

Internet of Things in Home, Air-Conditioner and Transportation Automation

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ABSTRACT

Internet of Things (IoT) is an emerging technology which creates a connected world. Interrelated computing devices, mechanical and digital machines, objects, animals and people are the building blocks of IoT. These blocks are embedded with electronic, software, sensors and network connectivity. This enables the blocks can communicate, share information with each other and act accordingly. Education, Industry, transportation, medical, agriculture, Retail, Energy management, Healthcare, poultry, Farming and many more are benefiting from IoT. Since IoT generates massive amount of data, Cloud Computing supports IoT in storing the data generated from sensors, devices, websites, applications and customers. As many devices are connected, it is essential to understand the architecture, sensors and tools used for effective communication. This paper discusses state-of-the the architecture of IoT in Home Automation, Intelligent Transportation and Air conditioner which connects the devices, sensors which senses the data from the devices and tools which support interactivity among IoT devices.

Keywords: IoT Architecture, Cloud Computing, Sensors, Tools, Networked Devices.

1. INTRODUCTION

The authors of ^{1,2} have introduced their definition of IoT things as: “things might be animals, objects, or even human as long as they contain special hardware that is uniquely identified and transfers data”. Internet of Things (IoT) is a state-of-the-art field that is affecting

every aspect of human life. As the applications of IoT list increases, it is becoming significant for professionals and students to understand what IoT is, how IoT works and how to bind its uses to improve the business by increasing efficiency, improving health/safety, creating better experiences and easier the life. Efficiency is significant parameter in industrial applications, energy management and agriculture because more production and more usage at less cost mean greater profit. Using energy efficiency, Google reduced 15% of its energy expenditure in its data centers³.

As year increases, the number of devices connected to IoT is significantly increasing. Recently, the number of devices that are connected to the Internet is significantly increased as expected by⁴, where more than 50 billion devices are to be connected to the Internet by 2020. Not only are the Computer machines, various types of standalone and embedded hardware becoming the dominant components in what is known as “things”.

In order to build the research gap, this paper presents a state-of-the-art overview of IoT architecture, sensors and tools. Moreover, it helps the researcher in designing future IoT architectures that fit into IoT environment. The remaining paper organized as follows: section 2 discusses related work, section 3 gives insight into the IoT architecture, tools and sensors and section4 concludes the discussion.

2. RELATED WORK

Many research works have been published in Home Automation, Intelligent transportation and Air-Conditioner controlling using IoT. In paper¹², the authors demonstrated an Intelligent Transportation System (ITS) prototype using the Internet of Things (IoT) platform with the components of the sensor system, monitoring system and the display system. The data is extracted from the sensor database, converted it in to a meaningful context and provided information to bus driver based on specific event occurred in the bus. The sensor system has Global Positioning System (GPS), Near Field Communication (NFC), Temperature and Humidity sensors, which are always connected with the internet via a GSM network to track the location, commuter and ambience inside the bus. This prototype could be used as fundamental components to build ITS.

Anitha *et al.*¹³ paper proposed ITS architecture, types of ITS Applications, IoT communication Technologies, sensing technologies, Security and challenges in ITS for future research on IoT-based intelligent transport.

3. IoT IN HOME AUTOMATION, AIR-CONDITIONER AUTOMATION AND ITS

This section describes IoT in Home Automation, Transportation and Air-conditioner. Different architecture and application have been proposed by many researches. In this section we discuss IoT components and type of sensors used in the application areas of Home Automation, Air-conditioner Automation and Intelligent Transportation. It also discusses Automation App available for the above mentioned application areas which are summarized in Table.1.

Table .1 IoT Application Areas and it Components

Application Area	Components	Sensors	Automation App
Home Automation[6]	sensors, gateways, protocols, firmware, cloud and databases, middleware	Temperature sensors Lux sensors Water level sensors Air composition sensors Video cameras for surveillance Voice/Sound sensors Pressure sensors Humidity sensors Accelerometers Infrared sensors Vibrations sensors Ultrasonic sensors	Piper, Video Doorbell, PlantLink, Nest Protect, Wink app, Schlage, Wink HUB, (Wifi) [11] Nest, Kasa, Stringify, MYCiTY LiTE, Vivint
Air- Conditioner Automation [7]	Cloud, Protocol	Temperature sensors Motion Sensor	iZen, IOTNext[8]
Transportation	Semiconductor and Wireless components[9]	infrastructure-based sensors and on-board diagnostics-based vehicle sensors[10], Temperature and Humidity sensors[12]	Road Safety App, Infotainment and comfort App, Traffic Management, Autonomous Driving App

3.1 IoT for Home Automation

Home Automation architecture has sensors, gateways, protocols, firmware, cloud and databases and middleware. Home automation has been projected to target digital customers. The applications of Home Automation covers: Lighting control, Lawn/Gardening management, Smart Home Appliances, Improved Home safety and security, Home air quality and water quality monitoring, Natural Language-based voice assistants, Better Infotainment delivery, AI-driven digital experiences, Smart Switches, Smart Locks and smart Energy Meters. The Purpose of few home automation app is described below⁶.

