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A Data Transmission Technique Based On RSSI in an Ad-Hoc Network

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Abstract: *In this paper we are proposing an intelligent routing protocol that routes the data from a given source node and a destination node in an in the floor ad-hoc network. We have used Bluetooth as the medium of transmission. Our system works in two different ways depending on the size of the packet. There are some pre-defined paths for a set of source and destination nodes. If the packet size is smaller than our threshold value, the system follows the static and pre-defined paths. On the other hand, if the packet size exceeds the threshold value, then the system dynamically determines the path in runtime. It calculates the distance of the nearby nodes based on the Received Signal Strength Indicator (RSSI). After that, according to the distance calculated, it transmits the packet to reach its destination.*

Keywords: *Gossip Routing Protocol, Ad-Hoc Network, Received Signal Strength Indicator, Epidemic Data Collection Protocol, Bluetooth*

I. Introduction

The technologies we have used in our system are Gossip Routing Protocol and Bluetooth as the medium of transmission of data.

Gossip Routing Protocol

Gossip Routing Protocol is a communication protocol among computer systems mimicking the form of gossip seen in social networks. The protocol serves an easy way of communication among large networks, large scale distributed systems and is one of the most efficient ones in simplicity, scalability, and high reliability even in constantly changing environment. Moreover, in this approach each node forwards a message with some probability to reduce the overhead of the routing protocols.

Bluetooth

Bluetooth is a wireless technology standard for exchanging data over short distances and operates in the 2.4 GHz frequency band without a license for wireless communication. This communication protocol has primarily been designed for low-power consumption and low cost. This technology can be used for real-time data transfer usually between 10-100 meters which is reasonable within a small building. Moreover, the data-transfer rate of the Bluetooth Technology is quite acceptable i.e. 3-4 Mbps.

Ad-hoc network

The wireless ad-hoc network is used in our project. It's basically a decentralized, infrastructure-less network because it doesn't rely on a pre-existing infrastructure like the routers or access points. The nodes in this kind of network is completely dynamic. In this system, each node that participates in data transmission, dynamically determines the node to whom the data needs to be forwarded.

II. Motivation

In traditional Ad-Hoc networks, all the nodes are not always static. The existing routing protocols are based on the consideration that the nodes in the network are static and fixed. In the primitive stage we thought of a routing protocol which will consider that the nodes in the network are not static. The preliminary issue of the static routing protocol is in some cases the data may not be transferred because, one or multiple node in the static path are down. In that case the path will be broken. We took that in consideration and thought of designing a system that will dynamically determine the path in runtime. Moreover, to reduce the complicacy of the system, we introduced the gossip routing protocol in an intelligent way instead of maintaining a bulky routing table.

III. Methodology

Our system can be divided mainly in three sections. Firstly, we are routing the data in the network according to the previously mapped fixed distance between the nodes, without considering the fact that the nodes can be mobile and the actual distance may vary in runtime. Secondly to solve this problem we are

determining the nearest nodes from a particular node according to the Received Signal Strength Indicator. To determine the RSSI we have transmitted a fixed size packet to all nearby nodes with a request for responding back. According to the response time of each node, we are determining the RSSI. Thirdly, we are routing the data using that dynamically determined protocol to increase reliability. The elaborate and detailed description of those sections are followed.

a. Determining the path statically when the packet size is smaller than 1024 bytes:

Having the nodes fixed within a floor area, we have fixed co-ordinates of those nodes. We have built a map of the nodes. Using the pre-built map, we determined the paths manually and saved in the data structures we have used in our system. Now, once a packet is generated and it is to be sent to a destination node, we are searching for the pair of that particular source node and the destination node. A pre-defined will be fetched from the data structure that we have saved earlier. Now, according to that path, the packet is sent from source to destination node.

Step Algorithm:

The algorithm that is being followed for routing the packets in static path is described below.

Step 1 – The packet is generated at the source node.
Step 2 – The size of the packet is determined and checked with the threshold of 1024 bytes.
Step 3 – If the size of the packet is less than the threshold value, the system will determine the path statically and route the packet.
Step 4 –At each node a map of devices is maintained for static routing. In that map a fixed path is defined for a given destination node from that source node.
Step 5 – That path is fetched from the defined map and the transmission is initiated according to the path.
Step 6 – The packet reaches the destination node in the end according to that path.

