Library Management system based on IoT

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----------ABSTRACT----------

Internet of things is an emerging technology which can and will lead to a better and dreamed future where maximum efficiency could be achieved with least efforts.The idea of the proposed system is provide an easy and user friendly library system to the users and at the same time to ensure a systematic approach towards library management so as to efficiently utilize the time and energy of the employees. Automation of library system is a convenient approach, as all the library devices can be managed from one place by implementing Internet of things (IOT).You are allowed to tap into high-tech functionality and luxury that wasn't possible in the past in RFID.

Keywords –

I. INTRODUCTION

The Internet of things provides "connected devices" and "smart devices by the internetworking of different physical devices, vehicles, buildings, etc embedded with various electronics, software, sensors, actuators, and network connectivity that enables different objects to communicate.

Objects are allowed to be controlled remotely across various networks by IOT, providing opportunities for more direct interaction of the physical world with the systems, and resulting in improved efficiency, accuracy and reduced human intervention. Various systems can be automated using IoT, like automated home, automated hospital, but here we'll focus on IoT based automated library management system.

Library management is a part of institutional management that focuses on particular set of issues faced by library management professionals and libraries. Library management consists of regular managerial tasks, as well as intellectual decisions and fundraising responsibilities.

Radio frequency identification detection uses radio waves to automatically identify individual items. The goal of any RFID system is to carry data in suitable tags and to retrieve it back, by machine readable means, to satisfy particular application needs.

RFID tags are used to create self check stations and smart bookshelves along with automation every appliances or suite of devices within the library perimeters in library.

Library management using RFID is easy and convenient. An RFID library management system consists of books attached with an RFID tag, it also consist of RFID reader, computer network and software. Library staff handle tagging, returning, lending, sorting, etc. of books, using RFID tags in this library system. RFID library books marked with a RFID tags can be located, using the RFID reader which also identifies the book. When the book is carried to the counter, electronic article surveillance bit in the book's tag can either activated or deactivated, referring if a book is borrowed, or returned.

1.1 ARCHITECHTURE OF IOT

Internet of Things is new emerging technologies of AR (Augmented Reality). IoT is a new emerging technology domain used to connect all objects through the Internet for remote sensing and control. Internet of things uses a combination of WSN (Wireless Sensor Network), M2M (Machine to Machine), Smart Devices, robotics, Internet technologies and wireless networking. Augmented Reality is the most efficient technology in providing real-world and real-time view information to users, where advancements in Smart Devices will trigger various new AR services.

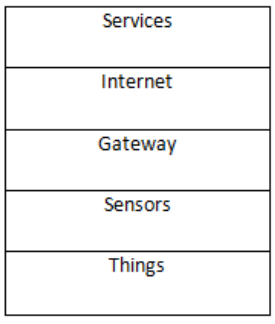

Fig:1 Architecture of IoT

1.2 ELEMENTS OF IOT

Different elements plays critical role in IOT, below are few.

Identification plays a crucial role in naming and matching services with their demand. Examples of identification methods used for the IoT are electronic product codes and ubiquitous codes, etc.

Sensing is for collecting various data from related objects and sending it to a database, data warehouse or data centre. The data will be gathered and is further analyzed to perform specific actions based on required services. The sensors can be humidity sensors, temperature sensors, wearable sensing devices, mobile phones and many others.

Communication technologies connect heterogeneous objects together to offer specific services. The protocols available for the IoT for communication are: Wi-Fi, Bluetooth, IEEE 802.15.4, Z-wave, LTE-Advanced, Near Field Communication, ultra-wide bandwidth, Low-Power Wide-Area Network and emerging standards.

Computation, the hardware processing units, like microcontrollers, microprocessors, system on chips or field programmable gate arrays, and software applications perform this task. Many hardware platforms like Arduino or Raspberry PI are developed and various software platforms are utilized. The cloud platform is a particularly important computational part of IoT, since it is very powerful in processing various data in real time and extracting all kinds of valuable information from the gathered data.

