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DESIGN & IMPLEMENTATION OF RFID BASED BOOK TRACKING SYSTEM IN LIBRARY

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ABSTRACT

The prime hurdle of user is to find exact title of book in library. The basic reason is wide spread of books or sometimes disordered arrangement in library. To avoid such issue, RFID based book tracking system is designed using PIC microcontroller. In this paper, near field RFID tags are used to locate exact position of books. The implemented system displayed the result on GLCD screen by tracing the shortest path. The main contribution of this work is that, the system is handy, easy to carry, highly accurate and reasonably low priced.

Keywords: Book Tracking, NFC, Passive Tags, PIC18F Microcontroller, RFID.

I. INTRODUCTION

The modern technology has increased the standard of living of humans in each field; let it be entertainment, domestic or educational. Everyone craves for better quality in every place and anywhere in field work. This is also seen in educational sectors such as library. Library is a vast place & many times one gets confused while searching for various literatures of different departments. There have been various searching and tracking systems being developed with the help of different technologies like NFC, ZIGBEE, ARDUINO and Wi-MAX. It would be better if the person knew in which sector the desired literature is placed. This in turn will be easy for him to move directly to that particular section and collect the material instead of going to each sector and searching different racks of articles. This will avoid wastage of time and unnecessary efforts by that person in searching the article. This will also avoid huge crowd mesh at an area.

In present condition there is no such system which would search literatures on the real time basis. So a remedial electronic product is been designed which would try to catch this problem. This can be achieved using RFID technique that get directions and route to get destination by tracing current location. By displaying the path on a display device with the help of a pointer, the required results can be achieved.

Radio Frequency Identification Technology was invented by Charlie Walton. This technology identifies each item by transmitting radio waves. This RFID tags contain data which is basically a transponder. In RFID system, data can be retrieved by machine readable form which can be used at particular time and place to satisfy particular

application.

The paper is organized as follows: Section 1 explains the brief and concise overview of RFID. Relevant papers about different tracking and navigation techniques to search books are studied in Section 2. The proposed architecture of use of RFID for library purpose is discussed in Section 3. Section 4 depicts overall finalized circuit diagram. Finally the paper is concluded in Section 5 that highlights the applications that merit attention in future scope for development.

II. LITERATURE SURVEY

Many researchers has developed book searching techniques which are studied here:

Authors in [1] presented a system for shopping mall where the position of a person can be located using a Wi-Fi router and also a Navigation Software. Wi-Fi router is used to make connection at once with the help of internet. This system is designed to track the various places in the mall itself such as ATMs, Restrooms, etc. It is a real-time Application. The major drawback of the system is that the accuracy of the system depends on the frequency of Wi-Fi signals or density of routers.

Akhi Choudhariet. al. developed an Android based application to navigate the position of the user in library [2]. In this system GPS is used to show the path to the book. This concept named Living Library gives interaction with Virtual world and Physical World using camera in mobile. It's useful to all the android users. The major drawbacks of this system are: - The GPS should be of high accuracy. The technique is applicable to small libraries with less number of books.

Authors in [3] proposed library management system using RFID technology [3]. In this system they have used RFID tags for each book and Categorized a batch of students. They have allocated a unique code of 16-digits to a batch of student. Of these 16-digits, 8-digits are common for batch of students while remaining 8-digits Vary from student to student in same batch itself. The passive tags along with RS232 cable and ATMEGA 162 are used to identify the people and books issued and the computation results are displayed on LCD. The Merit of this system is, the user need not check in or check out, which could be time consuming. The drawback of system is that any unauthenticated user can use the ID of authenticated user which may perhaps lead to mishap or theft.

Kehinde Daniel et. al. developed a software for digitization of library in [4], Where in the traditional articles or books are converted into electronic form. This is beneficial when thought of storing or retrieval or manipulate the data. The system is categorized into: Analysis and Design. The basic steps of analysis are: registered user, availability, check the user requirement, borrow data, and return data and Penalty. The Design process is in structured format.

Authors in [5] proposed new algorithm of locating small objects named as LANDMARC algorithm. It improved positioning accuracy effectively, lower the system cost complexity, and improve the borrowing efficiency of the readers.

A books tracking system based on RFID combined with ZIGBEE is proposed in [6] in order to solve a series of problems, such as readers intentionally keeping library books of their owns, putting the books on the wrong frames,

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checking large amount of books, etc. The system is innovatively blended with RFID technology which replaced library bar coding. In addition, the virtual routing algorithm is used in the system to realize ID positioning and together with ZIGBEE wireless network technology to transmit the real-time tracking data to PC.

