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Practice of Internet of Things in Education

Mrs. Mayuri Bapat

MIT ACSC, Alandi(D), Pune (India)

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***Corresponding Author**
Email: mmbapat[at]mitacsc.ac.in

ABSTRACT

The Internet of Things permits individuals and things to be connected Anytime, Anywhere, preferably by means of any route/network and any service provider." In this article, there is a brief overview of IoT areas, IOT basic definitions, Protocols used by IOT, Architecture of IOT and use of IOT in Education sector.

1. Introduction

IoT stands for Internet of Things. It is eternally growing network of physical devices which having IP address for internet connection, and these devices are able to communicate with each other devices having internet connectivity. Using IOT we can connect computers, mechanical machines, objects, animals, people that are having unique identification number along with the ability of transferring of data over the network without anyone's interaction.IOT platforms allows us to connect the devices like hardware, AP and other data networks to other part of value chain. In other words it works as middleware between IOT software and devices. The Internet of Things (**IoT**), also sometimes referred to as the Internet of Everything (IoE) which internet enable resources that save, send and collect data from surrounding using different sensors, communication hardware and processors. Ethernet or Bluetooth is used for local communication in IOT. Areas like education, Agriculture, Healthcare, Industry, Insurance, Chemical industry, Automobile industry, Supply chain, Smart cities etc. uses IOT now a days.

2. IOT Protocols

Following diagram depicts the layered model to represent working of protocols in IOT network model.

Infrastructure	6LowPAN, IPv4/IPv6, RPL
Identification	EPC, uCode, IPv6, URIs
Transport	Wi-Fi, Bluetooth, LPWAN
Discovery	Physical Web, mDNS, DNS-SD
Data Protocols	MQTT, CoAP, AMQP, Websocket, Node
Device Management	TR-069, OMA-DM
Semantic	JSON-LD, Web Thing Model
Multi-layer Frameworks	Alljoyn, IoTivity, Weave, Homekit

3. Introduction to Protocols used in IOT

- **IPv6 -** "IPv6 used in packet switching and works on internet layer of OSI model. It provides end-to-end datagram communication across various IP networks.

- **6LoWPAN -** 6LoWPAN is an abbreviation of IPv6 over Low power Wireless Personal Area Networks. It is revised layer for IPv6 over IEEE802.15.4 links. This protocol works only in the 2.4 GHz frequency range with 250 kbps transfer rate.

- **UDP (User Datagram Protocol)** –UDP works on transport layer protocol of OSI model which is used in client/server architecture for sending messages. Working of UDP is based on IP. UDP is the main substitute protocol to TCP. UDP introduced in 1980 by David P. Reed and it is one of the oldest network protocols in existence. UDP is frequently used in real time applications.

- **QUIC (Quick UDP Internet Connections, pronounced quick)** supports a set of multiplexed connections between two endpoints over User Datagram Protocol (UDP), and was designed to provide security protection equivalent to TLS/SSL, along with reduced connection and transport latency, and bandwidth estimation in each direction to avoid congestion.

- **Aeron –**Aeron is efficient Inter Process Communication message transport protocol which is trustworthy on UDP unicast, UDP multicast networks.

- **uIP -** The uIP is an open source TCP/IP protocol that able to use with 8- and 16-bit microcontrollers. It was

initially developed by Adam Dunkels of the "Networked Embedded Systems" group at the Swedish Institute of Computer Science, licensed under a BSD style license, and further developed by a wide group of developers.

- **DTLS (Datagram Transport Layer)** –To provide the communication confidentiality to datagram protocols DTLS protocol is used. It allows client/server applications to communicate in such mode that prevents snooping, interfering, or message falsification. The working of DTLS protocol is built on the Transport Layer Security (TLS) protocol and offersidentical security guarantees.

- **NanoIP**
  NanoIP stands for the Nano Internet Protocol, is a concept that was created to bring Internet-like networking services to embed and sensor devices, without the overhead of TCP/IP. NanoIP was designed with minimal overheads, wireless networking, and local addressing in mind.

- **Time Synchronized Mesh Protocol (TSMP)**
  TSMP is protocol designed to work in self-organizing networks where wireless devices called moted are used. Devices remain synchronized with each other device in the network using TSMP. Devices communicate to other devices in time slots similar to Time Division Multiplexing Systems.

- **mDNS (multicast Domain Name System)** –This protocol is used to find out host names to IP addresses within small networks that do not contain a local server name.

- **Physical Web -** The Physical Web allows you to get a list of URLs being broadcast by objects around you in environment with a Bluetooth Low Energy (BLE) beacon.

- **HyperCat –**For revealing collections of URLs HyperCat is used. It is open, trivial JSON-based hypermedia directory format.

- **UPnP (Universal Plug and Play)** –It is managed by the Open Connectivity Foundation and it is a collection of networking protocols that allows networked devices to effortlessly determine presence of each other on the network. It also allows establishingof efficient network services for sharing of data and communication.

- **MQTT (Message Queuing Telemetry Transport) -** The MQTT protocol mainly used with remote sites where bandwidth quality is best and small volume of space is required for hardware or software. It permits lightweight messaging model.

- **CoAP (Constrained Application Protocol)-**CoAP is a protocol works on an application layer that is projected for use in resource controlled internetworking devices, such as nodes of Wireless Sensor Network. CoAP is aimed to easily translate to HTTP which helps integration with the web in simple way and also meet the requirements like low overhead, simplicity, and multicast support.