Flow Diagram:

The following figure i.e. Fig. 1 represents the flow diagram of the process that is being followed to determine the path statically.

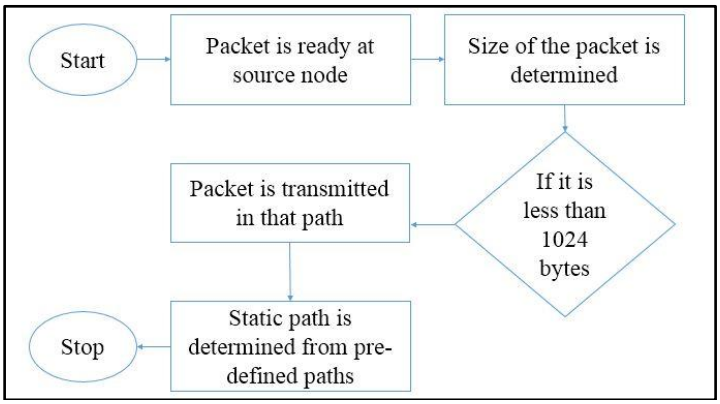

Fig. 1 – Flow diagram for determining the path statically from a pre-defined set of Paths given a source node and destination node

b. Determining the RSSI from time taken for transmitting a fixed size packet in different distances:

As we have proposed earlier that for the packets with a packet size of more than 1024 bytes, we will route the packet determining the path dynamically in the run-time, we need to find out the distance of the nearby nodes from the current node. We have designed an algorithm for calculating the distance. We have taken two things under consideration. Firstly, how the time taken for transmission varies with the increase of packet size. Secondly, how the time factor depends on the distance between nodes. Signal strength is directly proportional with the time taken for transmission. Now, according to the variation of the time taken by the nodes, we can determine the received signal strength. The following figure is showing our approach for determining the received signal strength indicator measuring the time taken by the nodes for transmitting a single packet.

Step Algorithm:

Step 1 – After the packet is generated at the source node, the size of the packet is determined.
Step 2 – If the packet size is more than 1024 bytes, the path will be routed using dynamic path determined in runtime according to the distance of the nearby nodes from that node.

Step 3 – To determine the distance received signal strength is calculated.
Step 4 – A request for response is sent to all the nearby nodes.
Step 5 – After receiving all the requests from all the nodes, the time is calculated individually for each node.
Step 6 – Then the distance is calculated according to the time taken and temporarily stored.
Step 7 – Sorting the distances we are selecting the node with minimum distance, i.e. the nearest node.
Step 8 – The packet is sent to the selected node.

Flow Diagram:

Fig. 2 depicts the flow diagram that is being followed for determining the received signal Strength indicator using the time taken for response.

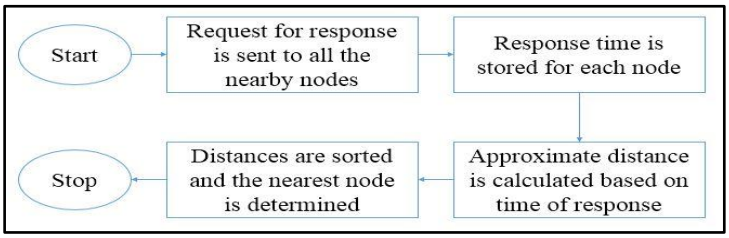

Fig. 2 – Flow diagram for determining the signal strength

c. Determining the path dynamically when the packet size is more than 1024 bytes:

As discussed earlier, our system is routing the packets having packet size of more than 1024 bytes using a dynamic path determined in the runtime. Now, when a packet is ready for transmission at the source node, it first sends a dummy packet with a request to response to the nearby nodes. Then it waits for the response to receive. After that, it calculates the time of response for each node and determines the signal strength in the method as described earlier. According the RSSI calculated, it determines the nearest node from itself and it sends the packet to the nearest node. The packet contains a flag showing whether it should be routed using a static path or a dynamic path. If it is dynamic, the next node follows the same process except the node from which it has received the packet. In this way, finally using the dynamic path, the packet reaches the destination node. Following flow diagram shows how the path is being determined in the run time.

