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Internet of Things (IoT), Applications, Open Issues, and Challenges: A Comprehensive Survey.

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Abstract: ***One of the most well-known names has been the Internet of Things (IoT), which has risen to greater levels and become a world standard in the last few years. Things (items) in the physical world have been changed into smart objects. The Internet of Things (IoT) aims to connect all of the world's things under one common framework, allowing users to monitor and report on their present status on a regular and timely basis. IoT has become a standard for creating communication between devices. In light of the current state of IoT, a comprehensive survey of literature on many topics of IoT, such as technology and challenges, has been conducted. Existing challenges and issues in these fields are also mentioned. Future research directions in the field of IoT have also been highlighted in the study to allow new researchers in this subject with the tools they need to examine current IoT standings and improve them with innovative ideas.***

Keywords: Internet of Things (IoT) · Wireless sensor networks (WSN) · Radio-frequency identification (RFID) ·

I. INTRODUCTION

Internet of things (IoT) is a unique system that expects the mixture of virtual domains by using the Internet. Here, the practical world is completely merged into artificial intelligence with IoT-based technologies and smart applications. The term IOT, “internet of things” was firstly used in 1999 by Kevin Ashton, in which things are connected with the assistance of the Internet through ZigBee, WSN, Bluetooth, RFID, Z-Wave, Bar Code, etc.

WSN and RFID both technologies aim to focus on communication and sensors, which are the pillars of IoT. Radio-Frequency Identification (RFID) is an auto-identification technology, and its applications are used in various fields of life, like identification, transportation, security, civil aviation, and logistics. RFID uses two devices: readers and tags. The Reader is a source of communicating wirelessly. Tags use sensor nodes, which can transmit data through sensors. In addition, Tags are of two types, active and passive. Active tags use a battery, while passive tags collect energy through the reader’s radio frequency (RF) signal. Passive tags are more in RFID’s application, security, and identification .

Wireless Sensor Networks (WSN) is a collection of sensor nodes that collect data and transfer it through the electrical signals in the main node. WSNs are used in security applications, healthcare, military, and entertainment. Wireless Sensor Networks (WSN) is a collection of Pc servers, routers, organizers, and sensor nodes. The sensor node collects data from its sensors, power source, memory, and processing chips and is transmitted with routers through the Pc server.

RFID is used to classify and locate devices; WSNs collect and transmit data sensors. Collaboration of RFID and WSN decreases the challenges faced in IoT.RFID uses different technologies in IoT such as WSN itself, NFC, Zigbee, Bar code, Bluetooth, sensor nodes, EPC, and gateways connected through the Pc server.

IoT applications make our lives easy and reliable; in this review article, we discuss 3 types of connections:

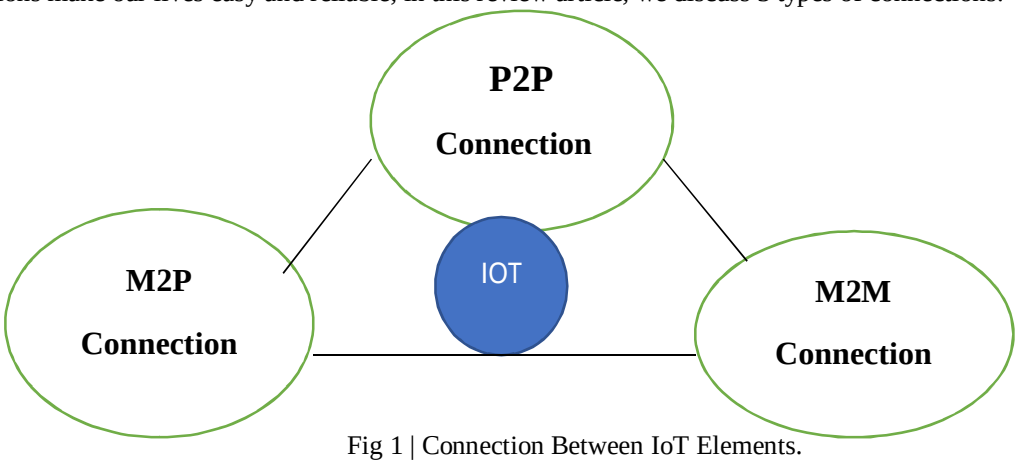


Fig 1 | Connection Between IoT Elements.

