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Electronic Identification System using RFID

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ABSTRACT:
In this modernization Era and rapid growing metro cities, security is must in every field. This work describes a location and the identity of the persons using RFID (Radio Frequency Identification) tags and readers. RFID is an automatic identification (auto-ID) technology that uses tags and readers for remotely storing and retrieving data. RFID reader can sense (identify) persons, animals, vehicles and goods by interrogating transponders tagged on them. From this perspective, RFID Reader, Reader Network is a Sensor and Sensor Network that is context-aware, respectively. However, only sensing is not enough in many scenarios. Hence this work also proposes a tracking algorithm such as coined Virtual Route Tracking (VRT), to realize tracking persons or objects in RFID Reader Network.

I. INTRODUCTION

RFID is a generic technology concept that refers to the use of radio waves to identify objects. Any object can be traced using RFID tags when those objects are moving in the network of RFID readers. The RFID Reader Network here consists of densely deployed RFID Readers which are connected by short-range wireless technologies in ad hoc mode. Consequently, an RFID system essentially consists of three parts: the RFID tag itself, the RFID reader device and a backend IT system. For example, in school area the RFID network is deployed by using Virtual Route Track algorithm. Using this algorithm, the system can real-timely track the location of the students who are moving within the premises.

RFID – (Radio Frequency Identification) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder.

RFID tags can be passive, active or battery-assisted passive. An active tag has an on-board battery and periodically transmits its ID signal. A battery-assisted passive (BAP) has a small battery on board and is activated when in the presence of an RFID reader. A passive tag is cheaper and smaller because it has no battery; instead, the tag uses the radio energy transmitted by the reader. However, to operate a passive tag, it must be illuminated with a power level roughly a thousand times stronger than for signal transmission. That makes a difference in interference and in exposure to radiation. RFID systems can be classified by the type of tag and reader. A Passive Reader Active Tag (PRAT) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only).An Active Reader Passive Tag (ARPT) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags. An Active Reader Active Tag (ARAT) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal. RFID system has six different frequency bands. These are 120-150 KHz (LF), 13.56 MHz (HF), 433 MHz (UHF), 865-868 MHz, 2450-5800 MHz (microwave), 3.1–10 GHz (microwave).

II. SYSTEM OVERVIEW

Figure.1 shows, an active RFID system, active RFID readers are typically connected by physical cables for data communications purposes. Active RFID systems have also been implemented using a Wi-Fi-based infrastructure. Using P2P network architecture we will get a more flexible active RFID system.