The services in IoT are categorized into four classes: identity-related services, information aggregation services, collaborative-aware services and ubiquitous services. Identity-related services lay the foundation for other types of services, since every application mapping real-world objects into the virtual world needs to identify the objects first. The raw information are gathered and summarized by information aggregation, which has to be processed and reported. The obtained data are further utilized by the collaborative-aware services to make decisions and react accordingly. Ubiquitous services are for offering the collaborative-aware services to anyone on demand, anytime and anywhere.

Semantic means the ability to extract knowledge intelligently so as to provide the required services. This process usually includes: discovering resources, utilizing resources, modelling information, and recognizing and analyzing data. The commonly used semantic technologies are: resource description

framework, web ontology language, efficient XML interchange, etc.

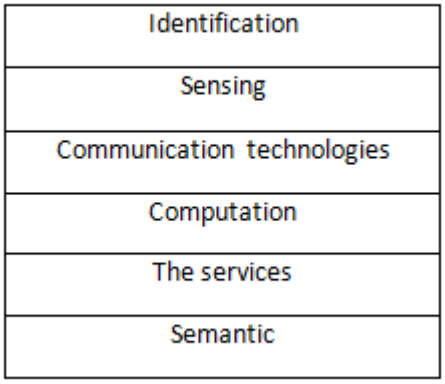

Fig:2 Elements of IoT

1.3 IOT LAYERS

The Internet is an arrangement of connected, yet autonomous networks and devices. Each device, or host, uses protocols or set of rules in order to communicate with other devices within a network.

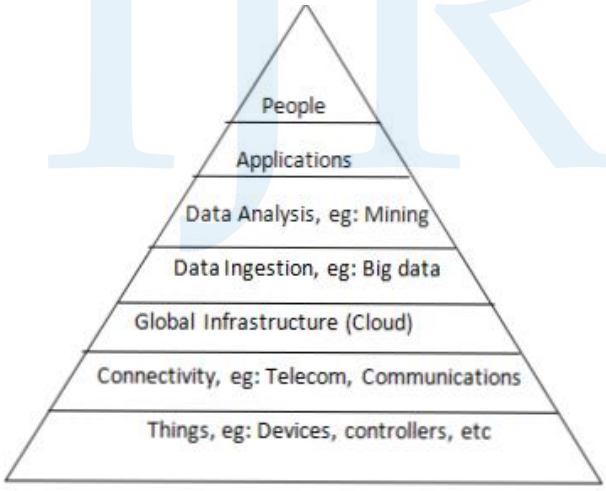

Fig:3 Layers of IoT

1.4 IOT IN LIBRARY MANGEMENT

1. **Smart bookshelves**: The system will provide smart bookshelves i.e. an LED alarm will be triggered if any book is misplaced in the shelves. This will help is better and fast management of the library increasing the efficiency by a great extent.

2. **Surveillance system**: The entire library will be monitored by the surveillance camera systems 24*7. This would lead to theft control and easy identification of any unusual condition or problem in the system. This is also a very good way to keep check on the employees and the customers.

3 **Self check counter**: Consider that the book is carried to the self check station, which is equipped with a RFID reader, the user card is swiped and the user is identified, immediately required modification is done in the database. This type of automated self service would need less man labour and human energy.

4. **Sensors**: Different types of sensors will be used to automate the library management system. Every Device will be connected to a central system that can be controlled like library's thermostat, lights, computer systems, security cameras, etc. For example the library temperature will alter based on the outdoor temperature, to maintain a soothing and stable environment for the readers

Motion and temperature sensor can be used to trigger the outlets as programmed. Every suite of devices, appliances or systems are connected to a central system that can be independently and remotely controlled like library's thermostat, lights, computer systems, security cameras, locks, appliances. Considering an example that a reader selects a book to read, as soon as the reader reaches the desk to read, the light bulb located above the desk detects the presences of human figure and the lights turn on keeping it on for as long the reader is present. This can be made possible using temperature and motion sensors which will trigger the outlets if the required condition is met.