- **STOMP** –It is Simple Text Oriented Messaging Protocol

- **XMPP (Extensible Messaging and Presence Protocol**) - It is one more technology for real-time communication, which influences a wide range of applications including chat with multiple persons, voice & video calls , instant messaging, lightweight middleware, collaboration, content organization, and widespread routing of XML data.

  AMQP (Advanced Message Queuing Protocol)
  This protocol used for message-oriented middleware on application layer. AMQP is message orientated, reliable, secure, queued point-to-point protocol.

- **LLAP (lightweight local automation protocol)**
  LLAP allows us to send short message between intelligent objects using normal text, it's not like WiFi, zigbee, bluetoooth, 6lowpan and TCP/IP etc. , which can accomplish at a low level "how" to move data around. It means LLAP can run over any medium of communication. The main asset of LLAP is it will run on anything now , anything in the future and it is easy to understand.

- **LWM2M (Lightweight Machine to machine Protocol)**
  Lightweight M2M (LWM2M) is a system standard in the Open Mobile Cooperation. It contains DTLS, CoAP, Block, Observe, Resource Directory and weaves them into a device server interface along with an Object structure.

- **SSI (Simple Sensor Interface**) is a communications protocol intended for data transfer between computers or user terminals and smart sensors.

- **Websocket**
  The WebSocket specification—developed as part of the HTML5 initiative—introduced the WebSocket JavaScript interface, which defines a full-duplex single socket connection over which messages can be sent between client and server. The WebSocket standard simplifies much of the complexity around bi-directional web communication and connection management.

4. IoT in Education System

Technology plays a crucial role for making change in education world. From the use of tablets in the classroom to the innovative learning process of open universities, education has transformed the way we lead life. It has changed the way of interaction between educators and students with the aid of digital technologies that helps to improve teaching and learning

process. Educators are continuously exploring opportunities and possibilities for application and services that can enhance teaching and learning process.

With the help of mobile technology, the educational institutions can now keep track of all resources relating to education. IoT is playing the key role in teaching, Learning and even in assessment. Content management tool, a centralized software application provides course creation, content delivery, management, tracking, reporting, and assessment of assignment easy for distance education and online courses. From KG to PG in all aspects of the education institution, the IoT is becoming the need of the hour. The implication of IoT will help the overall delivery of the resources in an innovative manner to the participants. The IoT has the latent to affect every aspect of student learning.

Abbasy and Quesada (2017) says IoT is transforming traditional education system into a scalable, adaptable with rapid dynamic changes, flexible and more efficient e-learning with a topology where the huge number of physical and virtual interacting objects are involved in the process of learning. Making use of IoT in learnings systems would open up new pathways to proffer effective learning. It helps to create energy-efficient and cost-efficient education system through automation of common tasks outside of the actual education process. The impact of IoT can be realized in many traits of education starting from student engagement and outcome in learning ,content creation, helping teachers in providing personalized content (Wellings& Levine, 2009).

IoT is one of the aspect of technology that have major applications (Lakshminarayanan& McBride, 2015) namely:

a) Virtual Reality
b) Personal electronic systems aka 'clickers'
c) Flipped classrooms
d) Mobile learning 'm-learning'
e) Massive Open Online Courses "MOOCs"
   - Khan Academy
   - Google Apps for Education
   - Coursera
   - edX
   - myHomework
   - NPTEL
   - MOODLE
   - Easy Classroom
f) Internet of Things "IoT"
g) Cloud Computing

5. IoT in Education

IOT can be used in education domain for the following purposes:-

a) Smart Education

Intelligent technologies like cloud computing, big data, learning analytics, Internet of things (IoT), wearable technology, etc., promote the manifestation of smart education. Although a great many studies focus on how to create smart environments or how to use smart environments for their learning, without a deal with how to use serene data for learning purposes.

b) Smart Teaching

Smart teaching is a teaching with the help of different electronic gadgets and it is totally different from traditional approach of chalk and board method. It is available 24x7 with quality contents and also help learner in learning based on the huge choice available.

c) Smart Learning

There is no clear and cohesive definition of smart learning up to now. Smart learning is a practice of learning the things with the help of e-gadgets. Here the learner is going to learn the aspects all the time based on learner availability. It supports personalized learning.

d) Smart Classroom

Smart classroom is an abode used for learning, teaching and for conduction of different educational activities. Here the learning, teaching, assessment happens very differently and effectively. Usually, smart classrooms consist of the e-gadgets, such as a digital screen, projector, Internet-enabled devices.

e) IoT Devices for Smart Classroom/School

Today market is full of many different types of IoT devices. For example,smart devices like smart phones, kindle, eBooks, smart lights and locks, tablets, fitness bands and wearables, virtual and amplified reality headsets are common in smart classroom.

Some other common IoT Devices include:

- Multi-touch tables (smart table)
- Smart white boards
- Student Smart ID Cards
- Facial Recognition Cameras
- Smart Cameras
- Attendance tracking systems
- Smart HVAC System
- Smart Temperature Monitoring
- Smart Lighting
- Telepresence Robots
- Smart School Bus
- Smart TVs, CCTVs
- Connected Sports Equipment

Advantages of IoT Application Areas in Education:

i. Better Learning Experience [8]
ii. Improved Operational Efficiency
iii. Reduced Cost
iv. Reliability
v. Safety Considerations
vi. Flexibility
vii. Improves Learner Performance
viii. Enhance collaboration between learner & educators.
ix. Free to all
x. Improves Creativity etc.

6. Conclusion

Above paper gives the brief idea about what is IOT, what are the different areas where IOT is used, basics of protocols used in IOT, how IOT get implemented in education system.

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