Algorithm Development and Deployment for Indoor Localization of Resources

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Abstract- In this paper we have proposed the system in order to track the resources in an indoor environment. This system provides solution for indoor location tracking of resources using WN (Wireless Network). We developed and deploy algorithm for indoor localization using WN. In WN system we place 'n' number of XBee S2C modules as fixed nodes to track movable node. Distance between fixed node and mobile node is estimate by using RSSI path loss model. Whole system based on Arduino Nano microcontroller. Objective of this study is development and deployment of algorithm for mobile node tracking system using RSSI and node ID'S to achieve less computation time for mobile node tracking.

Keywords- Location tracking algorithm, RSSI, Wireless Network (WN), XBee S2C.

I.INTRODUCTION

In industrial monitoring and location of resources tracking systems, Wireless Networks have become an important technology because of the various improvements, with comparison of other common technologies.

Wireless Network the abilities such as lowest power and time consumption, connection to the base station, data processing etc. are more improved. In order to obtain all these capabilities in nodes, such as power resource, data transmission and location tracking of mobile node some difficulties may be encountered. Localization is crucial for many services provided by wireless networks (WNs), which have received substantive attention in recent years. The Global Positioning System (GPS) consists of popular localization schemes, but usually fails to function indoors, under the ground and small area monitoring system. GPS devices cannot work.

In indoor and small area applications they are so big, and they are not reasonable about cost and are power consumption, while wireless network is required to be small, and low priced and low powered. The objective of this study is to investigate a localization of the distributed wireless networks in the indoor area with utilizing Tracking Using ID's (TRUI) algorithm. This algorithm based on Received Signal Strength Indicator (RSSI). In this system indoor location tracking of mobile system has been developed. Each room has one XBee S2C module to track mobile node, here we using RSSI to estimate distance between mobile node and fixed node. From that we can easily find mobile node location

There are many types of communication modules; we are using communication module to place fixed nodes to track mobile node as fast as possible. For that purpose module should have long communication range, good data rate, and works in different network topologies, large transmitting power. To select communication module configuration and testing in different topologies is more important part, from that results we can choose communication module. After selection of module our next step is choose compatible microcontroller for better communication. After selection of communication module and microcontroller next step is development of prototype board.

II. LITERATURE REVIEW

Author used pre-processing and post-processing method for indoor location tracking system. This technique based on received signal strength algorithm. IEEE 802.11 influences on the performance of RSSI based indoor location tracking scenario [1]. In another system RSSI and LQI (Link Quality Indicator) are used to estimate the distance in wireless sensor network (WSN). In this experiment they describe that RSSI is bad distance estimator, when using WSN in buildings due to reflections, scattering and another physical properties [2]. Researcher implements the RSSI based localization system. RSSI is used to estimate the distance between known and unknown target node, but it gives less accuracy in results [3]. Author proposes novel strategy for deployment of static sensor network based on the target motion probability model. Focus of this study is on the real time dynamic and optimal deployment of static network. In this system real time information about target node becomes available. This is based on probabilistic model for target motion. This strategy addresses the network coverage problem as well as obstacles in the network affects on tracking target node [4]. Researchers explain in this paper is, Device-free localization (DFL) with wireless sensor networks (WSN) is an emerging technology for target localization, which has received much attention in the area of Internet of Things. Received signal strength (RSS) measurement is the key to realize DFL and mainly affects the localization performance. Most existing approaches need to measure the RSSI of all the wireless nodes in Wireless Network, which is very much time consuming measurement process and large amounts of RSSI data, makes localization algorithm inefficient incase of object tracking. In this paper, author has used consecutiveness motion and presented an efficient strategy for measurement based on set of correlated wireless links. Intensity detection and so cannot be used to capture videos of both sides simultaneously [5].

III. PARAMETERS OF PROTOTYPE BOARD

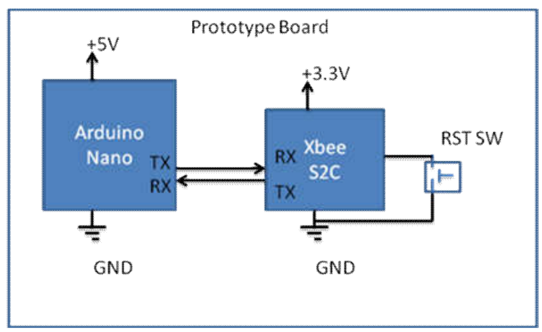

Fig.1 Prototype board

Above figure 1 shows the internal part of prototype board. It simply consists of Xbee S2C module and Arduino nano microcontroller operates on 3.3 V and 5 V respectively. From testing of ESP8266 Wi-Fi module and other Xbee series modules S1, S2, we select Xbee S2C series module to develop wireless network. We select the Xbee over other modules, because Xbee S2C module having more benefits than others. It works in different networking topologies, low cost, security specifications, having good transmitting range (40-50ft or 12m), good data rate (250 kbps) etc. Arduino nano is having same specifications as Arduino UNO. Prototype board operates on 5V power supply or batteries.

