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Developement of IoT Based Tracking and Monitoring System for Smart Homes

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Abstract:
In recent years Internet of things (IoT) plays a vital role in automation and tracking systems. The rapid growth of IoT attains a great attention for implementing Real Time Locating System (RTLS). This paper deals with the object tracking and monitoring system for smart homes using IoT such that it can be beneficial to track and locate the object inside home and can be handling from any place inside or outside home. This can be achieve using Radio Frequency Identification (RFID) for asset management, which can automatically identify and track physical objects within indoor or confined environments. There are different techniques, wireless technologies and mechanisms have been already addressed in the literature to provide object localization services in order to improve the services provided to the users. The drawbacks of already available mechanisms and technologies are inappropriate long range coverage algorithm thus the system become much complex. The proposed system uses simple active RFID concept which will deal with the same problem with easier manner. This includes the RFID tags which will communicate with the RFID tags and then this signal will be provided to the gateways for connectivity and tracking.

Keywords: IoT, tracking, monitoring, localization, RTLS, RFID, gateway.

I. INTRODUCTION

Internet of Things is a network in which all physical objects are connected to the internet through network devices or routers and exchange data. IoT allows objects to be controlled remotely across existing network infrastructure. IoT is a very good and intelligent technique which reduces human effort as well as easy access to physical devices. This technique also has autonomous control feature by which any device can control without any human interaction [28]. IoT become the most used technique to improve the work and make work easier. There are several used IoT verticals markets shown in Fig 1 which has adopted this technique all around the world.

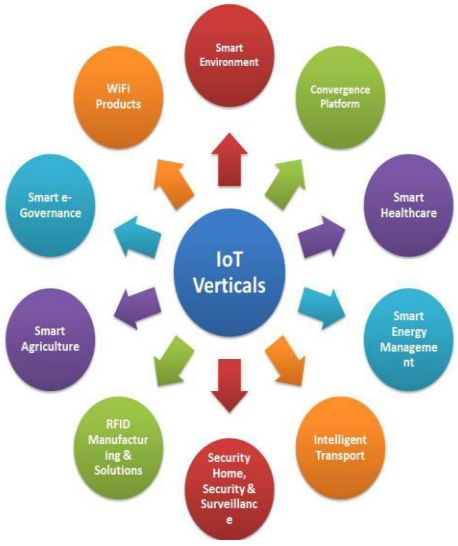

Figure.1. Internet of Things (IoT) verticals [27]

The term Internet of Things is 16 years old. But the actual idea of connected devices had been around longer, at least since the 70s. Back then, the idea was often called "embedded internet" or "pervasive computing". But the actual term "Internet of Things" was coined by Kevin Ashton in 1999 during his work at Procter & Gamble. Ashton who was working in supply chain optimization, wanted to attract senior management's attention to a new exciting technology called RFID. Because the internet was the hottest new trend in 1999 and because it somehow made sense, he called his presentation "Internet of Things" IOT is indeed a key factor for economic growth and improving the quality of life of people. By 2020, it is estimated that there will be up to 30 billion connected devices. So it is important to know the already available papers related to IOT so that every people can get the updated ideas. Till now we have not implemented that type of smart home in which all things are connected together. Here we are going to deals with the localization of object inside home which can track all type of objects. Here the brief review of available work has been discussed in section II. After knowing all the merits and demerits of available system the proposed work has been discussed in section III. The proposed work results and discussion has been done in section IV and finally section V will give the conclusion of the proposed system.

II. BRIEF REVIEW

Object tracking and monitoring system for smart home provides rich information for indoor lost objects. Here the brief overviews of available works with their merits and demerits are given below. In 2015, K. Rasool Reddy et al uses the Image processing technology for object identification. The proposed work based on Generative model encodes all the debut variations using a low dimension sub space. Discriminative model provides a Support vector machine using Histogram of Oriented Gradients (HOG). With this approaches the object can be handle easily but it become failure to reducing the tracking drift and become complicated.
A.Sravanthi et al in the year 2016 uses the Optical Character Recognition to identify the object. The proposed work is based on customizable and enables locating misplaced things using alarm signaling, reminds periodic and important schedules for

the day using easy and effective user interface. With this approaches the system is very simple and system doesn't involve complex artificial intelligence technology but the challenge arises when multiple devices are to be integrated in a centralized environment. In 2017 Farzad Amirjavid et al uses fuzzy logic for identify the object. The propose work is based on the applied hardware provides initial data for object localization process to the OLIS Then, it models the data and updates the Knowledge base with the new paradigm.

