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Device tracking using Ultrasonic Sensor By passive RFID tags

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Abstract: -Contrivance-free object tracking provides a promising solution for many localization and tracking systems to monitor non-cooperative objects, such as intruders, which do not carry any transceiver. However, subsisting contrivance-free solutions mainly use special sensors or active RFID tags, which are much more extravagant compared to passive tags. In this paper, we propose novel kineticism detection and tracking method utilizing passive RFID tags, denominated Twins. The method leverages an incipiently observed phenomenon called critical state caused by interference among passive tags. We contribute to both theory and practice of this phenomenon by presenting an incipient interference model that precisely expounds it and utilizing extensive experiments to validate it. We design a practical Twins predicated intrusion detection system and implement an authentic prototype by commercial off-the-shelf RFID reader and tags. Experimental results show that Twins is efficacious in detecting the moving object, with very low location errors of 0.75 m in average (with a deployment spacing of 0.6 m).

Keywords: -Raspberry Pi board, passive RFID tag, Ultrasonic Sensor.

1. INTRODUCTION

Wireless sensing systems have been accommodating as a core component of critical in restructures and industrial control systems recently. Typically, they are built upon sensors and control units for control and aegis of a physical infrastructure. Authentic-time sensing plays a paramount role in cumulating the computational and physical worlds together for these industrial applications. One of the fundamental tasks of a wireless sensing system is to detect and track intruders to ascertain the safety of lives and properties. Since intruders are uncooperative objects, they are infeasible to be bound with categorical contrivances. Consequently detection of contrivance-free intruders is a core requisite of an automatic anti-intrusion system. Categorical sensing contrivances, such as the passive infrared (PIR) sensors, sonic sensors, and video camera sensors have been utilized for contrivance-free kineticism detection and tracking. However, these solutions incur paramount cost concerns. Recently, Radio Frequency Identification (RFID) has become

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a promising technique for contrivance-free intrusion detection. An RFID reader may observe and analyze signal changes of pre-deployed tags to infer the kineticism of an intruder. RFID predicated kineticism detection is a captivating solution due to the convenient and cost-efficient deployment of RFID tags in physical environments. In fact, RFID tags have been widely applied to identification and monitoring tasks in industrial control systems for applications already, including logistics, inventory, and retailing. Reusing the subsisting RFID infrastructure further preserves the cost of an authentic-time kineticism detection system. However, subsisting RFID-predicated kineticism detection methods in the are mostly predicated on active tags, which are less ubiquitous and much more extravagant than passive tags. Subsisting passive tag predicated kineticism detection methods are contrivance-predicated and not congruous for intrusion detection. Meanwhile, many of them require customized contrivances. To the best of our cognizance, the most recent contrivance-free object tracking system utilizing passive tags is Twins. The conceptions of Twins are derived from the following observation. The mutual interference between two physical immediate readable tags caused by coupling effect will make one or both of them unreadable, which is called the critical state. The two coupled tags are denominated twins. If one object kinetically circumnavigates the twins, it will cause extra RF wave reflection to the tags such that unreadable tags may accumulate adequate puissance, and thus be able to backscatter their replications. In this way, the Twins system can report a nearby kineticism via the state shift from unreadable to readable. In this work, we present a precise and Efficient Kineticism Detection System for contrivance-free objects utilizing an infrastructure constructed by passive tags.

2. RELATED WORK

Subsisting System

The subsisting RFID-predicated contrivance-free techniques conventionally work in clear or semi-clear spaces (i.e., empty spaces or spaces with very few objects), and none of them are authentically tested in clustered residential environments, especially in a multiple-room scenario. In integration, most RFID-predicated localization techniques are predicated on the postulation that kenning the tags' coordinates in advance, which is impractical in authentic-world applications (accurately locating the tag's position is a time-consuming and challenging task itself). Besides, many state-of-the-art RFID-predicated systems (e.g., [10], [8], [5]) heavily rely on ideal propagation models of RF phase or RSSI, which may not be feasible in a full-furniture residential room where affluent multi-path reflections and frequent electromagnet interference subsist (e.g., turning on/off electronic appliances in a [6], [7]. To tackle these challenges

Proposed System

We propose a general Bayesian-predicated probabilistic framework that provides a way to feasibly fuse HOI events with RSSI signals to enhance the tracking performance. Concretely, for a multiple-room scenario (including two bedrooms and a kitchen), HOI Loc can achieve average 95% localization precision and 58cm tracking error, offering about 1.3×, 1.86× and 2.86× amendment compared with Twins [4], Tag Track [5] and SCPL [2]

3. IMPLEMENTATION

Raspberry Pi board

Raspberry Pi is a credit-card sized computer manufactured and designed in the Amalgamated Kingdom by the Raspberry Pi substructure with the intention of edifying rudimentary computer science to school students and every other person fascinated with computer hardware, programming and DIY-Do-it Yourself projects.