In [7], authors exploited IoT and mobile technologies for easy and efficient library management. The major goal is to reduce the burden of the library user to track a book and to fetch it from its location. Authors used the local positioning system and embedded tags on the book to communicate with each other and with the user's smartphone. With much ease, the user can interact with the library server to check whether the book is available and if available to locate it right to its position.

III SYSTEM DEVELOPMENT

3.1 Proposed Work

The basic block diagram for the proposed system is shown in Fig. 3.1. The major system components are:

1. PIC18F Microcontroller
2. RFID Readers and Tag
3. Power Supply

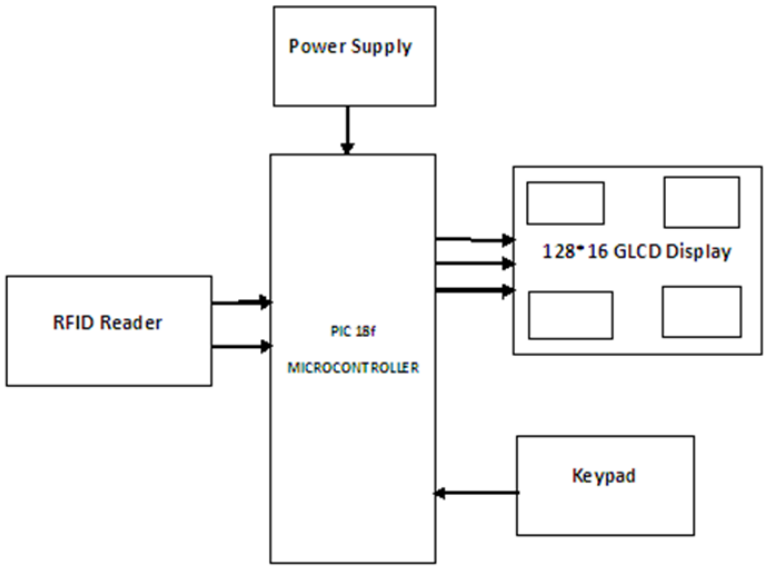

Fig. 3.1 Proposed Block Diagram of System

Along with these, keypad and a Graphical Liquid Crystal Display (GLCD) is used. This entire design is an embedded system. The entire system works on 5 V power supply. The input to microcontroller is given by the keypad. The keypad is interfaced with Port B of PIC microcontroller. The keys on the keypad are predefined for a particular set of books. The user with a hand held device will select the rack from which the book is to be issued. The keys on the keypad will be predefined for a particular rack. When the user presses the key, it will connect the column and the row. This will then correspond to the assigned book set. Now once the input is given, the RFID reader will start reading the location of the user and locate the RFID tag with respect to the location of the rack and

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show the shortest path for the same from the current location of user. The GLCD will then display the path. The next time when the user changes the position, the RFID reader will again read the location of the user and check the input, then it will show the shortest path from that location and the next rack will be located.

3.2 Passive RFID

Faraday's principle of magnetic induction is the basis of near-field coupling between a reader and tag Reader will pass A.C. signal through coil, which results formation of magnetic field in nearby region.

As Shown in Fig. 3.2, if tag with small coil is brought in this region, A.C. voltage will form across it. This voltage is converted to DC voltage and then connected with capacitor. Capacitor will charge and this will acts as power source to tag chip. Tags draw current that give its own small magnetic field that opposes reader's field. This small incremental current will be detected by coil which is similar to load applied to tag's coil. This is load modulation. Due to load modulation, tag sends data back to the reader.

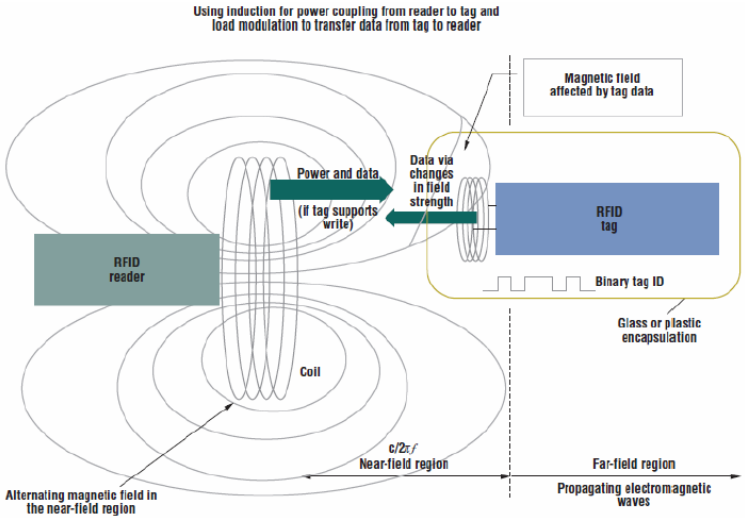

Fig. 3.2 Working of Passive RFID Tags [8]

