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A Survey on Challenges, Trends and Technologies of Internet of Things

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Abstract— This paper is a documentary survey on different areas in which Internet of Things (IoT) can be applied. Many concepts are also discussed on different IoT architectures along with several examples. This paper examines architecture of high level, conceptual levels for the IoT from a computational perspective. The paper also includes discussion about how the communication is established between IoT setup and the application. Different types of protocols to be implemented for the communication is also explained. By deploying these IoT systems the vision of smart city can be achieved. Many of the physical objects of the world are connected with sensors and actuators, which are linked by communication infrastructures and managed by computer algorithms. IoT sensor networks and integrated systems connect intelligent objects. These systems revolutionize the way we deal with our daily lives, medical care, energy and transport. These computational systems are addressed with a variety of different models and structures. In an effort to consolidate the use of these models, this document reviews research in IoT computing.

Keywords—Component, IOT applications, Energy efficiency, GPS, Biometric Systems, Routing Protocols

I. INTRODUCTION

Internet has drastically changed human life, starting from the social relationships to all aspects of day to day life. The IoT has the power of anytime, anywhere, any media, anything communications. Nowadays IoT is considered as a major part of the Internet of future. It is clear that Internet is the main medium for publishing and using the information.

Internet of Things (IoT) is the network of physical objects that contain electronic components which are integrated into architecture to communicate with one another or with the external environment. In the coming years, IoT-based technology will provide us advanced levels of applications and change the way people live their lives. Advances in medicine, energy, gene therapy, agriculture, smart cities and smart homes are just some of the examples in which the IoT is firmly rooted.

The components used in the IoT are described here. Lower battery feeding, high performance are the factors which plays a significant role when designing electronic systems which also leads to low power systems. Information collected via IoT devices is huge and this information must be stored on a reliable storage server. This is where cloud computing comes into play. Data is handled and used, giving more space for IoT setup to find out where things like electrical errors / errors are within the system. We know that IoT is dependent on sensors, especially in real time. As these electronic gadgets spread in every field, they use triggers to communicate with big data. To communicate, Internet connectivity is a must in which every existing object is represented by IP address. However, there is only a small number of addresses which are available based on the IP name. Due to the increasing number of devices, this naming system will no longer be feasible. Therefore, researchers are looking for another alternative naming system to represent each existing objects.

Today, the demand for Internet application development is very high. So IoT is an important technology with which we can produce various useful Internet applications. Basically, IoT is a network in which all physical objects are connected to the Internet via network devices or routers or gateways through which data can be exchanged. IoT allows objects to be remotely controlled through the existing network infrastructure. IoT is a very good and intelligent technique that reduces human effort and easy access to physical devices. This technique also has an autonomous control function which can control any devices without human interaction. ”Things” in the IoT sense, it is the combination of hardware, software, data and services. ”Things” can refer to a wide variety of devices such as DNA analysis devices for environmental monitoring, electrical terminals in coastal waters, Arduino chips in home automation and many others. These devices collect useful data with the help of various

existing technologies and share data between other devices. Examples include the home automation system that uses Wi-Fi or Bluetooth to exchange data between various home devices.

There are many applications of IOT available in the market in different application areas. Personal home automation system is the major example in this area. Wemo Switch Smart Plug is the most useful devices that connect home devices in the Switch, a smart socket. It connects to a normal outlet, accepts the power cord from any device and can be used to turn it on and off by pressing a button on the smart phone. In the enterprise area there are many applications such as the environmental monitoring system, the intelligent environment etc. Nest Smart Thermostat is connected to the Internet. Nest automatically learns your family's routines and automatically adjusts the temperature based on your activities to make your home more efficient. There is also a mobile app that allows the user to change the temperature and times. Smart metering, smart grid and water monitoring system are the most useful applications in various utilities. The Advanced Metering Infrastructure is the largest application in this area. Remote health monitoring and the emergency notification system are examples of IOT in the medical field. Health patch Health Monitor: can be used for the patient who cannot contact doctors, allowing them to get from ECG, heart rate, respiration rate, skin temperature, body posture, fall detection and remote activity readings. The electronic toll collection system is the most useful example in this sector.

There are several major projects in progress in the world. Songdo (South Korea), had weirdest Smart City, is almost completed. In this city everything is connected and transformed into a data stream that would be monitored by a series of computers without any human interaction. Another example is the Sino-Singapore Guangzhou Knowledge City work on improving air and water quality. French company Sigfox commenced building an ultra narrow band wireless data network in the San Francisco Bay area in 2014. Another example is the one completed by New York Waterways in New York City to connect all their vessels and being able to monitor them 24/7. So these are large applications present in the market which are based on IoT. This world is going to become a better place to live with more communication with everyone. In near future large number of devices connected to the internet and provide great facilities to the world.

