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Review Article

An overview of the Internet of Things (IoT) Architecture

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Abstract

The convergence of multiple technologies, including machine learning, embedded systems, and commodity sensors, has substantially changed the term "IoT.". The Internet of Things (IoT) is a network of interconnected devices that have been assigned unique identifiers (UIDS) in order to enable device control and data transfer. It made direct human interaction with technology less necessary. The Internet of Things (IoT) is a sophisticated automation and analytics system that provides whole systems for a good or service by utilizing big data, artificial intelligence, networking, sensing, and sensing technologies. These systems facilitate improved performance, control, and transparency in any system or industry. A review of the Internet of Things (IoT) architecture is discussed in this article.

Keywords: *Architecture, Internet of Things, Technological and Protocols, Features, Application Grounds, Security Systems.*

I. INTRODUCTION

The idea of the Internet of Things (IOT) is that every device has an IP address, which anyone may use to identify that item on the internet. Unique identifiers (UIDs) and network data transmission capabilities are offered to mechanical and digital machines, eliminating the need for human-to-human or human-to-computer interaction. It was essentially founded as the "Internet of Computers." Studies have predicted that the number of "things" or gadgets connected to the Internet will increase dramatically. The "Internet of Things" (IoT) is the name of the resulting network. The recent developments in technology that permit the use of wireless controlling environments like Bluetooth and Wi-Fi have enabled different devices to have the capability of connecting with each other. Using a Wi-Fi shield to act as a micro-web server for the Arduino eliminates the need for wired connections between the Arduino board and computer, which reduces cost and enables it to work as a standalone device. The Wi-Fi shield needs a connection to the internet from a wireless router or wireless hotspot, and this would act as the gateway for the Arduino to communicate with the internet. With this in mind, an internet-based home automation system for remote control and observing the status of home appliances is designed. Due to the advancement of wireless technology, several different types of connections have been introduced, such as GSM, WIFI, and BT. Each of the connections has its own unique specifications and applications. Among the four popular wireless connections that are often implemented in HAS projects, Wi-Fi is being chosen for its suitable capability. The capabilities of Wi-Fi are more than enough to be implemented in the design. Also, most current laptops, notebooks, and smartphones come with built-in Wi-Fi adapters. It will indirectly reduce the cost of this system. The concept of “home automation” has been in existence for several years. “Smart Home” and “Intelligent Home” are terms that have been used to introduce the concept of networking appliances within the house. Home automation systems (HASs) include centralized control and distance status monitoring of lighting, security systems, and other appliances and systems within a house. HASs enables energy efficiency, improves security systems, and certainly increases the comfort and ease of users. In the present emerging market, HASs is gaining popularity and has attracted the interests of many users. Hass comes with its own challenges. Mainly, in the present day, end users, especially the elderly and disabled, even though they have huge benefits, aren't seen to accept the system due to the complexity and cost factors.

II. RELATED WORKS

Satyendra et al. (2020) developed a smart energy-efficient home automation system using IOT. It uses IOT to convert home appliances into smart and intelligent devices with the help of design control. An energy-efficient system is designed that accesses the smart home remotely using IOT connectivity. The proposed system mainly requires Node MCU as the microcontroller unit, IFTTT to interpret voice commands, Adafruit, a library that supports MQTT, to act as an MQTT broker, and Arduino IDE to code the microcontroller. This multimodal system uses Google Assistant along with a web-based application to control the smart home. The smart home is implemented with a main controller unit that is connected to a 24-hour Wi-Fi network. To ensure that the Wi-Fi connection does not turn off, the main controller is programmed to establish an automatic connection with the available network and connected to the auto-power backup. Tui-Yi et al. (2019) proposed an energy management algorithm for a home sensor network for a home automation system. Their work proposes an optimization of home power consumption based on PLC (Power Line Communication) for easy access to home energy consumption. This also proposes a Zigbee and PLC-based renewable energy gateway to monitor the energy generation of renewable energies. The ACS and DDEM algorithms are proposed for the design of an intelligent distribution of power management systems to ensure the ongoing power supply of home networks. To provide efficient power management, the power supply models of the home sensor network are classified into four groups: main supply only, main supply and backup battery, rechargeable battery power, and non-rechargeable battery power. Devices with particular features are assigned to these groups. It targets establishing a real-time processing scheme to address variable sensor network topologies. Tushar Churasia and Prashant Kumar Jain. (2019) developed a model to reduce the computation overhead in existing smart home solutions that uses various encryption technologies like AES, ECHD, hybrid, etc. These solutions use an intermediate gateway for connecting various sensor devices. The proposed model provides a method for automation with sensor-based learning. The system uses a temperature sensor for development, but other sensors can also be used as per requirement. These smart home devices with sensors can configure themselves autonomously and operate without human intervention. This work minimizes encryption and decryption and focuses on authentication and automation of smart home devices with learning. The system bypasses the local gateway mentioned in the existing system to provide better security for smart home devices and sensor data and save computation overhead. The real-time broker cloud is directly connected to Smart Home and manages all incoming and outgoing requests between users and devices. The main purpose of using the real-time broker cloud is to save time on cryptographic operations. Suraj et al. (2020) designed a visual machine intelligence system for home automation. The proposed method of sensing the state of appliances results in a novel home automation system. The accessibility of the suite of devices in the home over a remote network is facilitated by the IP-addressing methods in the IOT. This project uses two boards, viz., the Raspberry Pi and the Intel Galileo Gen 2. The communication between the user devices, the Raspberry Pi, and the Intel Galileo boards happens over a wireless network. The UDP protocol is deployed to facilitate the wireless communication of the nodes present in the home automation network. A Pi Cam and a USB Logitech camera attached to the rotating shaft of two different servo motors capture snapshots that are passed as inputs to the machine learning-based models trained using dlib-C++ to detect the state of the operation of the appliances. The proposed method uses visual modality to automate the appliances, as privacy concerns may emerge while using the images from some specific places. As a counter to this issue, an SPDT switch is added to the Raspberry Pi, which, when turned off, ensures that even if the images are taken from the webcams, they are just passed as inputs to the machine learning models and are not displayed on the website when the users access the website on the server address obtained from the Raspberry Pi. Paul et al. (2021) developed a voice-controlled home automation system using natural language processing and the Internet of Things. A fully functional voice-based home automation system that uses the Internet of Things, artificial intelligence, and natural language processing (NLP) to provide a cost-effective, efficient way to work together with home appliances using various technologies such as GSM, NFC, etc. was designed. It implements a seamless integration of all the appliances into a central console, i.e., the mobile device. The prototype uses an Arduino MK1000, known as the Genuino MK1000. The NLP in this project gives the user the freedom to interact with the home appliances with his or her own voice and normal language rather than complicated computer commands. The appliances are connected to the mobile device through an Arduino board that establishes the concept of the Internet of Things. The Arduino boards are interfaced with the appliances and programmed in such a way that they respond to mobile inputs.

