IJCSE International Journal of Computer Sciences and Engineering Open Access
Survey Paper Vol.-7, Issue-5, May 2019 E-ISSN: 2347-2693

Analysis of Energy Efficient Techniques of IoT

Neha Sharma[1*] , Neeru Bhardwaj

[1,2]Dept. of Computer Science & Engineering,, Bahra University, Waknaghat, Shimla Hills

Corresponding Author: nehasharma7576@gmail.com

DOI: https://doi.org/10.26438/ijcse/v7i5.321325 | Available online at: www.ijcseonline.org

Accepted: 12/May/2019, Published: 31/May/2019

Abstract- With the demand in new technologies today internet of things has a big research area for the young researchers. It has a very vast area of field in almost every field of work today we are trying to implement the concept of internet of things. Researchers are focusing on the efficiency of the IOT networks. IOT's provides a researcher or user to implement his/her own self-made sensor to the open environment to collect the necessary data and then to implement it accordingly with the help of wireless sensor networks. The Internet of Things is the decentralized kind of system where sensor hubs sense data and pass it to the base station. Because of self-designing and far organization of the system vitality utilization is a serious issue of IoT's. The different methods have been planned by the creators to improve the lifetime of the system. In this paper, different vitality proficient systems are surveyed as far as specific parameters.

Keywords-- IoT, Sensors, Lifetime

I . INTRODUCTION

The internet of Things is a new prototype (paradigm). It is not a single technology; it's a combination of various technologies that work together in a troupe. In the internet of Things 'Things' stands for sensors, hardware, software, actuators, electronics etc. A large number of devices is connected over public or private internet protocol networks. In common parlance, the internet of Things refers to a new kind of world where almost all the devices and appliances that we use are connected to a network [2]. IOT is coined by 'Kevin Ashton' in 1999. The main purpose of using IOT is to connect the internet with the physical world to increase the comfort and security and control of our lives. In IOT there are different sensors are used to detect the current state of the monitoring area like pressure sensor, temperature sensor, Moisture sensor, light intensity detectors and most important RFID (Radio Frequency Identification). Devices and sensor are connected through a wireless network like wifi, Zigbee, Bluetooth, Z-wave, LORAWAN etc. IOT consists of three elements: hardware, middleware and presentation [1]. The hardware element is consists of battery-powered embedded sensors, actuators, and communication system. In this sensor collect the data from the monitoring area and communication system sends the collected data to the middleware element. Data is received by the middleware layer or element. Middleware element is also known as a gateway. It acts as a middle layer between devices and cloud to protect the system from malicious attacks and unauthorized access. In middleware received data is processed and analyzed by various data analysis tools like 'Raspberry Pi' to extract interpretable information. The presentation element is visible and tangible part of the IOT system. It is used to visualize the processed data and results in an easily readable form. Through presentation, element user queries also received and then pass these queries to the middleware element for further action.

Energy is consumed by IOT while collect and transmits the data. Accuracy of data increases when we collect and analyze the data and same time more energy consumed. Due to this, we need to maintain energy consumption of IOT system. The lifetime of the IOT system depends upon the availability of energy. The energy consumption issue not only increases the operational cost but also lead to emission of energy which affects the environment. Therefore, energy efficient solution is needed to minimize the impact of cloud computing on the environment.

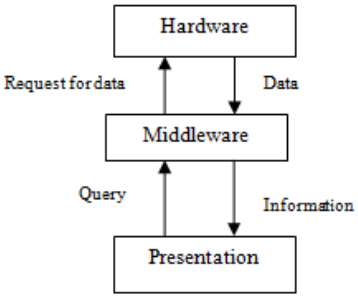

Fig. 1 Elements of IOT

In this paper, we have studied the different techniques used to maintain the energy consumed by the IOT system. Also, the lifeline of IoT resources is increased.