A. Motivation

The communication components of the IoT-architecture have become a promising research area. It motivates to explore a series of related researches, that highlights the benefit of IOT hardware and software

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IoT setup uses ZigBee wireless sensor to organize low power and secure wireless network. Cloud technologies are used to store and process large amounts of data which are produced by IOT network. Cloud technologies also presents an efficient services for users. Some IOT systems are based on a web platform which can integrate, monitor and manage many home automation sensors to reduce cost and energy consumption at remote locations. It is an IP-based hybrid architecture developed by integrating cloud-based and standalone modes. A smart automation systems are based on the integration of innovative router technology offers many exciting features, including low price, excellent performance and increased efficiency, portability, ease of installation, and intelligent real-time reliability.

IoT-based smart systems which are integrated with Web services and cloud computing, allows users to easily interact with intelligent things present in the system from anywhere. This mechanism improves the efficiency of data exchange using Java Script Object Notation(JSON) between application and IOT setup. A new IoT-based smart systems like home automation systems which incorporates and integrates the information, entertainment, telecommunications and living systems. It supports global control by providing users with easy access to the home network and the Internet (via 3G or Ethernet).

1. This paper helps in comparing various technologies, network architectures and algorithms for IOT and to choose the best one for the particular application.
2. This paper is useful and helps the consumer in situations whenever a technology, network architecture or algorithm need to be chosen for a new IOT application or to replace the existing technology of the application with the more suitable one.
3. This paper helps the consumer to compare various technologies, network architectures and algorithms of IOT at one place instead of searching for the same in various other sources of information.

Section I contains the introduction of challenges, trends and technologies of Internet of Things, Section II contains the related work, Section III concludes survey work with future directions.

II. RELATED WORK

Tayeb et al., [1] proposed IoT computation and communication which uses Address Resolution Protocol (ARP) and Dynamic ARP inspection (DAI). In this system mathematical model for the secure paradigms was proposed. It has added security features. But this system dearth in standardization. Yuning et al., [2] proposed Content Centred Internetworking for Resource-Constrained Devices in the IoT which uses mapping of tasks and Content-Centric Networking (CCN). Storing, retrieving and publishing are its main tasks. But it hinders in processing nested, and memory in networks. Moslehi et al., [3] proposed autonomous power

grid in an IOT landscape vision which uses nested model and coherence of the interactions. This system smoothens exchanges, including peer-to-peer market facility which uses the transactive grid capabilities.

Hancke at al., [4] proposed IoT in Industrial Wireless Sensor Networks which uses IETF standards. The proposed system is found to be fit for industrial applications which provides low latency. But differing characteristics of the communicating channel leads to synchronized radio transmissions and frequent retransmission leads packet loss. Xu et al., [5] proposed Internet of Things in Industries . It uses Network optimization algorithm for processing data. The advantage of the system is high performance simulation platform supporting multidisciplinary design of complex products. It uses IETF Low power Wireless Personal Area networks but the disadvantage of the system is it requires multi-layer SOA architecture.

Yilmaz et al., [6] proposed On the Use of the Millimetre Wave and Low Terahertz Bands for Internet of Things .The performance of the system is High. The advantage includes the system can be implemented in low-cost .The disadvantage is maximum bit rate, if there is an increase in the modulation technique or carrier frequency then the path length boundaries decreases. Albalawi et al.,[7] proposed Secure and Trusted Telemedicine in Internet of Things. AES and ABE algorithms are used. The system consumes less power .The advantages is high QoS. Privacy mechanisms are not implemented Elhosen et al., [8] proposed Secure Medical Data Transmission Model for IoT-Based Healthcare System. This system uses steganography techniques and system encryption algorithms. PSNR relatively varied from 50.59 to 57.44. which has a variable key size ranging from (2-2048) bits.

Balasubramanian et al.,[9] proposed A Unified Architecture for Integrating Energy Harvesting IoT devices. This system uses Mobile Edge Cloud. Greedy bin-packing algorithm is used.It is Energy efficient .The advantage is very low latencies .We have to lower the CPU utilization to reduce energy consumption. Carbajaleset al.,[10] proposed Energy-efficient Internet of Things Monitoring with Low-Capacity Devices . It consumes less energy as well as requires low cost. The advantages are The Smart Citizen Kit (SCK) a project which facilitates open source software and low-cost hardware. In reality the device is not steady much because there is lack of adjustment of the sensors.

Datta et al.,[11] proposed Extending Data Tweet IoT Architecture for Virtual Devices in IoT .The system makes better use of Cloud Computing and sensor resources which are available .The advantage is that it offers better consumer IoT services .The disadvantages are a wide spread distribution of cybernetic sensors in ongoing IoT platforms and user IoT services is not observed. This is because lack of untied approach towards creating, operating and managing sensors. Dhanalaxmi et al., [12] proposed A Study on Design and Analysis of Robust IoT Style. Genetic algorithm and Swarm Optimization procedures are used. These are highly dependable systems .The advantage is the mechanization allows the engineers to labour in risky units such as at great temperature surroundings. It uses high speed ram and hence costlier.