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A. People to People (P2P) Connection

It includes Skype, Facebook, Call, YouTube. One person can share information/data with another one.

B. (M2M) Machine to Machine Connection

Exchange of data without interaction of humans is called M 2 M. For Example, Wireless devices (Bluetooth), powerline connection (PLC), etc.

C. (M2P) Machine to Person Connection

It happens when a machine sends a message to humans. For example, Alarm, Smoke detector, weather predicting devices.

Thus this review article explains the concept of IoT in various fields of our daily life and smart devices in future research. It also discusses different research with helpful content and many citations over the years. Our contribution towards this comprehensive survey is as follow:

- We discover the pros, cons, ongoing challenges in IoT technologies.
- A detailed and step-by-step explanation of the concept of IoT with different duration of time.
- A brief discussion of the importance of IoT communication techniques.
- A significant discussion on future research and challenges that are helpful for researchers.

II. LITERATURE REVIEW

Our survey paper is different from other surveys mentioned in blow. We give a review on IoT face challenges, their various technologies, many applications, and we selected a large number of surveys in this paper. Past surveys that are related to our article is Aleem Colakoviet al. (2018), Balaji et al. (2019), S. Chaudhary et al. (2019), Lakhwani K. et al. (2019), Zikria et al. (2019), Khanna A et al. (2020), Landaluce et al. (2020), Selvaraj et al. (2020), Al-Emran M. et al. (2020), L. Chettri et al. (2020), Mohammed Sadeeq et al. (2021) have been very helpful. Aleem Colakoviet al. discusses challenges and open issues in technology purpose and future research. Literature reviews are discussed based on different research topics, but Karie et al. do not focus on IoT-based occurrence. Balaji et al. have presented security issues, challenges, and overview of many applications like industrial, smart cities, agricultural, lifesaving, etc. of the IoT technology and sheds light on the cons of IoT.

Conti et al. MacDermott et al. Alenezi , Lilis et al., Arafat et al., and Zawoad and Hasan are good surveys that investigate IoT challenges. Still, all of these papers are failed to explain the current work. S. Chaudhary et al. presents a systematic literature survey on the latest and new IoT applications, their concepts, and challenges. Still, some researchers, H. Chung et al. and M. Al-Sharrah et al. disapprove of the IoT forensic approaches. Lakhwani K. et al. briefly explain the benefits of IoT in agriculture, applications of IoT on agriculture, introduced the technology in IoT, and forestry in agriculture IoT. Also, discuss the literature review.

Zikria et al. shed light on the open issue on IoT operating system management, solutions, challenges, future research, and opportunities. Khanna A et al. focus on “things are connected through the internet” and IoT-based applications, various challenges, future aspects, and comprehensive surveys.

Landaluce et al. explains the technologies of RFID and WSN and discuss their challenges like cost feasibility, communication interference, and energy harvesting. Also, shed light on IoT applications, sensors, and their pros and cons. Selvaraj et al. shed light on the rapidly growing IoT in healthcare like health monitoring, detecting disease and fitness programs, etc. They also explain challenges, open issues, pros and cons, and security problems in IoT-based healthcare. Al-Emran M. et al. explains IoT usage in medical education, technologies in education, and greenhouse IoT in education are helpful for humans. Also discussed are IoT applications in education face challenges and opportunities in future research. L. Chettri et al. discussed IoT briefly in 5G as a game-changer; 4 G is insufficient to fulfill our requirements.

5G in future research is very helpful with the usage of its many application, technologies, and devices. 5G technology opens the door for smart services and wireless architecture. Mohammed Sadeeq et al. discuss the relationship between IoT and cloud computing, their challenges and problems, and computer technique that tells us how helpful the usage of IoT and cloud computing is in the industry.

