and design of wireless sensor networks, customers may get the advantage of both above mentioned fields because both provides interface using wireless connectivity.

Nowadays, IoT technologies are at their initial stages; however, many new developments have been occurred via sensors in cloud computing, big data & applications but are prone to cases of wires many areas. Many issues such a communication, security, privacy, interfaces, etc are involved in the development of IoT.

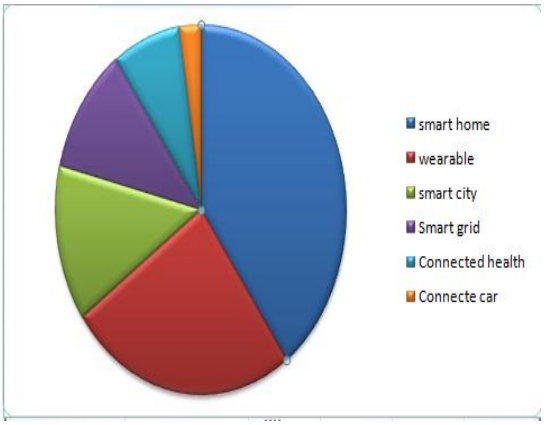

Figure 1: Some IoT Applications

IV. PERCEPTION OF IOT

Internet of Things refers to the concept that the internet is no longer just a global network for people to communicate with one another via computers. But it is also a platform for devices to communicate electronically with the world around them center of data and innovation. In an IoT physical and virtual "things" have identities and attributes and are capable of using intelligent interfaces and being integrated as an information network. Basically, Internet of things has the "potential to change the world, just as the internet did. Ideas and information are important but thing matter much more." Despite on the argument of definition of IoT, it has been discussed widely and corresponding technologies have been rapidly developed by various institutions in particular, intelligent sensing and wireless communication techniques become part of the IoT and new challenges and new research horizons have emerged [3]. The knowledge hierarchy of IoT's can be illustrated by several phases in figure3.

V.CURRENT RESEARCH PERPECTIVE IN IOT

IoT has become a global network infrastructure composed of numerous connected devices that depend on sensors, communication, networking, and most of information processing techniques things could be accessed and identified through internet. IoT has become a global network infrastructure composed of numerous connected devices that depend on sensors, communication, networking, and most of information processing techniques. A foundational technology for IoT is the RFID

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Figure 2: Knowledge hierarchy of IOT

The International Telecommunication Union (ITU) discussed the enabling technologies, potential markets, and the emerging challenges and the implications of the IoT. It is initiated by the use of RFID technology, which used in the logistics, pharmaceuticals production, retail and diverse industries. The evolvement of IoT can be illustrated by several phase as shown in figure3.

IoT can be seen as billions of connected "things", a sort of universal global network in the cloud comprised of smart machines interacting and communicating with other machines, people or environment. It can be implemented with RFIDS/WNS, mobile networks with event division data-device architecture. Huge volume of data will be generated and processed into useful actions that can "Command and Control" things to make lives much easier and safer, reducing over impact on environment. Extending, the current internet with interconnected physical objects and devices and their virtual objects and devices and their virtual representations has been a growing trend in recent years [3]. This will create a range of potentially new products and services in many different domains.

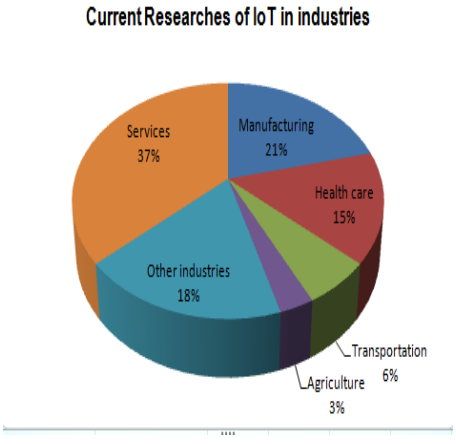

Figure 3: Current researches in IOT

Wireless communication, by RFID readers, people can identify, track and monitor any object attached with RFID tags automatically. RFID has widely used in logistics, pharmaceutical production, retailing, and supply chain management since 1980's. Another foundational technology for IoT is the wireless sensors networks (WSN), which mainly use interconnected intelligent sensors to sense and monitoring, healthcare monitoring and so on. The advances in both RFID and WSN significantly contribute to the development of IoT [3]. In addition, many other technologies and devices such as barcodes, smart-phones, social networks and cloud computing are big used to form an extensive network for supporting IoT.

