Computer vision-based system for tracking and monitoring aquatic animals

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Abstract

To monitor and manage the health status of domestic, pet, and aquatic animals, the Indian government has expanded the use of Internet of Things (IoT) and Wireless Sensor Networks (WSN) for livestock through digitisation, national start-up organisations, and programs promoting technological breakthroughs. Aquatic animal owners and farmers may now easily track and monitor the health of their animals thanks to the advent of Internet of Things (IoT) technologies and intelligent systems that use wireless technology and real-time sensors. By incorporating IoT into current systems or creating IoT systems with WSN that are safe for newborn and young aquatic animals, the full process of remotely monitoring the health of these domestic aquatic creatures can be accomplished. With the use of Internet of Things (IoT) technology, which is extensively used in many electronic products, it is possible to remotely track the location, health, and other pertinent behaviours of domestic, farm, and wild aquatic animals. The Internet of Things (IoT) and its collaborative technologies, such as Wireless Sensor Network, Artificial Intelligence, Data Analytics, and Automation, will enable owners and carers of aquatic creatures and gadgets to interact with anything, anywhere, at any time. The lifespan of such sensor nodes is determined by their power supply and energy consumption, which are frequently controlled by the communication subsystem. The suggested framework needs to

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concentrate more on maximising the data transmission rate using a variety of packet handling techniques.

Keywords: Aquatic animals, Wireless sensor networks, Internet of things

Introduction

Catching, trapping, holding aquatic species for study, branding, mutilating, tagging, and banding are some of the methods used to keep an eye on wildlife. Bands and tags in the form of radio collars employ alphanumeric numbers to identify individuals or groups. Although they can be constructed of many different materials, tags are usually composed of plastic or metal (Pai, Shenoy and Pai, 2022). Radio collars are used to track the development of animals. This technique locates a radio transmitter that has been connected to an animal by using radio transmissions. One can implant radio-transmitters, connect them to the skin, put them in a GPS collar, or wrap them around the neck, ankle, or dorsal fin of an animal. This method makes it possible to track aquatic species across the course of their lives, something that was previously not feasible. Fitting radio collar devices carries certain inherent dangers, such as discomfort around the animal's neck, behavioural or environmental alterations, and in rare cases, animal death (Barbedo, 2022). To avoid these issues, aquatic animals must be collared ethically in compliance with standard guidelines, which include checking the device weight, the animal's total body weight, studying the animal to be collared, etc. IoT and sensor technology are being used to monitor the aquatic creatures' physiological conditions and productivity (Kumar *et al.,* 2018). These developments are improving the physiological efficiency and profitability of dairy cow performance (Narayan and Balasubramanian, 2024). It is challenging to track cattle heat, lameness, body temperature, oestrus, fertility over time, etc. through physical observation. The Internet of Things (IoT), a new and developing technology, has allowed an animal caretaker to remotely check on an animal's health and has decreased labour expenses in many sectors of animal husbandry (Sharma and Iyer, 2023). Conventional surveillance is not effective. In other situations, it is challenging to detect random mating times and to estimate the duration of an animal's oestrus (Muthuraja *et al.*, 2021). It is challenging to identify a pattern in the behaviour of aquatic species, as approximately 65% of them will be in oestrus from morning till nightfall (Liu *et al.*, 2023; Kazempoor *et al.*, 2022). When it is hard to tell when an animal is in oestrus, the yield is drastically decreased. If the animal is in oestrus, the owner must be notified immediately (Kapoor and Iyer, 2024). The veterinarian can employ IOT-enabled equipment to rapidly provide aid to the animal during calving, while also helping the caretaker, thanks to remote monitoring (Biswas and Tiwari, 2024; Papadopoulos and Christodoulou, 2024). By using a carrier detecting mechanism at the cluster head, the protocol preserves energy efficiency and lowers communication overhead (Yağlıoğlu and Turan, 2021). Protocols used in relation to inter-packet delay variation and energy consumption throughput (Rathore and Shaikh, 2023). To accomplish the following goals, a plan for data compression and redundancy elimination as well as additional ideal node velocity has been proposed (Yang *et al.,* 2021; Bekri *et al.,* 2024). To comprehend and contrast the current tracking and monitoring techniques for aquatic animals in the wild, domestic, and farm (Bašić, 2018; Kofod-Petersen and Cassens, 2010).