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Architecture of IoT

There is different architecture introduce by different researchers [5]. The basic architecture of an IOT system can be understood from a model as follow: -

1. **IOT Application**- It is a collection of software at the cloud server which is used to process, analyse and extract data.
2. **Cloud / Server** – It is the edge of IOT system. It performs data mining on information or data collected from different IoT devices. It also manages connected devices and networks. Cloud communicates with other private or public cloud services to enable an IOT application.
3. **Communication Network**- It is generally internet network and communication protocol operating at different layers e.g. - application layer, transport, link and physical layer.
4. **IoT devices and Gateways** – IOT devices are connected with internet and espouse in communication with other devices. It must be sensors or actuators. The sensors may be collecting static or dynamic information from the physical world and this information shared with a server or cloud. Actuators act upon processed data or sent back by the cloud. These devices must be a controller or processor to capture data, and memory to store this data and operating system to process data received from the server.IOT devices included Raspberry Pi, Banana Pi, CubieBoard, Pinnocio, Arduino, Beagle Bone etc.

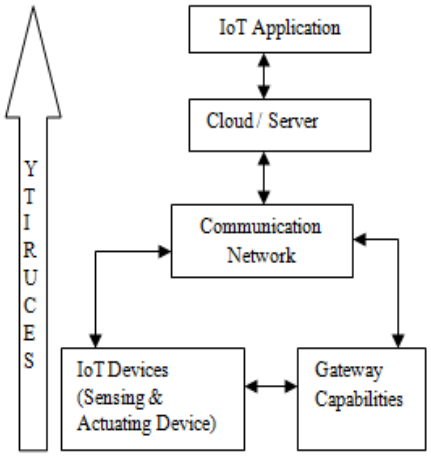

Fig. 2 Architecture of IoT

Gateway basically used for protocol conversion. Gateway act as a two-way bridge between the two networks when data send and receive through Zigbee interface the communicate through Zigbee protocol. And communication network is capable of communication through TCP-IP protocol. Then we need a gateway which converts data coming through the device using ZigBee protocol to data transmission through TCP-IP protocol and also data coming from server or cloud through TCP-IP protocol to Zigbee protocol. When data transmission through gateway it is indirect communication.

When data transmits without gateway then it is direct communication done between the communication network and IoT devices. In this the IoT devices and the communication network sharing and exchanging data using the same protocol. So there is no need for conversion protocol or any other gateway. In this, communication is done through application layer protocol like MQTT (Message Queuing Telemetry Transport) etc.

Application of IOT:-

There is a multifarious area in which IoT used to make an intelligent application. With these applications, we are taking a smart and intelligent decision to improve our lifestyle. In IoT applications GSM(Global System for Mobile), GPRS(General Packet Radio Services), LTE(Long Term Evolution), ZigBee and Wi-Fi(Wireless Fidelity) etc are used for communication while NFC(Near Field Communication), RFID(Radio FrequencyIdentification),GNSS(Global Navigation Satellite System), and BLE (Bluetooth Low Energy) are used for tracking [3]. IoT applications use different sensors to provide intelligent and automated services to the user. There are a number of IoT applications in our daily life and these are:-

- Smart Homes- Now a day's smart homes are more popular because of sensor and actuation technologies with wireless technologies. In the smart home we use different sensors like motion sensor for security. Smart home applications are beneficial for aged and abled people. We can track their health and home activities from an office or any other place. Smart homes save time, energy and money.
- Food Supply Chain- With the help of technology vendors can track the production of their products from farm to end users. This can increase food security and can be used to collect the data related to the production
- Smart Cities- In smart cities we have smart transport and smart water supply system comes. Smart transport application manages daily traffic using sensors. The main purpose of smart transport is to reduce traffic congestion and minimise the accident ratio also provides parking availability. RFID technology for vehicle identification used in which sensors for counting vehicles and passengers and vehicle movement for security.
- Health and Fitness- Many beneficial applications are available which is used to monitor a person's health condition. With the help of these applications, patients can live independently [6]. In these applications sensors monitor their health

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regularly and in abnormal condition sends a warning message. If there is a minor problem, then these IoT applications itself may suggest a prescription to the patient. There are different applications available in IoT through which we can maintain record blood sugar, blood pressure, allergies and stress recognition etc. These all can be recognized by smartphone sensors.