Domingos et al.,[13] proposed Ad-hoc Variations in IoT-aware Business Procedures . WS-BPEL process, event condition-action (ECA) rules are used in implementation. These structures can decrease the amount of swapped data along with central dispensation. It allows on-the-y reprogramming of sensors. The disadvantage is that it is not implemented for group of run-time implementation processes but for single process.

Kamilaris et al.,[14] proposed Agri-IoT: A Semantic Outline for Internet of Things qualified Smart Farming Uses. A rdf query language is used(CQELS) in implementation. For IoT based data analytic solutions ,this is a perfect customizable online platform , allowing large-scale data analysis, data processing and automatic reasoning. The advantages are protection of the environment, increase of production and productivity, less use of resources (e.g. water, fertilizers) and better products quality. There is a decline in performance due to the synchronization issue of the streaming function of CQELS.

Kataoka et al.,[15] proposed Tacit Calculating and its Use for Open IoT Era. Discovers suitable strategies for users by analysing the temporarily changing data produced from IoT expedients to allow users to use different devices without having to know about individual differences of the various devices. The advantages are to prevent the outgo of highly sensitive data from being leaked and reduces the network traffic .It is important to physically decide what type of expedient to be connected to the network and also what type of data generated from the connected device.

Kim et al.,[16] proposed Self confirming ID based reliable networking system for iot smart device. SCID(Self certifying id) algorithm/protocol is used. It conserves lot of time by automation of tasks .The advantage is protection of the iot from various IP based malicious attacks. We have to overcome Identity theft because details of things are openly available. Navas et al.,[17] proposed Nonce based Genuine Key Establishment over OAuth2.0 IoT Proof of Possession Design . The key algorithm for the COSE Key CBOR object is used here. It uses less-power. It is a good solution for the authorization problems. We have to over come security issues which are due to the RS validation of timestamp on the token .

Se-Ra Oh et al.,[18] proposed Development of IoT Security Component for Interoperability. OAuth 2.0 authorization protocol is used. It provides good privacy. The advantage is oneM2M security component is used to easily solve the Iot security issues. The disadvantage is fine-grained authorization cannot be got from oneM2M security component on IoT perspective data such as time, position, etc. and do not upkeep other authorizations except password credentials of resource owner. Yousuf et al.,[19] proposed A Stumpy Cost LoRaWAN Testbed for IoT: Execution and Measurements. LoRaWAN protocol is used. It maximizes overall capacity of the network and battery life .The advantages are low-cost network . The drawback is when the measurements are taken on the opposite side of the building, an indoor gateway location is especially apparent , where the gateway is located .

Kim et al.,[20] proposed Software Performance Freeze Safe Microcontroller With Power Prole Tracking for IoT-Driven Connected Facilities . MCU and LTU algorithms are used. It prevents a single Iot device affecting whole system. The advantages are compared to power for communication, extra power consumption is comparatively low. The disadvantage is seeing the complex connected association, IoT-driven applications demand more design efforts in organization of large scale IoT schemes. Miladinovic et al.,[21] proposed NFV Aided IoT Design for an Operating Room Atmosphere . IoT gateway protocol is used. The advantages are the architecture is largely accessible since it can be stretched by new IoT devices or gateways by an inform of the IC IoT application. For RESTful web service, the amount of traffic is comparatively low when compared to other applications.

Bin Da et al.,[22] proposed Identifier Enabled Networks (IDEAS) for Internet of Things (IoT). Identifier Locator Network Protocol (ILNP), Identifier Separation Protocol (LISP) ,Host Identity Protocol (HIP) are used. In the implementation outdated Identifier (IDF) and Detector are split. The advantages are ubiquitous mobility, low latency, high through put , intrinsic security .The future work focuses on vast applications which uses GRIDS and its detailed functional development , including diverse IoT scenarios. Mathew et al.,[23] proposed Innovative biometric home safekeeping system using digital sign and DNA cryptography. DNA cryptography algorithm is used. It consumes less power. It is cheaper .For user identification, the scheme requires camera equipment; hence, it is less likely to become famous till most computers include cameras as one of the standard tools.

Cao et al.,[24] proposed A Palm Vein basis Less cost Mobile Identification Scheme For Wide Age Range. Feature extraction and matching algorithms are used. The advantages are low power consumption, cheaper compared to other similar technologies. We have to overcome password limitation in usability and reliability. Iikramet al.,[25] proposed Design of an IoT-based Scheme for Football Supervision. Routing Protocol for Less Power (RPL), CoAP protocol are used. It facilitates safe and effective solution to recover and provides good level of performance of player. The advantages are useful to analyse and resolve in the occasion of sport related risks, wounds and incidents .We have to overcome addressing issues and Large OS simulations.