The system is accurate and improved performance but there is problem with privacy and costlier. The work which is based on a voice based location detection system which can be integrated in a smart home Environment is done by Rajdeep Kumar Nath et al in the year of 2018, uses Amazon Echo as the voice interface and HC-SR04 ultrasonic sensor. It is easy to operate but it is a short scale work and false response become higher. It is clearly identified in the review that the available system has less coverage, high cost and high complexity. For indoor localization there is no need for more complication. In the proposed work all the demerits of existing system overcomes by simple system.

III. PROPOSED SYSTEM

Every one has ever get into a situation in that whenever trying to look for something but it will spend very long time to look for it and still unable to find it. By leveraging RFID technology, using RFID reader and multiple RFID tags attached to the object, it can easily locate the object that stored. Whenever a new object bought simply paste a RFID tag onto it and registers object details into system. Once we need to look for the object but can't recall where it is, simply make a search on mobile application and you will know it is currently at which room of your house.

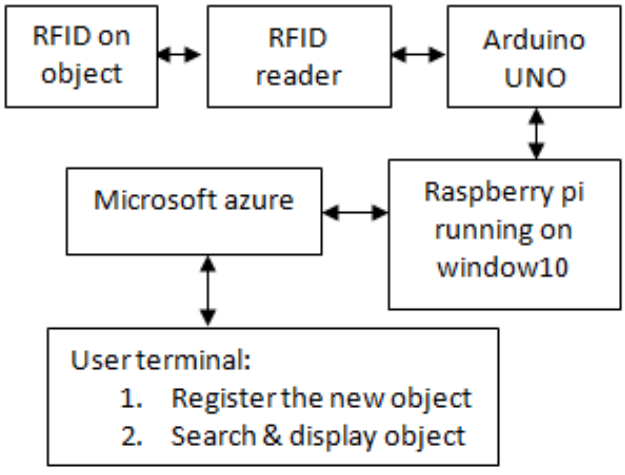

Figure.2. Block Diagram of object localization using RFID

The components of the proposed system is designed as block diagram in Fig 2 which consist of a UHF RFID reader module, a UHF RFID antenna, an Arduino UNO, a Raspberry Pi3 running Windows10 IoT core a mobile application and Azure web service for data storage. There will have multiple UHF RFID module in the house, and each UHF RFID module will be connected to Arduino UNO with Arduino will then connected to Raspberry Pi3. Whenever an object which would like to be tracked by system, a RFID tag will be attached. The detail of the object and the RFID value are required to register into system. The components connections of proposed system is shown in Fig 3.

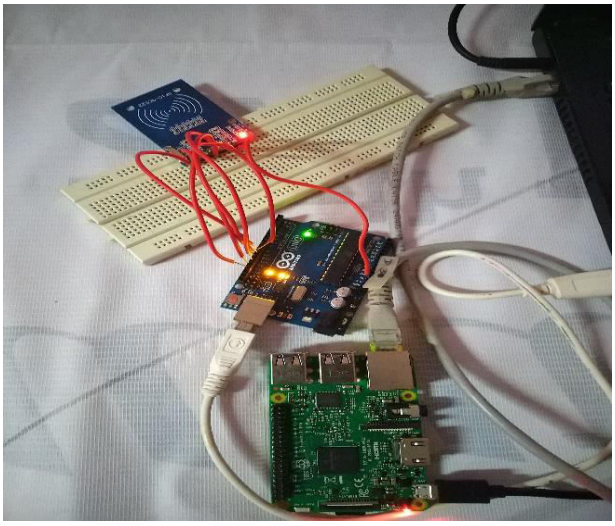

Figure.3. Component connection of proposed work

The data of every record will be stored into Azure SQL database through Azure Web API. For connecting API to Raspberry Pi3 there is a need to find the MAC address of the Raspberry Pi3. Fig 4 showing the reading of MAC address. Whenever user is going to search an object at home, but one is not sure the object will be located in which room of their house. One can turn on their mobile application. The mobile application will send the search request to Raspberry Pi2 through Wifi network. Once Raspberry Pi2 received the search request, it will send the request over to all Arduino Uno connected to it. Arduino UNO will send a read command over to UHF RFID module. Once any of the UHF RFID reader at different location manage to capture the required RFID, it will return a value back to Arduino UNO. Arduino UNO will return the RFID reader location back to Raspberry Pi2 and Raspberry Pi2 will further process the search result and return to mobile application.

