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Directional Location Finding of Intelligent Tags

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Abstract**-- Finding the location of a TAG is very important especially when objects to which the tags are attached are to be tracked. Tracking of the objects is a complicated process especially when there is fall down of the objects in the unknown places during airline crashers, atmospheric disasters etc. The objects must be tracked accurately, just finding the distance of an object from a master mobile device is not sufficient. It is also necessary to find the location of the object in relation to directions (North, North- East, West, South-West etc.,) in addition to the distance of the object from the master (hand held mobile device) accurately. In this paper a novel method has been presented using which the location of an object can be accurately determined.**

I. INTRODUCTION

Location management system is used to find the location of lost objects. Any object localization system is generally based on mobile phones. Mobile phones combine very useful features: They are omnipresent in environments in which users live and are at the same time inter-connected by a homogeneous world-wide infrastructure. Some important objects can be augmented with an electronic TAG such that they can be detected when brought into the vicinity of a mobile phone. Many new applications become possible revolving around managing, monitoring, or locating everyday items.

Several wireless technologies such as RFID, IR, Bluetooth, Wi-Fi, Hi-Fi, and NFC are used for locating the intelligent Tags in the vicinity of the Master device. GPS have become world-wide known over the last few years. GPS is able to show one's position on the Earth, mainly in outdoor locations. GPS satellites, 24 in all, orbit at 11,000 nautical miles in geosynchronous orbit above the Earth. They are continuously monitored by ground stations located worldwide. GPS receivers are cheap but the downside is that the line of sight to a satellite is needed. The usage of the GPS systems has to be explored to locate the TAG and make the HOST know exact location of the TAG.

Various hardware devices could be employed for object Tagging and sensing. For example, RFID Tags are attached to various consumer products for tracking the valuable assets. The issue of identification of the Tags arises in many of the applications that include prison monitoring, child safety, indoor gaming, security, health care etc.

Efficient TAG location identification system is required for the users of the Tags to locate them with ease.

Several wireless technologies and methods are in existence for location tracking. These location technologies are used for locating the intelligent TAG in the vicinity of the master device. Some of the methods include Received Signal Strength Indicator (RSSI), GPS, GPS tracking unit etc.

The intelligent Tags can communicate with the handheld device by using different kinds of communication methods and generally uses different types of signals of various strengths. It is quite possible that intelligent Tags which are not related to a particular mobile device may interfere with signals released by the intelligent Tags that are directly related to a mobile device. Some of the major issues that must be considered so as to affect the identification of the TAG with the mobile device include the following:

1. Choices of appropriate location management method that help identify the location of a particular TAG uniquely with the Mobile Phone when several Tags are in communication with the Mobile device.
2. A TAG identifying its own location accurately with the Mobile device in the presence of attacks.
3. To address the issues like Accuracy, Cost Efficiency, Reliability, Simplicity and Scalability

The most important issue related to location management system is accuracy. The location management system should perform efficient object locating. Using the accurate method for object locating, the system users meet their needs for high level application. The location management system has to be designed and implemented under consideration of cost efficiency. Depending on the number of objects of interest, the requirement and available location technology can be varied.

The location management system has to perform exactly under harsh and practical conditions. Thus, the system must carry out robust and reliable performance against many environmental factors. The localization system should be implemented simply in the monitoring area. Thus, better localization system should be applied and implemented within an application with less intervention.

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The location management system should be easily expanded for large monitoring area with constant performance. Depending on the requirement of application, the location management system can be expanded to larger area, and the expanding process should consider simple and easy construction of system infrastructure. An intelligent TAG management system involves communication between a TAG and a handheld device and many other functions. Out of all, the most important function of the system is to locate the position of the Tags which are attached to user related objects.

A TAG can be located with reference to longitude and latitude, angle and distance from a reference point with a XY plane, and geometrical distances using co-ordinates within the XY plane. The most relevant way of locating an intelligent TAG is through angle and distance from the reference point. Several technologies are available using which the angle and distance can be measured. In a typical TAG management system many of the Tags shall be operating in the same neighborhood and therefore forms an interference network, thereby effecting the identification of the location of the TAG. Angle and distance from a reference point along will not give the exact location of the object. The directions also are equally important to locate an object most accurately.

II. Related Work

A method for localizing stationary and mobile objects by using only RFID-based technology [1] as the Radio signal properties such as power-distance relationships can ascertain these locations. Various indoor positioning techniques have been proposed [2] which uses Infrared, Ultrasonic and RF technologies for position fixing within indoor areas. These systems use wireless concepts, optical tracking or ultrasonic techniques. Object detection and tracking is the basis of many applications in surveillance and activity recognition.

