International Journal of Advance Scientific Research
(ISSN – 2750-1396)
VOLUME 03 ISSUE 09 Pages: 343-349
SJIF IMPACT FACTOR (2021: 5.478) (2022: 5.636) (2023: 6.741)
OCLC – 1368736135

Journal Website: http://sciencebring.com/index.php/ijasr

Research Article

APPLICATION OF ZIGBEE TECHNOLOGY IN IOT

Submission Date: September 20, 2023, **Accepted Date:** September 25, 2023,
Published Date: September 30, 2023
Crossref doi: https://doi.org/10.37547/ijasr-03-09-54

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ABSTRACT

ZigBee has become a popular technology for building device networks. ZigBee is a wireless communication technology that is widely used in devices IoT. This article discusses the features of ZigBee and its application in IoT Theoretical research was conducted on the proposed options and the author's conclusions were given.

KEYWORDS

ZigBee, Internet of things, network topology, mesh network, coordinator, router.

INTRODUCTION

ZigBee is a wireless protocol that uses low-power radio signals to connect devices. It is based on the IEEE 802.15.4 standard, which defines the physical and media access control layers for low-speed wireless personal area networks (LR-WPAN). LR-WPANs are designed for low-power devices with limited computing and memory capabilities [1-4].

ZigBee is a mesh networking technology, which means it can create a network of devices where each device can act as a router for other devices on the network. This allows ZigBee provide reliable and redundant communication paths even in challenging environments. Radius of action ZigBee is up to 100 meters, and it can support up to 65,000 devices on the same network. This technology widely used in devices

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IoT such as smart home devices, smart lighting and industrial automation. Devices ZigBee typically have low power consumption, making them ideal for battery-powered devices [5-9].

ZigBee works by creating a mesh network of devices that communicate with each other using low-power radio signals. Each device on a network can act as a router, meaning that it can receive and forward messages to other devices on the network. This allows ZigBee create a redundant communication path between devices, which increases network reliability. ZigBee also uses a unique addressing scheme that allows devices on the network to be uniquely identified. This addressing scheme allows ZigBee provide security features such as encryption and authentication to protect the network from unauthorized access [10-16].

ZigBee is a standards-based wireless technology that is designed to be reliable, secure, and easy to use. Some of the key features of ZigBee include:

- Low power consumption: ZigBee designed to operate with low power consumption, making it ideal for use in battery-powered devices.
- Mesh network: ZigBee supports mesh networking, which allows devices to communicate with each other over multiple paths, increasing reliability and range.
- Low latency: ZigBee Provides low latency communications allowing for real-time control and monitoring.
- Easy to use: ZigBee Easy to use and plug-and-play.
- Security: ZigBee includes advanced security features to protect against unauthorized access.

METHODOLOGY

The structure of a ZigBee network and the devices it may contain are as follows (Figure 1):

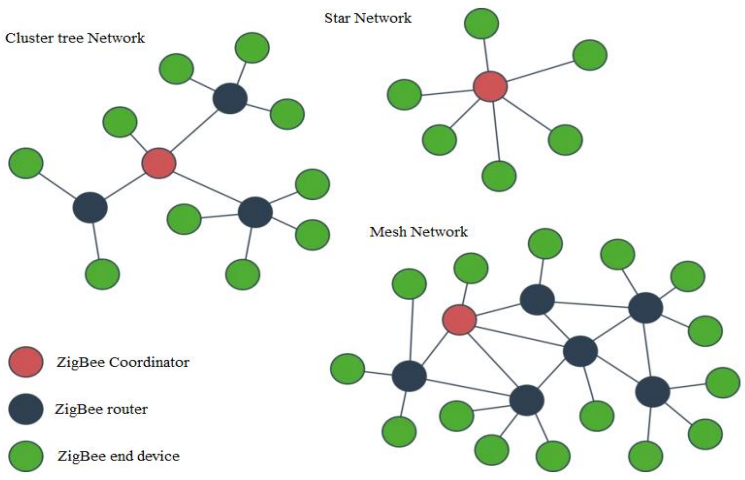

Figure 1. ZigBee network and the devices.

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Coordinator— the node that organized the network. It selects the network security policy, allows or denies the connection of new devices to the network, and also, if there is interference on the radio, initiates the process of transferring all devices on the network to another frequency channel [15-19].

Router - a node that has stationary power and therefore can constantly participate in the operation of the network. The coordinator is also a router. Nodes of this type are responsible for routing network traffic. Routers constantly maintain special routing tables, which are used to plot the optimal route and find a new one if any device suddenly fails. For example, routers on the network ZigBee could be smart plugs, lighting control units, or any other device that has a power connection.

