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A Survey on Research Activities & Futuristic Approaches of IoT

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ABSTRACT

The Internet of Things (IoT) involves the connection of many objects, systems, and machines, allowing them to share information and interact without requiring human input or intervention.These connected devices utilize technologies such as radio frequency identification (RFID) tags, sensors, and actuators to collect and transmit data with each other. This data is then used to improve efficiency, automate tasks, and make decisions with minimal human intervention. IoT is used in many areas such as healthcare, transportation, retail, and manufacturing, providing convenience and greater automation for everyday activities.The current cloud-computing concept has its limits when it comes to analyzing very large data in a very short time.Edge computing is a distributed computing architecture that decentralizes data processing from the cloud to the edge of the network, allowing for faster processing and improved Quality of Service (QoS). It reduces the amount of data that needs to be transmitted over long distances, reducing network congestion and overall cost of ownership.In this paper, we provide a comprehensive overview of existing research in the field of edge computing and its applications in the Internet of Things (IoT). We discuss existing approaches, architectures, and technologies as well as their advantages and disadvantages. Furthermore, we present potential research opportunities and future trends in the field.

Keywords: IoT, Edge Computing, Sensors, QoS, RFID.

INTRODUCTION

The emergence of new generations of networks has created challenges in providing adequate resources for new applications, which require advanced infrastructure to ensure optimal quality of service [1]. As a result, existing cloud-based architectures are reaching their limits in terms of scalability, latency, and reliability. Edge computing offers an alternative approach to meet these challenges by providing a distributed computing infrastructure that is closer to the user. Edge computing is capable of providing computing resources closer to the user, resulting in reduced latency, improved scalability, and higher reliability.The term "Internet of Things (IoT)" was first coined by professors at MIT in the late 1990s. It refers to a connected world of devices, sensors, and other technology which can interact with each other and the environment. IoT is made possible by the use of advanced networks, enabling a variety of devices to transfer data and interact with each other. IoT can be used to not only control individual devices, but also to control entire networks, allowing for sophisticated communication and higher levels of automation [2].The main objective of the Internet of Things (IoT) is to process and analyze the massive amounts of data emanating from connected devices in the cloud. This process, known as cloud computing, allows thousands, or even millions of small amounts of individual data gathered by connected devices to be processed in the cloud. Cloud computing utilizes virtualized computing resources to facilitate data processing, storage, and analysis, enabling powerful analytics and insights [3]. Additionally, it also provides scalability, allowing applications to grow as data increases without overburdening the local system [4].

The internet of Things (IoT) has enabled devices to be connected to each other and the cloud. However, connecting devices to the internet can create opportunities for malicious actors to gain access to systems and devices that would otherwise be inaccessible. This can lead to serious security threats such as burglary if hackers gain access to smart alarms and other connected systems [5]. Without adequate security measures in place, IoT technologies can be vulnerable to the most sophisticated of attacks. To mitigate this threat, security protocols should be implemented to protect both data and devices from malicious attacks and exploitation [6]. Security protocols should also be updated regularly to ensure that users are safe from the latest threats. By taking these proactive steps, businesses and individuals can rely on the IoT and its connected devices to provide essential features and security [7].

Edge Computing

Edge computing is a distributed computing architecture that enables data processing at the edge of the network. It works by taking the data from the source, either from the cloud or local networks, and transferring it to the data centres

located closer to the user [8]. This way, the data can be processed closer to the source, rather than transferring it to a remote centralized location. Edge computing reduces the strain on the network by eliminating the need to transmit large volumes of data over long distances, thus improving the quality of service [9]. Additionally, as the data processing occurs directly at the edge, computationally intensive tasks such as analytics can be processed faster and with lower latency. This not only enables applications to run more efficiently, but also helps minimize network congestion and reduce the overall cost of ownership [10].The massive scale of the internet of things (IoT) means that it has the potential to connect billions or even trillions of devices. Since each device is potentially generating large amounts of data, the amount of data that is being generated, collected, stored and processed can be significant [11]. For example, an individual's wearable device can generate copious amounts of data about an individual's health and activity levels, which can then be analyzed in the cloud to provide insights about an individual's lifestyle and habits. Smart homes can monitor and control many aspects of a home, from lighting to heating to appliances and more, which also results in large amounts of data [12]. All these data can be understood and analyzed using big data technologies to gain insights and allow better decision-making [13].

Applications of Edge Computing

Edge computing provides an efficient platform for smart IoT applications by providing near-instantaneous data processing without requiring communication with a server or centralized control point [14]. It is capable of harnessing the power of the internet of things (IoT) and its associated devices, sensors, and other data sources to provide real-time analytics, monitoring and control. Edge computing is advantageous for scenarios involving swift data processing of large proportions for automation purposes, such as in smart homes, smart vehicles, smartgrids, and smart cities.By providing near-instantaneous processing of data, edge computing can provide real-time data analysis and enable smarter decision-making [15]. This can enable the automation of everyday tasks, from turning lights on and off to controlling environmental settings in a home or city. Edge computing also enables tighter security, as the data collected from connected devices remains localized and relatively private. Thus, edge computing can enable real-time decisions and automation, without compromising privacy or data security in smart IoT applications [16].

