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Investigation of Data Transmission Mechanism to Reduce Overhead & Energy Saving in Fly Ad hoc Network

[1]Archana Godbole, [2]Dr. Kalpana Rai

[1]Ph. D. Scholar of Department Computer Science Engineering, Madhyanchal Professional University Bhopal (M.P.)

archana.godbole82@gmail.com

[2]Professor, Computer Science Engineering, Madhyanchal Professional University Bhopal (M.P.)

Kalpanarai2961@gmail.com

ABSTRACT

FANET is an acronym for Flying Ad-Hoc Network. It is a collection of flying devices that are capable of coordinating, communicating, and assisting in the decentralized creation of routes. In the FANET, unmanned aerial vehicles (UAVs) act as sensors, collecting real-time environmental data such as humidity, temperature, humidity, and wind speed and transmitting it to a base station (BS). FANET's primary features are its high dynamic nature, scalability for a variety of applications, and resilience to potential communication failures. They do, however, have many limitations, including restricted flight duration for UAVs owing to low energy devices (direct electrical supply is not feasible during flight time) and routing protocols capable of supporting dynamic networks. In recent research many researcher focus to improve the QoS of FANET which is in future real time adoptable for real time data retrieval from remote area and helps to military services, weather forecasting, atmospheric data gathering etc. To improve the quality of service in this paper we investigate various exiting system which is work in the area QoS of FANET and proposed a system based on data priority provision to increase the importance of network with respect to type of data so that most important data taken as higher priority which helps application like military service where critical data very important to take real time decision. Data priority classify on the bases on type of data i.e. data is TCP with VBR which taken as higher priority and UDP with CBR as low priority. Data priority play the important role to utilize network for fruit full data gathering in base station (BS).

Keywords: FANET, QoS, IoT, UAV, Dynamic Routing, Base Station, Energy.

I. INTRODUCTION

The Internet of Things has grown to such prominence in modern technology that almost every smart gadget is now connected to the internet. As more devices connect to the internet, the Internet of Things (IoT) becomes increasingly attractive [1]. The Internet of Things (IoT) connects almost every area of our lives, from smart homes and healthcare to wearable technology. Diverse utilities may interact and collaborate to provide a variety of services. This intelligent nature of things has been shown in a variety of applications, including smart cities, smart agriculture, home automation, healthcare, and military surveillance security [2].The application of IPv6 made IoT acceptance more apparent and feasible. As a result of IPv6's wider address space, more computers may be connected to the internet. As a result, they can communicate with one another. The concept of machine learning is used for selection of messages and set the priority of communication. In machine learning concepts are apply on data set for increasing the accuracy of output.

The key point of this research is, there is no need to use any existing data set. First of all create real time data set through simulation and apply the novel approach on them.

Wireless technologies enable one or more devices to communicate without any physical connections. Flying Ad hoc Network (FANETs) [3] [4] have risen, which are systems constructed entirely of insignificant gadgets capable of communicating with Unmanned Aerial Vehicles (UAV) and other ground-based UAV-to-ground technologies. FANET can assume an essential job in crucial applications. In any case, these particular highlights implement a progression of rules to be considered for its proficient organization. FANET give network among flying hubs (e.g., UAV) to help different momentary applications and assignments [5]. Different UAV can be sent to fly over a focused on district and to perform observation, identification, and checking.

Machines also have finite energy, processing capacity, and computation. It uses IPv6 networks to link resource-constrained sensing devices to the internet in order to monitor and control them. As a consequence, secure connections between these devices are needed for IoT applications to succeed in the future. Not only does the attacker impact routing speed, but he also continuously injects fake information or sends unwanted packets into the network [6]. In terms of outsourcing storage, the cloud server manages enormous amounts of data on behalf of its customers (data owners). On the other side, a malicious cloud server may erase part of the client's data that is seldom visited in order to conserve space. Secure cloud storage protocols (two-party protocols between the client and the server) enable the client and the server to determine if the server interfered with the client's data. These protocols are categorized according to the kind of outsourced data as secure cloud storage protocols for static data (SSCS) [7] or dynamic cloud storage protocols for static data (DSCS) [8]. Following the first outsourcing, the client is unable to change her data for static data (e.g., backup/archival data). Because the consumer may modify its data as much as it wishes, dynamic data are broader. In IoT, the devices collect data dynamically.

II. RELATED WORK

The previous work done by various authors are discussed in this section. These approaches are very useful for developing any new approach.