This signal can be recovered by the reader by controlling change in current flows through the reader coil. The number of modulation encoding methods are used that depends on number of ID bits needed, data transfer rate, and additional redundancy bits placed in the code to remove errors resulting from noise in the communication channel. Near-field coupling is the most straightforward approach for implementing a passive RFID system.

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3.3 Dataflow

Fig. 3.3 shows dataflow of the proposed work.

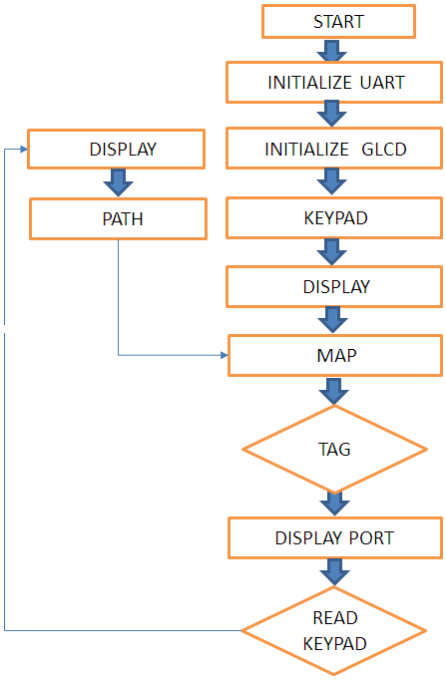

Fig. 3.3 Dataflow of Proposed System

It is briefed as:

1. Start the system.
2. Enter a valid input for book search from the keypad.
3. Antenna of the tag reads from the reader's antenna.
4. Reader will pick up the frequencies and give it to display port.
5. Observe the path on GLCD to reach to the destined location and trace the book.
6. Read the keypad again for location change.
7. Give another input from the keypad to move to another rack.

IV PERFORMANCE ANALYSIS

4.1 Circuit Diagram

The circuit diagram of proposed system is shown in Fig. 4.1. This GLCD is interfaced to the PIC microcontroller which processes and finds the position of the user in library using RFID reader. In this design, the RFID transmit pin is connected to the receiver pin of PIC18 microcontroller. The crystal pin is an 8 MHz which is connected to pin 13 & 14 of the PIC microcontroller. By pressing low, Active reset circuit appears on Pin1, Port A of the PIC microcontroller is being used. Data lines D0-D7 are connected to GLCD. Along with these data lines the control select, read write, enable and reset are also connected to the GLCD. Port B is interfaced with the Keypad. In this design Port A & Port E is not being used.

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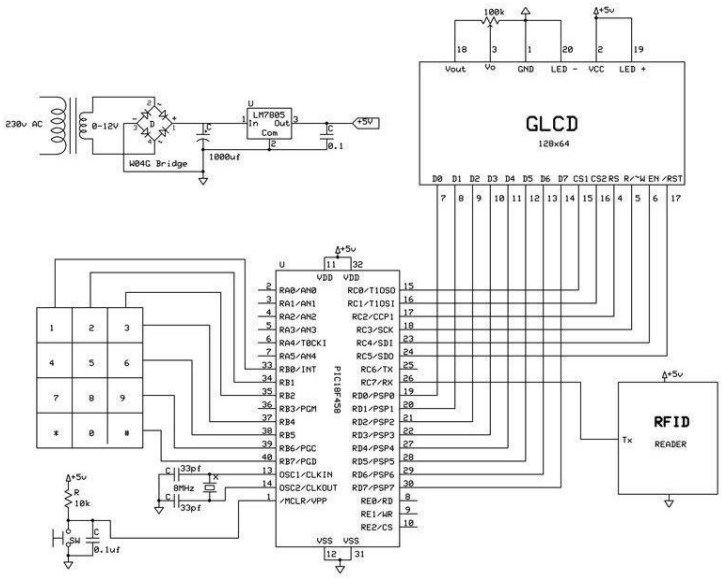