There are many solutions developed for position estimation of indoor or outdoor objects. Many positioning systems with different architectures to determine the location of objects have been presented. The position fixing systems proposed have different accuracies, configurations, and reliabilities. Some of the position fixing systems that are being used include GPS [**3**], AT&T Cambridge Ultrasonic Bats [**4**], Microsoft Research's Wave LAN system [**5**], Active Badges, [**6**], Smart Floor from Georgia Tech [**7**], Radio Tags, Computer vision systems, and cellular phone based systems.

[**8]** have presented general overview of GPS systems which include most popular Indoor positioning systems using infrared, ultrasonic and RSSI techniques together with Computer vision, cell phone and Integrated RFID positioning systems.

Tracking of a user position in both indoor and outdoor environments can be undertaken [9] by using a single wireless device with minimal tracking error. RSSI (Received Signal Strength Indication) technique together with enhancement algorithms is proposed to cater this solution. The proposed RSSI-based tracking technique is divided into two main phases, namely the calibration of RSSI coefficients (deterministic phase) and the distance along with position estimation of user location by iterative trilateration (probabilistic phase). A low complexity RSSI smoothing algorithm is implemented to minimize the dynamic fluctuation of radio signal received from each reference node when the target node is moving.

The main aim is to track a user position in both indoor and outdoor environments with a minimal tracking error by incorporating a radio location device which uses IEEE 802.15.4 standard. The device possesses a location estimation capability via Received Signal Strength Indicator (RSSI). This method computes distances based on the transmitted and received signal strengths between blind node and reference nodes. Blind node, which is embedded within CC2431 location engine, will collect signals from all reference nodes responding to a request, reads out the calculated position and sends the position information to a monitoring application.

The system consists of a set of static reference nodes at preset coordinates, and a blind node carried by the mobile target. Blind node broadcasts signal to the reference nodes nearby and reference nodes reply by sending their coordinates and RSSI values at that distance back to the blind node. Blind node then selects the best eight highest RSSI signals (from -40dBm to -95dBm) to be dispatched to the base station, which is connected to a laptop, using RF transmission from CC2420 radio chip. Refining algorithm and estimation of blind node's position are implemented in the base station after the reference nodes' RSSI data ($RSSI_i$) and position information (X_i, Y_i) are received. Estimated position is continuously updated and visually represented on a monitoring application. The position information can be accessed remotely from other personal computer (PC) via Wireless LAN. And also he discussed about the deterministic phase and probabilistic phase.

In this he proposed location estimation algorithm having 4 steps which include Input phase (receive debug text from CC2431 i.e.; ($RSSI_i$, X_i, Y_i)), deterministic phase (calculate the 'n' value), and probabilistic phase (Estimate the distance between the blind node and the reference node) and last phase is the position estimation (X_E, Y_E). By iterative trilateration the position estimation of the target node is made.

An alternative design and a proof-of-concept prototype of object locators based on the RFID technology **[10]** has been proposed. An object locator is a device designed to assist its user in finding misplaced household and personal objects. A locator contains an interrogator with several buttons of different colors and a TAG of the each color matching the color of the each button. By attaching a TAG to an object to be tracked, the user can look for the object by pressing the button of matching color on the interrogator. The TAG attached to the object beeps and flashes in response and thus enables the user to find the object. Various scenarios of implementation have been explained. Three designs related to RFID based object locators and a proof-of-concept has been implemented. The reader collision problem encountered while developing the prototype and the solution for the same have also been presented.

High availability of handheld devices with Bluetooth technology that allows users to be located with sufficient precision for offering context-sensitive services has been proposed [11]. Scalable architecture for indoor positioning based on Bluetooth sensors have been designed and implemented. Distance from sensors is estimated at different cyclic power levels, while a centralized positioning system collects data sent through an adhoc network formed by the sensors themselves. During the development of the project, it has been realized that the design of complex architectures based on sensor networks is not linear (top-down, or bottom-up), but it is a holistic process, where all aspects must be considered together. Unfortunately GPS or GSM based positioning systems do not work well indoors.

A system has been proposed [12] for monitoring and locating everyday items using mobile phones. The system is based on phones which are enhanced with the capability to detect the electronically Tagged objects in their vicinity. It supports various functionalities: On the one hand, the phones can store the context in which users leave registered items and thus help to locate them later on. On the other hand, object owners can search for their objects using the infrastructure of mobile phones carried by other users.

