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# IoT-based approach to locate books in library system for integration with the automated library systems

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**ABSTRACT**

The main challenge in a large library is to retrieve a book effectively, where traditional barcode or radio frequency identification (RFID) based systems require significant infrastructure and complex inventory management. An integrated Internet of Things (IoT) system consisting of light-emitting diode (LED)-assisted shelf identification and an interactive web visualization application is proposed in this study for enhancing the reliability and effectiveness of automated library book retrieval. In this, a networked microcontroller architecture is used for real-time identification of the exact physical location of books by allowing users to visually locate the required books to be retrieved using LED indicators. Along with this, an interactive web visualization application is developed using HTML5, CSS, JavaScript, PHP, JSON, and MySQL for visualization of the shelf real-time location and location of the book within the shelf. The proposed system offers a cost-effective, scalable, and user-friendly solution compared to conventional RFID or barcode-based systems. Experimental testing of the proposed system passed all 9 tests conducted for its conformance in identifying the required book locations across four distinct test conditions. Beyond the library book retrieval application, the proposed system architecture has potential applications in smart warehouses, storage inventory management, and application as a supporting architecture for future systems such as autonomous service robots.



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## 1. INTRODUCTION

Conventional library systems consist of number of shelves on which the books are placed in a specific manner. The details of the books available in the library are maintained in the form of catalogues in digital or printed form. The location of the book in the library can be identified through these catalogues. Also, the books carry a tag, typically on the binding edge carrying all the necessary information about the book. The book inventory management system of a typical traditional library system is extensively dependent on proper manual sorting and catalogue preparation and maintenance. These manual processes are most of the times laborious, error prone, and inefficient. Sometimes, after surfing for the book in the library some of the users do not put the books back to their original place on the rack. Consequently, the required books are often unavailable at the specified location for the next user. It has been observed that due to the complexity involved in manually locating the book in conventional libraries, significant time is consumed in identifying the required books.

Nowadays, smart infrastructure systems are being developed for autonomous navigation, robot-based storage-retrieval applications and automated inventory management with the use of rapid advancements in robotics and automation along with Internet of Things (IoT). For the development of autonomous service robots in smart libraries integrated with navigation and manipulation task capability, real time localization of books and respective shelves is a major automation challenge. Existing conventional library systems primarily focus on digital cataloguing and record management rather than providing reliable physical localization feedback required for robot perception and autonomous retrieval operations.

Despite the emergence of digital technologies, there has not been many changes in the storage and retrieval systems of the library. Web-based inventory management solutions have become more and more popular in recent years because of its usability, scalability, and accessibility [1], [2]. These systems help customers manage their inventories more efficiently by providing a range of capabilities that include recording, search, and reporting [3], [4]. The application of interactive visualization methods for bookshelf inventory management has, however, not received much attention in the researches.

Traditional library management systems are designed mainly for manual operations such as searching books, maintaining catalogues, arranging books according to classification systems and maintaining borrowing records. Smart library systems, on the other hand, enable remote access to digital resources and utilize IoT technologies for improving service, sustainability and security [5]–[7]. However, most of these systems still lack an effective real-time physical localization mechanism that can support robotic navigation and autonomous book retrieval in smart library environments. Modern libraries also provide digital research support tools such as Tableau, Excel, Gephi, R and Plotly for data analysis and visualization [8], [9].

Improving user experience is one of the needs of any system, for the same reason Norrie *et al.* [10] developed a prototype consisting of Kinect depth sensor, a mobile application and physical book shelf with visual cues (*i.e.,* labelled notes) for representing different book sections [10]. The proposed system is similar to this system, where the location of the bookshelf in a library environment and book in a shelf can be identified using the web application developed as shown in Figures 1 and 2. Similarly, Chen *et al.* [11] proposed a mobile-based inventory management system using image processing, accelerometer traces, digital compass and Wi-Fi information for localization of books. Sawant *et al.* [12] developed a software based automated library management system for reducing human interaction in book issuing and returning processes using MATLAB and LabView. Gade *et al.* [13] developed an automated library management system using LabView software, which utilizes EM-18 radio frequency identification (RFID) reader for recognizing books and for keeping track of bookshelf arrangement [13]. Although these research studies significantly contributed towards library automation, most available systems are limited to digital inventory tracking without concerning direct physical localization for robot manipulation.