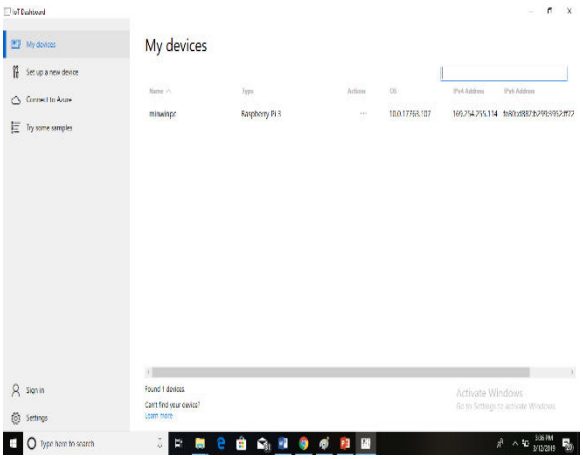

Figure.4. Reading of MAC Address

This cycle can be return every time when the object want be searched and new object want be added to data base or azure cloud storage. By using technology all the thing and object can easily connected to the internet through the internet of things (IoT).

IV. RESULTS AND DISCUSSIONS

The proposed system can easily identify the object for indoor. This is capable covering 10m distances which are greater, compare than other systems for indoor object localization. Multiple tags can be connected in single model so that system

is cost effective and efficient. Since there is no need for additional storage all database of the object will be stored in the cloud, it can also be use for an industrial purpose as well as commercial purpose. Here fig 5 compares the available technology for object tracking in smart home. This graph compares the power consumption, maximum throughput and maximum range for the existing schemes. As per the detail view of above parameter it is clearly seems that RFID scheme is the best in terms of all parameter for indoor object localization and Table 1 address all the demerits of existing system which are overcome by proposed system with simple and efficient way.

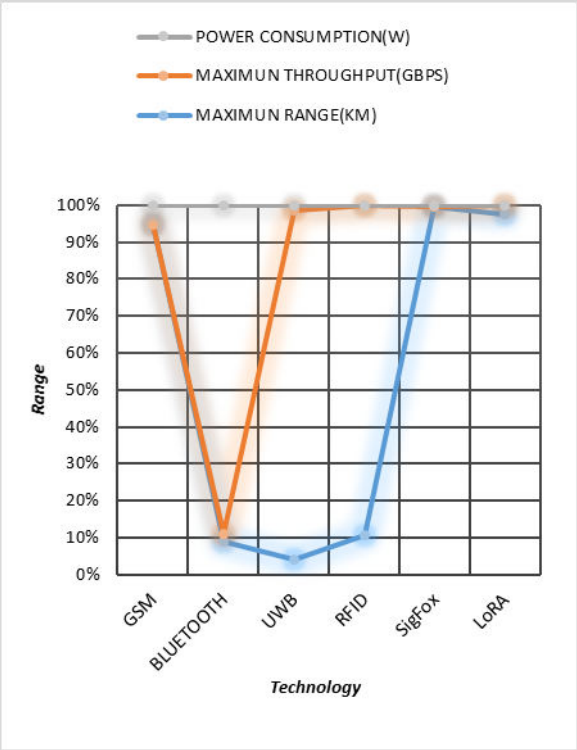

Figure.5. Comparison Graph of existing technology

The proposed system can cover whole Building by adding series connection of arduino to the raspberry pi so that the number of object connected to IoT will be increased and also the system will consume less power for operation.