Table 1: Parameters of communication module

Data rate	250 kbps
Communication range	40-50ft or 12 m
Supply voltage	3.3 V
Frequency	2.4 GHz
Transmitting power	3.1 mW at normal mode
	6.4mW at boost mode
Transmitting antenna	Omni directional
Network topology	Star, Mesh
Power level	Low or medium

IV. CALCULATION OF REQUIRED FIXED NODES

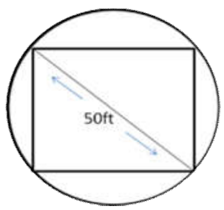

Fig.2 coverage area of single node

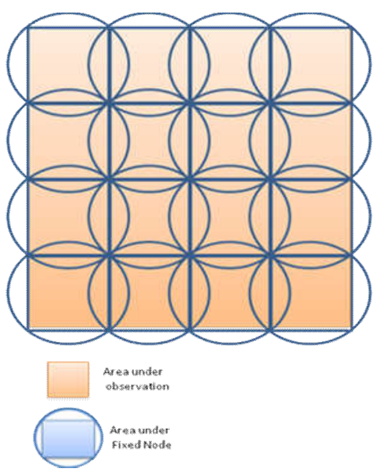

Fig.3 Division of Monitoring Area

Xbee S2C has a whip antenna which having donut shape radiation pattern. We have to place these Xbee S2C nodes as fixed nodes under monitoring area within each cell and a cell should be covered by 40-50ft or 12m area as shown in figure. For this setup we have to divide area into equal number of parts to calculate exact number of Xbee nodes. By using following formula we can select required number of nodes for particular (square or rectangle) shape of area.

$$Required\ No.of\ Node = \frac{Total\ Monitoring\ Area}{cell\ area}$$

By using this formula we can cover all monitoring area.

V. PROPOSED SYSTEM

The objective of this study is to deploy wireless network and development of algorithm for mobile node tracking. In this system XBee S2C has been used as communication module for development and deployment of algorithm for location tracking as well as path tracking. In this tracking system we use TRUI (Tracking Using ID's) algorithm which is based on node ID's and RSSI value of mobile node from fixed node. Using ID's we can trace path and exact location of mobile node.

a) System Implementation

Below figure 4 simply shows the whole proposed system to track unknown position of mobile node. In this system number of fixed nodes have been calculted from measurement of monitoring area.

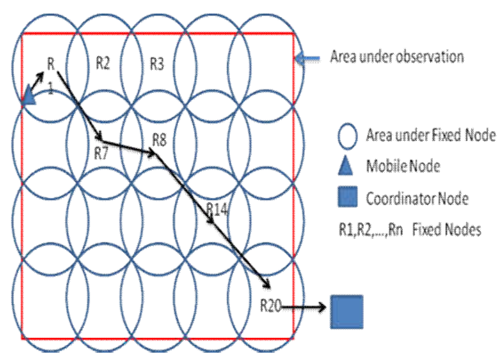

Fig.4 system implementation

To develop system we required minimum three numbers of fixed node to track exact position and path of mobile node nodes calculted from monitoring area.Above figure 4 shows the system implementation, in that we can see monitoring area under which nodes are placed to track target node and send through coordinator. For implementation setup we required some area under observation where we place fixed nodes and coordinator.

