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DESIGN ANALYSIS OF A BOOKSHELF FOR FEDERAL POLYTECHNIC ILARO STUDENT LIBRARY

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ABSTRACT

Libraries in years make use of a manual cataloguing method in which a register is opened to take the account of books available in libraries and to check against pilfering and safe returns of books borrowed by reader under a given day ultimatum. This creates a lot of issues when librarians are making accounts of available books in the bookshelves and readers do not have the idea of available books in the libraries until he/she gets to the library to check each shelf for available books. In this report, the use of Radio Frequency Identification technology to construct a network-based bookshelf is used to identify each book available in various compartments of the shelf with the aid of a tag and reader which sense the availability of the book and check against wrong placement of books in the wrong bookshelf compartment. A networking device is also used which serves as a communicating device between the shelf and database. The website is used as the trigger point for updating the retrieved status of the book to eliminate bottleneck at the counter that cannot render the real-time circulation status of book in the library upon borrowing or returning the book. With the help of a database system to integrate the information architecture of the library and provide intelligent service applications, the overall structure is conducive in enhancing the efficiency of the library collections and improving the satisfactions of readers.

KEYWORDS: Network, RFID, Libraries, Bookshelf

I. INTRODUCTION

Library automation and its attendant digital technologies present new opportunities and challenges to libraries to enhance their services. Some of the cultural functions of libraries are changing in the digital age and providing promising opportunities for the acquisition, organization and bibliographic control of the available vast knowledge. However, automation is the reality of 21st century and any library that ignores its capability in transforming the information environment is at risk of losing ground (Bansode, 2009). Libraries, the repositories of human knowledge have been striving to improve their productivity through the use of computers (Fauty, 2004). The library is the heart of the educational enterprise and also the reservoir of knowledge communicated through information resources. Information is fast becoming a vital national resource that determines the direction of any nation. Therefore, librarians and must be conversant with development in information and its communication technologies for the organization and dissemination of information in order to increase knowledge and improve scholarship (Sahu, 2005). Integrated online system more closely represent the activities of the library, where one unit's processing of library may impact materials availability and the function of another. Integrated systems group a number of activities, (e.g. Acquisition, Serials control, Circulation and course reserves, the public catalogue, bindery and interlibrary

loan) in one system using common command and sharing common patron and items record base.

II. LITERATURE REVIEWS

Okoroma presented a comparative study in 2010 at the Kenneth Dike Library of the University of Ibadan and the Obafemi Awolowo University Library in Nigeria to show the adoption of automation and electronic information resources. He cites the benefits of automated library services. The librarians and other staff of the two chosen libraries were polled about the automation decision-making process, specifically the purchase of computer gear and software. It also addressed issues that arose throughout the automation phases. On the basis of the survey's findings, recommendations are made to other university libraries.

Tiwari (2002) in a study proved that automation was becoming a more diverse challenge, particularly in terms of resources, skills, and capacities. The field of library automation has changed dramatically in the last several years. The use of computing and telecommunication tools grew out of library automation, which began with the in-house processing of traditional duties. There is now a "library without walls" that makes use of technology to enhance services, resources, and relationships between libraries and resources all over the world. According to IBM digital library, this "virtual library" is a reality in which the world of digital information is just a click away.

Information kiosks will be a part of the future library automation system, allowing even computer novices to quickly access information. Human-computer interfaces will be created by information scientists, and librarians will be responsible for maintaining libraries.

Library Smart Shelf is a technology that does real-time inventory checks and detects misplaced books. This system would display book details based on the most recent book status, such as available, borrowed, and in use for certain volumes. This system displays the exact shelf and level for each item. This system's user is limited to librarians exclusively. "This system uses to RFID technology, Programming and database support are required, so C# and SQL Server 2008 are used (Coyle, 2005). Fix reader and antenna are used in this project. Every level of the shelf has two antennae, which are placed on both sides of the shelf's

level, with the reader placed at the top or bottom of the shelf". The reader and antenna number for one shelf is determined by the amount of level on the shelf. Furthermore, every book in this system must have an RFID tag attached to it in order to identify its identification, and each tag (book) has its own unique code (Stanford, 2003).

III. METHODOLOGY

This work is based on library book automation, which helps in knowing and determining the status of books in each compartment of a bookshelf via a dedicated database and to achieve this a hardware and software method is adopted to designed and construct a network based bookshelf.

