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Review of RFID technology in Inventory Management System

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ABSTRACT

This paper presents a review of the existing Radio Frequency Identification (RFID) technology used in inventory management system. The Inventory management system is done by RFID tags, readers, scanners. The RFID tags are attached to the items placed on the shelves. The RFID reader detects the tag and hence sends the data to the server accordingly. This system provides accurate information about the quantity and security of the items. Inventory management system using RFID technology is used in libraries, warehouses, inventories, localization of objects, supply chain, stock management. As per the review presented here, RFID technology proves to be very efficient when compared to traditional bar codes system.

Keywords— RFID, Inventory Management system, Library, passive tags, Miniature Aerial Vehicle(MAV)

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I. INTRODUCTION

RFID (radio frequency identification) technology is fast replacing the old fashioned ways and technologies of asset tracking and inventory management. Rfid tags have read and write capabilities. Data stored on rfid tags can be changed, updated and locked. Originally, rfid tags called inductively coupled rfid tags, were complex systems of metal coils, antennae and glass. These tags were powered by rfid reader's generated magnetic field. New innovations in the rfid industry include active, semi-active and passive rfid tags. They can store up to 2 kilobytes of data. They are composed of a microchip, antenna and a battery. They are enclosed within plastic, silicon or sometimes glass. RFID (Radio Frequency Identification) technology is fast replacing the old fashioned ways and technologies of asset tracking and inventory management. RFID tags have read and write capabilities. Data stored on RFID tags can be changed, updated and locked. Originally, RFID tags called inductively coupled RFID tags, were complex systems of metal coils, antennae and glass. These tags were powered by RFID reader's generated magnetic field. New innovations in the RFID industry include active, semi-active and passive RFID tags. They can store up to 2 kilobytes of data. They are composed of a microchip, antenna and a battery. They are enclosed within plastic, silicon or sometimes glass.

I.1 RFID tags works as follows:

Data which is stored within the RFID tag's microchip waits to be read. Then the tag's antenna receives electromagnetic energy from the RFID reader's antenna. By using power from its internal battery or the power transferred from the reader's electromagnetic field, the tag sends radio waves back to the reader. The reader picks up the radio waves sent by the tag and interprets the frequencies as meaningful data. Active and semi-passive tags broadcast high frequencies from 850 to 950 MHz that can be read 100 feet (30.5 meters) or more away. Passive RFID tags are read up to 20 feet (six meters) away. Low Frequency RFID: They can operate between 30 KHz to 300 KHz range. They have a read range of up to 10 cm. High Frequency (HF) RFID: They can operate between 3MHz to 30 MHz range and provide read range of up to 10 cm to 1m.Ultra-High Frequency (UHF) RFID: They can operate between 300MHz to 3 GHz range. They have a read range of up to 12m and also have faster data transfer rates.

II. LITERAURE REVIEW

Vladimir Savie et al. [1] proposed a novel semi-passive RFID system for indoor localization. This system has the capability to detect and decode the backscattered signals from RFID tags in its proximity and also to communicate this information to a standard RFID reader. To estimate the location with high accuracy, the object is attached with

a sensatag. A sensatag is a new type of semi-passive tags. This object is placed in the indoor area which is populated with passive tags with known locations. This RFID system is comprises of a personal computer (host) that runs the localization algorithms, a RFID reader, multiple passive Gen 2 tags that are placed at known locations and sensatags attached to objects that we desire to locate. The the detection range of the sensatag, i.e., the area around it where it detects backscatter from tags is shown in the figure by a dotted circle. The maximum range of detection of the sensatag depends upon the strength backscatter of the tag and also the sensitivity of the sensatag. Prior to operation, the location of all the tags are recorded into the system. As seen from the figure, two of the tags are in the range of the sensatag. Consequently, the sensatag will detect the backscatter from these two tags. The result of this detection is stored temporarily as binary information on the sensatag. Subsequently, the sensatags talk to the reader as if they were regular tags and convey the information of this detection to the reader. Based on this information, the location of the sensatag can be determined. Passive tags are often used in environments such as warehouses, retail stores and offices for tagging a large number of low-to-medium cost items.