The algorithm used for object location can be used to search for lost or misplaced objects efficiently by selecting the most suitable sensors based on arbitrary domain knowledge.

The mobile phone system provides a unique opportunity to overcome these difficulties. Sensing technologies can be embedded into mobile handset devices or accessed from the handset via short-range wireless communication. Wide-area communication is a core property of the cellular network. It enables the integration of data from many sensors and the support of applications with backend services such as data storage and dissemination.

Accurate tracking of objects in the range of meters to hundreds of meters which has widespread application has been proposed [13]. A review of the methods which calculate the position of a remote object based on electromagnetic radiation from the radio to light frequencies has been presented. The methods discussed include: manual triangulation, time of flight, time difference of arrival and angle of arrival. For each method a description is given of the calculations and the equipment that is used and the advantages and disadvantages are stated. A discussion is presented that provides the detailed methods for tracking multiple objects, and the suitability of using wireless electronic devices for positioning. Today the applications for accurate positioning are wide and varied. Examples include: personal navigation, smart weapon guidance, location of nodes in a distributed sensor network, tracing the origin of emergency calls made from mobile phones, and locating the positions of emergency locator beacons. Due to this wide range of applications, many methods of position tracking have been proposed to suit the requirements of a particular task.

A method for finding the lost items for the visually impaired has been proposed [14]. They have presented the design and evaluation of a mobile solution, called FETCH, for allowing the visually impaired to track and locate objects they lose frequently but for which they do not have a specific strategy for tracking. FETCH uses devices the user already owns, such as their cell phone or laptop, to locate objects around their house. Through an iterative process, they have designed a mobile solution for aiding the visually impaired in quickly and easily tracking and locating objects. The system, called FETCH (**F**inding **E**verything using **T**echnology **C**onvenient and **H**andy), is completely mobile and uses Bluetooth-enabled Tags similar to key fobs and a Bluetooth-enabled cell phone or laptop with screen readers.

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The Tags emit an audible beep and work within a range of 30 meters, a range large enough to find an object anywhere within a house, apartment, or office.

A method has been proposed [15] for locating a TAG in both indoor and outdoor environments with a minimal tracking error by using Bluetooth, WI-FI standards. A device connected to the embedded board possesses a location estimation capability via Received Signal Strength Indicator (RSSI). A method has been proposed that computes distances of the TAG between blind and reference nodes, thereby estimating exact location of the TAG. Software architecture has also been proposed [16] that can be used for development of "Location finding software" using which the distance of the TAG from a reference and blind positions can be computed.

III. Directional Location Management Method

The basic process for tracking an object by using the mobile phone is shown in the **Figure I**. The ID numbers of all the Tags are stored in a mobile phone and the user can choose the Tag ID for finding the location of the Tag. The requirement of knowing the Tag location is transmitted to the TAG using either Bluetooth or Wi-Fi interface. The ES software resident on the TAG side read the Longitude and latitude through GPS systems and direction and angle through Gyro attached to the embedded systems through USB interface. The distance of the TAG with a reference location is read through received signal strength (RSSI). The received signal from the reference object is compared with expected signal strength to find the correctness of the received strength. The distance is computed based on the strength of the signl received from the reference object. The Tag transits the Longitude, latitude, distance, direction and angle of incidence ti the HOST where the details of the location of the TAG are displayed.

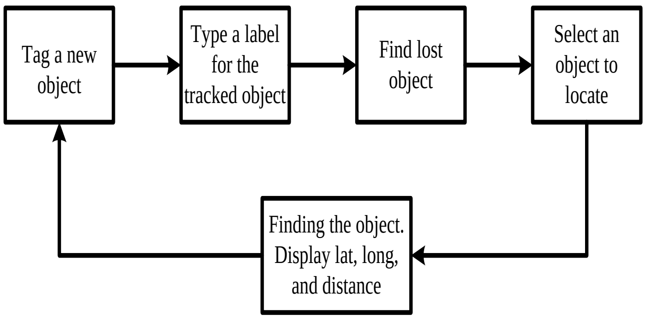

Figure I: Location Tracking System

Various mobile devices and sensor nodes such as the BTnode are equipped with Bluetooth radio transceivers. Because of the read range of about 15 m, they are not precise enough to consider just the reachability of the sensor nodes as in the RFID-based approach. Thus, for positioning, received signal strength indications (RSSI) are used because the RSSI value decreases with distance between sender and receiver. As the distance between sender and receiver increases, also the received signal strength decays.