Bahadori et al.,[26] proposed High hustle and energy effectual carry skip adder functioning under a wide range of quantity voltage levels. CI-CSKA protocol algorithm/protocol is used. The performance is without considerably decreasing the speed, lowers the power consumption. The advantages are a better candidate for low-energy high-speed applications .We have to reduce highest slack time. Wei et al., [27] proposed DNA Method for Password Change Generator. DNA Stenography by means of the Mealy Machine theory is used. The performance is by using DNA cryptography, high safekeeping protection for the information and data .The advantages are high defence on the sensitive data during communications through the internet connection. The disadvantage is for the password conversion, at least 3 levels of combinations are required.

Park et al., [28] proposed IoT Direct Design with Autonomous Schemes of Things .Interior Gateway Protocols (IGPs), like Routing Information Protocol (RIP) are used. The performance is high degree of information transfer, independent service operation, interoperability and system connectivity. The advantages are cheaper and less power consumption .We have to improve inter domain connectivity. Chze et al., [29] proposed A Safe Multi-Hop Routing for IoT Community. Safe Multi-Hop Routing Protocol (SMRP) is used. It has the ability to isolate the IoT devices grounded on the data-link address and the network address .The advantages are the adaptive environment of the architecture is able to vigorously re-define logical networks in a network of IoT devices. We have to overcome information security risks.

Biswas et al., [30] proposed IoT and Cloud Convergence: Opportunities and Challenges. It is reliable and has high performance. The advantages are scalability and efficiency. Future work to be made is that research and business vision is to merge the IOT and Cloud Computing concepts, i.e., enable an Everything as a Service model.Benazzouz et al., [31] proposed Sharing User IoT Devices in the Cloud . CoAP, ZigBee, KNX ,UPnP algorithm and protocols are used. The system has high reliability. The advantages are high accessibility from anywhere and at any time .The users need to have an account on the platform, if they want to use shared devices .

Park et al., [32] proposed Semantic Open IoT Service Platform Technology. SPARQL(Sparql Protocol and RDF Query Language) is used in the implementation. It provides easy access to and use of the sensed data and global IoT resource .The advantages are easy development and easy connection of IoT resources as well as distribution of various applications . The organization and storage of the semantic web pages need to be improved. Lin et al.,[33] proposed Expedient Clustering Algorithm which is Based on Multimodal Data Correlation in Cognitive IoT. Device Clustering Algorithm Based on multi model data correlation is used. IoT is an spread direction which is capable to improve the realize intellectualization to the present IoT and its performance .It is possible to classify the device according to the expedient distribution and data relation .We have to overcome extensive simulations used to analyze and evaluate the proposed algorithm.

Giovanelli et al., [34] proposed Improving Bluetooth Less Energy with wake up radios for IoT applications. MAC protocol is used. The disadvantage is the there will be more impacts and chief device will take long time to notice all the beacons if number of nodes is high. Ramezani et al., [35] proposed Safeguarding the IoT with Recursive Inter Network Architecture (RINA) . Common Distributed Application Protocol (CDAP) is used. IPSec can be used in the network layer, but in wireless environments, it hides all the transportation details which marks network performance. RINA is a good network design that has shown significant developments in many performance and security aspects. While current infrastructures have difficulties in conjurations and variety of services, for smart infrastructure, administration of network communication becomes a bigger challenge.

Li-hong et al., [36] proposed sensors access scheme design based on IoT gateways. A short range radio frequency (RF) technology is used. On various communication technologies, this architecture helps to solve different use case requirements. The advantages are the Gateway solution is added with an Application layer which acts as a bridge between the Cloud and Things Application . After the gateway is accessed by sensor the registration should be completed first. Cheng et al., [37] proposed Situation- Aware IoT Service Coordination It uses different algorithms like Event Automation Processing(EAP) algorithm, Service Oriented Architecture(SOA) algorithm, Situational Event Detection, Event-Driven SOA Paradigm, Event Driven Architecture (EDA) algorithm. In experimental environments for evaluating the performance of a situation aware service IoT coordination platform , coal mines are used .The advantages are like it facilitates the distribution of on-demand sensed data and in a IoT environment of large scale distributed it provides asynchronous communication .The disadvantage is that, the sensor objects visibility can be increased because of an existing visualizations expansion technology, and lightweight service middleware mashup,. It is very much important optimize the strategy of scheduling data congestion and the distribution of real time data service with the different types of QoS.

Estrada et al., [38] proposed Technology Enabling Circuits and Systems for the Internet-of-Things An Overview. Here it uses Maximum power point tracking (MPPT) algorithm. The design of both harvesting PMUs and ULP transmitter circuits involve increasing the IoT applications performance in the architecture for the first two layers. The trade off is good between the consumed and converted power. Good output voltage regulation and tracking accuracy. We have to overcome limited tracking accuracy. Power consumption can be increased due to the continuous monitoring . Increased design complexity.