IoT based machine vision system can also be used effectively for object recognition and dimensional measurement [14]. Integrating machine vision with IoT can be considered as future scope of research in the field of supporting autonomous service robots in smart libraries, warehouses and storage management applications.

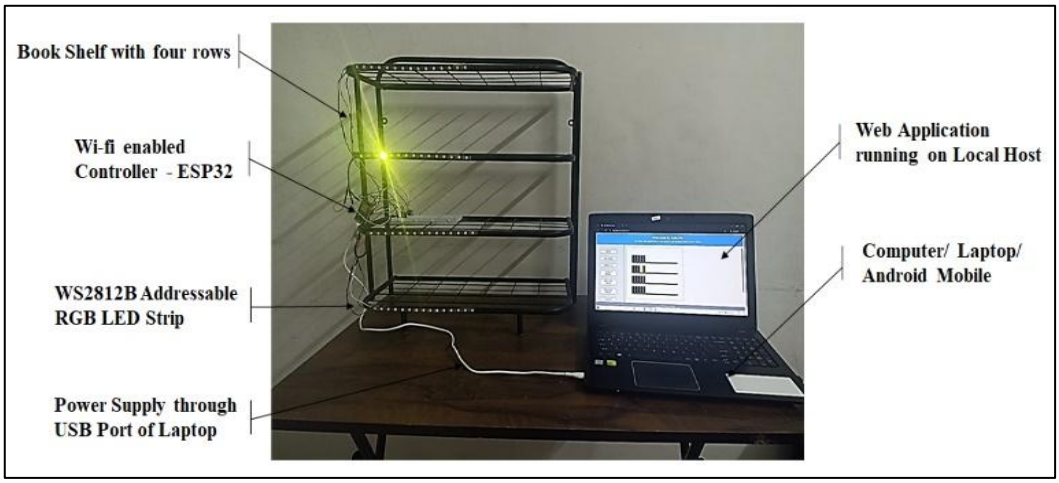



Figure 1. Developed IoT enabled LED addressing technique


Figure 2. Real time virtual book shelf navigation

Researchers have also focused on smart laboratories and remotely accessible experimental platforms using HTML-based web applications [15]. For smart laboratories, use of HTML has shown its own importance along with other supporting languages such as CSS3, AJAX, and HTML5 Canvas. Using HTML based web applications have multiple benefits such as remote access, multiple user accessibility, faster performance, ease of access without installation and improved compatibility with any browser [15]–[19]. Hence, HTML is preferred for development of the proposed system [20]. Interactive graphical features such as tracking values, pan-and-zoom, and dynamic visualization can significantly improve user interaction and system understanding [21]. Further, using a combinational set of HTML for web based framework development, MySQL for database generation and Canvas for simulation or visualization of the testing environment can be used for successful implementation of the system architecture [18], [22], [23]. Hence, the web application is developed using HTML and MySQL for detecting location and interactive visualization of a shelf, row number in a particular shelf and book placed on a shelf. Further, the developed web application is connected to IoT enabled LED addressing technique based physical shelf system using Arduino microcontroller ESP32 [24], to test the feasibility of proposed system in Figure 1.

The limitations of the conventional identification or localization techniques used in library are discussed in Table 1 and these systems primarily focus on identification rather than providing real time physical localization of feedback integrated with visualization tools. In current existing libraries the emphasis is digital cataloging of books and remote access, but the proposed system addresses the key answer to the automation gap *i.e.,* a novel hybrid framework that combine interactive visualization with IoT-driven physical localization. This further helps to automate the process of library automation using autonomous service robots in future. Also, this proposed hybrid framework addresses the scientific question effectively as follows: How does IoT enable physical book localization system integrated with interactive visualization improve the library automation reliability?

Table 1. Comparison of conventional identification or localization and proposed system [11], [25]–[27]

| Parameter | Barcode system | RFID system | Vision based system | Proposed IoT based system |
|---|---|---|---|---|
| Infrastructure Cost | Low | High | Medium - High | Low |
| Automation capability | Limited | Moderate | High | High |
| Real-time physical localization | No | Limited | Yes | Yes |
| Integration with robots | Limited | Moderate | Complex | Direct and structured |
| Scalability | Moderate | Moderate | Computationally intensive | High |
| Maintenance complexity | Low | High | High | Low |
| Visualization integration | No | No | Partial | Integrated |

Therefore, the primary objective of the proposed research is to develop and experimentally validate an IoT-enabled interactive localization framework capable of assisting autonomous robotic systems in identifying, locating and retrieving books efficiently from library shelves with minimal human intervention.