2. TECNOLOGIES

2.1 RFID

Elements: RFID is a combination of radio-frequency and microchip.

The concept of RFID can be simplified to that of an electronic barcode and can be used to identify, track,

sort or detect library holdings at the circulation desk and in the daily stock maintenance.

Tools and Functioning: The RFID system consist of smart RFID labels, hardware and software, provides libraries with more effective way of managing their collections while providing greater customer service to their patrons.

The technology works through flexible, paper-thin smart labels, approximately 2"X2" in size, which allows it to be placed inconspicuously on the inside cover of each book in a library's collection. The tag consists of an etched antenna and a tiny chip which stores vital bibliographic data including a unique Accession number to identify each item.

This contrasts with a barcode label, which does not store any information, but merely points to a database. These smart labels are applied directly on library books and can be read with an RFID interrogator/scanner.

The information contained on microchips in the tags affixed to library materials is read using radio frequency technology regardless of item orientation or alignment. It provides a contact less data link, without need for line of sight.

How It Works: The self-checkout station allows patrons to borrow books without assistance from the library staff. The staff checkout station is used when patrons prefer staff assistance. The shelving station speeds the process of sorting the returned books for re-shelving. The shelf scanner allows library staff to take inventory and find wrongly shelved books without having to pull the books off the stacks.

Benefits of using RFID: With RFID, Line of sight is not essential for reading the tags with the scanner, therefore, the books require much less human handling to be read and processed. A middleware or Server software integrates the reader hardware with the existing Library Automation Software for seamless functioning of circulation.

RFID has no concerns about harsh environments that restrict other auto ID technologies such as bar codes. Tags have a discrete memory capacity that varies from 96 bits to 2kbytes.

2.2 BOARDS

2.2.1 THE RASPBERRY PI:

The Raspberry Pi is a series of small single-board computers. It may be operated with any generic USB computer keyboard and mouse. The first generation (Raspberry Pi 1 Model B) was released in February 2012. It was followed by a simpler and inexpensive model Model A. In 2014, the foundation released a board with an improved design in Raspberry Pi 1 Model B+. These boards are approximately credit-card sized and represent the standard mainline form-factor. Improved A+ and B+ models were released a year later. A cut down "compute module" was released in April 2014, and a Raspberry Pi Zero with smaller size and reduced input/output (I/O) and general-purpose input/output (GPIO) capabilities was released in November 2015 for US$5. The Raspberry Pi 2 which added more RAM was released in February 2015. Raspberry Pi 3 Model B released in February 2016 is bundled with on-board WiFi and Bluetooth. As of January 2017, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. RPi boards.

2.2.2 ARDUINO:

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1]permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

The project's board designs use a variety of microprocessors and controllers. These systems provide sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. The

microcontrollers are mainly programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

2.3 SENSORS:

A sensor is an object whose purpose is to detect events or changes in its environment and sends the information to the computer which then tells the actuator (output devices) to provide the corresponding output. A sensor is a device that converts real world data (Analog) into data that a computer can understand using ADC (Analog to Digital converter).

Sensors are used in everyday objects such as touch-sensitive elevator buttons (tactile sensor) and lamps which dim or brighten by touching the base, besides innumerable applications of which most people are never aware. With advances in micromachinery and easy-to-use micro controller platforms, the uses of sensors have expanded beyond the most traditional fields of temperature, pressure or flow measurement,[1] for example into MARG sensors. Moreover, analog sensors such as potentiometers and force-sensing resistors are still widely used. Applications include manufacturing and machinery, airplanes and aerospace, cars, medicine, robotics and many other aspects of our day-to-day life.