Above figure 4 shows the whole system which is based on TRUI scenario. When mobile node comes in to the observation area mobile node itself request neighbor table list by using ZDO (Zigbee Device Object) command. From that we get neighbor table (nearest fixed nodes in network). This ZDO command is more important in this algorithm becausedue to this frame mobile node displys it's neighbors very easily. After that mobile node send self ID to the fixed node which found in neighbord table list. At fixed node it calculate RSSI value with respect to mobile node and forward to the coordinator.

b) Configuration of XBee nodes on XCTU

XBee S2C having three types of devices, namely coordinator, Router and End device, as per devices we deploy Xbee in Mesh topology to track target node. After this selection of parameters testing of Xbee in point to point, star and mesh networking topologies are carried out. While testing of Mesh topology three nodes has been placed or deploy at 40 to 50 ft long from each other. In mesh topology every Xbee S2C needed to be set same PAN ID and channel for successful communication. We configure router and end device to route the data frames. In our system these terms fixed node, mobile node and coordinator has been used to create network.

c) TRUI Implementation:

Following constraint are decided for the system:

- Each Fixed Node must be in range of at least one other fixed node.
- The fixed node has assign a Fixed Node ID (FNID) manually while installation at site.
- Coordinator node must be in range of at least one Fixed Node.
- All fixed node are configured as Router.
- Mobile node is configured as Router too.
- Coordinator in TRUI is configured as Coordinator in Xbee network.
- Mobile node has assigned Fixed ID.

At Mobile Node:

The mobile node in this system is initialized. Once the initialization is done the mobile node searches for the neighbor table using the ZDO commands. In response to the neighbor table request ZDO command, we get all the active neighbors in range of the mobile node. Then the received response is analyzed and neighbors present entry table is generated. Then Mobile node transmit it's self ID to the all neighboring Fixed Nodes.

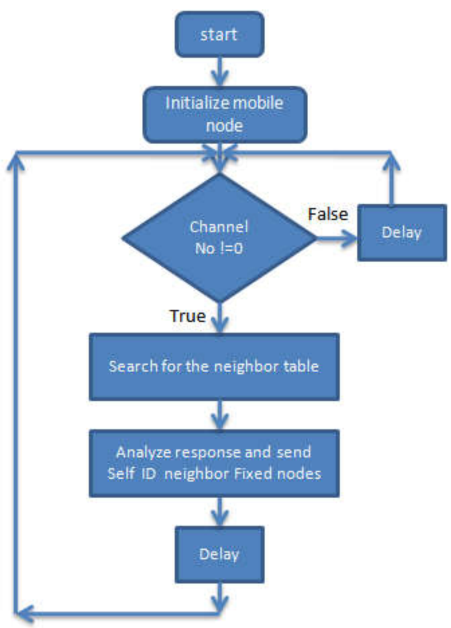

Fig. 5: Algorithm flowchart at the Mobile Node

At Fixed Node:

The fixed node in this system waits for the frames from the mobile node. Once frame is received, it analyzes the frames. The sender mobile node ID is decoded from the frame. Along with this Fixed node request the RSSI value of the last received packet. The decode Mobile Node ID and the RSSI of the corresponding packet is then forwarded to the Coordinator.

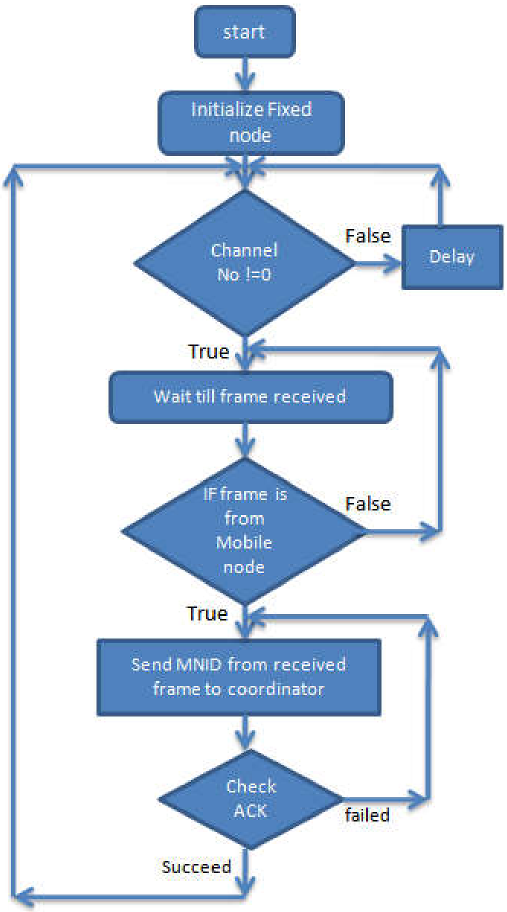

Fig. 6: Algorithm flowchart at the Fixed Node

At Coordinator:

The coordinator here is the data collector. It receives all the frames transmitted by the Fixed Nodes in the deployed system. All the other data frames are ignored at the coordinator. The frame transmitted by the Fixed Node consists of the Fixed Node ID, Mobile Node ID and the RSSI value corresponding to the pair. The coordinator decodes this information from the frame received. Coordinator waits for frames from the at least three different fixed nodes to corresponding mobile node. As the frames from the three different fixed nodes are received it goes for the distance calculation corresponding to the each RSSI received. Here we have used long distance path loss model for the distance estimation. once the distances are calculates the decision is taken, that which node is nearest to the mobile node. Then next task is to maintain the path history of the Mobile Node. Nearest node is added to the path history only if the last entry is different. This leads to the elimination of the repeated redundant entries. once the entry is done path tracked by mobile node is displayed at the terminal by coordinator.