Fig. 4.1 Circuit Diagram of Proposed System

4.2 Experimental Setup

5 V, 1 A linear regulated power supply is designed using IC 7805 voltage regulator. Power supply used here for testing and troubleshooting purpose and can be replaced by 5 V Battery for better portability. Schematic versus Layout of PCB is developed. The experimental setup is shown in Fig. 4.2. The hardware shown in Fig. 4.2 is kept in enclosure which is in hand of user. The RFID tags are placed at various racks in library which indicate various compartments. The distance among various racks and entrance of library which generally referred as 'Gate' is kept less than 100 meters.

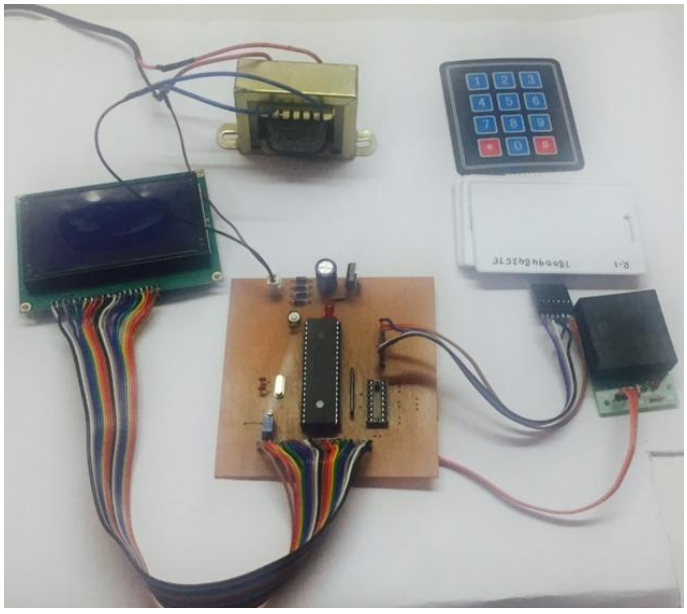

Fig. 4.2 Experimental Setup

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The programming is carried out in Embedded C with the help of 'Mikro C' as software platform. Initially, when system is started then GLCD shows database of 8 books and its GUI is shown in Fig. 4.3

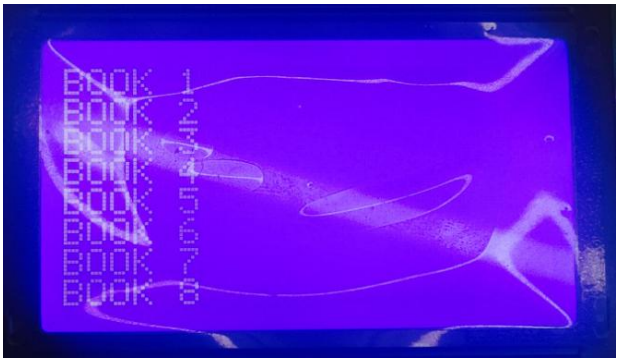

Fig. 4.3 Database of Books on GLCD

The desired book will be searched by pressing its equivalent number with the help of keypad. Then RFID reader will send the signal to various tags. The only single matched RFID tag will receive the signal which is kept at various racks in library. Then GLCD will show shortest path from current location of user to desired location of book. The GUI obtained on GLCD is shown in Fig. 4.4.

Fig. 4.4 GUI showing Path of Book Tracking on GLCD

The time required to search a book is depends on instruction cycle and is calculated as 1.5 second. The book searching time depends on distance travelled and can be minimized and in some cases can be delayed. As per Fig. 4.4, current location of user is Rack 2 and if further user want to search another book, then also user can access another book by pressing desired number using keypad.

V. CONCLUSION

Initially, various book searching techniques is discussed in this paper. Secondly, working of Near Field RFID is studied. Real time RFID based book search system is developed with the help of PIC18F microcontroller. The result is displayed in terms of tracing shortest path on 128*64 GLCD. The main advantages are the system is handy, portable, reasonably priced and require less time. The system also provides automatic reading at various places for user, so that it reduces time lag. This system is standalone and does not require librarian intervention.

In future, this system can be used on Smart Phones by developing its software applications. With this technique, the

book issue and return information will be stored and security will be provided from getting theft.

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