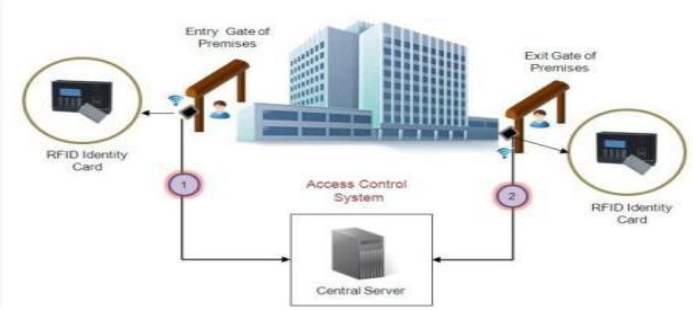

Figure 1. System Overview

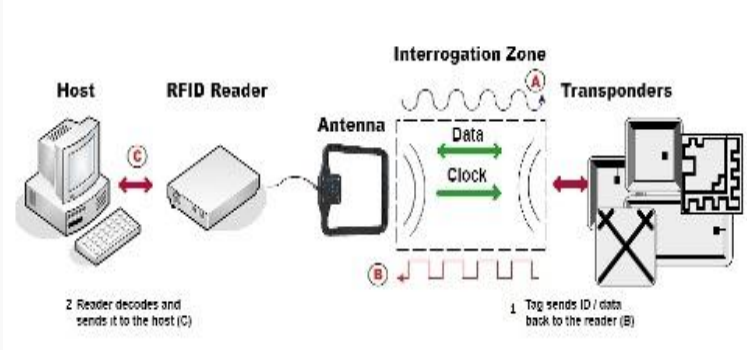

Figure 2. System Architecture

Figure. 2 demonstrate the system architecture of the RFID-based location system makes use of a 2.4GHz. This architecture includes major elements such as mobile, active tag, reader, node (reader), and server. A tag is a 2.4 GHz active tag, which is attached to a tracking object. Each node is an active RFID reader that communicates with the tags and the server. Using this architecture and virtual route track algorithm the location of the person can easily get track. Architecture helps the system with implementing the use of Wi-Fi technologies so that when the person get track by the RFID, the location of the person get updated on the server. This technology is used for contacting end users (PARENTS) i.e. for sending messages to the parents. System Network protocol stack consists of Application, TCP, IP, WI FI Driver, Physical layers. In Transmitting a message travels down the stack from the application layer that initiates the message to the network interface that places the message on network. In receiving message travels up the stack from the network interface to application layer that uses the data in received message. Within local network the application layer communicate directly with the WI FI driver.

2.1. VIRTUAL ROUTE TRACK PRINCIPLE

The Virtual Track algorithm is presented in Figure.3. The basis of VRT algorithm is that the debriefing range of RFID system is very short compared to the distance between readers. Instead of powering the RFID transponder directly by battery, it gets power through magnetic, electric and electromagnetic coupling with RFID readers. One or more batteries are embedded for Active transponders. However, the embedded battery only provides power to run chips, and data are transferred from transponder to reader by modulating on reflected electromagnetic waves emitted by RFID reader, like the ways of Radars. Thus, the RFID system can achieve a very short range varied from a few millimeters to several meters.

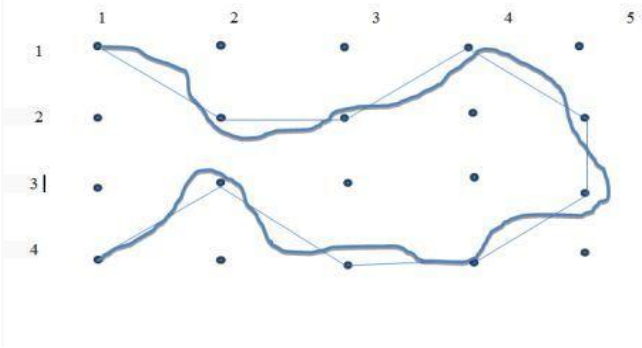

Figure 3. VRT Principle

On the contrast, the range of wireless technologies used to connect RFID readers is large. For example, ZigBee or UWB can connect two readers within 10 meters, and Bluetooth or Wi-Fi is effective at the distance of 100 meters. Therefore, when a transponder is sensed by a reader i.e. the transponder is located in the interrogation zone of this reader; the real distance between reader and transponder is less than the range of the RFID system. When the scale of the RFID Reader Network is large enough and the distance of deployed readers is relatively long, VRT algorithm is very accurate.

The above figure3 indicates the RFID network in which the points denote the RFID reader and the lines from one point to other point denote the path in which direction object is moving. The figure3 is in the form of matrix. When an object is moving from reader (1, 1) to reader (2, 2) the straight line considered as track of the transponder. In the above figure the object is moving following direction. The thick path denotes the actual path of the object and the virtual line is defined as the track of the object.

Track = Virtual Route = (1, 1)→(2, 2) →(2, 3)→ (1, 4)→ (2, 5)→ (3,5)→

(4, 4)→ (4, 3) →(4, 2) →(4, 1)

When a reader interrogates one transponder, the next reader interrogating it along the track MUST be adjacent to the previous reader. According to the figure 3, it is obvious that the transponder at (2, 3) cannot jump to (2, 5) directly without activating reader (1, 4), (2, 4) or (3, 4). Hence, the next reader of (2, 3) along the track MUST be one of following readers: { (1,2), (1,3), (1,4), (2,2), (2,4), (3,2), (3,3), (3,4) } Hence, VRT algorithm MUST choose adjacent readers along the track. If two successive readers along the track are not adjacent to each other, special mechanism will be executed to guarantee that each reader along the track is contiguous to its last and next reader in real-word position. The virtual line connecting readers in figure 3 looks like a Route transferring data packets along the nodes. The route is not real in this so named as "Virtual Route". In VRT algorithm "Virtual Route" is used to stand for track of transponder in the RFID Reader Network. And that is why this algorithm is coined Virtual Route Tracking (VRT).