Ortiz et al., [39] proposed The Cluster Between Internet of Things and Social Networks.(SIoT) Social Internet of Things is used in implementation. It has a number of nodes that can communicate to each other and it has low-power that are frequently changing, The number of nodes work together and various variables which are present in the environment is monitored by that nodes and sensor is used to measure it. And sensors are embedded in the nodes .The advantages are Privacy, Security and Trust. To make real SIoT The open research must be solved.

Krupka et al., [40] proposed The Issue of LPWAN Technology Coexistence in IoT Environment. LoRa, Sigfox and IQRF technologies are used for wireless connection. These wide area networks consume less power. The advantages are LPWAN networks are the part of (IoT)Internet of Things, that can help users by providing large range of the applications. The limitation is that the count of devices should not be exceeded to avoid deterioration in the availability of services running on these technologies or in the quality. Hossain et al., [41] proposed Towards the Security Issues analysis, iot Challenges, and the problems in iot. Memory efficiency is not considered in traditional security algorithms. Most of the time, for a source of power IoT devices use battery and low power consuming devices and low clock rate is there in CPUs. Shubhamsharma et al., [42] studied Women safety device. It uses Global Positioning System. It provides the security for women. Global Positioning System is available anywhere on the globe. Global Positioning System chip is a power hungry.

Hamzei et al., [42] proposed Towards Efficient Service Composition Techniques in the iot. Contextual band algorithm with linear payoffs is used. The proposed approach provides low cost and improves availability , but it suffers from low precision and performance .The advantages are high availability , high efficiency and simplifies

management. Gazis et al., [43] proposed Short Paper- IoT-Challenges, Projects, Architectures. Some of the major domains that are identified here are: Smart home, Transportation, Supply chain, energy, smart city, Health Care. It has very low energy and computational demand .The core technological challenges, such as high energy and computational demand, connectivity among heterogeneous devices, have to be overcome. Salman et al.,[45] have proposed Energy Efficient IoT-Based Smart Home. Zigbee network is used. The advantages are more energy efficient. A Metaphysics analysis approach is used focusing on kitchen of a home model .

Wan et al., [44] proposed Context Aware Cloud Robotics for Material Handling in Cognitive Industrial Internet of Things. For ensuring the time related parameters and the real time performance that is, time of data processing for the infrastructure of cloud, network communication time of response and AGV data processing time should be considered in production environment. The benefits are like access to huge amount of data . There is some critical in the implementing and design of low-energy, flexible and recognisable and highly efficient smart factories. The limitation is more communication bandwidth is required. Jiafu Wan proposed Contexture Aware Cloud Robotics for IoT which uses contexture-aware cloud robotics (CACR). Using this system, development processes can be optimized significantly. Its highlight is its efficient energy consumption and cost-saving material handling stuffs.

Granjal et al., [45] proposed security for communications on IoT. The system is based on the cryptographic algorithms. The performance of data delivery from end to end is increased. The advantage is end-to-end network-layer security, employment of IPHC compression scheme. The disadvantage is that in the Medium access control and physical layer has low energy communications. Ercan et al., [46] proposed RF Energy Harvesting and Transfer for Spectrum Sharing Cellular IoT. The system uses spectrum sensing algorithms. Increased the PU performance, also Increased spectrum access opportunities. advantage is there is decrease in harvesting by RF. Disadvantage of the system is increased individual traffic load. Pankajavalli et al., [50] proposed Hydration Reminding Smart Bottle IoT Experimentation. It uses cellular based monitoring protocol. Performance of the proposed is good. The system works with many smartphone applications. For the content of water in the human body this system is not accurate.

Stankovic et al., [47] proposed Communications in 5G Systems Research Directions for the Internet of Things. This system uses Control algorithm for adjusting set points. performance increases based on Good privacy and security. advantages of the system includes increased sophistication in sensing, actuation, communications. Added advantage includes that the every CSP can provision the control qualification. Chatterjee et al., [48] proposed CSP Selection and the estimation of QoS in the Oligopoly Environment for IoT. It uses (QASeC)QoS based Automated Selection of CSP. For the scenarios of real life the time of simulation is realizable and affordable. Increased sophistication in sensing, actuation, communications, Every CSP can provision the QoSs control qualification. The accuracy of sensor is independent of the gateway and it is not normalized. Fekade et al., [49] proposed Probabilistic Recovery of Incomplete Sensed Data in IoT. It uses K-means algorithm. Performance of the system is based on (PMF) Probabilistic Matrix Factorization. Advantage of the system is high data recovery. Disadvantage is data incompleteness.

Lin et al., [50] proposed Optimal Smart Gateway Deployment for the Internet of Things in Smart Home Environments. It is based on binary integer programming. Performance of the system is measured using coverage mask matrix. Advantage is that the cost for deployment is low,. For the deployment of GSW this system cannot be used. Vishwajeet et al., [55] proposed the Home Automation having Intelligent Self Learning System in lot. This system uses Naive Bayes Classifier algorithm. Performance of the system is good. It creates advanced dynamic network. It has ubiquitous sensing system.