- Smart Environment and Agriculture- In smart environment temperature and humidity are important factors foragriculture production. In the field sensors are used by farmer to measure these factors and this information can be used for efficient production. Most famous example of smart agriculture is production in greenhouses.

II. ISSUES AND CHALLENGES IN IOT

There are many challenges occur in IOT technologies. These challenges are like energy efficiency in IoT devices, security and privacy of IoT devices. Security of IoT devices is the main concern of researchers. In the IOT system, aliquot devices are connected to each other through the internet. There are presumably risks of digital irruption and data outrage. A hacker's intend for user data, so IOT applications need to be more secure with modern technologies such as biometrics or cryptography to overcome this obstruction.
In IOT applications different sensors are used and energy consumed by these sensors are very large. Issues occur in energy conservation in IoT applications:-[4]

- Idle Listening – Active mode node is a major source of energy consumption. A node in awaiting state to transmit data even not receiving or sending packets is called idle listening. We need to reduce the overall active time of the node. Sensor nodes are switch back to the active mode after a certain interval of time or any wake-up signal.
- Collision – Collision defined as when the node receives multiple data signal at the same time. Then the received data is useless. These transactions could consume a lot of energy [7].
- Over Hearing – Sensor nodes with high density lead to interconnect with neighbour nodes during the data transmission process. This is known as overhearing. In this overhearing, process energy consumed more in collecting useless data or information

III. LITERATURE SURVEY

S.Nisha, et.al (2017) introduces an ESMR (Energy Efficient Self-organizing Multicast Routing Protocol). In ESMR nodes divided into two types such as network node and non-network node. Markov process used to measure the weight of network node. The highest weighted node known as sink node. For utilization of energy automatic tree pruning operation is performed. At last ESMR is compared with ADMR (Adaptive demand driven multicast routing) protocol, DSDV (Destination sequence distance vector routing) and AODV (ad-hoc on demand distance vector routing) to show success rate of energy efficiency. They use AVL tree structure to construct the network. It reduces the energy consumption and increase the success rate and improve the life time of sensor networks.

AlgimantasVenckauskas, et.al. (2015)introduces that every object is part of internet and uniquely identified. They present the energy efficient SSl protocol which ensures maximum bandwidth and security with minimum energy consumption. By the management of the CPU operating modes it is possible to optimize energy consumption for the given level of security. CPU multiplier (reducing CPU energy consumption) can save to 35% of the energy required for data encryption. Increase the CPU multiplier cause increase of energy consumption which is required to encrypt the information unit and decrease the execution time.

Nguyen Bach Long, et.al (2018)proposes routing scheme for enhances energy consumption in IIoT(Industrial Internet of Things) which is based on IEEE 802.15.4a MAC. This is proposed for large scale system. Energy based clustering method employing selecting factor parameter which is used by I/O devices to join an eligible cluster. Clustering is most efficient methods to enhance the overall efficiency of large scale system. The formation of cluster depends on number of routers or in the communication range of I/O devices. Energy-Aware Real-Time Routing Scheme (ERRS) outperformed the conventional schemes in terms of power savings, network lifetime, and average end-to-end delay. Introduces the use of ERRS in ,military and agricultural applications.

Cristian Chilipirea, et.al (2016) proposes a model in which describe the capabilities of each device and replace fault device with other. Also overlap characteristics to preserve energy. This model is also used in home security system. Examples of this model are to replace a faulty security camera we use WiFi scanner, a heat sensor and door opening sensor. On this fuzzy logic is used that a camera can not identify person 100% accuracy, but combined with Wifi scanner the accuracy can increase. In this model energy efficiency is achieves b powering of devices that are not needed and powering on only when need for that device. RFID method is used in communication system to achieve energy efficiency.

Ahmed Lawey, et.al. (2018) presents framework for energy efficiency using Mixed Integer Linear Programming (MILP). In this framework set of metricssuch as scalability, flexible resources allocation, cost reduction and efficient use of resources. Service Oriented Architecture(SOA) in order toprovide service abstraction of basic services which can be composed into complex services and exploited by

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application layer. Develop a framework for optimizing the selection of IoT nodes and routes in IoT network to meet the business process virtual nodes demands and links with goal to minimize energy use.