III. PROBLEM DEFINITION

Over time, research efforts and developments in IoT have steadily increased. This survey paper sheds light on major findings from earlier surveys and gives a new methodological literature analysis that assesses and uncovers potentials in IoT based on available research. This paper highlights challenges and issues that are faced IoT and provides its solutions.

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IV. RESEARCH METHODOLOGY

This survey paper aims to identify the current state of IoT accurately. The research was carried out in-depth by studying the current literature on the subject. The research highlighted the origins of IoT and its current standings, trends, and technologies to provide a solid foundation for this review article. Moreover, the goal was to determine how the concept came to be and its current status. This survey paper's final goal was to identify future IoT directions accurately. A thorough review of the literature was conducted to achieve the goal. The existing study's framework is based on a comprehensive review of many publications, conference papers, articles, and edited volumes that have made contributions. By searching from google scholar, important publications were identified and information extracted. Out of a total collection of 437 publications, 182 papers have been read carefully. A unique domain category was explored, analyzed, and classed in each paper.

V. OBJECTIVE OF INTERNET OF THINGS (IOT)

Since the Internet of things is all about universal integration via IP-based Service Oriented Architecture (SOA), permitting heterogeneous devices and interoperability is required. Therefore, the objectives of the Internet of Things are as follows:

1) The research finding also aims to extend IPv4 capabilities to IPv6 and other relevant standards capable of supporting the future of IoT and overcoming its current destruction difficulties.
2) To provide a highly scalable IPv6-based SOA to address difficulties such as mobility, interoperability, cloud computing integration, and intelligence distribution across heterogeneous key features, applications, and services.
3) Multi-protocol integration, Cloud Computing Services, Intelligent Distribution Systems, Self-interoperability with heterogeneous devices, and Self-identification of RFID tags and other related services are all examples of self-capable exploring creative types of interactions.

VI. ANALYSIS AND FINDINGS

The major issues faced by IoT in recent years can be considered based on the examination of the following indicators:

A. Technology for Identification

The key challenge is to map a unique identifier (globally unique or unique within a specific scope) to an entity so that it can be identified and retrieved without circumlocution.

B. Architecture for the Internet of Things

The most challenging task in SOA is to force providers and requesters to concerns and perspectives with one another, given their variety.

C. Discovery of Networks

They are overcoming the existing network dynamically to alter the ongoing evolution of things so that they can have varying levels of flexibility.

D. Standardization is Important.

Standards must be created to support a wide range of applications and fulfill the common requirements of all possible IoT applications.

E. Technology for Networks

The correct implementation of the vision is to reach out to physical world items and bring them online.

VII. LIMITATION & FUTURE SCOPE

The resources accessible beneath the hood of IoT have run out, and the current situation creates lots of new questions that must be answered before we get to the next level. Furthermore, given the ever-expanding scope of the Internet of Things, numerous future-related questions have been raised that must be solved before entering a new horizon.

1) What would be the next great step in effectively identifying and managing the vast array of devices being added to the Internet?
2) How will the next generation of information systems function in tandem with the Internet of Things, especially as technology evolves?
3) How will newer approaches deal with the inherent complexity and volume of data to provide a usable DSS?

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VIII. CONCLUSION

This paper gives a detailed literature review on the Internet of Things (IoT). The phrase "Internet of Things" has been broadly defined in light of the current state of IoT, its evolution over time, and the numerous communication technologies employed by various devices for interface and communications reasons. Moreover, the study represents a complete literature analysis of several IoT application areas, highlighting the author's perspective on the topic, the recommended methodology, and various other informative details related to the research paper.

Finally, the findings and future scope of IoT have been thoroughly examined.