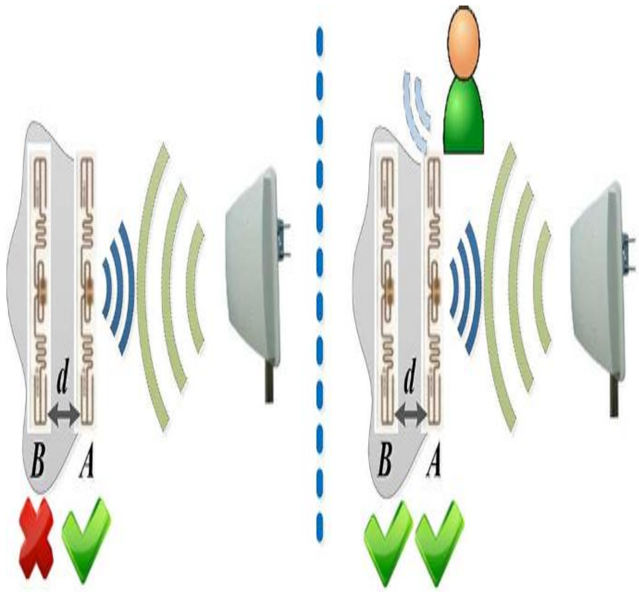

Fig:-1 System Flow

The Raspberry Pi is manufactured in three board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online. Egoman engenders a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is identically tantamount across all manufacturers. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU and was pristinely shipped with 256 megabytes of RAM, later upgraded (Model B & Model B+) to 512 MB. It does not include a built-in hard disk or solid-state drive, but it utilizes an SD card for booting and assiduous storage, with the

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Model B+ utilizing a Micro SD. The Substratum provides Debian and Arch Linux ARM distributions for download. Implements are available for Python as the main programming language, with support for BBC RUDIMENTAL (via the RISC OS image or the Brandy Rudimental clone for Linux), C, Java and Perl.

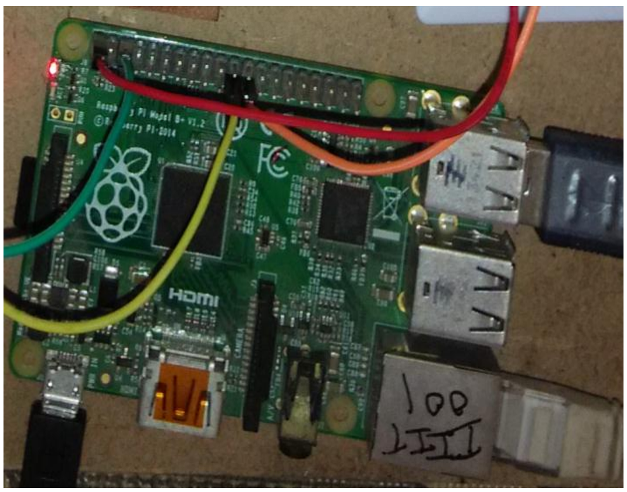

Fig:-2 Raspberry Pi board

RFID:

Radio Frequency Identification (RFID) is a silicon chip-predicated transponder that communicates via radio waves. Radio Frequency Identification is a technology which uses tags as a component in an integrated supply chain solution set that will evolve over the next several years. RFID tags contain a chip which holds an electronic product code (EPC) number that points to adscititious data detailing the contents of the package. Readers identify the EPC numbers at a distance, without line-of-visual perception scanning or involving physical contact. Middleware can perform initial filtering on data from the readers. Applications are evolving to comply with shipping products to automatically processing transactions predicated on RFID technology RFID Reader Module, are additionally called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make utilization of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems utilize many different frequencies, but the most mundane and widely used & fortified by our Reader is 125 KHz.

Fig:-3 RFID Reader Module

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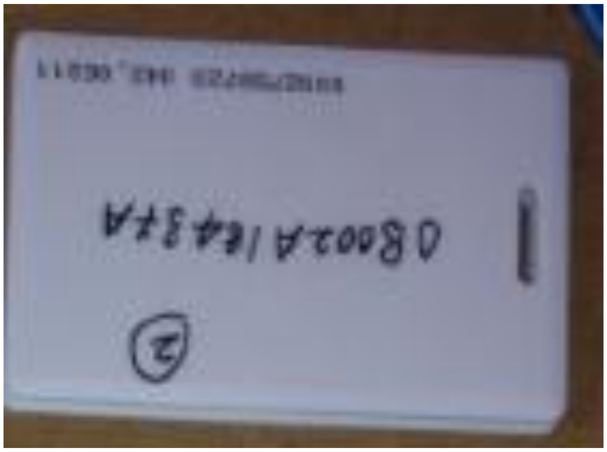


Fig:-4 RFID Cards

Ultrasonic Sensor

Fig:-5 Ultrasonic Sensor

The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 apertures on its front. One opening transmits ultrasonic waves, (like a diminutive verbalizer), the other receives them, (like a diminutive microphone). The celerity of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor utilizes this information along with the time distinction between sending and receiving the sound pulse to determine the distance to an object.

It utilizes the following mathematical equation:

Distance = Time x Speed of Sound divided by 2

Time = the time between when an ultrasonic wave is transmitted and when it is received

You divide this number by 2 because the sound wave has to peregrinate to the object and back.