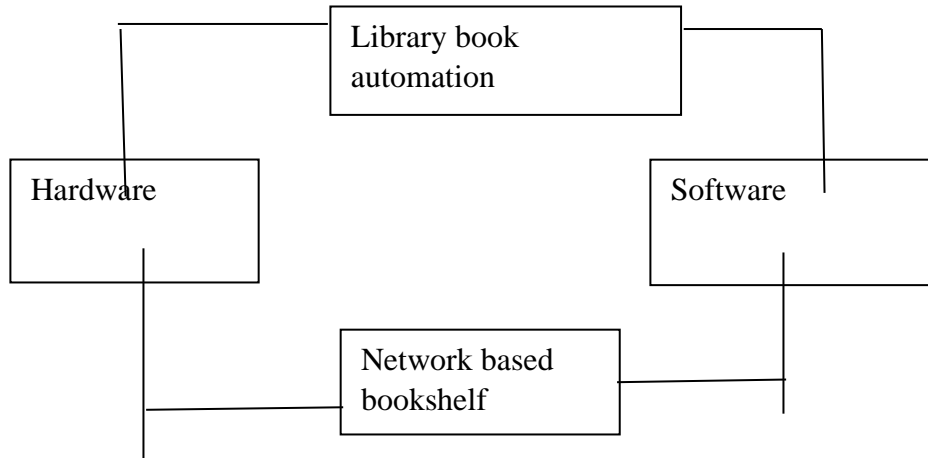


Fig 1.0: Block diagram of methodology

IV. DESIGN ANALYSIS OF THE HARDWARE

This gives the details on the fabrication of the bookshelf and network hardware.

The hardware part of this work forms the physical part of this projects which include the fabrication of a bookshelf using MDF wood with a given dimension and it as four compartment and it is

automated using a RFID sensor and card with an ESP 32 as the communicating device.

❖ SHELF FABRICATION

The shelf is constructed using a MDF wood and it is constructed in such a way that it has four equal compartment with the same dimension for book to be placed.



Fig 2.0: Screws and bolt

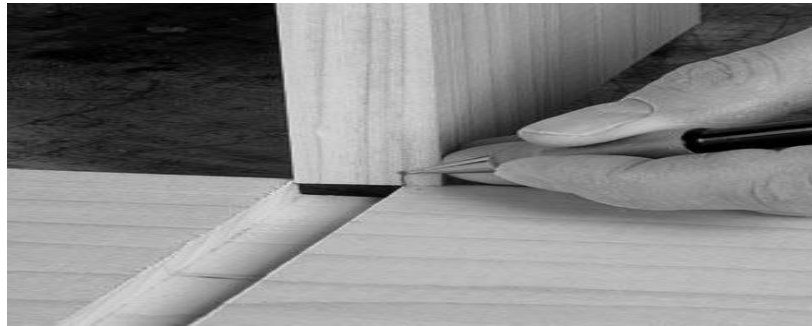


Fig 3.0 Marking out cut-off sections of the wood



Fig 4.0: drilling of holes on the MDF wood.



Fig 5.0: assembling of the various part of the wood



Fig 6.0 The completed wooden bookshelf

❖ **CONNECTIONS OF THE HARDWARE COMPONENTS AND CONTROLLER ON THE BOOKSHELF**

This involves the connections of the main circuitry of the hardware components and controller on veroboard. The steps are;

- The RFID sensors are connected using a jumper wire in each compartment and a glue is applied to the wall of the shelf in each compartment to hold the RFID sensor firmly.



Fig 7.0: Placing the RFID sensors in each compartment.

- The ESP 32 is connected to the Arduino UNO through a USB cable interface to send data to the Arduino UNO.
- The ESP 32 is connected to the veroboard by soldering a female header to the board and the output of ESP 32 is a male header which is plug into the male header on the board.
- The LCD screen is fixed in the dignity cases and the dignity case is fixed beside the shelf.
- The LEDs are fixed on the dignity case and connected to the veroboard.
- The output terminal of all the components are connected to the veroboard.
- The positive and negative terminal of the SMPS is connected to the veroboard to power all the hardware components.
- The veroboard is placed in the dignity case.