The study's findings lead to the following conclusions:

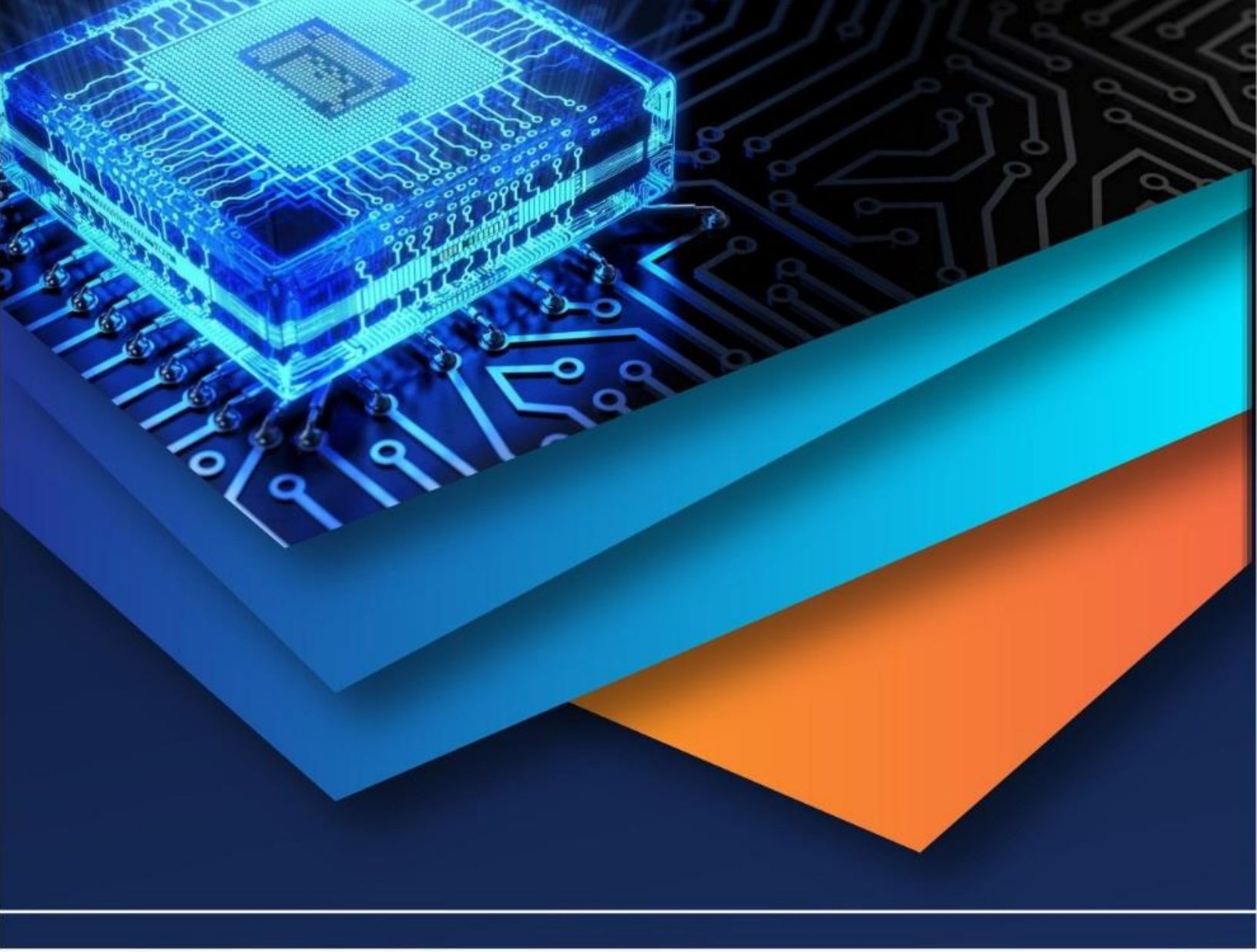
1) Because technology is not static, a current IoT period will soon be replaced by a fresh IoT dimension in the future.
2) Any proposed approach for a research article would fall short at some point, given the growing demand and requirements of end-users.
3) The data provided by multiple sensors is critical and must be managed and analyzed with extreme precision.
4) Over the next five years, nearly everything that exists physically will be connected to the Internet with the primary goal of interaction and accurate evaluation.
5) Comprehensive review in this sector will take a major step forward with only one goal in mind: zero human involvement.

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