1. Autonomous Cars: Edge computing is essential for autonomous vehicles, allowing them to interpret sensor readings and make decisions without needing a connection to the cloud.Edge computing is a vital part of autonomous vehicles as it allows them to process data from the various sensors in their environment without needing to connect to the cloud [17]. Not only does this help reduce latency to make quicker decisions, it also helps ensure data privacy is maintained as the data never leaves the car. By making decisions locally, the car is able to operate independently, choosing the right actions based on the data it interprets [18] Edge computing also provides the capability to carry out complex operations, such as facial recognition and deep learning, in an offline environment that is not accessible to the cloud. This allows autonomous vehicles to make decisions quickly and safely, while still benefiting from comprehensive AI [19].

2. Smart Agriculture: Edge computing can be used to interpret data from sensors in soil and on crops to help improve agricultural efficiency and reduce waste.Edge computing can be used to interpret data from sensors in soil and on crops to optimize crop yield [20]. The data from the sensors can be used to collect information about the soil, such as moisture levels, nutrient status, and pH values, which can then be analyzed to determine the best course of action for the crop [21]. This data can also be used to tailor the application of fertilizers and herbicides, increasing efficiency and reducing waste. Additionally, edge computing can be used to collect data on pests, temperature, and other environmental factors to provide farmers with a more precise understanding of their land, enabling them to make informed decisions about their crops [22,23].

3. IoT Networks: Edge computing can interpret billions of sensors' data in real time, and make decisions without having to transmit data back and forth to the cloud [24].Edge computing allows for the interpretation of billions of sensor readings from various pieces of equipment in real-time, without the need to send the data back and forth from the cloud. This allows the user to make decisions quickly and accurately, as the data can be processed locally, significantly reducing the amount of time and energy needed for the task [25]. Additionally, edge computing can process the data even in low-bandwidth or low-connectivity environments, making it a viable option for applications where data needs to be processed in remote locations. Finally, edge computing can provide higher levels of security and reliability, as data can be processed without ever leaving the local environment [26].

4. Augmented Reality Experiences: Edge computing can enable real-time interaction between digital and physical worlds, allowing more immersive augmented reality experiences.Edge computing can enable real-time interaction between digital and physical worlds by processing data locally and in real-time [27]. This makes it possible to create more immersive augmented reality experiences, as the data can be used to overlay an augmented reality layer over physical objects and environments. This layer can then interact with the user in real time, creating an interactive and immersive experience. Additionally, edge computing can make the experience more secure by processing the data locally and not having to send it back and forth from the cloud [28].

5. Industrial Automation: By using edge computing, machines can communicate with each other for efficient decision making and process optimization.Edge computing enables machines to communicate with each other and for efficient decision making and process optimization by allowing them to share data and insights in real time and at the device level rather than having to go through the cloud [29]. This makes it possible for machines to collaborate with each other to make decisions and optimize processes, as they have immediate access to the most up-to-date information and insights. This enables better decision making and process optimization and can help to reduce operational costs, improve operational efficiency and increase customer satisfaction [30,31].

6. Smart City Infrastructure: Edge computing can be used to interpret data from different smart city sensors and implement real-time traffic control and monitoring [32].Edge computing can be used to interpret data from different smart city sensors and implement real-time traffic control and monitoring [33]. By using edge computing technology, traffic data can be filtered, analyzed, and distributed directly to traffic control systems in order to make better informed decisions about traffic flow and patterns. Edge computing technology can also be used to detect accidents and other traffic events, and give appropriate responses via automated instructions to mitigate the effects of potential traffic delays [34,35]. In addition, edge computing can be used to send live updates to traffic controllers, allowing them to make real-time adjustments to traffic flow, thus improving overall efficiency and helping ensure the safe and timely arrival of drivers [36].

CONCLUSION

The Internet of Things (IoT) networks are rapidly becoming more complex and require a greater need for computing resources. Edge computing provides a viable solution to this issue by performing processing and analysis of data closer to the IoT devices or sensors themselves, instead of relying on a centralized cloud. This allows faster and more efficient data processing, leading to improved performance and scalability of the IoT network. In addition, edge computing provides a secure and cost-effective way to control and manage the large volume of connected devices and sensors, as the data processing resources can be located right at the edge instead of in a central location. Edge computing also enables improved network latency, flexibility, and faster responsiveness to connected devices, allowing for more efficient decision making and creating an overall better user experience.

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