This is a test. But we can do more

1 Related Work

We investigated the current body of knowledge in traditional routing algorithms and artificial intelligence-based routing algorithms, as well as their use cases, in the literature. We dissected the widely adopted methods and investigated how they can be used to reduce the number of devices involved in message transmission. Furthermore, we analysed the benefits of integrating various AI algorithms in a network composed of IoT devices and evaluated different algorithms to determine their viability in handling uncertainty and energy consumption.

3.1 Studies investigating traditional IoT routing algorithms.

[1] defines the Internet of Things (IoT) as a paradigm that uses information and communication technologies to connect physical and/or virtual objects and incorporate them into networks. The Internet of Things (IoT) continues to incorporate a significant number of parts and things that stand out for their complexity and variety [2]. To exploit the benefits of IoT, it is necessary to manage the data generated and exchanged in the network in an efficient manner [3]. Routing consists of applying an algorithm to determine the best route between the source and the destination among multiple routes. In IoT networks, routing becomes essential because of its exceptional characteristics: intelligence, connectivity, dynamic nature, security, and ability to host large-scale devices. The network sends data to gateways as hosts and routers [4]. Thus, routing policy specifies how routing devices connect to the network and circulate information, controlling the best route between two nodes among different routes.

[3] stated that several characteristics affect routing policies. Integration of heterogeneity is preferred since the node's energy affects its power. For faster processing, fewer memories result in high packet loss, hence incorporation. Hybrid mechanisms are encouraged. Another factor is the security of the data. Authentication is encouraged between two devices. Congestion causes packet loss and delays. Multi-routing can be inspiring to balance the load and stop the exhaustion of specific nodes.

3.2 The AI techniques to overcome routing challenges in a network composed of IoT devices

According to [3] applications of artificial intelligence for routing are another way to address challenges in routing. Artificial intelligence is defined by [5] as the science of getting machines to mimic the problem-solving and decision-making abilities of a human brain. According to [2] an algorithm called SERA exploits the experience acquired by the sent packets on the used route to evaluate its effectiveness factor compared to the other possible routes. This factor is calculated according to the communication parameters and the networks' new situation. SERA recorded better results than three different routing algorithms regarding QoS parameters and device lifetime. According to the [2]'s findings, using SERA as a routing algorithm significantly improves IoT communications. [6] proposed a new smart ration control algorithm (s-RCA) to create an intelli-

gent path in the network between source and destination, which speeds up the medical surgery packets used in emergencies. This algorithm will read high-emergency traffic and open a session between the source and destination. It is configured to wait for some time; if no more packets are received, it will stop booking the path and return to normal mode. Node buffering was used to monitor emergency packets. Moreover, this simulation has demonstrated significant improvements in network congestion, throughput, delay time, loss ratio, and network overhead [6].

An efficient and intelligent routing algorithm, SERA (Smart and Self-Organized Routing Algorithm) was proposed by [2] to improve IoT communications. The proposed algorithm can select the best route for the packets in Smart cities. This makes their installation and deployment easy, and their use is solicited by all areas, such as smart cities. . [3] conducted a survey to examine existing works that use artificial intelligence to overcome IoT routing challenges. In the case of congested links, the QI-RM algorithm, which used both machine learning algorithms and a data flow classification method, improved the following QoS criteria: delay, bandwidth, packet loss rate [7] . [3] conducted a survey to examine existing works that use artificial intelligence and link load balancing. However, these performances need to be demonstrated by actual experiments. In 2022, [3] discussed a routing optimization problem modelled as a "multi-constrained shortest path problem" (CSP) to improve performance and optimise resources. A multi-CSP problem is an NP-hard problem. The results of the simulations of an NP-hard issue suggest a solution that improves performance in the following areas: transmission delay, throughput, energy consumption, packet loss rate, and consumption of bandwidth. However, there is a need for improvement to ensure support for failure management and network scalability.

Several studies have been carried out in the area of IoT routing. The AI-based routing algorithms, or "intelligent routing" were preferred as they yielded better results in effectively determining the best route in IoT networks than traditional IoT algorithms, However, actual experiments in the real world need to test their effectiveness.

In previous studies, a lot of emphases has been placed on routing algorithms to improve the following criteria: heterogeneity, energy efficiency, and service quality. There is still limited work on algorithms targeted at minimising the number of devices participating in message transmission. Furthermore, IoT devices are less reliable and traditional routing algorithms may be insufficient in dealing with uncertainty, such as inaccessible devices due to mobility. In this study, we developed a message-oriented middleware that incorporates an AI algorithm for a more robust and comprehensive routing mechanism for IoT networks.

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