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# Real Time Crowd Tracking Using Wireless Ad-Hoc Network

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Abstract - *This paper uses wireless network as a medium to track people in a limited closed environment without the internet connection using their existing mobile phones. This technology can be used in a scenario where a huge crowd of people are to be tracked along with their location coordinates with reference to a stationary point in the environment known as the Hub. The technology used is wireless mesh networking, where a string of devices connect to each known as nodes. Here, each device is a node which communicates with other nodes. The Hub is also a node whose location coordinates is known to the tracking server. Locations of the nodes are sent with reference to the nearest Hub via other nodes. Numerous Hubs are connected to each other there by forming a mesh network of themselves, which are in turn connected to the server. It uses Wi-Fi on the mobile to let it communicate with the other nodes directly. This makes it particularly useful in areas where the internet and GPS are restricted or unavailable. This technology is superior to the RFID tracking mechanism in many ways regarding cost, set-up, tag collision and range. This technology can be used for real time tracking with partially accurate location coordinates which is not possible using RFIDs.*

*Key Words: Tracking, wireless tracking, crowd tracking, real time tracking*

## 1. INTRODUCTION

Real-time location systems (RTLS) [1] are used to track and identify the location of objects in real time using

A. "Nodes" or "tags" attached to, or embedded in the objects tracked [2]

B. "Readers" that receive and process the wireless signals from these tags to determine their locations [2]

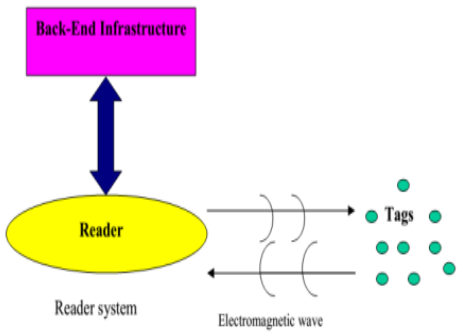


Fig -1: RFID System

RTLS systems may perform passive or active (automatic) collection of location information of an object in real-time in a given physical space. RTLS systems use radio frequency (RF), optical (usually infrared) or acoustic (usually ultrasound) technology. Fixed point transmitters and receivers known as Tags may use a combination of these technologies. Location information usually does not include speed, direction, or spatial orientation.

RTLS are by and large utilized as a part of indoor and/or confined areas, for example, buildings, and don't give worldwide scope like GPS. RTLS tags are fastened to mobile things to be tracked and reported. RTLS reference points (transmitters or receivers) are installed at various locations to provide consistent tag coverage. As a rule, the more RTLS reference points that are introduced, the better the area precision, until the technological barriers are reached.

## 2. SHORTFALLS OF EXISTING RFID SYSTEM [3]

A. RFID Reader Collision: Reader collision is caused when the signals from 2 or additional readers overlap. The tag is unable to reply to synchronous queries. Hence, tags can only be read in an

 

environment where the readers are isolated from one another.

B. RFID Tag Collision can only be read in a serial manner based on a queue system to avoid collisions.

C. Real time monitoring: Since, the tags need to be near or under the tag reader for tracking; real time tracking of these tags may not be possible if mobility is to be achieved by an object containing the tag. The tags need to be under a specific coverage area of the readers. Hence, Real Time Tracking only up to a certain level is possible.

## 3. ARCHITECHTURE OF A TYPICAL GPS BASED RTLS SYSTEM [4]

Major constituents of the GPS based tracking are:-

A. GPS tracking device: The GPS unit is a device that uses the Global Positioning System to determine the precise location of an object under observation. It transmits location details to a remote system at specified intervals. The GPS module contains the GPS module to send and receive signals to a navigation satellite and calculate the coordinates using techniques like Triangulation.

B. GPS tracking server: The tracking server does the task of receiving and storing the information from the GPS module and serving it to the required user or system.

C. User interface: The UI helps to view, manage and analyze the information recorded. Data can be shown in the form of mathematical graphs and charts to make information easier to visualize and recognize patterns.

## 4. APPLICATIONS OF REAL TIME LOCATION TRACKING SYSTEM (RTLS)

A. Vehicle tracking: Vehicles can be outfitted with Radio Frequency (RF) or Global Positioning System (GPS) units to allow tracking and recovery.

B. Fleet management: Knowing the real-time location of all drivers allows management of a fleet of cars a taxi company and so by serving the passenger with the nearest vehicle in a minimal amount of time thereby saving both money and time.

C. Transit tracking: Tracking of assets transported from one place to another can be tracked at each pick up or delivery point.

D. Stolen vehicle recovery: Vehicles with inbuilt GPS unit can be tracked real time in the case of theft of the vehicle.

E. Cattle monitoring: Cattle tracking allow the farmers to monitor the movements of livestock throughout the landscape, plot grazing patterns and see what areas the livestock have been depleting nutrients in the soil. Farmers utilize real-time GPS tracking to keep an eye on livestock have the ability to monitor spatial movements and spatial activities, information that can provide multiple benefits.

F. Prisoner tracking: Monitoring and locating prisoners inside the prison perimeter or while on parole can be done efficiently via GPS tracking.

## 5. PROPOSED SYSTEM

'Real Time Crowd Tracking' is a system that allows to track crowd of people using their existing mobile devices without any additional 'Tags' or 'Readers' required. It uses the inbuilt wireless technology to create a mesh network of devices. These devices called as 'nodes' connect to each other rather than connecting to a central server directly, thus forming a Wireless Ad-Hoc network [5]. Location coordinates are tracked by 'Hubs' installed at various locations. Locations of the nodes are sent using 'Multi hop' technique to the hub via neighbor nodes.