Yuichi Inagaki, *et.al.* [11] Has been suggested Prioritization of Mobile IoT Data Transmission Using Machine Learning Model-Extracted Data Importance. Their suggested system is divided into two distinct components. Mobile IoT devices and an edge server Prioritize gathered data and transmit high-value input data for prediction to the edge server through mobile IoT devices (such as probe cars, smart phones, and UAVs). The edge server collects data from mobile IoT devices, fills in gaps in the data, and conducts predictive analytics. The machine learning model used in this approach has been developed in advance using all accessible data gathered by mobile IoT devices. This is a reasonable assumption given their work's goal of reducing the amount of data required as input for real-time prediction. Additionally, since training data collection is not time-sensitive, it may be done in the background through mobile networks during off-peak hours or via other communication networks with adequate capacity.

Drawbacks of research [11]: In this technique they not work to assigning priority of data so that further that work optimized based on priority assignment based transmission o edge server. They also not discuss the communication overhead.

Rajalakshmi Krishnamurthi, *et. al.* A Survey of Techniques for Processing, Fusing, and Analyzing IoT Sensor Data [12] The fundamental architecture of IoT sensor data processing, fusion, and analysis has been described in detail to illustrate the capabilities of each of these processes. Following that, the features of IoT sensor data were discussed, including their large size, heterogeneity, real-time processing, and scalability. The article discusses different methods for processing IoT sensor data, including data de-noising, missing data imputation, outlier identification, and data aggregation. Along with data processing methods, this article discusses the definitions and procedures of data fusion in IoT sensor-based networks.

Yawei Yue, , *et. al.* According to a survey of deep learning based security behavior analysis in IoT environments, deep learning has great promise in IoT environments [13]. This study focuses on the use of deep learning technology to the investigation of device security aspects in the context of the Internet of Things. Specifically, device profiling and fingerprinting using deep learning were addressed in detail.

Wei Wang and Min Zhang, Tensor Deep Learning Model for Heterogeneous Data Fusion in the Internet of Things has been suggested [14]. The tensor component decomposition technique is used in this research to extract high-level semantic characteristics from data. It is used to the tensor-based depth calculation model: the TDL model is a tensor-based depth calculation model for large data feature learning. Due to the fact that multi-source heterogeneous data describing the same ontology exhibit some correlation in terms of high-level semantic features and the data are extended from linear space to multiple linear space, the internal structure of the data, including the integrity of data features, can be preserved. The model for calculating the tensor depth is composed of a stack of several tensor automated encoders. Following that, we will discuss the TAE's fundamental concepts.

Aaisha Makkar, *et.al.* has been suggested A Machine Learning Based Technique for Efficient Spam Detection in IoT Devices [15], To prevent IoT devices from generating harmful data, this solution focuses on online spam detection. They examined a variety of machine learning methods for detecting spam emanating from IoT devices. The objective is to address problems with IoT devices installed in the house. However, the suggested approach takes into account all data engineering characteristics before testing it using machine learning models.

Mohammad Saeid Mahdavinejad, *et. al.*, Survey of machine learning for data analysis in the internet of things [16], Numerous IoT data analytics research are discussed in this article to solve this problem. Three things should be taken into account when using data analytic algorithms to smart data. The first is that various IoT and smart city applications have unique features, such as the number of devices and the kind of data generated. The second is that the produced data will have unique characteristics that need be taken into account. Thirdly, the taxonomy of algorithms is critical when it comes to applying data analysis to smart data.

Himanshu Sharma, *et. al.* Machine Learning in Wireless Sensor Networks for Smart Cities [17], In this paper, we performed a detailed survey of ML techniques in WSN IoT for the smart city challenges. From this survey, it was concluded that the supervised learning algorithms have been used with the highest amount, i.e., 61% as compared to RL at 27% and unsupervised at 12% only. The ML algorithms are so versatile and powerful that a single type of ML algorithm can be used for multiple tasks in WSN-IoT in smart cities.

Inam Ullah Khan, *et.al.*, Has been suggested Intelligent IoT Control-Based Nature-Inspired Energy-Efficient Routing Protocol for Flying Ad Hoc Networks (FANET) [18], Nature-inspired algorithms are often iterative in nature, which means they follow a path iteratively to the most optimal answer. Ants create new viable solutions with each repetition. This study proposes a novel meta-heuristics-based routing protocol to address the difficulties associated with current routing problems in flying ad-hoc networks.

X. Xu, et. al.[19] A cross-layer optimized opportunistic routing scheme for WSNs that are prone to loss and delay suggested an Optimized Opportunistic Cross-layer Routing scheme to increase the channel's stability and minimize delay by maximizing the transmitting capacity of the majority of nodes by utilizing the remaining network resources.