Miladinovic et al., [51] proposed Architecture od IoT which is Highly scalable through the model of Network Function Virtualization. The system can separate the logic of application from gateway of IoT by using the architecture For a naming infrastructure the (NDN)Named Data Networking (NDN) is used. 5G, NFV, (SDN) Software Defined Network, Mobile edge computing, Large Scale Environments,. Advantage is that in the operating room requirements of the high energy is there and it is Lightweight Cryptosystems and Security Protocols. Privacy in IoT increased. The keys that are pre shared keys cryptographically are not applicable.

Shafiee et al., [52] proposed Infrastructure Circuits for Lifetime Improvement of Ultra-Low Power IoT Devices. ULP energy harvesting IoT system is available for communication of system and processing of the system. Advantages of the system are harvesting of the energy having Ultra low power and SIMO Management of power but the circuits of RF requires higher power supplies. LEUNG et al., [53] proposed Special Issue on Software Defined Networking for Internet of Things. It has framework of end to end security assessment ,and that frame work is based on SDN. Between the health care and smart mobile phones there is a data flow and its performance can be improved. It has centralized controller. Network traffic load of the system is high.

Chiang et al., [54]. proposed Research On Fog and IoT. The applications which is delay sensitive is supported by using deterministic latency. The gateways which are present here will perform the functions for network control in core networks of LTE. It has high Security. but it has Stringent Latency Requirements. Oma, et al., [60] proposed A model for the efficiency of energy of Fog and Device Nodes in IoT. This system is based on Simple Energy-Aware Algorithms. In the digital ecosystem and the computation type of processes is performed. Energy Consumption is less. The accuracy of the system is not as expected.

Ratasuk et al., [55] proposed NB-IoT System for M2M Communication. For the header of protocol of upper layer 65 bytes are used. Evaluations of performance for the capacity of system and latency are good. Here the battery will last longer. It contains low-cost devices, high coverage but it has high power consumption. Goins et al., [62] Proposed Protocol for Reliable Packet Delivery in Low-Power IoT applications. It is based on physical (PHY) layer preamble. Performance is good. It consumes less energy. Sensor are required.

Deepak et al., [56] proposed Data-driven Ecosystems in Smart Cities: A Living Example from Seesta dt Aspern. It uses OAuth open standard. Energy management is good. It has Resource Cycles. Quality of each single platform is not good. Ramprasad et al.,[64] proposed Leveraging Existing Sensor Networks as IoT Devices for Smart Buildings. protocol for the data communication used here is BACNet. Here the system has low-latency and high-throughput .It has open nature .We have to overcome compliant issue.

SamueleFoni et al., [57] proposed Evaluation methodologies for the ongoing effects and issues in the NB-IOT system. It uses the principle of NBIOT. InterRAT (Inter Radio Access Technology) support is good. It supports InterRAT (Inter Radio Access Technology).Unexpected behaviours introduced by the software components. Larosa et al., [58] proposed Socio-Organism Inspired Multi-Level Computational Model Forming Scheme for Integrated IoT Service Architecture. It uses Novel Programming Framework. The proposed system consumes Less energy. Time complexity of the system is high.

Prasse et al., [59] proposed a system that proposes how IoT is going to change the design as well asp operation of logistics systems. It is based on the software agents and swarm algorithms. The proposed system performing well with other CPS. Robustness of the system is high. Complexity of structure is high. Song Han et al., [60] proposed A Low Cost Open System Wireless Marshalling Module used in Industrial Environments. It has sensor protocols. The system has best energy performance. The system is controlled by the software. High power supply is required for the system.

Chen et al., [61] proposed Situation-Aware IoT Service Coordination Using the Event-Driven SOA Paradigm. The principle used is Extensible Messaging and Presence Protocol (XMPP). Performance of the system is Good. It has flexible configuration. Pattern detection is not good. Mardini et al., [62] proposed a Genetic Algorithm for friendship selection in Social using IoT. This system uses Genetic algorithm. Performance of the system is Good. The system has good scalability. But it cannot scale properly more devices and queries.

Shah et al., [63] proposed customized IoT enabled wireless sensing network which also has a monitoring platform for smart buildings which uses wireless sensor network (WSN).This proposal is successfully implemented and it is attested in a building environment. It is reliable to a great extent but it consumes too much power. Milas et al., [64] proposed industrial big data as a result of using IoT in manufacturing which uses wireless sensor network (WSN).This system shows how IOT generates industry related big data. This work is flexible and adaptive in decision-making yet the drawback is that using only the most important data in the process of decision making is made difficult.