S.Santiago, et.al (2016) presents the issues and ways to minimize the energy consumption in IoT environment. Issues in energy conservation are idle listening, Traffic fluctuation, Over hearing, Reduction of protocol overhead and collision etc. In this paper different ways are presented for energy conservation like Node activity management, Data Aggregation and Transmission Process, and MAC Protocol.

Navroop Kaur, et.al (2015) Iot is a smart technology that connect different system at anytime. This nature of IoT is responsible for draning out energy from its resources. Presents energy efficiency architecture for IoT, which is combination of three layers such as sensing and control, information processing, presentation. In this architecture allow the system to predict the sleep interval of sensor which is based on remaining energy level. This is tested by Amazon EC2 i2xlarge instance. Hardware resources of SCL (Sensing & Control Layer) & IPL (Information Processing Layer) are switched for energy efficiency to sleep mode. The main purpose of this architecture is the exchange of energy related information between the two layers. Proposed architecture increases resources utilization of hardware resources of both SCL & IPL. Resilient nature of proposed architecture is applied in large number of IoT networks.

Table 1: is a comparison table of different authors outcome in their respective papers.

Author	Year	Description	Outcome
S.Nisha , Balakannan.S.P.	2017	Introduce Energy Efficient Self-Organizing Multicast Routing Protocol (ESMR). In ESMR nodes categorized under into network node and non-network node. ESMR compared with ADMR(Adoptive demand driven multicast routing protocol), DSDV(Destination sequence distance vector routing) and AODV (ad-hoc on demand distance vector routing).	Use AVL tree structure to construct the network. Reliable tree based network can be constructed using ESMR and it also helps to reduce the energy consumption and improve the lifespan of sensor networks.
AlgimantasVenckauskas , NerijusJusas, EgidijusKazanavicius , VytautasStuikys	2015	Presents the energy efficient SSL (Secure Sock Layer) protocol which ensures the maximum bandwidth and the required level of security with minimum energy consumption.	By the management of CPU operating modes it is possible to optimize energy consumption for the given level of security.
Nguyen Bach Long, Hoa Tran-Dang, Dong-Seong Kim	2018	Purposes a routing scheme that enhances energy consumption and end to end delay for large scale industrial internet of things (IIoT) systems based on IEEE 802.15.4a MAC.	This method can reduce the energy consumption and end-to-end delay effectively.
Cristian Chilipirea, Andrei Ursache, Dan Octavian Popa, Florin Pop	2016	Purpose a model in which the capabilities of each device and use this information to dynamically replace faulty devices with other, not directly-compatible ones. Energy efficiency can be achieved by powering off devices that are not needed and powering them on only when there is a clear need for that device.	Model increase home security. In robustness technique one component fails, a different one or a set of others can take its place.
HaiderQays AI-Shammari, Ahmed Lawey, Taisir EI-Gorashi, JaafarM.H.Elmirghani	2018	Author presents an energy efficient service embedding framework by using mixed integer linear programming (MILP). In this framework set of metrics such as scalability, flexible resources allocation, cost reduction and efficient use of resources.	Energy efficiency framework show that optimized network can save an average of 27% and 30% of the processing and network power consumption.

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S.Santiago, Dr.L.Arckiam	2016	Author describes different ways for energy conservation such as node activity management, data aggregation, transmission process, Mac protocol, security management, topology management and routing.	
Navroop Kaur, Sandeep K.Sood	2015	Energy efficient architecture proposed. In this architecture find the sleep interval of sensors which is based on the remaining battery level, previous usage history and quality of information required by particular application..	Architecture tested by using medical data on Amazon EC2 i2.xlarge instance. Energy is effectively and efficiently saved by switching the hardware resources.

IV. CONCLUSION

In this paper, various energy efficient techniques of IoT are reviewed in terms of certain parameters. The sensor nodes are used to sense information and pass sensed information to base station. Due to unique properties of the network, energy consumption is the major issue of the network. The technique needs to designed which improve lifetime of IoT

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Authors Profile

Mrs. Neha Sharma

Dr. Neeru Bhardwaj

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