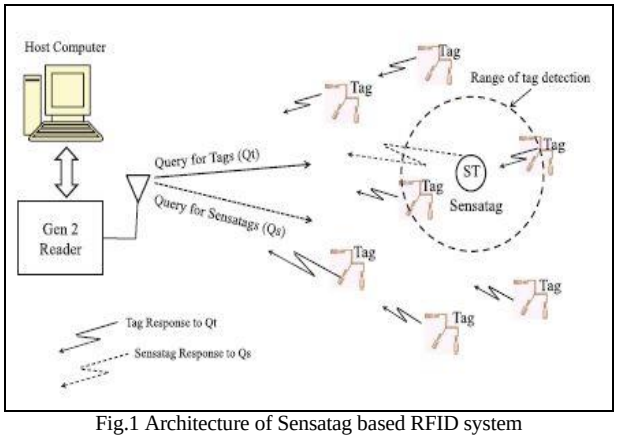

Fig.1 Architecture of Sensatag based RFID system

Marius Beul et al. [2] introduced one of the best method for monitoring the inventory by using the Miniature aerial vehicle (MAV). As there are many applications of MAV's thus it can be applied for monitoring stock in warehouses in indoor and outdoor. The main aim of the MAV is to inspect the stock and items quickly through small passage and cover large area in short time. The MAV is highly robust, adaptable to various conditions and also it is provided by stable navigation systems for its autonomous mechanism.

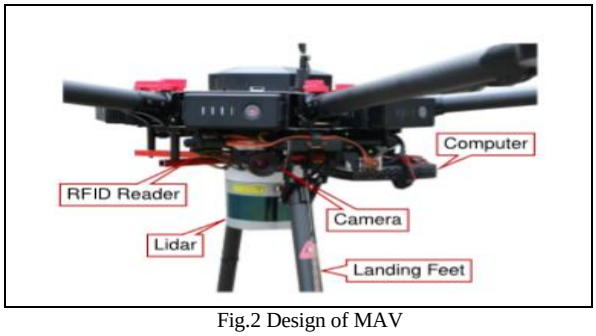

Fig.2 Design of MAV

The radio frequency identification (RFID) is used to determine and map the stored objects. It is highly fast in speed and able to detect up to 750tags per second. The localization objective is achieved by 6D Lidar which does 3D mapping due to this tracking of MAV also becomes easy. The controlling under high velocity of following accurate trajectory path is fulfilled by Model predictive controller. Two high resolution cameras are provided for continuous recording of images with 3Hz frequency. The MAV automatically reacts towards the obstacles. When any obstacle is determined the MAV stops at a safe distance. The limitation of MAV is that it is unable to detect certain items when high vibrations take place in warehouse. Because of low light intensity or shadow images are not captured and recorded in specific areas. But due to MAV identifying the place of certain item becomes simple and time consuming. MAV consists of enough on board processing power integrated with high bandwidth ground connection and long battery life.

Fig.3 MAV performing the inspection task in warehouse

Vaishali Kanekar, Dr. Siddhi Azeza[3] have illustrated RFID and its applications in Libraries. RFID technology can replace the barcodes in library applications. The RFID tags are placed in the books and are usually covered with the sticker. RFID reader and antenna are often coordinated into self checkout machines. The reader powers the antenna to generate the RF fields to decode the information stored on the chip. Reader sends information to the central server, which communicates with the library automation software. Library Management System use RFID technology for Self-issuing purpose, return, stock verification, theft detection, inventory counts. Advantages of this system include increased staff productivity; ensure security, save time, more user friendly, integrates with library management software.