Step Algorithm:

Step 1 –The packet is generated in the source node.
Step 2 – The size of the packet is determined and checked with the threshold value.
Step 3 – If the size of the packet is more than the threshold value, the packet is routed using the path that is being determined dynamically.
Step 4 – Now, distances are calculated from using the method described above.
Step 5 –According to the distances calculated, the node having minimum distance is determined, i.e. the nearest node.
Step 6 – The routing is initiated in dynamical method.
Step 7 – Following the steps the packet reaches the destination node.

Flow Diagram:

The following figure, i.e. Fig. 3 is showing the flow diagram that is being used for routing the packets with packet size more than 1024 bytes. The path for routing that packet is determined dynamically in run time.

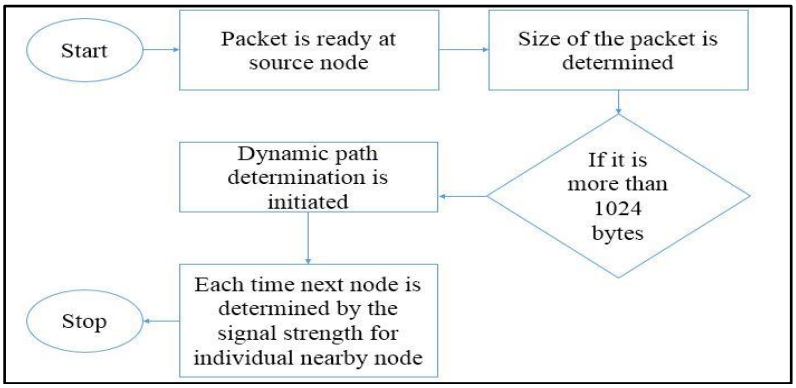

Fig. 3 – Flow diagram of the dynamic path determination

d. Data Structures

In our system we have used data structure stored in binary files to store the important information like the location of each node, or the static paths to be followed to reach any node. We have avoided the use of database to make our system lighter and more efficient. The following snapshot is showing one of those data structures.

```
{'time': 1.6299998760223389, 'size': 512}, {'time': 1.6299998760234401, 'size': 1024}
```

Fig. 4 – Data Structure we are using to store data

IV. Results And Discussion

The following figure i.e. Fig. 5 depicts the path that has been determined using static routing by our system, when the source node is mac2 and the destination node is mac40 and the packet size is 512 bytes.