With the advances in the wireless communication smart-phones and sensor network technologies more and more networked things are smart objects are being involved in IoT. As a result, these IoT related technologies have also made a large impact on new ICT and enterprise system technologies as shown in fig.4. In order to provide high quality services to end users, IoT technical standards need to be designed to define the specification for information exchange, processing and communication between things. The success of IoT depends on standardization, which provides interoperability, compatibility, reliability, and effective operations on a global scale. As so, many organizations are involved in the development of IoT standard, a strong coordination and govern the relationship between international standards organization and national/ regional standards organisation. In china, the government officially launched the "Sensing China" project in June 2010: the objective of the project was to develop the technologies so that any objects in an environment have identity tags, which are able to broadcast information and such information can be accessed through the Internet. People could be tracked within IoT and any condition variables can be monitored, so that the performances of the networked systems can be optimized to reduce waste and costs.

V. Concept Of Smart Homes

Smart home can be categorised as a home or that environment in which human live but with all devices connected to each other that will work via smart sensors and will be controlled automatically. Usually the general architecture of IoT based smart homes and component technologies consider the four layered hierarchy including: Application layer, Software infrastructure layer, Networking layer and Percipient layer. These are in the order as shown in the figure 5. The application layer deals with user and creates a friendly user interface. It defines all the services or facilities required for the setup of a smart home base on IOT as it will include the family's health care, buisiness services, security and many more. The second layer discusses about the required software

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infrastructure that will provide with the platform for webservices and SOA framework. Third layer deals with the network access required for the applications to run. It also ensures the connectivity of the devices for proper informtion for better interoperability[5]. Various network transmission interfaces are employed like PLC Network etc which are capable of handling the communications with the host computers, teminals and other smart operable devices. Percipient layer ususally includes the key technologies of IOT: RFID (Radio Frequency Identification), Sensor controlling, intelligent embedded technology. From these the RFID technology has important role to play as it introduces the passive data collecting mechanism for getting the information.

VI. WORKING SCENARIO OF SMART HOMES

Many methodologies have been used since the day in using IoT in home automation like: Bluetooth, Rapberry-pi, Z-wave etc. The trending technology is sprting because of the cheap smart phone that can help in controling the automated devices. For the home automation differents frameworks have been proposed namely 1) Home Automation using Bluetooth and 2) Ethernet based Home Automation [4-5].

The idea of smart home using IoT is realised using 10 Watt cost micro-controller based Arduino board and an android based smart mobile phone. Arduino can be describes as an open source platform that can be used for processing any hardware and software. Arduino board can be programmed to feed the data or information to various peripheral devices and sensors. As smart phones are wire1ess communication devices, hence connection between Arduino board and a smart phone is established using Bluetooth. It enables the short range communication between multiple devices, suiting an automated indoor environment. The operating frequency of a Bluetooth is 2.6MHz which can enable communication between the devices at a distance of 10 to 20 meters. The information through it can be delivered at the speed of 256kbps to 1 mbps. Arduino micro-controller do not support inbuilt Bluetooth radio so an external HC-05 Bluetooth module is used. This establishes the wireless connectivity. Hence via an Arduino board and a Bluetooth service one can connect to the devices through their phones providing the facilities of a smart home.