M. Ploumidis, et. al.[20] The article Flow allocation for maximum throughput and minimum delay on multiple discontinuous routes for multi-hop wireless random access networks addressed the issue of multiple flow allocation on various paths with multiple packet reception capabilities in random-access wireless. The issue is framed as a non-convex optimization problem, and a distributed flow allocation method is suggested to maximize average aggregate flow throughput and minimize packet latency. Due to the need for network reconfiguration, current systems fail to handle QoS-aware data distribution in next-generation wireless networks.

M.H. Hajiesmaili, et. al.[21] Dynamic rate allocation that maximizes utility under average end-to-end delay constraints. Proposed a maximizing algorithm for delay-aware dynamic network utility as a dual-based solution to the rate control issue for real-time streaming and video surveillance systems. The method seeks to aggregate the best network efficiency over a specified time period in a distributed way. There is a fundamental issue in real-time multimedia applications: how to identify a path that satisfies many restrictions.

III. PROBLEM DEFINITION

FANET nodes equipped with a high processing capability but a limited amount of memory. The sender forwards the hello messages to the next node to establish the connection, and the less flooding of hello packets, the lower the routing overhead and energy consumption. During the route selection stage, each node chooses a next-hop node based on its mobility metrics (i.e., the relative speed of nodes), selecting neighbor nodes with comparable mobility metrics. When there are multiple potential next-hop nodes, the farthest node is chosen to increase the possibility of link breakage, thereby increasing the end-to-end delay of packet transmission. Priority-based communication has a number of advantages over conventional communication in FANETs, as detailed in the network layer subsection. Apart from the advantages of conventional communication, it introduces novel design challenges, particularly at the network layer. To overcome the unique challenges of FANET, standard communication must be enhanced to eliminate unnecessary delay and overhead in a high mobility network.

• It is necessary for the development of a communication system that allows UAVs to communicate directly across long distances.

• In FANETs, where nodes are extremely mobile, determining their location and exchanging information is more difficult.

• Under adverse circumstances, the greater priority selection of UAVs presents a significant issue in terms of wireless connection reliability.

• Due to the high mobility and physical limitations imposed by a UAV, the link performance may be degraded.

• As a result of UAV movements and changes in FANET node distances, connection quality fluctuates quickly, resulting in link outages and topology changes.

The majority of schemes are centered on location information, however owing to the rapid movement of people, it is unable to provide a strong and integrated solution at the MAC layer.

IV. PROPOSED RESEARCH

Wireless communication technologies advance at a breakneck pace. Reduced-size UAVs are being developed with an eye toward greater integration with FANET applications. As a result, the security of networked communication between numerous UAVs and the ground station has become a critical job. Additionally, in order to successfully perform the complicated duties, the UAVs must maintain immediate synchronization with one another. A decentralized communication architecture is well-suited for FANET connectivity of numerous Unmanned Aerial Vehicles (UAVs) or Internet of Things (IoT) devices. This communication architecture may offer expanded coverage for data transfer due to its multi-hop design.

The priority decided on the basis of category like high(3), medium(2), low(1) and lowest(0). Priority table for type of data are mentioned in table1.

Priority base data transmission useful to delivery important data first which is crucial data for military like service. In our proposed system flying node deploy randomly in simulation environment. Out of n flying device m (m<n) node want to transmit data to base station with the help of intermediate UAVs nodes which is capable to handle route packet and treated as router in network, through the UAV to UAV based route are created and select shortest path with low energy required UAV node. After the route selection all source UAV use the application protocol as VBR, CBR and transport layer protocol as TCP, UDP as per requirement of UAV node. During the data transmission intermediate node decide which packet is higher priority and which is low priority and take decision to forward data to base station based on priority of data. Proposed data priority mechanism useful to utilized better channel of bandwidth constraint system and improve the QoS with respect to energy utilization, data receiving etc.

Table 1 Priority to type of data

Type (TCP or UDP)	Application layer (CBR or VBR)	Priority	Measures
TCP	VBR	High	3
TCP	CBR	Medium	2
UDP	VBR	Low	1
UDP	CBR	Lowest	0

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V. PROPOSED FLOW CHART

The step of step working of proposed High Priority Selection Messages (HPSM) for UAV (HPSM) scheme is mentioned in given flow chart.