4. EXPERMENTAL RESULTS

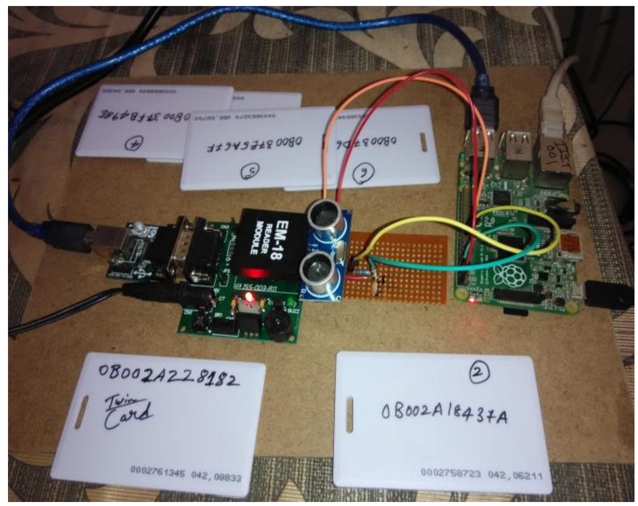
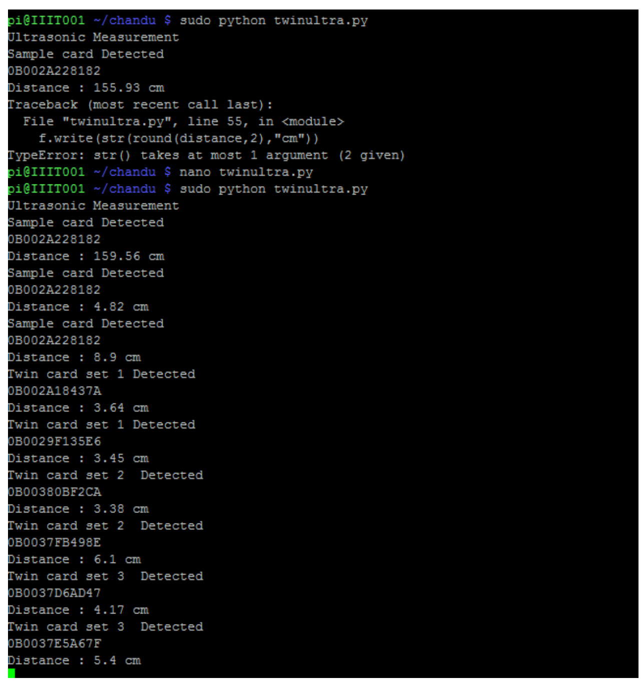


Fig:-6 Main Kit



```
pi@IIIT001 ~/chandu $ sudo python twinultra.py
Ultrasonic Measurement
Sample card Detected
0B002A228182
Distance : 155.93 cm
Traceback (most recent call last):
  File "twinultra.py", line 55, in <module>
    f.write(str(round(distance,2),"cm"))
TypeError: str() takes at most 1 argument (2 given)
pi@IIIT001 ~/chandu $ nano twinultra.py
pi@IIIT001 ~/chandu $ sudo python twinultra.py
Ultrasonic Measurement
Sample card Detected
0B002A228182
Distance : 159.56 cm
Sample card Detected
0B002A228182
Distance : 4.82 cm
Sample card Detected
0B002A228182
Distance : 8.9 cm
Twin card set 1 Detected
0B002A18437A
Distance : 3.64 cm
Twin card set 1 Detected
0B0029F135E6
Distance : 3.45 cm
Twin card set 2  Detected
0B00380BF2CA
Distance : 3.38 cm
Twin card set 2  Detected
0B0037FB498E
Distance : 6.1 cm
Twin card set 3  Detected
0B0037D6AD47
Distance : 4.17 cm
Twin card set 3  Detected
0B0037E5A67F
Distance : 5.4 cm
```

Fig:-7 Results on Consol

Fig:-8Final Results on Webapplication

5. GRAPH RESULTS

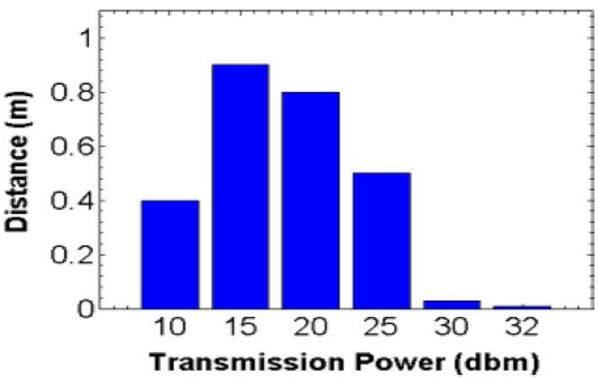


Fig:-9 Transmission

6. CONCLUSION

In this paper, we propose a contrivance-free object tracking scheme, Twins. We contribute to both the theory and practice of an incipient observed phenomenon, i.e., critical state on two adjacent tags. We withal design a practical tracking method utilizing passive tags. The extensive authentic experiments demonstrate the efficacy of our method. Our future work includes studying critical state on a single tag, utilizing Twins to track multiple objects, and elongating the detection region by refining the tracking algorithms.

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