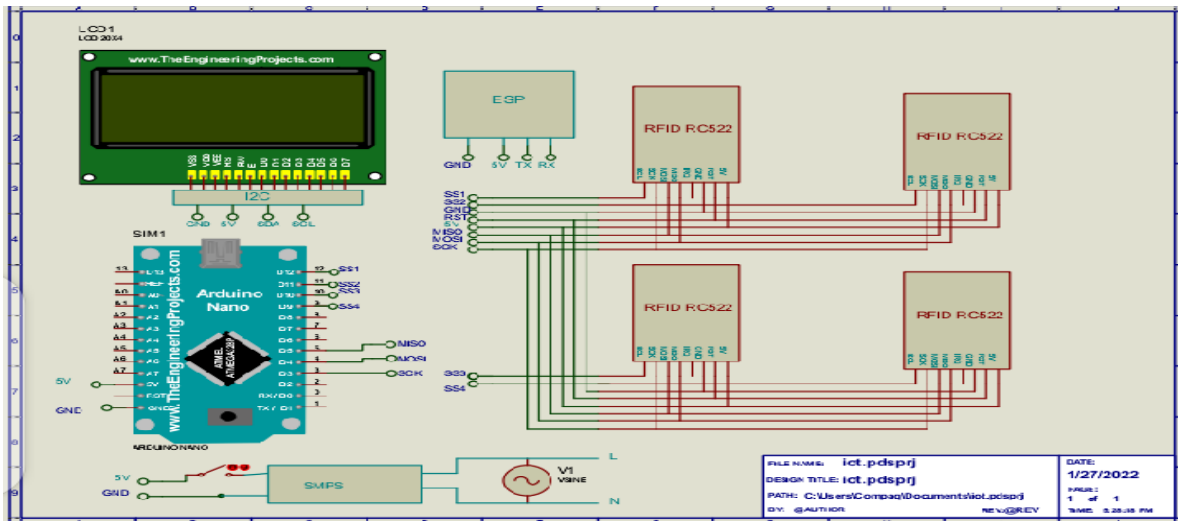


Fig 8.0: The circuit diagram

❖ **RFID CARD AND SENSOR**

The RFID Sensor and card is an ID system that uses small Radio frequency identification devices for identification and tracking purposes. It includes the tag itself, read/write device, and a host system application for data collection, processing, and transmission. RFID uses electromagnetic fields to transfer data over short distances. RFID is used in this project to detect books in each compartment of the shelf.

The configuration of the RFID sensor and card use are:

- INPUT VOLTAGE: 3.3V
- FREQUENCY: 13.56MHz
- PIN WIRING TO ARDUINO

- SDA to Digital 10
- SCK to Digital 13
- MOSI to Digital 11
- MISO to Digital 12
- IRQ to Unconnected
- GND to GND
- 3.3 to 3.3V

V. DESIGN ANALYSIS OF THE SOFTWARE

The software part of this work is based on the design of a database for the books in the library and to link the bookshelf to the database.

