

IoT based Asset Tracking and Monitoring System

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Abstract— Industries are growing rapidly. However, asset management which is a crucial task in any organization, is semi-automated or manual. Human involvement makes asset tracking prone to errors. Radio Frequency Identification (RFID) along with IoT (Internet of Things) provides solution. In IoT devices and objects are embedded with sensors and chips. These devices gain the ability to communicate using the IoT. Asset tracking system is a kind of location based services (LBSs) and has two key components: identification and positioning units. With an asset tracking software one can look on their PC to quickly find out where each asset is located and see who the assigned custodian is. The system can pinpoint the location of any asset to exact room in which it is currently located. Furthermore the check-in and check-out timing of an asset is recorded. This system can also be used to track cost and value of asset. Organizations can use this system to improve business processes and reduce costs, strengthen security and manage risks.

Keywords—Internet of things, Location Based Services, Radio Frequency Identification, check-in, check-out

I. INTRODUCTION

1. Assets in an organization

Asset tracking systems are defined as a system that can track and monitor things that are valued to an entity or organization. It consists of both tangible and intangible assets. Tangible assets include assets such as equipment, machinery, furniture, inventory. These assets are of great importance for any organization. Tangible assets are at a risk of theft, improper maintenance, improper manual operation, lack of intelligence to the system or damage by accidents.[2] Tangible assets can be divided further into two types-current assets and fixed assets. Current assets are also described as liquid assets that can be turned into cash. Fixed assets are the assets of value to an organization that the organization uses for a longer period of time. Examples of fixed assets are furniture, vehicles, computers and office equipment. Intangible assets are the non-physical assets such as patents, internet domain names, computer software, medical records and copyrights. Both tangible and intangible assets are of great value to every organization. Hence, they must be recorded. With the help of asset tracking system one can know the location, status, maintenance schedule and other important information about organization's physical assets.

2. Background

Inventory management is critical in any organization. It is about capturing the basics; knowing what devices you own and who owns them. All organizations have a range of assets that need to be managed effectively. In response to this need, processes were developed where all transactions, record keeping, and tracking of inventory was done manually. In 1960s and 1970s most of the organizations started tracking and monitoring their inventory and goods with the help of computers. Technology sparked new and exciting innovations in logistics planning where companies could improve their inventory management and transportation routing instead of blindly storing their goods in warehouses. Even more efficient tracking was provided with spreadsheets and map-based interfaces in 1980s.

Features such as barcode scanning and QR inventory tracking revolutionized the way businesses keep up with assets and inventory. However, barcodes are line-of-sight technology. A scanner has to see the barcode to read it, which means that the barcode has to be manually oriented towards a scanner for it to be read. Barcodes have other limitations like if a label is ripped or soiled or has fallen off i.e. if it gets tampered, the item cannot be scanned properly. Standard barcodes can identify only few things like name of the manufacturer and product. It cannot uniquely differentiate the item.

One major disadvantage of both barcode and QR codes is that they have to be scanned manually. Along with barcodes and QR codes the GPS systems have gained popularity by providing well known location tracking systems. However, these systems cannot pinpoint exact locations or locations of an entity within a building or on a particular floor or room. So a smart asset tracking system is proposed that allows to track location of objects, goods, personnel within a building or any facility. The proposed system makes use of Radio Frequency (RF) technology along with IoT to achieve this system. Radio-Frequency Identification (RFID) technology is predicated on Wireless Communication Technology that uses an electromagnetic field to perceive information from tags attached to the objects.[1]

3. Problem Statement

The number of valuable and movable assets are available in limited quantities. Improving the utilization rate of such assets for an institution is crucial. However it is hard to find an asset in a short time under urgent needs. In other words, a system which can locate assets, will improve the efficiency of asset utilization. The assets are scattered, the process needs to be automated for remote tracking so one can get real-time and precise information. Misplaced and damaged assets are very common and human involvement makes it prone to errors. The problem is to develop a system for a better, cost effective asset management to identify assets and track their locations. The asset tracking system has two key components:

- Identification
- Positioning

4. Purpose

The aim of the project is to create Real Time Locating Systems (RTLs) that can automatically identify, track, and visualize objects that are usually within indoor or confined environments mainly using RF identification (RFID).[3]. The purpose is to increase efficiency of automated processes for adding and disposing of assets, transferring assets and making it cost-effective. Good asset management underpins service delivery and risk management. Adopting long term asset management will help institutions achieve:

- Overdue alert
- Perform physical inventory
- Create, run, schedule and share reports

II. RELATED WORK

1. *Rasika Patil, Dr. Shikha Nema and Suraj Kadam, 2017, "Radio Frequency Identification System for Asset Tracking and Inventory Management in Hospitals."*

The Radio Frequency Identification system based on wireless communication yields a solution to inappropriate data management. The asset tracking system comprises of software integrated with hardware for management and tracking of assets. The system consists of Radio Frequency Identification reader interfaced with Microsoft Visual Studio 2012 connected to the back-end Microsoft SQL (Structured Query Language) server database. The reader is placed at the checkpoints and in the drug store in the hospital environment. The Radio Frequency Identification tags attached to the assets are identified by the reader and database is updated with information stored in tags. The arrival and outgoing timing of assets are recorded for security purpose.[1]

2. *Sanam Kadge, Chaudhary Hasan, Abdul Qadir Zilani and Yash Jain, 2016, "Asset Management based on Internet of Things"*

IT asset management is semi-automated and unmanaged. IoT provides solution by enabling the design and development of Systems that can adapt themselves to meet the requirements without manual intervention. IT asset involves gathering of detailed software and hardware inventory information which can be further used to make decisions about their purchases and redistribution. IoT helps in managing large data collection for asset management through value chain. When an application connects to the service, it registers with the organization that has the API key. For security it is impossible for other organization communication within the Internet of Things eco-system, intentional or otherwise. A device is not able to directly interact with other devices due to security reasons. Devices are able to accept data and commands from applications. Devices uniquely identify themselves to the IoT with an authentication API that will only be accepted for that device. Devices must be registered before they can connect to the IoT.[2]

3. *Daqiang Zhang, Laurence Tianruo Yang, Min Chen, Shengjie Zhao, Minyi Guo and Yin Zhang, 2014, "Real-Time Locating Systems Using Active RFID for Internet of Things"*

The proliferation of the Internet of Things (IoT) has fostered growing attention to real-time locating systems (RTLs) using Radio Frequency Identification (RFID) for asset management. It can automatically identify and track physical objects within indoor or confined environments. Various RFID indoor locating systems have been proposed. However, most of them are inappropriate for large-scale IoT applications owing to severe radio multipath, diffraction, and reflection. The system consists of newly fashioned RTLs using active RFID for the IoT, i.e. iLocate, which locates objects at high levels of accuracy up to 30 cm with ultra long distance transmission. To achieve fine-grained localization accuracy, iLocate presents the concept of virtual reference tags. To overcome signal multipath, iLocate employs a frequency-hopping technique to schedule RFID communication. To support large scale RFID networks, iLocate leverages the ZigBee.[3]

4. *Lee Carman Ka Man, Cheng Mei Na and Ng Chun Kit, 2015, "IoT-based Asset Management System for Healthcare-related Industries"*

The healthcare industry has been focusing efforts on optimizing inventory management procedures through the incorporation of Information and Communication Technology, in the form of tracking devices and data mining, to establish ideal inventory models. An IoT-based healthcare asset management system (IoT-HAMS) is developed based on Artificial Neural Network (ANN) and Fuzzy Logic (FL), incorporating IoT technologies for asset management to optimize the supply of resources. The IoT-based healthcare asset management system (IoT-HAMS) integrates with IoT technologies, e.g. RFID and WSN, which not only tracks various healthcare-related assets such as infusion pumps, blood bags and medical waste, but also monitors the conditions of such assets, such as temperature, humidity, acceleration and orientation.[4]