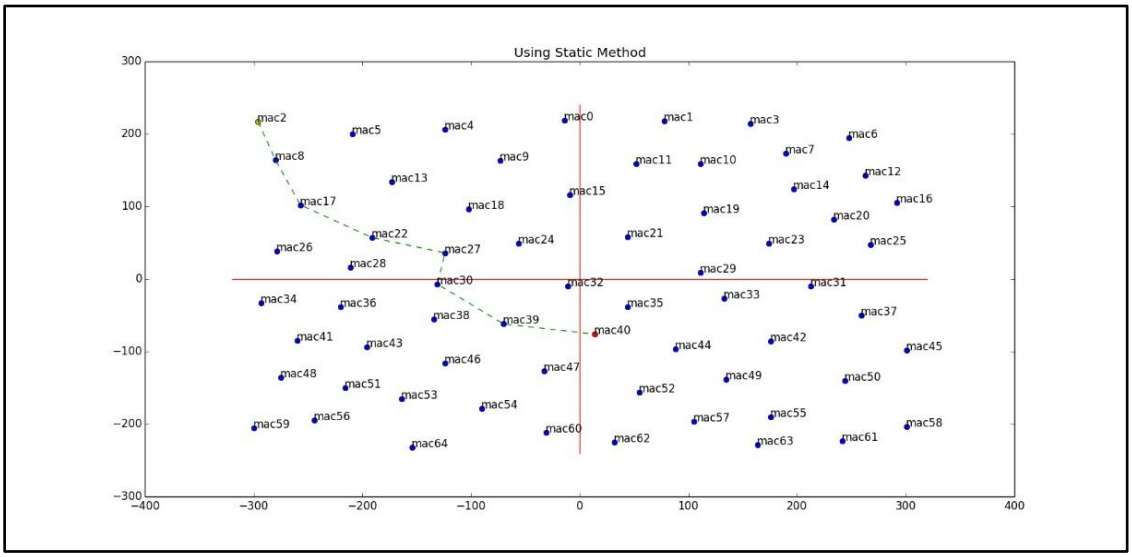

Fig. 5 – Shows the routing of data in static method when source node is mac2 and destination node is mac40 and the packet size being 512 bytes.

In Fig. 6 we are showing the path when the source and destination node are same as the previous one, i.e. mac2and mac40 respectively, but the packet size has been changed to 2048 bytes. Now, as the packet size exceeds our threshold, our system is routing the packet using dynamic routing. Thus, the path between two same nodes are different.

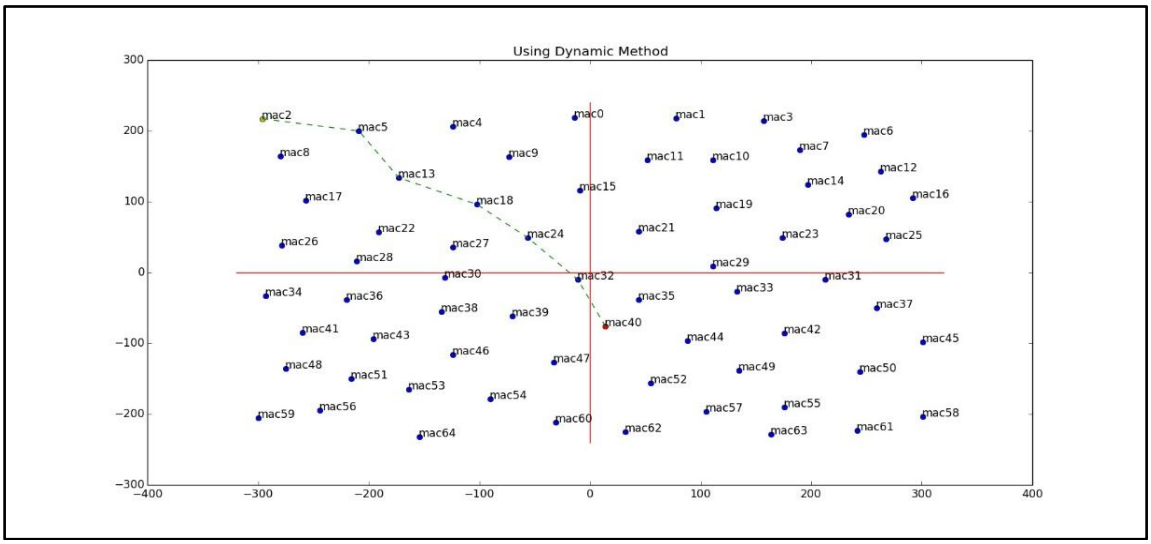

Fig. 6 – Shows the routing of data in dynamic method, when source node is mac2 and destination

Node is mac40 and the packet size being 2048 bytes.

Now as the above two pictures suggests, depending on the packet size, the method for routing the packets varies and so as the path. The static routing protocol has some disadvantages. As the paths are predefined, we cannot determine whether all the nodes are active or not. Now during transmission, if a node is down or inactive, then the path will be broken and the packet will not reach the destination. In the contrary, during dynamic routing we are checking the distances of the nearby active nodes. Thus, if a particular node is down, our system will be able to transmit the data successfully using dynamic routing protocol.

V. Conclusion And Future Work

Our system is working as per our expectation. The algorithms that was initially sketched upon papers with pencils using the mathematical formulas and concepts are working in a real life system. Moreover, we are still working in the system to make it further better. In future we will try to integrate this system with body area network and wearable system so that it can be used to ease our daily life burdens and tasks that we perform every day.

Acknowledgement

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