3. RELATED WORKS

In [1] it is mentioned that an integrated module that monitors books stored in the shelves, easy circulation, theft control, etc.

Two types of shelf antenna can be use to achieve this, the first is a 50 ohm microchip line terminated by a 50 ohm resistive load and the second one is a patch antenna. Considering the spillover energy & EM exposure to human near the shelves, A Patch antenna is not suitable choice while a microchip line antenna would be a better option. A wooden cabinet is considered using the same analysis for both types.

The primary goal is to minimize false identification of books from antennas placed in adjacent shelves while maintaining 100% readability of books placed on the target shelf. Better impedence matching and higher Return loss (RL) is needed at the center frequency (866.5MHz). The major problem with the wooden cabinet was the energy spillover from the adjacent shelves leading to false identification. Moving the strip off by center by 60mm towards the front edge suppresses EMI further.

To check SAR three different Human models were used a child, a pregnant women & an adult man. After different observations it is found that the Maximum SAR values for child 0.58 w/kg, for women 0.38w/kg for man 0.51 w/kg and max SAR in body part is the arm, the most used body part near the cabinet. Wooden cabinet SAR values reduced by a factor of 10 as compared to those obtained for the metallic cabinet.

In[2] The idea was to use the passive RFID technology at UTF frequencies in order to develop an intelligent low-cost library management system is to reduce running cost & improve productivity. Objectives for this technology are self check in and out, automated stock taking process, Improve productivity at workplace by eliminating tedious & paper bond process, Reduce cost due to high productivity & efficient working environment and Theft control.

An antenna can be Far field and Near field. In Far field larger range which allows reading tags from a relatively large distance (4-7m) depending on the tag type, readers sensitivity, antenna input power and environment. The disadvantage is spill over energy to nearby shelf and radiation to users. While Near field has shorter range of 10cm in with difficulty to design and read. Two types of antenna are used in this analysis. A simple Microstrip line terminated by a matched load and a patch antenna printed on the FR-4 substrate were designed as an isolated radiated element using the HFSS. Microstrip antennas used to reduce spill over electric field to other shelf while Patch antenna is for best exposure to human. But the exposure to human for Microstrip is lower than the exposure guideline (2w/kg) so acceptable.

In [2] an ongoing pilot project where RFID technology finds a useful and potentially promising application in the field of library science. Attempt to replace the barcode system with an intelligent library

management system to improve productivity and reduce labor cost. Goals of this proposed system is concaving books on shelves with push of a button theft control and time efficient. The barcode or magnetic tape used today requires line of sight and time consuming circulation processing of each individual book. Also delay in work for both library staff and users. Also barcode technology has a limited read range is inappropriate for automated stock taking or for quick locating misplaced items- declared cost resulting in significant replacement costs. We can use RFID with multiplexer to overcome all those problems.

The GUI is developed for the betterment of library staff and on a daily basis. GUI fully interfaces with hardware & database server which provides flexibility and transparency to the library IT administrator. A Nearfield antenna is use for check in checkout for cabinet shelf avoiding false identification.. The antenna design should be optimized both in terms of tag readability and reduced SAR thus the antennas are simulated using SEMCAD-X to calculate SAR. The antenna is 50-ohm microchip line built on foam which is terminated by a 50-ohm resistive load. The microstrip was excited by an N-type female connector perpendicular to the strip. The length of the microstrip was 96cm: The return interest was high and the highest power level that could be applied to the antenna input was 27 dbm. Inside the cover of each book the tags were placed both horizontally and then vertically in three different position bottoms, middle & top, the input power was set to 27dBm- the effectiveness of the near field antenna to detect and identify the books in all the possible orientation.

In[4] passive RFID technology at UHF frequencies are used to develop an intelligent low-cost library management system, reduces labor, running cost & improves productivity at work plan. Goals of this can be cost effectiveness, improved management, and reduction of labor. A smart RFID bookshelf with computer technology via a user-friendly & portability & versatile GUI: Shelf check out for library user , book drop box whenever user is willing to return the book and theft control. Focuses on smart cabinet using passive UHF RFID system interfaced with computer tech via casing a user friendly & portable GUI .