III. PROPOSED SYSTEM

1. Goals

The major goals of this system are as follows:

- Enable users to track assets and update its location
- Establish an easily accessible, online, one-stop location to access data on asset location, conditions and asset information
- To ensure that the system operates cost effectively

2. System Architecture

The main components of this system are RFID transmitter, RFID reader, a local Server and a web based database application. RFID reader is interfaced with Raspberry Pi that forms the back-end of the system. Data from tags and sensors is pushed on to Relational Database Management System (RDBMS) which is implemented using SQLite. First the data is stored locally and then synced to cloud at regular intervals. Raspberry Pi Zero acts as a client and Raspberry Pi 3B acts as a server. The application consists of three user classes-Administrator, Manager and Users. These three classes have different permissions for accessing the application. The Administrator has rights to perform administrative tasks for the User Application. The Administrator has special privileges such as Invite, remove or restore Users in the account and Create and Manage Attributes within the User Application. The Manager can perform selected operations within the User application. A user is an authenticated user having read rights. The User Application can be configured so that users can:

- View the location and status of an asset
- Request an asset
- View the status of previous requests

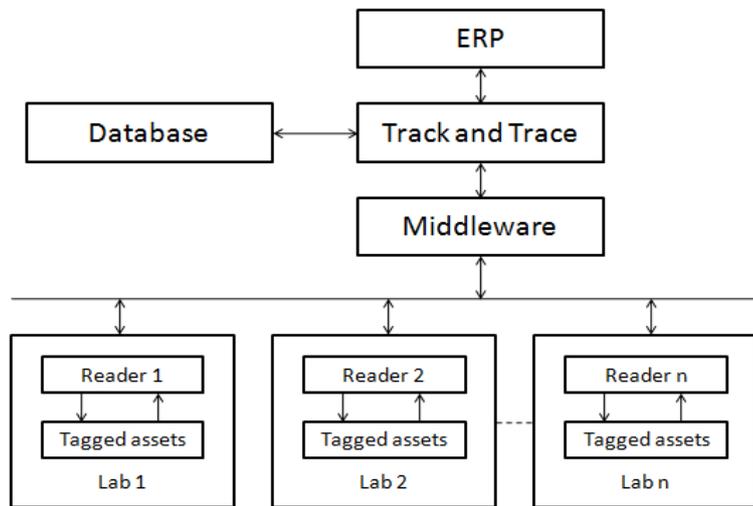


Fig 2.1. System Flow Diagram

3. Working of the System

- The smart labels are placed on the assets in a way that they do not get tampered easily.
- The reader is placed at entry and exit points within the institution.
- The RFID tags attached to the assets are identified by the reader and database is updated with information stored in tags.
- The arrival and outgoing timing of assets are recorded for security purpose.
- Notifications and alert messages are generated in case of suspicious activities or depending upon asset movement