Mamta Kumari [4] reviewed about the growing applications of RFID technology for management of books in library. The RFID technology assures high security and safety to the objects. The objects are easily detected, identified, separated, shared, received .Thus it is used for the libraries. RFID provides well organized book circulation method in libraries. Earlier barcode system was used. In this system each book contained number of code, these numbers were noted in computers and data was maintained. But the disadvantage of this system was that the barcode would be removed easily and then this failed in identification of that book. Due to RFID tags and readers

the tracking of books became easy. RFID can be facilitated in libraries in different ways such as-Access control system - At the doors of library gate detection system are placed so that books containing appropriate tags are only able to be taken. If books with wrong tags are detected then alert sound is made by the system. Issuing of books - when a particular book is issued then the tag is read by the reader and receipt is printed with it. Also the data related to quantity of books is maintained. Book return drop box - a box is placed before the exit door of library. When book is dropped in box and receipt is printed which contain fine if have to be paid. This makes flexible way of returning the books. Handheld scanner - These are designed for shelf reading and searching of a specific book. It also accomplish the task of quantity verification. The tags and readers of RFID are costly. If problem related to receiving of signal occurs then this may create big issue. Thus the selection of appropriate operating frequency of RFID is necessary by considering the application. Still the RFID technology can be used in multiple ways in libraries with high speed and accuracy. It also reduce the manpower. Therefore borrowing of books becomes effective, easy and safe.

III. COMPARATIVE CHART

TABLE I
THE TABLE SHOWS THE COMPARITIVE CHART ON LITERATURE SURVEY

Author name	Method used	Results	Limitations
AkshayAthalye, Vladimir Savic,MiodragBolic, and Petar M. Djuric	By placing sensatag placed on the objects and using backscatter phenomena.	Accurate object localization.	-More rfid tags of known locations must be placed. - It can detect backscatter only when the RFID tag with known location is placed in sensatag's vicinity.
Marius Beul , David Droeschel , Matthias Nieuwenhuisen , Jan Quenzel , Sebastian Houben , Sven Behnke.	Moving aerial vehicle -6D lidar based localization using 3D mapping. -it is combined with time optimal model predictive control.	-Robust self localization based on lidar at high velocities. -fully autonomous navigation and control over obstacles. -high speed with long battery life.	It cannot monitor on the quantity of stock/products present in warehouse.
Vaishali Kanekar, Dr. Siddhi Azeza	By placing the tag inside the book cover and detecting using RFID reader.	More efficient way managing the library inventory system.	Training of staff is required.
Mamta Kumari	-Gate detection system -staff circulation station -Self check in/check out -drop box for book returning -handheld scanner	-Efficient in managing of material in library -Provides good security -Time effective	-Installation is highly costly -Sometime signal problems occur -Sometime fail to read tags

VI. CONCLUSION

The main aim of this paper is to view the latest trends used in inventory management by using the RFID technology. The bits mentioned in the literature review describes about the inventions and innovations done by including RFID technology. Thus modifications can be made to increase the proficiency and consume time for many more applications further. Despite of having high cost of implementation, the use of RFID technology for applications like inventory management, libraries, and warehouses has increased high productivity. It also improves quality of data capturing, it gives precise and relevant management information. Hence it achieves regulatory compliance.

REFRENCES

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[2] Marius Beul, David Droeschel ,Matthias Nieuwenhuisen, Jan Quenzel , Sebastian Houben and Sven Behnke "Fast Autonomous Flight in Warehouses for Inventory Applications" IEEE robotics and automation letters, Vol. 3, No. 4, October 2018

[3]Vaishali Kanekar, Dr. Siddhi Azeza "RFID and its Applications in Libraries" International Journal of Library and Information Studies,Vol.8, Jan-Mar 2018

[4] Mamta Kumari "Impact of RFID technology on Libraries"International Research Journal of Management Sociology &Humanities, Vol 8, No. 12, Year 2017