Location coordinates of the nodes are determined using hubs whose location are known in advance and are fixed. Signal strength of each node from each other neighbor node is sent to the central server which uses 'Triangulation' and 'Fuzzy Logic' to calculate the location of each node with reference to the hub.

### 5.1 MESH COMMUNICATION [6]

The communication between the nodes takes place in 2 scenarios.

A. Intra mesh communication: Communication within a specific set of nodes in a single mesh network.

 

B. Inter mesh communication: Communication between 2 or more mesh networks each having a specific set of nodes.

### 5.1.2 INTRA MESH COMMUNICATION

Intra mesh communication takes place when s set of nodes within the same mesh network form an ad-hoc network and exchange data.

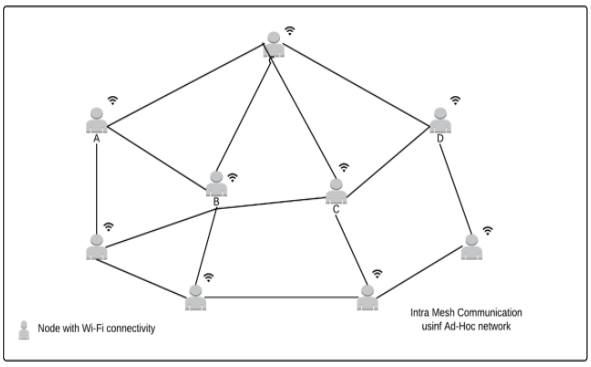


Fig -2: Intra mesh communication using ad-hoc network

Here, each node is connected to every other node via their neighboring nodes. Communication between non-connected nodes takes place via Hopping [7]. Communication between node A and node D takes place as follows:-

i. Node A sends data to node B.
ii. Node B sends data to node C.
iii. Finally, node C sends data to node D.

### 5.1.3 INTER MESH COMMUNICATION

Inter mesh communication takes place when nodes belonging to 2 different mesh networks transfer data among each other. Inter mesh communication using a hopper node takes place when a node belonging to a mesh network leaves the current network and joins another network thus transferring data from one network to another.

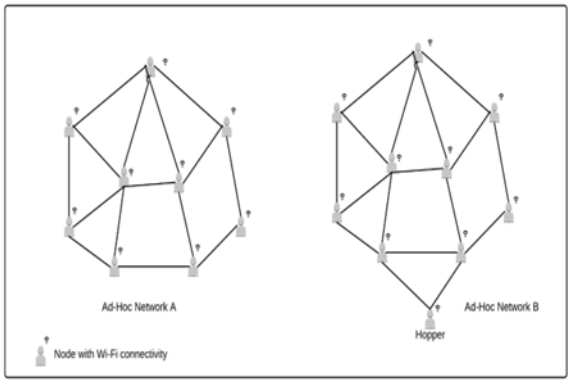


Fig -3: Hopper node connected to Network B

Communication from Network B to Network A takes place as follows

i. Hopper node connected to network B exchanges data with other nodes in a normal fashion. Hopper node is completely unaware of its transition from network B to network A.
ii. Whenever, the hopper node moves away from the network B, it gets disconnected from the network. A node needs to be connected to at least 1 other node to be involved in a network.

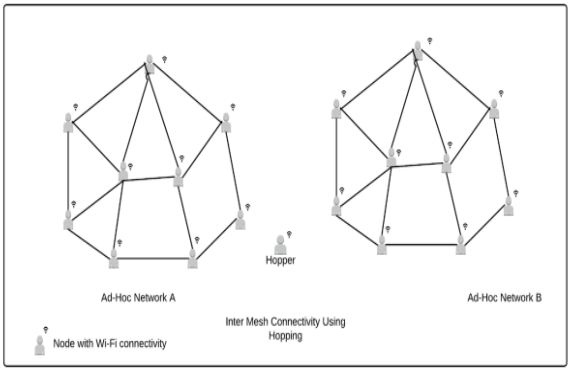


Fig. 4: Hopper node disconnected from a network

iii. The hopper nodes further moves away from the previous network and remains disconnected there by halting it's communication with any other node.

iv. The hopper node keeps searching for other networks in its vicinity.

 

v. On coming under the coverage of another network and their nodes, the hopper node instantly connects to the new network.

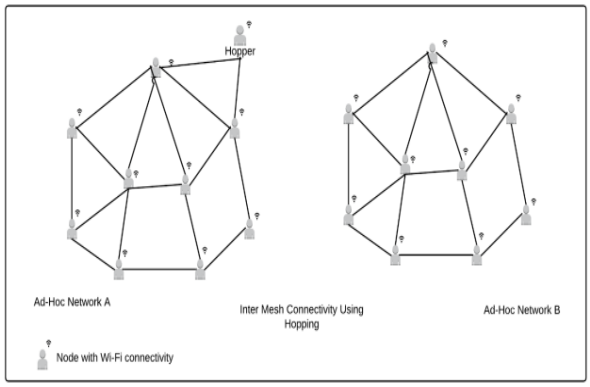


Fig -5: Hopper node connected to Network A

vi. The hopper node then transfers the node data of the previous network to the nodes of the new network.

Thus communication between 2 different networks takes place using a hopper node which keeps moving and participating in different network activities. This forms the basic technique for sharing location data among other nodes which may be spread out in different locations, connected to a different set of nodes thereby forming their own ad-hoc network.

## 6. CONCLUSIONS

In this paper we have studied the problem of tracking Mobile objects using RFID and GPS technology.
We proposed a hybrid system for achieving high efficiency in object tracking using the existing frameworks and technology which are easily scalable. The system thus provides a novel but simple solution to real time crowd tracking.

Our future work includes implementing and validating the proposed system.

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