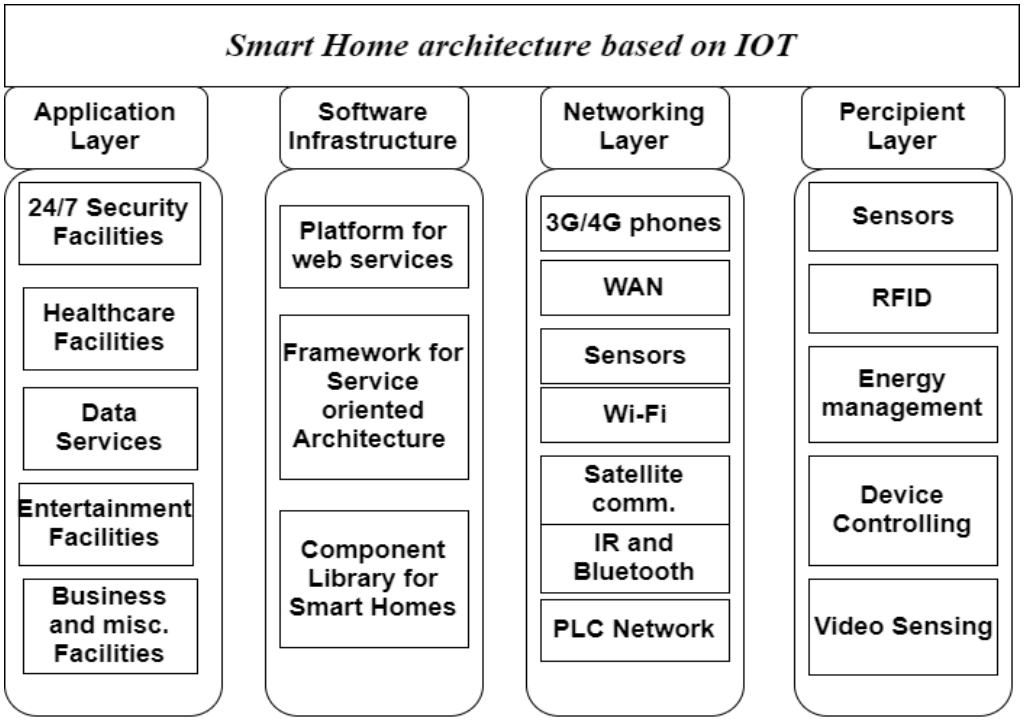

Figure 4: General Architecture of Smart Homes [5]

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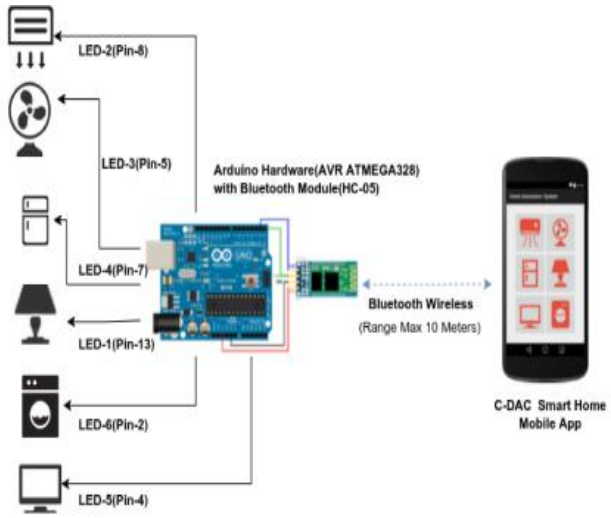

Figure 5: Smart Home Implementation [6]

The development platform used for the development of an android application is Android Studio (Ver-1.5). It provides a full furnished platform with the facilities of compiling, verifying, debugging and packaging. The Android application used shows two activities here 1) A front end which displays the home screen of the home automation app and 2) It shows the number of appliances connected to the smart phone via Arduino board which includes Lamp, TV, Desktop, Fan and many more as shown in fig 5. The LED's on the board shows the current condition of the appliances. Red colour LED indicates the appliance is OFF and Green indicates that the appliance is ON. The connection between Arduino board and Bluetooth includes various steps. Firstly, the connections between Bluetooth ground and Arduino ground are set with the VCC respectively. Secondly, the LED's are connected to Arduino with their respective pin positions. Finally, A HC-05 is interfaced between the Arduino(RX and RXD pins) and Bluetooth(TXD pin). This forms the pathway for a serial communication between the devices. HC-05 used reduced the time taken to identify the Bluetooth device as it's MAC address helps in direct pairing up with the mobile app without scanning for other devices nearby. Hence it connects the board with the app whenever it is launched. Whenever the user taps on the icon representing the particular appliance the information is sent and then received by the Arduino's Bluetooth module [6-7]. The respective configuration of pins helps in identification of a particular appliance. When the data is sent by the smart phone application a then received by the Bluetooth module of Arduino, the data is verified with respective LED's performance. This can be explained as if the user taps on the ion of TV and the respective pin number LED glows RED this will imply that the appliance is switched off. Similarly the GREEN colour shows that the appliance is ON. This is how the home automation is realised via Bluetooth

VII.CONCLUSION

Association of Internet of Things (IoT) with the wireless sensor networks (or WSNs) provide plethora of new applications in smart-cities, transportation, manufacturing, water, and other emergent technologies. As IoT is a collection of a large number of physical devices associated into one network and connected via radio signals. IoT deals with sharing and transferring of large volumes of data between the devices connected over the network .Smart homes are the most important applications of the IoT and is becoming the need of the surviving this era. IoT cannot only be limited to this but have a wide range of products developed and some are being developed leading to emergence of new technologies. Therefore, it has wide range of applications. In this paper, we have discussed architecture, technology and conceptual overview of smart homes.

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