Table.1. Comparison table for existing and proposed work

EXISTING WORK	PROPOESD WORK
Range up to 36cm	Range up to 10m
High cost	Cost efficient
Need for connecting live streaming	No need for live streaming connectivity
Issue with privacy	Privacy is secured
High complexity	Less complex
Multiple object cannot be tracked at single time	It is possible to track multiple object at single time
High power consumption	Less power consumption

VI. CONCLUSION

Implementation of IoT based tracking and monitoring system at smart home spresented all the demerits of previous work and establishes a simple module for object localization. As earlier for monitoring the object cameras are used but every time keeping the camera will make this surveillance, which is no need for simple object localization. By using camera concept, clearly increases the power consumption and cost. And using RSSI, increasing the mathematical calculation with complex localization hence removing the complexity is the biggest challenge. Proposed system only used fewer components with less power consumption. It could be used by all the age group easily anytime from anywhere.

VII. REFERENCES:

[1]. Jinsong Han, Chen Qian, Xing Wang, Dan Ma, Jizhong Zhao, Wei Xi, Zhiping Jiang and Zhi Wang, **Twins: Device-Free Object Tracking Using Passive Tags**, IEEE INFOCOM 2014 - IEEE Conference on Computer Communications, Toronto, ON Canada. July 2014.

[2]. Xiaolin Jia, Quanyuan Feng, Taihua Fan and Quanshui Lei, **RFID Technology and Its Applications in Internet of Things (IOT)**, 2nd International Conference on Consumer Electronics, Communications and Networks (CECNet). Yichang, China, May 2012.

[3]. Daqiang Zhang, Laurence Tianruo Yang, Min Chen, Shengjie Zhao and Minyi Guo, **Real-Time Locating Systems Using Active RFID for Internet of Things**, IEEE Systems Journal. Vol.10, No. 3, PP.1226 - 1235, Sept. 2016.

[4]. Farzad Amirjavid, Petros Spachos and Konstantinos N. Plataniotis, **3-D Object Localization in Smart Homes: A Distributed Sensor and Video Mining Approach**, IEEE Systems Journal. Vol.12, No. 2 , PP. 1307 – 1316, June 2018.

[5]. Wenjie Ruan, Quan Z. Sheng, Lina Yao, Tao Gu, Michele Ruta and Longfei Shangguan, **Device-free Indoor Localization and Tracking through Human-Object Interactions**, 2016 IEEE 17th International Symposium on A World of Wireless, Mobile and Multimedia Networks (WoWMoM). Coimbra, Portugal. July 2016.

[6]. Rajdeep Kumar Nath, Rajnish Bajpai and Himanshu Thapliyal**, IoT Based Indoor Location Detection System for Smart Home Environment**, 2018 IEEE International Conference on Consumer Electronics (ICCE). Las Vegas, NV, USA. March 2018.

[7]. Luca Mainetti, Vincenzo Mighali and Luigi Patrono **An IoT-based User-centric Ecosystem for Heterogeneous Smart Home Environments**, 2015 IEEE International Conference on Communications (ICC). London, UK. September 2015.

[8]. Ying-Tsung Lee, Wei-Hsuan Hsiao, Chin-Meng Huang and Seng-Cho T. Chou, **An Integrated Cloud-Based Smart Home Management System with Community Hierarchy**, IEEE Transactions on Consumer Electronics. Vol. 62, No. 1 , PP. 1 – 9, February 2016.

[9]. Juan C. Caicedo and Svetlana Lazebnik, **Active Object Localization with Deep Reinforcement Learning**, IEEE International Conference on Computer Vision (ICCV). Santiago, Chile. 2015.

[10]. Dany Fortin-Simard, Kevin Bouchard, Sebastien Gaboury, Bruno Bouchard and Abdenour Bouzouane, **Accurate Passive RFID Localization System for Smart Homes**, IEEE 3rd International Conference on Networked

Embedded Systems for Every Application (NESEA). Liverpool, UK. 2012.

[11]. Qichuan Yang, Zhiqiang He, Kai Zhao and Tian Gao, **A Time Localization System in Smart Home Using Hierarchical Structure and Dynamic Frequency**, 2016 IEEE 18th International Conference on High Performance Computing and Communications; IEEE 14th International Conference on Smart City; IEEE 2nd International Conference on Data Science and Systems (HPCC/SmartCity/DSS). Sydney, NSW, Australia. 2016.