III. INTERNET OF THINGS ARCHITECTURE

A high degree of smoothness in the information and discussion is provided by the Internet of Things-based framework. This is a tactic that can be used in a wide range of unique settings, including security, visitor sign manipulation, affected person monitoring systems, and application control. The Internet of Things endeavor aims to address the drawbacks of using the Internet of Things by providing a variety of IPv6 usage options and related requirements. Depending on the kind of solution we plan to provide, IoT architecture differs from solution to solution. The Internet of Things is primarily made up of four components, around which an architecture is built.

i. Sensors

ii. Devices
iii. Gateway
iv. Cloud

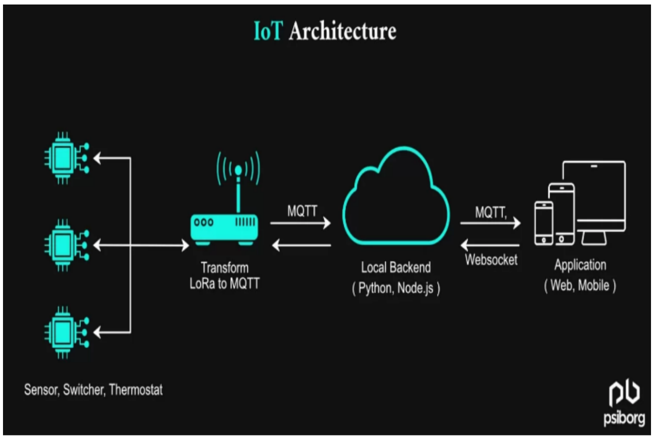

Figure 1: IoT System Architecture

IV. FEATURES OF INTERNET OF THINGS

1. Intelligence: IOT is intelligent because it combines hardware, software, and algorithms with compute. IOT's ambient intelligence improves its capabilities, enabling objects to respond intelligently to a given circumstance and assist in completing specified activities. Despite the widespread usage of smart technologies, the term "intelligent" in the context of the Internet of Things refers solely to a method of communication between devices; graphical user interfaces and standard input techniques are used to do this.

2. Connectivity: By connecting commonplace devices, connectivity enhances the capabilities of the Internet of Things. The importance of these objects' connectedness lies in the fact that even basic interactions among them foster the IOT network's collective intelligence. It makes networks compatible and accessible. The networking of smart objects and apps can open up new markets for the Internet of Things with this connectivity.

3. Dynamic Nature: The gathering of environmental data is the Internet of Things' main function. The dynamic changes that occur around the gadgets help to achieve this. These devices' states fluctuate dynamically, for instance, when they are connected or not, sleeping or waking up, and in different contexts with respect to temperature, location, and speed. The quantity of devices varies dynamically with the person, place, and time in addition to the device's status.

4. Enormous Scale: Compared to the number of devices already connected to the Internet, there will be a significant increase in the number of devices that need to be managed and communicate with one another. It becomes more important to handle the data produced by these devices and understand it for use in applications. The large scope of IOT is confirmed by Gartner (2015) in their anticipated research, which states that 6.4 billion connected items will be in operation worldwide in 2016, up 30% from 2015, and that 5.5 million new things will get linked every day. According to the research, there will be 20.8 billion linked devices by 2020.