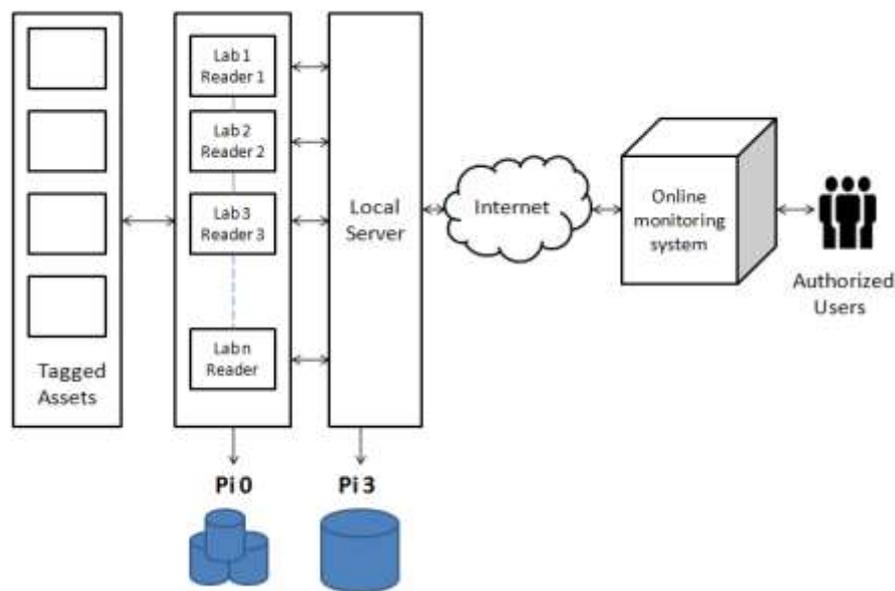


Fig 3.1. System Architecture

RFID system's operating range and performance depends on a number of factors such as: Operating Frequency, RF power output of the reader - this generally depends on the local radio regulations, Size of the Tag, Material composition of the item to which the tag is attached, whether the tag is battery powered.

The system has following characteristics:

- Usability: Provides simple user interface that is easily accessible by the concerned user.
- Scalability: Scalable as the new assets can be easily added to the existing system.
- Security: Secure as the system asks for user's credentials to provide access to system.
- Accurate: Gives the accurate location of indoor assets.
- Cost-effective: Hardware used in this project is highly economical

IV. ADVANTAGES

- Quickly locates critical equipments
- Accurate and efficient in data reading
- Reduces inventory time
- Achieves real-time physical inventory of assets
- Remote monitoring helps organizations enhance productivity

- The asset check-in and check-out timing is recorded that ensures security of assets by generating alert messages depending upon the time of access
- Delivers more timely information for decision making

V. CONCLUSION

The proposed system provides solution for inventory management and asset tracking using RFID technology. The User Interface (UI) developed provides an easy interface to the user of the system. The moving assets are identified over the RFID reader which are located at entry and exit points in the environment and the information is updated in the database. This gives accurate and real-time information of assets. The chances of items being lost is minimized and lost assets can be tracked easily. This in turn saves the time and reduces the errors involved in searching the assets.

References

- [1] Rasika Patil, Shikha Nema, Suraj Kadam, "Radio Frequency Identification System for Asset Tracking and Inventory Management in Hospitals", Published in Signal Processing and Integrated Networks (SPIN), 2017 4th International Conference.
- [2] Sanam Kadge, Chaudhary Hasan, Abdul Qadir Zilani and Yash Jain, "Asset Management based on Internet of Things", Published in International Journal of Computer Applications(0975-8887), Volume 137-No.10, March 2016.
- [3] Daqiang Zhang, Laurence Tianruo Yang, Min Chen, Shengjie Zhao, Minyi Guo and Yin Zhang, "Real-Time Locating Systems Using Active RFID for Internet of Things", Published in IEEE Sysems Journal (Volume: 10, Issue:3, Sept. 2016).
- [4] Lee Carman Ka Man, Cheng Mei Na and Ng Chun Kit, "IoT-based Asset Management System for Healthcare-related Industries", Published in International Journal of Engineering Business Management, ISSN: 1847-9790.
- [5] T. Dylan McAllister, Samy El-Tawab and M. Hossain Heydari, "Localization of Health Center Assets Through an IoT Environment (LoCATE)", Published in Systems and Information Engineering Design Symposium (SIEDS), 2017.
- [6] Chun-Hao Kao, Rong-Shue Hsiao, Tian-Xiang Chen, Po-Shao Chen, and Mei-Jin Pan, "A Hybrid Indoor Positioning for Asset Tracking Using Bluetooth Low Energy and Wi-Fi", Published in Consumer Electronics- Taiwan (ICCE-TW), 2017 IEEE International Conference.