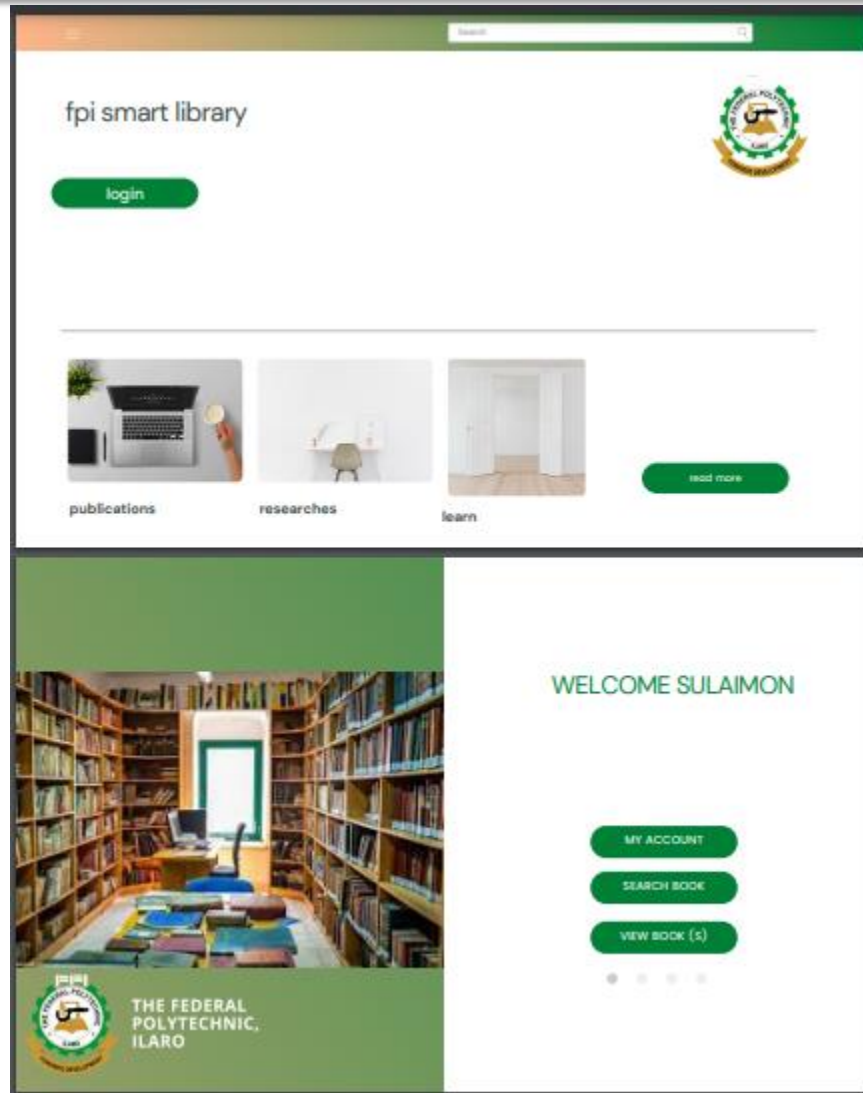


FIG 9.0: The webpage

VI. WORKING OPERATIONS

The working operations includes the design of a flowchart for the whole design.