- To create and suggest methods to enhance tracking and health monitoring
- To develop and deploy a monitoring system that will lessen conflict between humans and wild animals in domestic and farm aquatic animals by reducing human labour and providing real-time updates on the location and health of the animals;
- To design a wireless sensor network-based tracking and monitoring device that is inexpensive, lightweight, has a large battery backup, and allows remote access to real-time data using internet of things applications.

Proposed Methodology

In order to save network bandwidth against uniform and non-uniform loads related to data communication and application sharing, I have proposed using animal monitoring and tracking as my research to establish metaheuristics techniques by utilising the Internet of Things (IOT) nature of the network medium and merging trace files using coding to the data packets (Cisar *et al.,* 2021). The proposed protocol enables non-uniform load distributions and multicasting while optimising the use of available space. Multicasting allows you to deliver a single message to several recipients on the same channel. The following aspects are taken into consideration when conducting research on the Mobile Adhoc Network in order to achieve an efficient load balancing and channel allocation paradigm.

In order to achieve high throughput, the suggested method for animal monitoring has attempted to address the issues of prediction errors in the acquisition of sensor information, data assignment strategies, health conditions, bandwidth synchronisation, and resizing on channel assignment for data transmission (Xia *et al.,* 2018). Broadcasting and multicasting at the link layer often enhance efficient use of network resources. Network overhead is decreased by using Channel Strength Analysis and the node redundancy elimination technique. Finding and sustaining calving aquatic creatures in a WSN network is a complex process that depends on energy, traffic load, channel bandwidth, and dynamic Changes in node status (e.g., failure) frequently and randomly cause changes in health (Shreesha *et al.,* 2020). The prediction was made using multiparticle swarm optimisation. In figure 1 display the overall proposed framework.

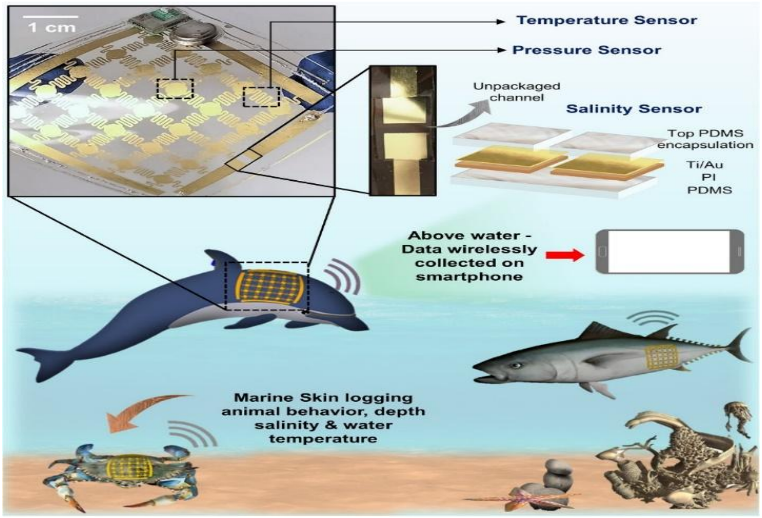

Figure 1: Overall proposed framework.

An essential network class, wireless sensor networks dynamically reconfigure without the need for management to provide communication in crucial situations. The use of WSNs is growing rapidly as their significance for applications changes. Therefore, to effectively manage the application bandwidth in resource-intensive applications, the Medium Access Control protocol has been modified for dynamic environments. Coordinated MAC protocols are also used to control channel access in order to ensure energy efficiency.

Experimental Results

The performance results were acquired when the improved routing protocol was implemented.