The present study is organized as follows: first, a detailed introduction to IoT-based book detection is presented, followed by an overview of related research. The proposed web application system architecture is subsequently addressed, followed by the development and testing of a web application for system simulation and an overview of the developed and proposed IoT based system. Finally, important results and conclusions are presented.

## 2. PROPOSED IOT-BASED BOOK LOCALIZATION FRAMEWORK

### 2.1. System overview

The present work is an effort towards providing an effective solution that can efficiently resolve the issue of storage and retrieval of the required book from the library shelves. It is proposed to fully robotize the storage and retrieval of books in the library. As the first step in this direction, a novel IoT based approach to visualize and locate the inventories on the bookshelves is proposed. To facilitate effective book retrieval and organize, the suggested system offers an easy-to-use interface for managing book being placed on a virtual shelf. By leveraging client-side scripting and persistent data storage, the system offers real time location of bookshelf in a layout of library environment, as shown in Figure 2, the real time row number of a book in a bookshelf, and it also facilitates the book location identification on a bookshelf with highlighting by different color. Further, the novel method is developed using IoT based Arduino Wi-Fi module ESP32 and proposed for detecting a book using "LED Addressing" Technique, which can also be extended for developing a physical autonomous library serving robot (see Figure 1).

### 2.2. System architecture

The system architecture of the developed IoT enabled LED addressing technique-based shelf system is shown in Figure 3. First part of the shelf system developed is bookshelf management system (*i.e.,* web application) and second part is the developed IoT enabled LED addressing technique based physical shelf.

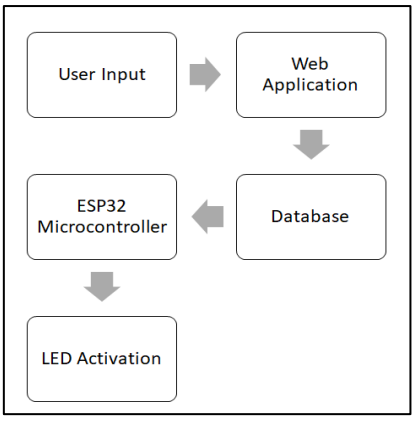



Figure 3. System architecture

As shown in the architecture in Figure 3, there are four main components of the system and those are - Web Application, Database, ESP32 microcontroller and LED addressing technique based physical shelf. User input is provided using a client-side interface of a web application. The client-side interface constructed using HTML, CSS, HTML5 Canvas, JSON, PHP, and JavaScript, and the data storage method, which makes use of local storage and a MySQL database. For complete development, MySQL and Apache servers from XAMPP Control Panel v3.3.0 are used. As shown in Figures 3 and 4, client-side interface of a web application is used to handle user interactions and render virtual bookshelf. Whereas data storage mechanism is used to store and retrieve data related to book and shelf location in local storage of the browser as well as in MySQL database as per requirement of the respective task. With the help of the web storage application programming interface (API) known as local storage, web-based applications may preserve data locally in the browser, accessible to the same origin, data stored in Local Storage remains intact throughout browser sessions. Data such as selected book shelf location, book row number and book location in a row from either left side or right side is stored in local storage, whereas the book details are facilitated to be stored and retrieved wherever necessary using MySQL database.

Further, the second part of the architecture, IoT enabled LED addressing technique based physical shelf system, it is developed using the following: i) book shelf with four rows, ii) Wi-Fi enabled controller - ESP32, iii) WS2812B addressable RGB LED strip, and iii) power supply through USB port of laptop. The detailed description of the developed setup is discussed in the subsequent chapter.