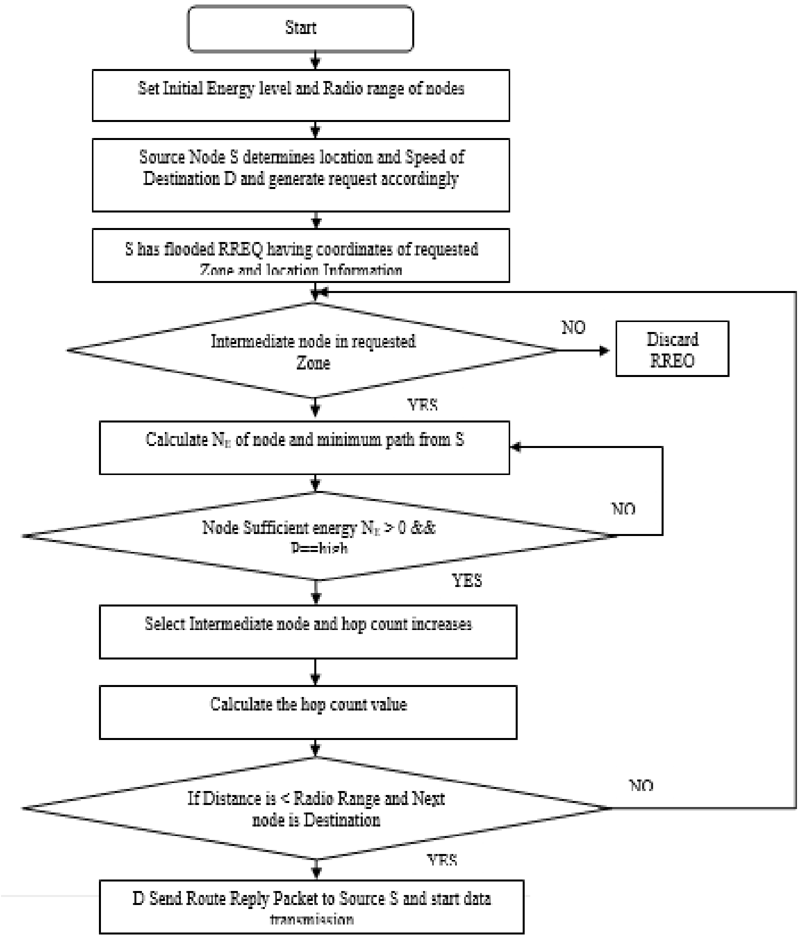

Figure 2: Flow Chart of Proposed Data Priority FANET

VI. EXPECTED OUTCOME

The performance of existing and proposed protocols simulated on the basis of:-

1. Simulation Time

Simulate the two protocols (previous and proposed) will done in simulation time of 200 seconds.

2. Mobility of nodes

In various mobility scenarios, the protocol's performance is evaluated at a maximum speed of 900 kilometers per second.

3. Unpredictable Mobility

In the case of random mobility, each node in the network travels at a different pace in the surrounding region, with the maximum speed being 900 km/s.

4. Varying Node Density

The network's node density is increased to examine the performance of routing protocols when there are more senders and receivers, as well as the impact of dense networks on energy usage.

To maximize the lifespan of network nodes and to improve the overall functioning of the network, the algorithm primary objective is to promote equitable energy conservation by evenly distributing sleep times across network nodes, thus providing nodes with an equal chance to save energy.

- Assisting routing algorithms in creating energy-fair routing choices
- For example, a little effect on network functioning results in minimal or no extra traffic or energy costs.
- Simulate and compare the proposed system's performance to that of a prior scheme. Performance Metrics like as throughput, routing load, energy consumption per packet, and energy drain rate are used to assess the network's overall performance.

In our simulations, we compare the proposed protocol against the current one using a variety of performance measures. The following metrics were compared:

- **Throughput:** The throughput of a receiver is the number of data packets received in a unit of time.
- **Packet delivery Ratio (PDR):** The ratio of packets sent by source nodes to packets received properly by matching destination nodes.
- **Average end-to-end latency:** The average end-to-end latency of data packets. The time difference between data transmission and reception in a network.
- **Normalized Routing Load:** The number of routing packets sent in exchange for each data packet supplied to the destination.

VII. CONCLUSION AND FUTURE WORK

Flying ad hoc network gaining popularity due to their versatile application in every area i.e. military, weather forecasting, tsunami, forest where direct communication not possible by mobile communication to take real time data. In this paper investigate about FANET architecture, devices, their constraint, nature, dependencies. Through the study also we found that various QoS improvement technique in FANET environment. In this paper we contribute proposed data priority based delivery system which helps to improve the network QoS system for important data to base station in heterogeneous UAV to UAV based communication. The proposed system in future simulate with the help of network simulator where source device take like IoT equipped devices and analyze their impact in terms of QoS parameters.

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