Gupta et al., [65] proposed a firewall for IOT which uses IPv4 and ICMP. This system is made secure against privacy breaches and it delivers security at low cost. But the disadvantage is that computational power is less. AlEnezi et al., [66] studied challenges of IoT based smart-government progress. It states whether the target smart government is an prolonging of existing e-government. This study provides a secure, better quality of life while reducing costs. Anjum et al., [67] proposed Peer-assisted content delivery networks which uses CDN. Systems performance was found satisfactory with reduced infrastructural costs. But there was unreliableness of peer to-peer networks, the need of incentives for peers involvement, and copyright issues.

Carlos et al., [68] proposed New Security Architecture for IoT Network which uses Software-Denied Networking (SDN). The main idea is that edge controller shave to work in a new distributed interaction for to guaranteeing the non dependability of each domain in case of failure. Equal interaction, scalable with multiple SDN domains is the main advantage but security threats are still present. Alam et al.,[69] proposed Analysis Eight Data Mining Algorithms for better IOT which makes use of K-Nearest Neighbors (KNN),Support Vector Machine (SVM), Naive Bayes (NB), Linear Discriminant Analysis (LDA). This leads in better processing and gives relatively higher accuracy results. But the problem is that SVM uses a lot of system resources and has slow processing speed, KNN is lighter and has low execution time.

Kumar et al., [70] proposed Public Healthcare System based on Ontology in Internet of Things. Ontology content accessing will helps to cure the patient in a small period of time and also cures the patients in the easiest way. But the interoperability of multiple resources is difficult. Chakibbekara [71] studied Security Issues and Challenges in the IoT-based Smart Grid. The system used (CoAP)Constrained Application Protocol and (RPL)Routing Protocol for LowPower and Lossy Networks. In this study the main security obstacles for the SG and major required security services have been addressed. It provides authentication, data integrity, confidentiality, users privacy but large-scale acceptance and deployment of the SG was found to be difficult.

Zhan et al., [72] proposed Implementation of Cognitive Management Framework for IOT which uses Service oriented Architecture. Improvement of web service technology, high Flexibility was the main motive. This theory was found to be more flexible. But there is no R-VO in R-VO database instead we need to create it. Jiang et al., [73] proposed Implementation of Cognitive Management Framework for IOT which uses Service oriented Architecture. Improvement of web service technology, high Flexibility was the main motive. This theory was found to be more flexible. But there is no suitable R-VO in R-VO database we need to create it.

Nigussie et al., [74] proposed A Secure and Efficient Authentication and Authorization Architecture for IoT Based Healthcare Using Smart Gateways which uses DTLS handshake protocol. This theory gave a secure and efficient architecture for IoT-based healthcare systems. This also reduced the impact of DoS attacks. The main disadvantage is that sensors used in medical applications are extremely resource constrained. Cercas et al., [75] proposed Design and implementation of an IoT gateway to create smart environments which makes use of Message Queuing Telemetry Transport protocol. This theory focused have focused on secure system through the implementation of encryption in communication. Flexibility and simplicity were its main advantages. It was small, cheap, and used low power and low memory. The disadvantage was both parts has to be connected to the broker so that it can receive the messages.

Malek et al., [76] proposed the use of IoT and Big Data Technologies for Real-time Monitoring and Data. The processing was done using Message Queuing Telemetry Transport protocol. The proposed theory preliminary results were promising. This system introduced a real-time data stream processing and monitoring platform. Future work involves integration with the work done for energy efficiency structures and smart grids in order to demo the actual data processing for context-driven controls.

Koo et al., [77] proposed Schematic Development of Big Data Collection Using Internet of Things. Automated Meter Reading (AMR) was used. The main advantages were automated system condition monitoring including optimizing water supply, leak detection, production, optimizing water consumption and energy consumption. But it requires large capital. Carlos et al., [78] proposed New Security Architecture for IoT Network which uses Software-Denied Networking (SDN). In case of failures to guarantee the independence of each domain, edge controllers have to work in a new distributed interaction. The proposed theory highlighted equal interaction and its was scalable with multiple SDN domains. But the security threats are still present.

Russo et al., [79] proposed Enabling IoT interoperability through timeserving smartphone-based mobile gateways which uses replication method for steady-state simulations. All the results presented, satisfy the chosen confidence level. It featured IoT interoperability but energy consumption was high. A.Helen Joyce et al., [80] studied the computing concept and the normal physical items concept is described. ZigBee is used here. The design of four five blocks of ZigBee transmitter used in IOT application is described here. Power requirement that must be required is very low and has better battery life. Transmission rate is very low.

Meng Di Yin et al., [81] studied Battery management system for fast charging. It uses MCU. It is application used in large scale battery cells such as electrical vehicles for fast charging. It saves power. Maintenance is difficult. Ayushishrivastava et al., [82] studied Green IoT for smart city. It uses Adaptive Threshold Algorithm(ATA). It is used for sensing vehicles by different types of sensor nodes is used and it is IOT application in smart city. Advantage is it can be remotely programed. Disadvantage is that it is harder to understand.