Either far field or near field antenna can be used. Using passive UHF RFID system interfaced with computer technology via a user friendly and portable GUI. An antenna is installed on each shelf of the cabinet with maximum readability of RFID tag on the books. An antenna can be Far field or Near field. Far field provides larger range is there which allows reading tags from a relatively large distance (4-7m) .The disadvantage is spill over energy to nearby shelf and radiation to users. Near field provides shorter range of 10cm with difficulty to design and read. Different human model of different gender, age and BMI was used to check SAR for both the antennas. The resolution of the models was 1mm*1mm*1mm. Microstrip antennas used to reduce spill over electric field to other shelf. Patch antenna is for best exposure to human. But the exposure to human for Microstrip is lower than the exposure guideline (2w/kg) so acceptable.

In[5] RFID systems are divided into different frequency system, high frequency system, ultra high frequency system, microwave system etc. Their identification distance, R/W character, tag size, anti-collision character, propagation character etc. The general identification distance is 3m, since there are many tag on the same zone, it is fitted to adopt LF system. Character of passive microwave tag is close to UTF tag, but it has higher cost. Active microwave electric tag has distant identification distances but it has larger volume and higher cost & identification distance gradually shorter with the consumption of electric change of battery.

Tags of two types can be used Active and Passive, Active comes with battery energy so reaches more distance - but limited life and high price, while Passive has no battery. It receives R/W electromagnetic signal to communicate, no maintenance required, its light weight, small volume, long life & cheap but limited transmitting distance.

The four principles of information identification:

1) Efficiency - within short time store & access info.

2) Economy - limited interested, low cost aggregation cost.

3) Reliability - secure & authenticated access &

storage.

4) Actionability – does not disturb other operations and be compatible.

The tag contains information like, bookid, book information, id of library, information of bookshelf, information of borrower, date of borrowing , other content. Library management system based on RFID realizes organic connection RFID tech & library management methods, which provides effective techniques for the management of library, automated so easy for staff as well as for users. Library intelligent management system can function independently which reflects intelligence.

4. PROPOSED SYSTEM

A smart library system using Internet of things (IOT) Controls and monitors the following components

a) Temperature and humidity.

b) Motion detection.

The Arduino Ethernet is used to eliminate the use of a personal concept keeping the cost of the overall system to a minimum. Devices such as light switches, temperature sensors, humidity sensors, intrusion detection sensors, smoke/gas sensors and sirens have been integrated in the system. This system helps to do complete monitoring and control functionalities of the library environment using wireless sensors and actuators modules. Using IOT multiple appliances can be controlled and monitored in proposed system.

RFID systems can be divided into different frequency system, high frequency system, ultra high frequency system, microwave system etc. Their identification distance, R/W character, tag size, anti-collision character, propagation character etc. The general identification distance is 3m, since there are many tag on the same zone, it is fitted to adopt LF system.

ID-2015.

A 50 ohm microchip line terminated by a 50 ohm resistive load can be the antenna used in this system with a Graphic User Interface (GUI) for the betterment of library staff and on a daily basis. GUI fully interfaces with hardware & database server which provides flexibility and transparency to the library IT administrator.

The system will also contain motion and temperature sensor to trigger the outlets as programmed. The Arduino will be instructed using Assembly language programming while SQL will be used for the Database. All of these connected together using a centralized processor and a common GUI.

5.CONCLUSION

In conclusion a better and more efficient, library can be developed with the existing technology but that should be achieved without causing harm to the human beings and the environment. Such library system which would not only be user friendly but also take care of the staff, i.e. with least number of human energy and recourses managing a library system. The effectiveness of the proposed approach will be evaluated by implementing the same.

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