The Bluetooth, WI-FI device possesses a location estimation capability via Received Signal Strength Indicator (RSSI). This method computes distances based on the transmitted and received signal strengths between blind nodes and reference nodes. Blind nodes, which are embedded within the intelligent tag, will collect signals from the reference node responding to a request, reads out the calculated position and sends the position information to a monitoring application.

The system consists of a reference node at present coordinates, and blind nodes carried by targets. Blind nodes broadcasts signal to the reference node nearby and reference node reply by sending their coordinates and RSSI values at that distance back to the blind nodes (shown in below figure). Blind node selects the best eight highest RSSI signals (from -40dBm to -95dBm). Estimation of blind nodes positions are implemented, after the reference node RSSI data ($RSSI_i$) and the position information (X_i, Y_i) are received. Estimated position is continuously updated and visually represented on a monitoring application. The arrangement is sown in the Figure II.

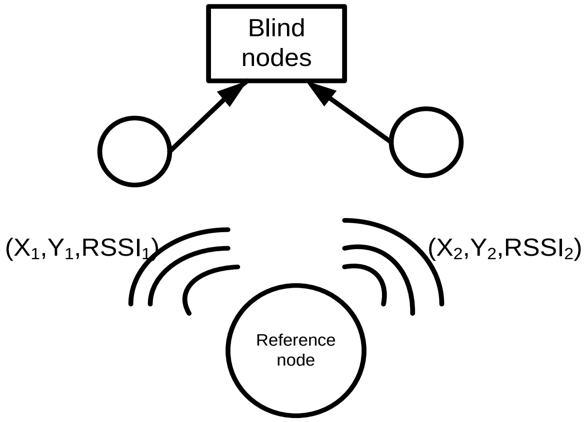

Figure II: System Architecture for Finding the Position Information

The position information can be accessed remotely. For calculating the distance estimation the following formula is required.

$$\text{RSSI}=-(10n\log_{10} d + A)$$

Where n is the signal propagation constant, d is the exponent which is the distance from sender and A is the received signal strength at 1 meter distance. A series of calibration shows that uniform computation of signal propagation constant is required in order to determine the distance according to signal strength. This is verified with different mediums (free space, glass, and wall) surrounding the reference nodes which affect the signal attenuation differently. Different single propagation constants are used for different reference nodes to avoid distance miscalculation.

IV. Experimentation For Directional Location Finding

GPS module is connected to the PC using UART1 /RS 232 interface using which the longitude and latitude of the object are obtained. The Bluetooth module is interfaced to UART 0. **Figure II** shows the ARM7 LPC2148 board interfacing the Bluetooth and GPS modules. The gyro is connected to USB interface which read the directions and the angle of incidence within the directions.

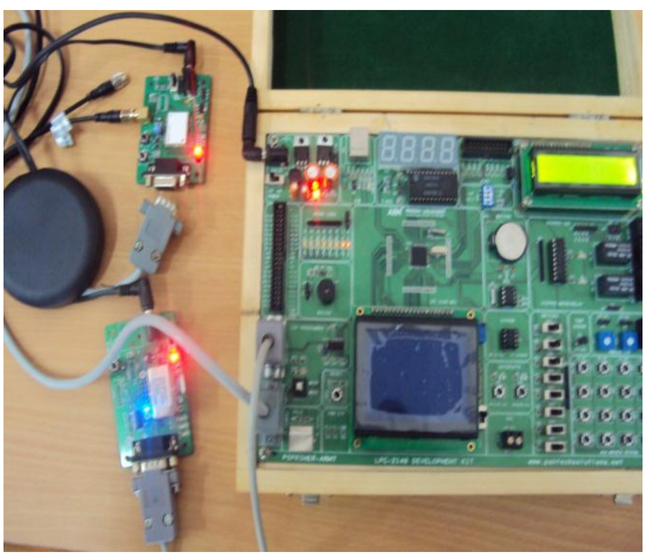

Figure II ARM LPC2148 Board Interfacing Bluetooth and GPS

The GPS module receives the data from the satellite and the output is displayed on the LCD and the data is sent to the mobile phone through Bluetooth or Wi-Fi.

By using GPS, the longitude and latitude of the object can be found. The details of the location as displayed on the Tag side and on the mobile phone are shown in the figure III.