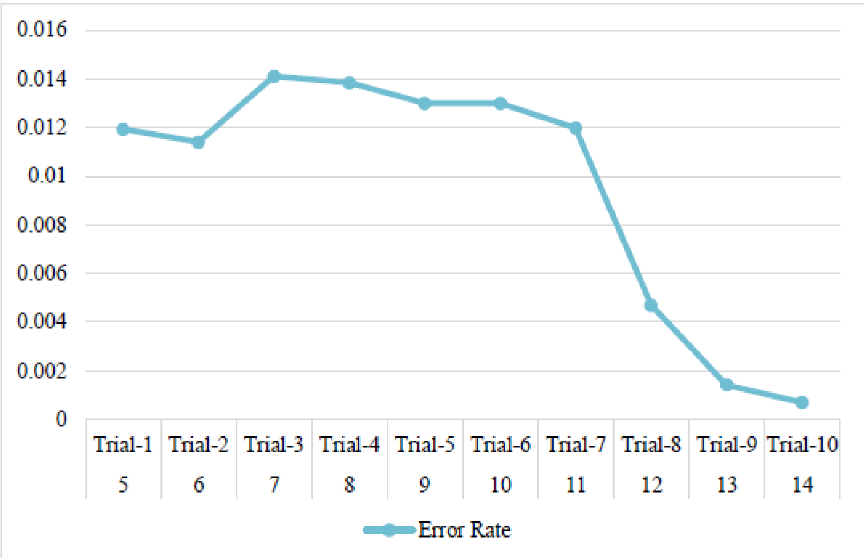

Figure 2: Error rate for 10-trial runs.

The proposed model's error rate for 10 trial runs is displayed in Figure 2, along with the associated hidden layers. Deep learning models' primary duty is to address the overfitting issue, which may be done by looking at the training effectiveness of the recommended model displayed in Figure 3.

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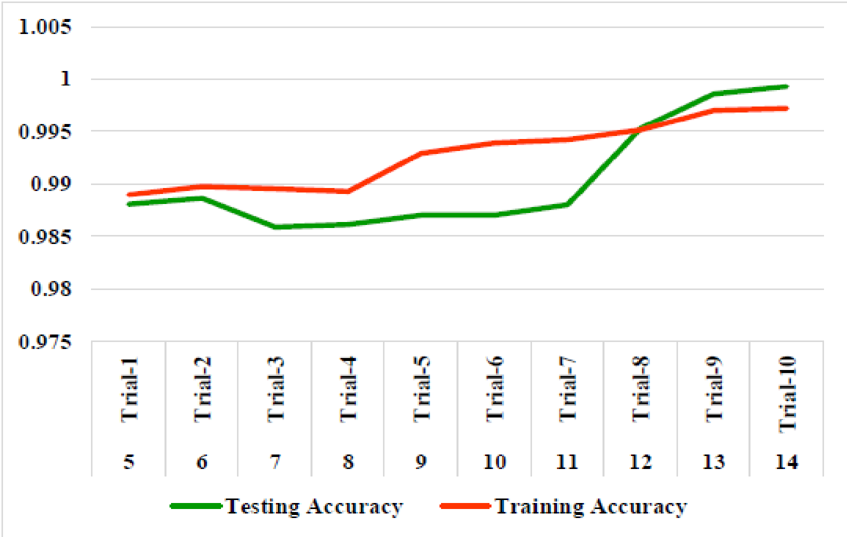

Figure 3: The suggested model's training effectiveness for ten trial runs.

The wireless sensor network's performance evaluation, experimental results, and prediction and routing design. In order to accomplish data prediction and aquatic animal health monitoring with high throughput and little network overhead, the suggested routing framework was created and put into use using the routing protocol composition. Additionally, as the number of source nodes increases, the channel throughput of the system drastically drops. This is due to two factors: A heavy workload generated by many source nodes increases the likelihood of race conflict and link failure in the system. More transmission hops are produced by more nodes, increasing the likelihood of link failure.

Conclusion

Many WSN applications have various routing table information management systems with varying administrative channel requirements. Therefore, it suggests a limited channel constraint for these applications utilising the suggested routing paradigm. While wireless node movement and placement are important factors, the main features of node utilisation are explained by taking into account dormancy, reliability, residual vitality, and transmission management in a restricted way. In order to ensure that every gearbox has the exact channel that is required for each dynamic load model, the suggested channel conditioning framework is built using a measurable technique. By extending the coverage, the network offers constant data transfer. The study prototype gains more value when traffic redundancy and node density are reduced. The bandwidth is managed by the data compression process. As the number of nodes increases, the QoS throughput in two-hop with two source nodes is slightly reduced since there are more nodes in the system that are close to the source nodes. Because the higher channel throughput from idle nodes outweighs the lower channel throughput from interference, the channel throughput rises overall when additional idle nodes are used for packet transmission.

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