- 1) Nest App works with various devices – Nest Learning Thermostat, Nest Cam, Dropcam, Nest Protect. Using this app, user can choose the temperature in smart home and sends notifications so user can monitor any changes in the house. This app is at free of cost. Every family member can have their own account.
- 2) Kasa App control all connected TP-LINK Smart Home devices no matter where user are – at home or on a vacation. Users can set their appliances to turn on and off according to the schedule 24/7, 365 days a year. There is a great option to turn off the lights using countdown. This app is at free of cost and very easy to use.
- 3) Stringify – It is an award-winning app. It has a user-friendly interface, it controls locks, lights, temperature and a lot more in a way that user can save money and feel safe and

relaxed in house. It is used for monitoring every connected device at home. It is available only for iOS and support more than 500 products and services.

- 4) MYCiTY LiTE- It controls cameras, locks and alarm system. It also helps in find favourite movie, watch movie, draw the curtains and dim the lights. At the end of the movie lights will be softly switched on. It is available at free of cost.
- 5) Vivint – It helps in controlling security cameras, smart thermostat, door and window sensors, smoke detectors etc. Sends notifications if user forget to lock the front or garage doors. Users can even speak with their visitor from anywhere with Vivint Doorbell Camera. It is a Good security system. No cost for this application.

The Home Automation apps like Piper, Video Doorbell, PlantLink, Nest Protect, Wink app, Schlage, and Wink HUB¹¹ are Wi-fi applications for smart home.

3.2 IoT for Air-Conditioner Automation

There are many wired and wireless technologies and scenarios to remotely control your Air Conditioning system¹⁴. According to the room temperature, IoT controls the Air-Conditioner. There are two WiFi Air Conditioning control concepts:

1. Air Conditioner-> Wifi connectivity-> WLAN
2. Air Conditioner-> Wifi connectivity -> Cloud

While we are not in the house, it is essential to operate local WiFi devices by smartphones using native apps, developed by the manufacturer of the air conditioning system. The disadvantage of local WiFi networks is interruptions in the network connectivity. Once the phone set for WiFi, it can automatically switch to another WiFi network and the air conditioner is not accessible anymore¹⁴.

Cloud-based technology is used to fulfill the need of remote accessibility. The data can be stored locally in the client place or can be hosted to any of the cloud storage providers. Every end device in Air Conditioning system must have a proper Internet connection. With cloud service, having internet connection means we have a reliable remote control that works from anywhere. Cloud services provide better security with zero cost infrastructure maintenance.

3.3 IoT for Intelligent Transportation System

The global IoT market in intelligent transportation systems can be classified into semiconductor and wireless components⁹. The semiconductors components can further be segmented into microcontroller (MCU), digital signal processing (DSP), field programmable gate array (FFGA), memory protection unit (MPU), application specific standard product (AASP), and application specific integrated circuit (ASIC).

Infrastructure-based sensors include pressure detectors, inductive loop detectors, magnetic detectors, ultrasonic detectors, microwave detectors, infrared detectors, and image detectors. These types of sensors utilize a part of the signal control and traffic operation in an

ITS. In contrast, vehicle sensors include GPS, automatic vehicle identification (AVI) using radio frequency identification (RFID) tags, and (on-board diagnostic) OBD-based vehicle sensors, which are connected to an in-vehicle network¹⁰.

The conventional transportation systems are slowly transforming in to Intelligent Transportation System using IoT technology. ITS will optimize the movement of people and goods, improving economics, public safety, and the environment. Smart transportation systems will automate our roadways, railways, and airways, transform passenger experiences, and reshape the way cargo and merchandise are tracked and delivered, creating substantial business opportunities for system integrators, independent software vendors (ISVs), service providers, and other solution providers.

IoT plays a vital role in following areas of transportation: 1. Fleet telematics and management solutions. 2. Transport logistics applications. 3. Guidance and control systems. 4. Inventory and supply chain management solutions. 5. Passenger entertainment and commerce applications. 6. Smart vehicle applications. 7. Reservation, toll, and ticketing systems. 8. Peer-to-peer services like car sharing. 9. Security and surveillance systems.

For reliable and secure ITS, the National Transportation Communications for Intelligent Transportation System Protocol (NTCIP) provides rules for communicating (protocols) and the vocabulary necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system.

4. CONCLUSION

In this context, this article reviewed how IoT is applied in Home Automation, Air-Conditioner Automation and Transportation Automation. It also offered a broad view on how communication technologies, sensors, sensing technologies and other computational technologies have motivated to connect the people with many devices using IoT. Applications of IoT in Home Automation, Air-Conditioner Automation and Transportation Automation are also discussed. Overall, this paper will benefit the beginner researchers, and engineers in further deepening the scope of research and motivates them to innovate new IoT Architecture IoT App for digital users.

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