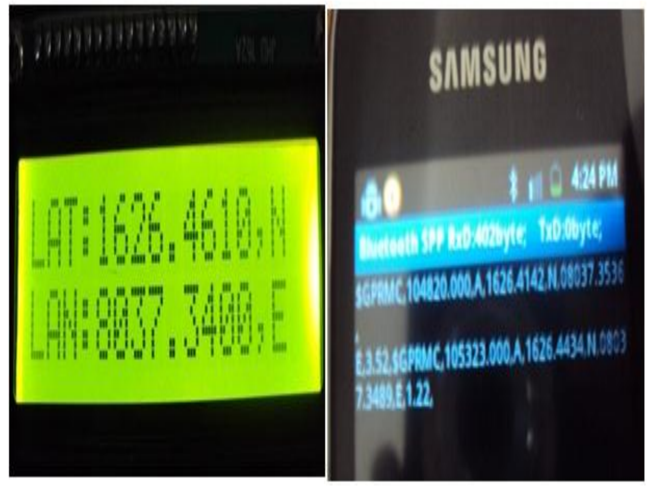

Figure III. Locating Tag using GPS and Display Values on Mobile

For the purposes of conducting the experiment the mobile device has been positioned at one known location. The Tag is fixed at some other location and the distance measurements are made and tabulated as shown in the **Table I.** The Tag is moved in relation to its fixed position in different directions and the expected and computed distances are tabulated. It could be seen from the Table that the computed and expected distances are very much in the neighborhood and therefore the method adopted for computing the location of the tag is proved to be correct. A gyro connected to the embedded system gives the directions considering East, West, South and North and the angle of the object with reference to the directions. The computations related to Angle and distance to a reference position and angle with reference to the direction will give exact location identification of the Tag. The positioning of the tags for experimenting is shown in the Figure IV.

V. Conclusions

Most important issue that must be built into an intelligent TAG is the ability of the TAG to find its location in relation to a reference point especially when the Tag is moved from one location to the other. Many techniques are available to identify the location of the TAG from the mobile side. The choice of location finding technique must consider the factors that include accuracy, cost efficiency, reliability, simplicity, and scalability.

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Exact location of an object can only be known through distance, angle and direction. The Angle and direction are measured from a reference point. The location of the object can be known with the help of longitude using a GPS system and the distance is known from a reference point and the direction of the object and the angle of incidence with the direction can be obtained through Gyro.

REFERENCES

[1] Kirti Chawla and Gabriel Robins, 2011, "An RFID-based object localization framework", Int. J. Radio Frequency Identification Technology and Applications, Vol. 3, Iss. 2, Pg. 20-28

[2] Hakan Koyuncu, Shuang Hua Yang, 2010, "A Survey of Indoor Positioning and Object Locating Systems" IJCSNS International Journal of Computer Science and Network Security, Vol. 10, Iss. 5, Pg. 300-310

[3] Starlink Incorporated, 1999, "DGPS Explained", http://www.starlinkdgps.com/dgpsexp.htm

[4] R.Want, A.Hopper, V. Falcao and J. Gibbons, 1992, "The active Badge location system", ACM Transactions on Information systems, Vol. 40, Iss. 1, Pg. 91-102

[5] P. Bahl, V. N. Padmanabhan, 1999, "User Location and Tracking in an In-Building Radio Network", Microsoft Research Technical Report: MSR-TR-99-12,

[6] Harter A and A. Hopper, 1994, "A Distributed Location System for the Active Office", IEEE ,Network

[7] Robert J. Orr, Gregory D. Abowd, 2000, "The Smart Floor: A Mechanism for Natural User Identification and Tracking", GVU Technical Report GIT-GVU-00-02 (full paper)

[8] John Krumm, Steve Harris, Brian Meyers, Barry Brumitt, Michael Hale, Steve Shafer, 2000, "Multi camera lti-person tracking easy living", Third IEEE International Workshop on Visual Surveillance

[9] Erin-Ee-Lin Lau, Boon-Giin Lee, Seung-Chul Lee, Wan-Young Chung, 2008, "Enhanced RSSI-Based High Accuracy real-Time User Location Tracking System for Indoor and Outdoor Environments", International Journal on smart sensing and intelligent systems, Vol. 1, Iss. 2, Pg. 534-538

[10] T. S. Chou and J. W. S. Liu, 2007, "Design and Implementation of RFID-Based Object Locator", "Institute of Information Science, Academia Sinica, Technical Report No. TR-IIS-06-014",

[11] JKR Sastry, N. Venkataram, Ms. P Sahithi Ramya, L.S.S Reddy, 2012-3, "On Locating Intelligent TAGS" IFRSA International Journal of Electronics Circuits and Systems, Vol. 1, Iss. 2

[12] JKR Sastry, N. Venkataram, Ms. P Sahithi Ramya, 2012-4, "Software Architecture for Implementation of Location Management in Intelligent TAGS", International Transactions on Electrical, Electronics and Communication engineering, Vol. 2, Iss. 3

[13] F. Forno, G. Malnati and G. Portelli, 2005, "Design and implementation of a Bluetooth ad hoc network for indoor positioning", Software, IEEE proceedings, Vol. 152, Iss. 5, Pg. 234-242.