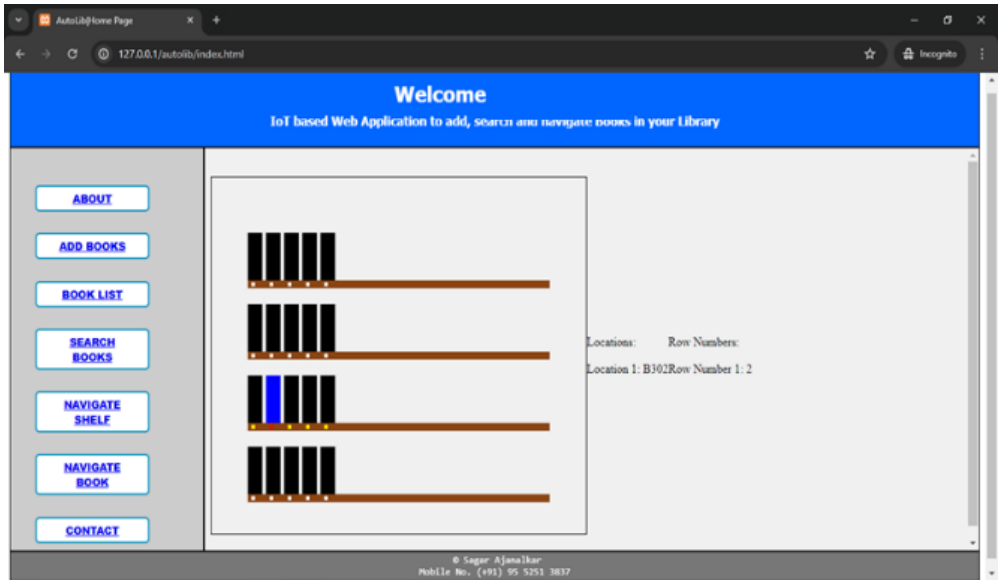



Figure 4. Interactive visualization of a book shelf

## 3. DEVELOPMENT OF PROTOTYPE FRAMEWORK

A novel approach based on IoT is developed for effective localization of shelf, bookshelf inventory management, interactive visualization and proposed automated storage and retrieval of book using service robot. The part of proposed system developed is a physical system using "LED addressing technique" as shown in Figures 1, 2 and 3. Those are discussed in detail as follows:

### 3.1. Development of an interactive visualization using HTML

The developed interactive visualization of a book shelf using HTML is shown in Figure 4 and step-by-step procedure for developing it is given in Figure 5. For developing the same, HTML 5 Canvas is used along with PHP and JSON. Also, all the related details of the languages used to build the system architecture are discussed in chapter 2.

The procedure followed for visualization of book shelf is as follows:

- Insert the book details and store in MySQL database: HTML file 'addbooks.html' provides a structured form interface allowing users to input book details including title, author, publisher, location, and row number within a table layout. PHP script 'insert.php' establishes a connection to a MySQL database, retrieves the book details submitted via POST method, constructs an SQL INSERT query, and executes it to add the book details into the database table 'booklist'. Input fields are designed for user-friendly data entry, with inline CSS for basic styling, while PHP script handles backend processing. Upon submission, users receive feedback indicating whether the insertion was successful or not, with redirection to the homepage after a brief delay for a smooth user experience.
- Search and select book/s: A PHP script, 'search.php' is designed to facilitate searching for books in a database. It receives search criteria and keywords via POST method, constructs an SQL query to search for matching books, and displays the results in a table format. The search results dynamically populate a table with book details such as ID, title, author, publisher, location, and row number. Users can select specific books using checkboxes, and JavaScript functions enable interactive features like checkbox highlighting and retrieval of selected book locations and row numbers. Overall, 'search.php' provides an intuitive interface for searching and selecting books from the database, enhancing user experience and usability.
- Store the location and row number of book: By using JSON functions, store the details of the book selected using checkbox, in local storage of the browser on temporary basis. Further, these details are used to highlight the books and LED's using different colors (see Figures 2 and 3).

– Interactive visualization of Book and Book shelves: At the last, the HTML 5 canvas along with HTML and JavaScript is used to display real time library layout (see Figure 2) and shelf front view (see Figure 4) for showing the exact location of all the book shelves with highlighted color of selected book and book shelves. Also, a new technique is implemented virtually, known as "LED Addressing Technique". This will help to identify the exact location of book placed on a shelf by highlighting a different colored LED placed below the book.