Furthermore, the concept of Tracking Vector (TV) is used here [1]. In the collection of tracking information and calculating the track the tracking vector plays a vital role. The combination of the transponder identity, the interrogation time and the identifier of reader define as a Tracking Vector. The structure of TV is: (Ti, tj, Rk) = < Transponder i timestamp j Reader k > Here, the transponder identity is a global unique number (such as EPC global number) stored in the electronic chip of each transponder and interrogated by reader. Timestamp is the interrogation time of RFID reader when the transponder entering its interrogation zone. Here the assumption is that all RFID readers in RFID Reader Network are synchronous. And only one tracking vector is generated no matter how long a transponder stays within the interrogation zone of one reader. The third parameter in tracking vector is the identifier of the reader. VRT algorithm uses the position of readers to track transponders. It is noted that successive selected readers are all adjacent to each other and therefore can form a Virtual Route, therefore, reader identifiers of two successive Tracking vectors MUST stand for two contiguous readers in real network.

2.2 TRACKING VECTOR ALGORITHM

The tracking calculation is as given. Suppose the following two TVs are sent to RFID Application System simultaneously.

$$\{ \langle T1, t1, R1\rangle \quad \langle T2, t2, R2\rangle \} \qquad (t1 < t2).$$

The former reports that the reader with the identifier R1 has interrogated transponder T1 at time indicated by timestamp t1. And the latter is the result of the reader R2 interrogated the transponder T2 at time indicated by timestamp t2. If T1 is equal to T2, two Tracking vectors are derived from the same transponder. Suppose t2 is greater than t1 and two readers are adjacent to each other, Virtual Route (or the track) is: Track = Virtual Route = R1 → R2. However, the above is merely the simplest and ideal condition of tracking. The generalized conditions are given as follow.

$$\begin{cases} T1=T2 & \begin{cases} t1<t2 & R1 \leftrightarrow R2 \\ t1=t2 & R1 \infty R2 \\ t1>t2 & R1=R2 \end{cases} \\ T1 \neq T2 & \end{cases} \quad (\leftrightarrow : \text{Adjacent}, \infty : \text{Not Adjacent})$$

When transponder T1 is equal to T2, these two TVs are derived from one single transponder and should be classified into the same vector group to calculate the track of this transponder. Otherwise, they are classified into different vector groups for tracking transponder T1 and T2, respectively. About timestamp, when t1 is less than t2, it is simply. And if t1 is greater than t2, exchange the sequence of two tracking vectors and it is exactly as same as the above condition. The relationship of two readers can be grouped into three categories: Adjacent, Not Adjacent and Equality. It is simply to calculate the condition that reader R1 is adjacent to R2. However, the condition that R1 is not adjacent to R2 and the condition that R1 is equal to R2 require a more complex processing method.

III. SYSTEM IMPLEMENTATION

The figure 4 shows the interfacing of Raspberry pi b+. The whole system is implemented by using Raspberry pi b+ and Nordic nrf24L01. The connection between Raspberry pi b+ and nrf24L01 is shown in figure 4 and the connection detail is shown in table 1.

Figure 4. Interfacing of Raspberry pi

Figure 5. System Implementation using Raspberry pi

Figure.5 shows the one reader and one tag connection by using router and one to one connector. The connection of Raspberry pi b+ and nrf24L01 works as a reader as well as tag also.

Following table1 represents the interfacing of the pins of raspberry pi b+

Table 1Raspberry pi Interfacing Pin Details

Radio 7(miso)	Gpio9/bcm21
Radio 6(miso)	Gpio10/bcm19
Radio 5(sck)	Gpio11/bcm23
Radio4 (csn)	Gpio7/bcm26
Radio3 (ce)	Gpio25/bcm22
Radio2 (3.3)	3.3v
Radio1 (gnd)	Gnd

IV. CONCLUSION

This System describes the concept of location tracking and updating the location using RFID system which is based on the Virtual Route Track algorithm. System can easily track the location of the object. It helps in keeping Security as its top priority.VRT algorithm can track tens and hundreds of transponders simultaneously, instead of only one each time. This helps in time saving and managing multi task as required. VRT is both effective and efficient in real network. System provides the advance tags and readers to work fast and efficiently "Electronic Identification System" is going to reduce the crimes and will provide security and information to parents as well as the society.

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