[14] Christian Frank, Philipp Bolliger, Friedemann Mattern, Wolfgang Kellerer, 2008, "The sensor internet at work: Locating Everyday Items using Mobile Phones", Pervasive and Mobile Computing, Vol. 4 Iss. 3 Pg. 421-447

[15] Timothy T J Brooks, Huub HC Bakker, Ken A Mercer, Wyatt H Page, 2005, "A Review of Position Tracking Methods", 1st International Conference on Sensing Technology, Palmerston North, New Zealand

[16] Julie A. Kientz, Shwetak N. Patel, Arwa Z. Tyebkhan, Brian Gane, Jennifer Wiley, Gregory D. Abowd, 2006, "Where's My Stuff? Design and Evaluation of a Mobile System for Locating Lost Items for the Visually Impaired", Assets, ACM proceedings.

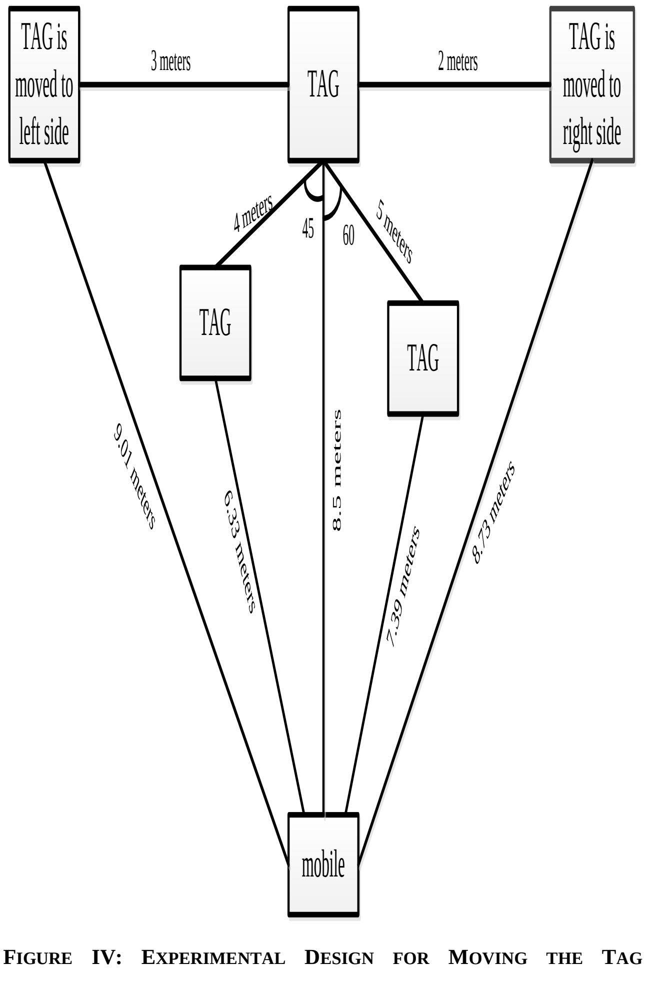

FIGURE IV: EXPERIMENTAL DESIGN FOR MOVING THE TAG

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TABLE I
EXPERIMENTAL RESULTS

Serial Number	Tag ID	Mobile ID	Operation	RSSI measurement	GPS Measurement		Gyro reading		Actual Distance In Meters	Expected distance In Meters
				Distance in meters	Longitude	Latitude	Gyro Direction	Gyro Angle		
1	15	12	In the Position	8.27	E23	N55	NE	127	8.50	8.50
2	15	12	Move two meters right horizontally	8.44	E25	N59	NE	132	8.73	8.73
3	15	12	Move three meters left horizontally	8.71	W32	N61	NW	277	9.01	9.01
4	15	12	Move 45 degrees with four meters to left	6.24	W18	S44	SW	323	6.33	6.33
5	15	12	Move 60 degrees with five meters to right	6.94	E21	S49	SE	87	7.39	7.39