5. Sensing: Without sensors that can measure or detect changes in their surroundings and produce data that can be used to report on their status or even interact with the environment, the Internet of Things would not be conceivable. The ability to develop capabilities that represent a true understanding of the physical world and the people in it is made possible by sensing technology. Although the sensing data is just an analog input from the outside world, it can nonetheless provide us a deep insight of our intricate reality.

V. APPLICATION GROUNDS OF IOT

1. Wearables Wearable technologies are a hallmark of IOT applications and are one of the earliest industries to have deployed IOT in its services. Fit Bits, heart rate monitors, smartwatches, and glucose monitoring devices reflect the successful applications of IOT. 2. Smart homes This area of application is concerned with this particular project, so a detailed application is discussed further. Jarvis, an AI home automation employed by Mark Zuckerberg, is a remarkable example in this field of application. 3. Health care IOT applications have turned reactive medical-based systems into proactive wellness-based systems. IOT focuses on creating systems rather than equipment. IOT creates a future of medicine and healthcare that exploits a highly integrated network of sophisticated medical devices. The integration of all elements provides more accuracy, more attention to detail, faster reactions to events, and constant improvement while reducing the typical overhead of medical research and organizations. 4. Agriculture A greenhouse farming technique enhances the yield of crops by controlling environmental parameters. However, manual handling results in production loss, energy loss, and labor costs, making the process less effective. A greenhouse with embedded devices not only makes it easier to be monitored but also enables us to control the climate inside it. Sensors measure different parameters

according to the plant requirements and send them to the cloud. It then processes the data and applies a control action. 5. Industrial Automation For a higher return on investment, this field requires both fast developments and quality products. This vitality thus coined the term IIOT. This whole schematic is re-engineered for IOT applications. Following are the domains of IOT applications in industrial automation. • Factory Digitalization • Product flow Monitoring • Inventory Management • Safety and Security • Quality Control • Packaging optimization • Logistics and Supply Chain Optimization • Government and Safety IOT applied to government and safety allows for improved law enforcement, defense, city planning, and economic management. The technology fills in the current gaps, corrects many current flaws, and expands the reach of these efforts. For example, IOT can help city planners have a clearer view of the impact of their designs and governments have a better idea of the local economy.

VI. TECHNOLOGIES AND PROTOCOLS

Several communication protocols and technologies cater to and meet the specific functional requirements of IOT systems.

1. Bluetooth: is a short-range IOT communication protocol and technology that is profound in many consumer product markets and computing. It is expected to be key for wearable products in particular, again connecting to the IOT, albeit probably via a smartphone in many cases. The new Bluetooth Low-Energy (BLE)—or Bluetooth Smart, as it is now branded—is a significant protocol for IOT applications. Importantly, while it offers a similar range to Bluetooth, it has been designed to offer significantly reduced power consumption.

2. Zigbee: is similar to Bluetooth and is mostly used in industrial settings. It has some significant advantages in complex systems, offering low-power operation, high security, robustness, and high reliability, and is well positioned to take advantage of wireless control and sensor networks in IOT applications. The latest version of ZigBee is the recently launched 3.0, which is essentially the unification of the various ZigBee wireless standards into a single standard.

3. Z-Wavv: is a low-power RF communications IOT technology that is primarily designed for home automation for products such as lamp controllers and sensors, among many other devices. A Z-wave uses a simpler protocol than some others, which can enable faster and simpler development, but the only maker of chips is Sigma Designs compared to multiple sources for other wireless technologies such as ZigBee and others.

4. Wi-Fi: connectivity is one of the most popular IOT communication protocols and is often an obvious choice for many developers, especially given the availability of Wi-Fi within the home environment within LANs. There is a wide existing infrastructure as well as fast data transfer and the ability to handle large quantities of data. Currently, the most common Wi-Fi standard used in homes and many businesses is 802.11n, which offers a range of hundreds of megabits per second, which is fine for file transfers but may be too power-consuming for many IOT applications.

5. Cellular: any IOT application that requires operation over longer distances can take advantage of GSM/3G/4G cellular communication capabilities. While cellular is clearly capable of sending large quantities of data, especially for 4G, the cost and power consumption will be too high for many applications. But it can be ideal for sensor-based low-bandwidthdata projects that will send very low amounts of data over the Internet.

6. NFC: (Near Field Communication) is an IOT technology. It enables simple and safe communications between electronic devices, specifically smartphones, allowing consumers to perform transactions in which one does not have to be physically present. It helps the user access digital content and connect electronic devices. Essentially, it extends the capability of contactless card technology and enables devices to share information at a distance that is less than 4 cm.

CONCLUSION

We looked over a lot of current articles on the internet of things in preparation for our study. On the internet of things, their advantages, disadvantages, features, technical protocols, and areas of application have all been noted. This page also covers the Internet of Things (IoT): Features, Application Grounds, Technologies, and Protocols.

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