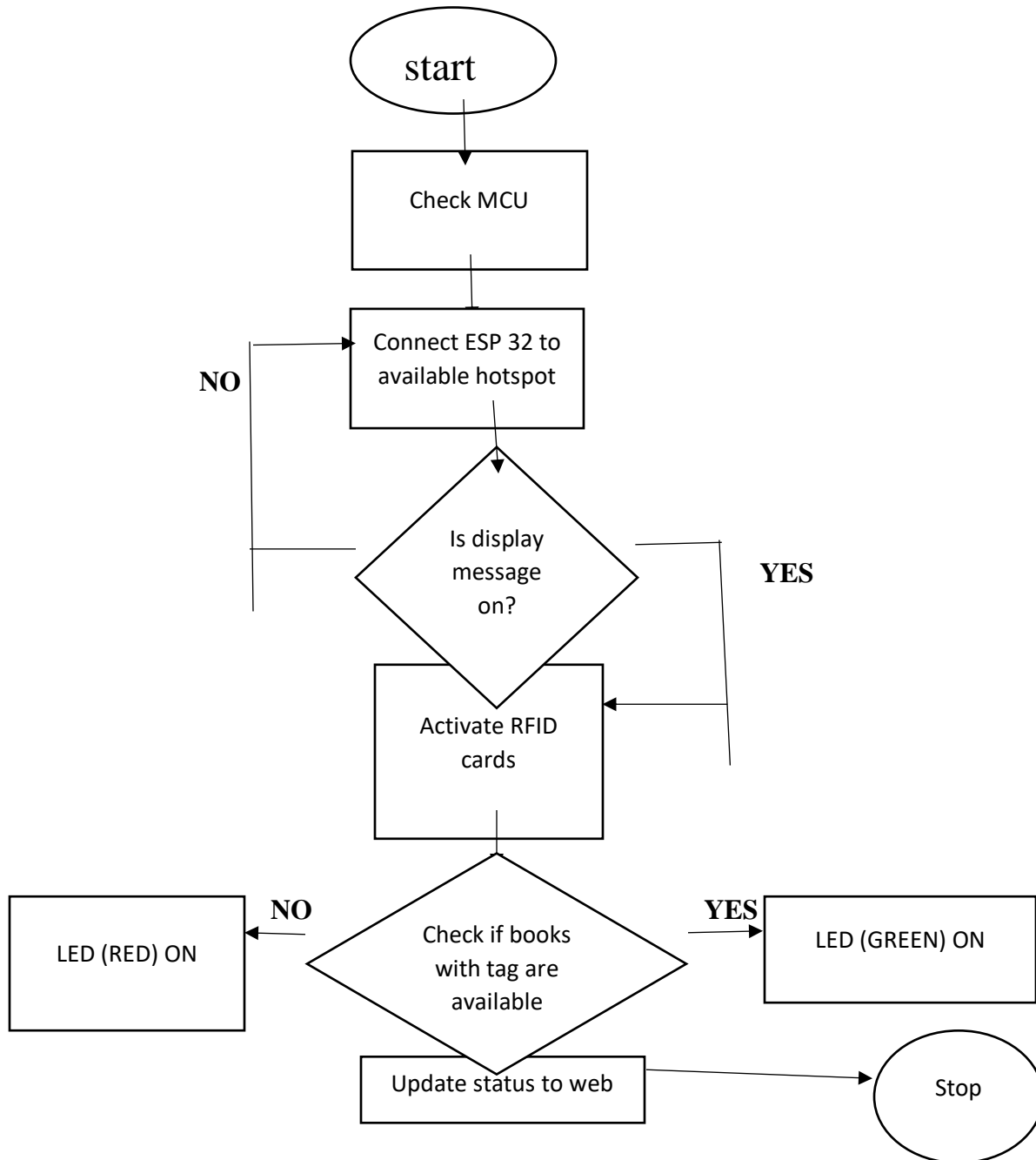


Fig 10.0: The bookshelf and database design flowchart



The flowchart above explains how the bookshelf and the database are linked together. Once the microcontroller unit is activated which is the Arduino UNO, the ESP 32 check for the available hotspot to connect to display in other to send a pop up display message on the screen and the RFID cards are activated, if there is no pop up message the ESP 32 is not yet connected to the available hotspot. The red LED light shows the unavailability of books in the shelf while the green LED light shows the availability of books in the shelf and the status is updated on the web.

VII. RESULTS AND DISCUSSION

Test were carried out to test the certainty of the functionality of the construction work, to check for bugs and make use of corrective measures to rectify the error and ensure the effective working of the entire system.

❖ PERFORMANCE TEST

The performance test of the selected materials are as follows:

ESP 32 : The ESP 32 is powered by a micro-USB connector which is plugged to a PC. The Wi-Fi connectivity is tested and the Bluetooth connectivity to determine the range of its connection with the bookshelf and it is connected to the PC in other load the program written on it and it is tested by its Wi-Fi connectivity to load the created webpage.

ARDUINO UNO TEST: This test is carried out by setting each channel to ground and power and read output in the serial monitor. This is done by connecting a wire between the input connectors and power connectors on the Arduino uno board.

- Connect one end of the wire to A0 port
- Connect the other end to GND port
- Analog0 in the Serial Monitor should now read 0.0 volts
- Remove the wire from GND and connect it to 5V
- Analog0 should now read approximately 5.0 volts
- Remove the wire from 5V and connect it to 3.3V
- Analog0 should now read approximately 3.3 volts
- Repeat the same procedure with A1, D2 and D3

VIII. PRESENTATION OF RESULTS

After the test that was carried out, all errors were rectified to ensure that the system is responding effectively to its given command. The bookshelf constructed is more efficient compared to its contemporaries. The biggest advantage of the bookshelf is that it creates easier access to library materials according to the requirement.

IX. DISCUSSION OF RESULTS

The bookshelf is being automated by a database which as the records of books available in the shelf and update the status of each book in each compartment to the webpage, this is made easier by the aid of the ESP 32 as the communicating device. The RFID cards are being sensed by the sensor in order to take records of each book contained in different compartments. The database

is designed based on two programming languages which are C++ and HTML.

X. CONCLUSION

At the end of this research work, a network based bookshelf was designed and constructed for the Federal polytechnic Ilaro library in order to aid ease access to books in a more convenient way through a dedicated database which consists of a webpage with a unique ID login details the librarian and students.

This work is designed in order to automate a bookshelf compared to the ordinary wooden bookshelf available in the library which students find it difficult to check for available books and made it easier for librarians to check against pilfering and to give account of books available in each compartment.

XI. RECOMMENDATION

Having gone through the design and construction of this project and processing the design and working knowledge of this system, I recommend a complex database to be designed for this project in the future, by which improvement can be added for better and easy functionality of the system. This project designed and construction work should be adopted in all departments in Federal

Polytechnic Ilaro to aid easy access to files available in each department.

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