[12]. Xin Li, Kejun Wang,Wei Wang and Yang Li, **A Multiple Object Tracking Method Using Kalman Filter**, IEEE International Conference on Information and Automation, Harbin, China. 2010.

[13]. Alexander Andreopoulos and John K. Tsotsos, **A Theory of Active Object Localization**, IEEE 12th International Conference on Computer Vision. Kyoto, Japan. 2009.

[14]. Marcin Marszaek and Cordelia Schmid, **Accurate Object Localization with Shape Masks**, IEEE Conference on Computer Vision and Pattern Recognition. Minneapolis, MN, USA. 2007.

[15]. Juan C. Caicedo and Svetlana Lazebnik, **Active Object Localization with Deep Reinforcement Learning**, IEEE International Conference on Computer Vision (ICCV). Santiago, Chile.2015.

[16]. Kai-Wen Cheng, Yie-Tarng Chen and Wen-Hsien Fang, **Improved Object Detection with Iterative Localization Refinement in Convolutional Neural Networks**, IEEE Transactions on Circuits and Systems for Video Technology. Vol.28, No. 9 , PP. 2261 – 2275. 2018.

[17]. Qieyun Dai and Derek Hoiem, **Learning to Localize Detected Objects**, IEEE Conference on Computer Vision and Pattern Recognition. Providence, RI, USA. 2012.

[18]. Harald Vogt, **Multiple Object Identification with Passive RFID Tags**, IEEE International Conference on Systems Man and Cybernetics. Yasmine Hammamet, Tunisia, Tunisia. 2002.

[19]. Cory Hekimian-Williams, Brandon Grant, Xiuwen Liu, Zhenghao Zhang and Piyush Kumar, **Accurate Localization of RFID Tags Using Phase Difference**, IEEE International Conference on RFID (IEEE RFID 2010). Orlando, FL, USA. 2010.

[20]. Masaya Tanbo, RyomXiaoa Nojiri , Yuusuke Kawakita and Haruhisa Ichikawa, **Active RFID Attached Object Clustering Method Based on RSSI Series for Finding Lost Objects**, IEEE 2nd World Forum on Internet of Things (WF-IoT). Milan, Italy. 2015.

[21]. lin Jia, Quanyuan Feng, Taihua Fan and Quanshui Lei, **Analysis of Anti-collision Protocols for RFID Tag Identification**, 2012 2nd International Conference on Consumer Electronics, Communications and Networks (CECNet). Yichang, China. April 2012.

[22]. Ching-Nung Yang, Li-Jen Hu and Jia-Bin Lai**, Query Tree Algorithm for RFID Tag with Binary-Coded Decimal EPC**, IEEE Communications Letters.Vol.16 , No. 10 , PP. 1616 – 1619. October 2012.

[23]. Biplob R. Ray, Morshed Chowdhury and Jemal Abawajy, **Secure Object Tracking Protocol for the Internet of Things**, IEEE Internet of Things Journal. Vol.3, No. 4 , PP. 544 – 553. Aug. 2016.

[24]. D.-H. Shih, P.-L. Sun, and S.-M. Huang, **Taxonomy and survey of RFID anti-collision protocols,** *Comput. Commun.* vol. 29, no. 11, pp. 2150–2166, Jul. 2006.

[25]. A. Shirehjini, A. Yassine, and S. Shirmohammadi, **Equipment location in hospitals using RFID-based positioning system,** *IEEE Trans. Inf.Technol. Biomed,* vol. 16, no. 6, pp. 1058–1069, Nov. 2012.

[26]. A. Bekkali, H. Sanson, and M. Matsumoto, **RFID indoor positioning based on probabilistic RFID map and Kalman filtering**, in *Proc. IEEE WiMOB*, White Plains, NY, USA, pp. 21–30, 2007.

[27].https://www.google.com/url?sa=i&source=images&cd=& cad =rja&uact=8&ved=0ahUKEwiayp_dgv3gAhVZU30 K HbnLAK4QMwhUKAcwBw&url=http%3A%2F%2Fwww.itil td india.com%2Fiot&psig=AOvVaw1NQnvZaYRzRn tFIl6 b xNX9&ust=1552494472038330&ictx=3&uact=3

[28]. http://www.gkmit.co/articles/internet-of-things-iot-introduction-applications-and-future-scope