Uchida et al., [83] studied Three dimensional wireless power transfer method to realize efficient charging of Iot devices. It uses PMA. It is 3D wireless power transfer system that can charge a smartphone. It is used in charging a smartphone without using wires. It has high maintenance cost. S. Arvind Raj et.al., [84] studied Peer to peer file sharing by Block chain using IoT. It uses TPA. It can be efficient way to share large files with others. Files can be sent anywhere at anytime. It has limited functionality. Fuqaha et al., [85] proposed Internet of Things: A Survey on Enabling Protocols, Technologies as well as Applications. It uses the data analytics algorithms. It performs opportunistic traffic analytics. Advantages of the system includes Standardization, Reliability, Enhancement. Disadvantage is decrease in area coverage.

Mayank et al., [86] studied IoT based Ration card System. It uses NFC. This will replace manual handling of data with automatic processing. It provides secure communication to all the users. It is not compatible with other devices.

Lalitha et al., [87] studied Virtual wardrobe an IoT based closet. It uses RFID. Here important technology used is Eddystone which basically send information about its product around it. It has low cost. It has security issues. Karthigeyan et al.,[88] studied Smart security Administration for ZigBee GPRS protocol through IoT Gateway. It uses ZigBee. It will be successful in measuring the current within tolerable range of error. It is flexible .It is not secured.

Nirde et al., [89] studied solid waste management system for smart city. It uses GSM which allows municipal corporations to keep cities clean very efficiently by monitoring the status of dustbins remotely through web server. It minimizes time and cost required. It provides very cost effective products and solutions. GSM provides limited data rate capability.

Wijaya et.al [90] proposed a Design a Smart Waste Bin for Smart Waste Management. This is a smart city based waste management bin. The system has sensors that detect level of waste and measure weight of waste. The system connects with network, to manage the information from waste monitoring system. This paper presents a protocol which is suitable for various waste management system. It can be used in efficient solid waste management system.

Wilson et.al [91] proposed the SWaCH (Smart Waste Collecting Hopper).The country's per capita waste generation is so high, that leading to an unhygienic environment. For that there is automated system that is SWaCH for automated waste collection and has facility to specify time of waste collection through a web portal. In the manual mode the system requires users presence. Users presence is not necessary in the automatic mode. A dispenser module is used for waste disposal. The collector module is responsible for automatic collection of waste. This system is useful in waste collection in apartments, shopping malls, hospitals etc.

P Haribabu et al., [92] studied a system through a mobile application associated with a Smart Trash Bin used for waste collection service and he bin will be emptied at regular time period. GSM/GPRS modem along with standard communication interfaces like RS-232bin used. The system has facility to collect biodegradable and non-biodegradable wastes separately. It is cheaper and utilizes less power. Network can slow down when more number of GPRS users of the same area use the gprs services simultaneously.

Bhattacharyya et al., [93] studied Harnessing Green Energy for Smart Dustbin. The Radio Frequency Identification (RFID) is used here. PZT sensors are used to convert stress produced by walking into ac power. This ac power is converted to dc power by Villard cascade circuit. It is less reliable but overcomes energy crises.

Premalatha has [94] proposed automatic smart irrigation system using IOT. Intelligent irrigaton system uses wireless sensor network in the implementation. It provides a valuable tool for conserving water planning .The advantages are minimal wastage of water and controlling the amount of water delivered to the plants based on plant type .The disadvantages are power failure can cause system to stop working and the working conditions of sensors need to be checked periodically.

Tiwari et.al., [95] have proposed implementation of IoT in home automation using android application .It uses a user defined switch ON/OFF algorithm in the implementation. The advantage is reduces manual effort by making the home automated, prevents wastage of energies like gas, electricity by monitoring their use .The disadvantages are without internet connection, most of the appliances won't work, some appliances are costlier.

Raghavendra et.al., [96] have proposed survey on data storage and retrieval techniques over encrypted cloud data. This survey can be used to analyse which storage and retrieval technique can be used for IOT data in the cloud. Kobusińska et.al., [97] have proposed emerging trends, issues and challenges in internet of things, big data and cloud computing. This paper presents novel research approaches related to big data, IOT and cloud computing. It also discusses the encountered problems and open issues.

III. CONCLUSION

Different Iot architectures have been discussed in this paper. This paper also discusses about how the communication is established between Iot setup and the application. Different types of protocols to be implemented for the communication is also explained. By deploying these IoT systems the vision of smart city can be achieved. The information about different IoT devices and it's working which are used for smart city have been discussed along with it's performance, issues, advantages and disadvantages. The heterogeneous devices present in IoT setup are connected through routers to the Internet. Large amount of data will be produced by these systems can be stored in cloud for further data processing. Business Intelligence can be applied on this data to study user behaviour. Thus this paper explains about different IoT applications.

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