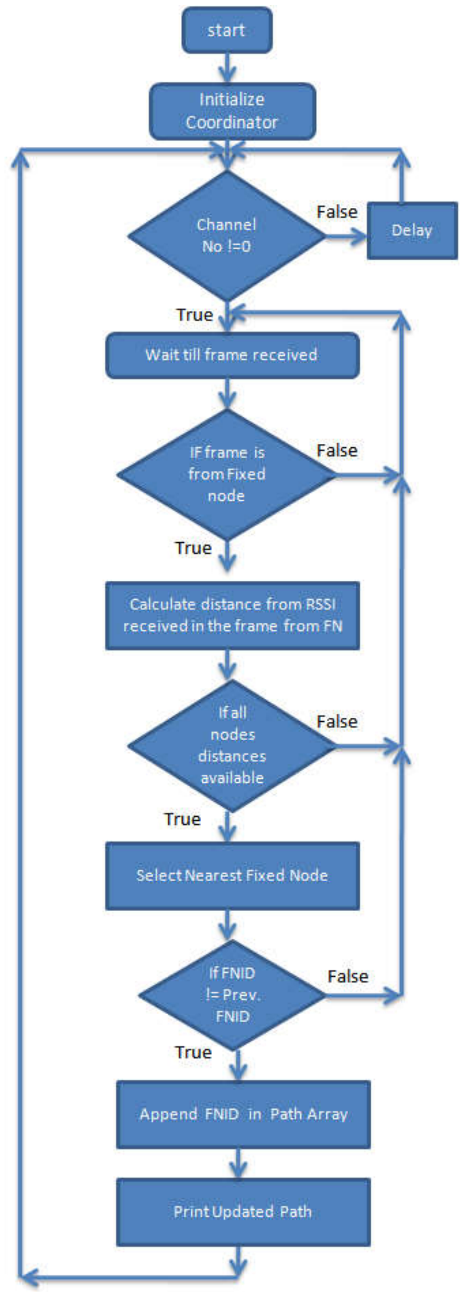

Fig. 7: Algorithm flowchart at the Coordinator

V. RESULTS

In this system we can use 'n' number of nodes but here we use five nodes. one for coordinator three for fixed nodes and one for mobile node.

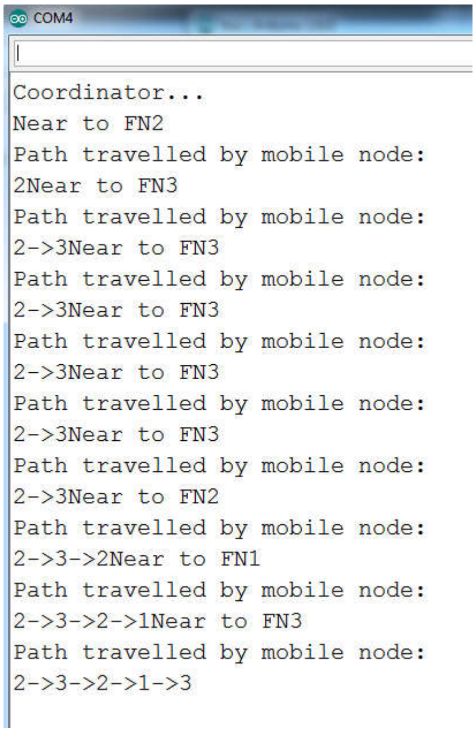

Fig. 8: Results at Coordinator.

The system is deployed and tested in the 1bhk flat. Fixed nodes were places 1 in each room and the mobile node was travelling along the flat. The coordinator was placed in the balcony in order to minimize the interference.

We can see the path tracking results in fig.8 as the mobile node changes its position.

VI. CONCLUSION

The implementation of TRUI algorithm is completed and tested on developed prototyped board. The testing was carried out with one Mobile node, three Fixed Nodes and one Coordinator Node. The successful tracking of the Mobile Node is demonstrated. References

VII. REFERENCES

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