End device is a device that connects to the network through a parent node - a router or coordinator - and does not participate in traffic routing. All communication with the network for them is limited to transmitting packets to the "parent" node or reading incoming data from it. The "parent" for such devices can be any router or coordinator. End devices spend most of their time in sleep mode and send control or information messages. This allows them to retain the energy of the built-in power source for a long time.

ZigBee offers several benefits, including:

- Low cost: ZigBee— a relatively inexpensive solution for wireless control and monitoring.
- Long battery life: Low power consumption ZigBee Allows devices to operate on a single battery for a long time.
- Reliability: Mesh technology ZigBee Provides a reliable and durable communication network.
- Scalability: ZigBee is a scalable technology that can be easily expanded to support larger networks.
- Easy to install: Functionality ZigBee "Plug and play (work)" simplifies installation and configuration.

ZigBee is not the only wireless communication protocol used in IoT. Other wireless protocols include Wi-Fi, Bluetooth and Thread. The table below describes wireless communication protocols for frequency 2.4 GHz. Each protocol has its own advantages and disadvantages (Table 1).

Table 1.

Technology	*Wi-Fi*	*Bluetooth*	*ZigBee*	*Thread*
Communication standard	IEEE 802.11	IEEE 802.15.4	IEEE 802.15.4	IEEE 802.15.4
Data transfer rate	300+ Mbit/s	up to 3 Mbit/s	250 Kbps	250 Kbps
Energy consumption	High	Low	Low	Low
frequency range	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz
IP technology support	+	—	—	+
Topology	"star"	"star"	"mesh"	"mesh"

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Wi-Fi is a high-speed wireless communication protocol that is widely used to connect to the Internet. However Wi-Fi consumes a lot of power, making it unsuitable for battery-powered devices.

Bluetooth is a low-power wireless communication protocol that is widely used for short-distance communications. However Bluetooth has a limited range, making it unsuitable for large-scale applications IoT. Thread is a wireless communication protocol that is similar to ZigBee. However, in Thread IP protocol support has been added, which simplifies network integration Thread with network applications [20-23].

Compared to other protocols, ZigBee is a low-power, inexpensive and reliable technology that is widely used in devices IoT. On networks Bluetooth and Wi-Fi network communication occurs through a central gateway. And if it fails, data exchange will become impossible. In addition, individual nodes may be left without communication if an obstacle unexpectedly arises along the route of the radio signal [24-27].

On networks ZigBee and Thread Communication reliability is increased due to the presence of redundant connections between devices. All devices that do not go into sleep mode perform the role routers, which are responsible for routing network traffic, choosing the optimal route and relaying packets. Even if the device that acted as the network organizer fails, ZigBee - the network will continue to function. The occurrence of interference or obstacles, as well as the failure of any of the routers, is not critical due to the presence of redundant connections. Therefore, with the introduction of additional nodes that have stationary power and can perform the tasks of the router, the network becomes more reliable.

ZigBee widely used in solutions IoT such as smart homes, industrial automation and healthcare.

- In smart homes ZigBee Used to connect smart home devices such as smart thermostats, smart locks and smart lighting. ZigBee allows these devices to communicate with each other and with the Internet.
- In industrial automation ZigBee used for wireless sensor networks and industrial control systems. ZigBee provides wireless communication between sensors, controllers and other devices. This allows monitoring and control of industrial processes in real time.
- In healthcare ZigBee used for remote patient monitoring and connecting medical devices. ZigBee provides wireless connectivity between medical devices and the Internet, allowing for remote patient monitoring and real-time communication between healthcare professionals.

CONCLUSIONS

Zigbee is a wireless communication technology that is widely used in devices IoT. It is a low-power, low-cost, and reliable technology that allows devices to communicate with each other wirelessly. ZigBee operates on a mesh network topology, which allows devices to communicate with each other directly or indirectly. Radius of

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action ZigBee is up to 100 meters, and it can support up to 65,000 devices on the same network.

ZigBee widely used in solutions IoT, such as smart homes, industrial automation and healthcare. ZigBee provides wireless communication between devices, allowing real-time monitoring and control of industrial processes, remote patient monitoring and real-time communication between medical institutions.

Compared to other wireless protocols, ZigBee is a low-power, inexpensive and reliable technology that is widely used in devices IoT.

If we want to implement reliable communication technology for our IoT-devices, ZigBee definitely worth considering. With its secure mesh network and redundancy features, ZigBee can guarantee that our IoT-devices will remain connected and function properly.

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