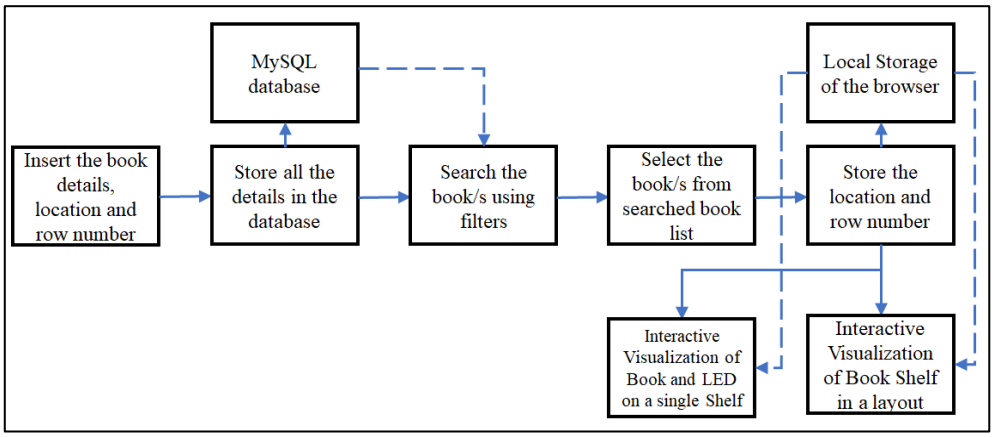



Figure 5. Step-by-step procedure for development of an interactive visualization using HTML

### 3.2. Development of IoT enabled LED addressing technique-based book shelf

Similar to the web application developed for interactive visualization of book using HTML as discussed in earlier section, the physical working model of IoT enabled LED addressing technique-based book shelf is developed as shown in Figure 1 and the system architecture on which it is based is shown in Figure 3.

The main components of the whole book shelf system developed are as follows: i) Book shelf with four rows, ii) Wi-Fi enabled controller - ESP32, iii) WS2812B addressable RGB LED strip, iv) power supply through USB Port of laptop, v) web application running on local host, and vi) computer/laptop/Android mobile.

The details of book searched and selected using web application developed are stored in local storage. Further, those details, such as book number from left side and row number from bottom in which row the book selected is placed, are communicated to Wi-Fi enabled Arduino microcontroller module ESP32. Then, corresponding input-output pins trigger a signal to respective WS2812B addressable RGB LED strip based on the row number data stored in local storage of web application. According to the location of book from left side, respective LED from the triggered LED strip will glow with a specified color. This LED is helpful for the user to detect the exact location of book and row in a shelf where the book is placed. The electronic circuit needed to work the book shelf is shown in Figure 6.

As shown in above circuit diagram, micro-USB port of the microcontroller is used to supply electrical power needed to operate the microcontroller module. Further, the same power supply is used by all the four WS2812B addressable RGB LED strips using 5V and GND ports provided on the module as shown in Figure 6. For triggering the specific LED strip and LED from the same strip, digital input output pins are used such as GPIO05, GPIO18, GPIO19 and GPIO21 respectively for first row to fourth row from bottom, and those pins are connected to each "Din" pins provided on each LED strip separately.

### 3.3. Development of proposed IoT system

The system is proposed to work on "IoT" and "LED addressing technique". This will allow the service robot to identify the correct location of book selected either with the help of predefined location of the respective book stored. Also, to self-verify the same using LED glowing at the place exactly below the book selected using a web application developed. The system architecture for the proposed system is shown in Figure 7. Further, data such as book retrieved or not, can be stored using an interface for inventory management in a library system. The development of the proposed system consists of three main modules, such as i) software/web application module, ii) controller, and iii) hardware module (refer Figures 1 and 6 for more details).

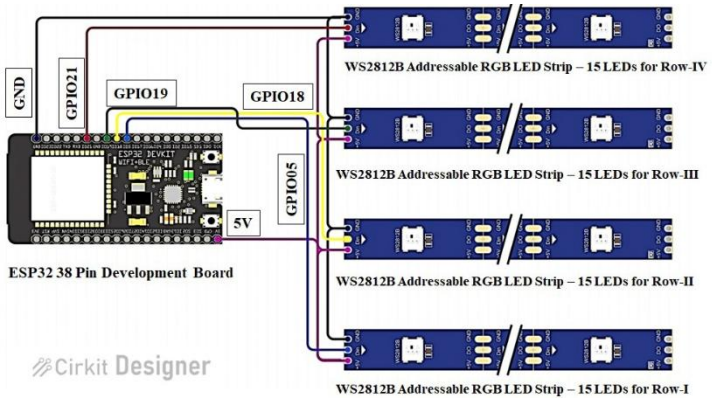



Figure 6. Circuit diagram for IoT based LED addressing technique

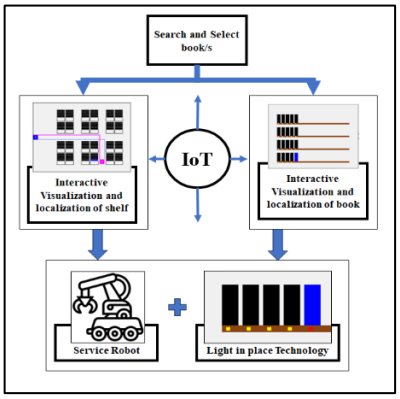



Figure 7. Proposed IoT system architecture

## 4. RESULTS AND DISCUSSION OF EXPERIMENTAL TESTING

The developed interactive visualization tool and IoT enabled LED addressing technique-based book shelf were experimentally evaluated to validate their feasibility, capability and potential for smart library applications. The results related to the same is discussed along with relative significance and automation implications as follows:

### 4.1. Testing of interactive visualization tool using experimental evaluation

To evaluate the practical effectiveness of the developed interactive visualization tool, results in terms of feedback received from localhost servers, programmed if-else statements, html display commands and actual final experimental testing of the tool were performed in the best way possible. During the programming stage, the results obtained from the feedback received using localhost servers, programmed if-else statements and html display commands are analyzed. Then, the modifications are implemented accordingly to enhance the system visualization and performance. For testing purpose, check sheet is designed and implemented to record the results.

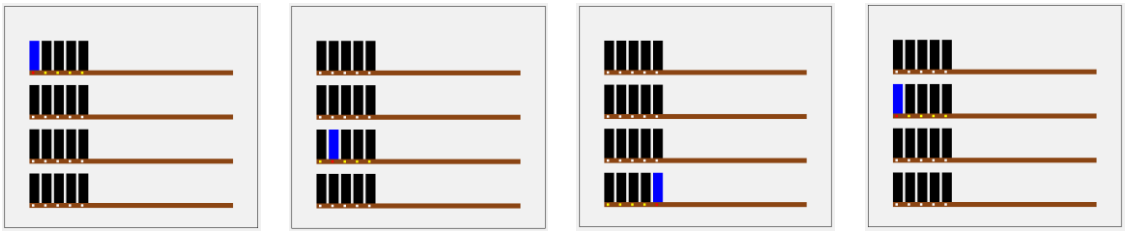
From Table 2, enlisted parameters and respective tools required to achieve the targeted results are tested using experimental conformance test. Total 9 parameters are used for testing the performance of the developed visualization of the shelf and books placed on a shelf. During programming stage, if any one of the testing parameters does not fit as conformance, then the modifications were done and again tested for conformance. The process of testing continued until the conformance stage was not achieved. After successful programming trials, the whole system was tested for four different conditions as shown in Figure 8.

Table 2. Check sheet for testing of interactive visualization tool

| Testing parameter | Tool | Conformance | Non-conformance |
|---|---|---|---|
| Servers started? | XAMPP control panel v3.3.0 | ✓ | × |
| Connection to server (Apache/MySQL) is formed? | Localhost server (PHP) | ✓ | × |
| Book details are inserted in MySQL database? | Programmed if-else statements (HTML and JavaScript) | ✓ | × |
| Required book is displayed using filters provided for search? | Display booklist related to filters (HTML and JavaScript) | ✓ | × |
| Proper book is selected using check box provided? | Color the row (HTML, JavaScript and CSS) | ✓ | × |
| Is the data related to book location stored in local storage of the browser? | Display the data stored (HTML and JSON) | ✓ | × |
| The parsed data from local storage is the same as per requirement of the program? | Display the data parsed (HTML and JSON) | ✓ | × |
| Is the book shelf navigation properly visualized and easy to understand? | Display the book and shelf location in a layout (HTML 5 Canvas) | ✓ | × |
| Is the book placed in a shelf properly visualized using different color contrast for book and LED? | Display the book and LED (HTML 5 Canvas) | ✓ | × |

In all the four conditions, the developed system shows the results as per expectations, without any error. For conducting this test, initially the books are searched using ‘Search Book’ tab and selected the required book using checkbox. The selected book has value of location as ‘A201’ and value of row number

from bottom as ‘4’. Here, ‘01’ from ‘A201’ is the sequential number of a selected book from left side and value of row number is the sequential number of a row in a shelf from bottom. Using these details from MySQL database, the visualization of the single shelf, book selected along with other books and LED was displayed accurately for better understanding of the user. Colors such as blue, red and yellow are used for displaying the visualization results of a selected book, LED and row in a book shelf respectively, see Figure 8(a). Similarly, the visualization results for all the three cases viz. B302:2, D405:1 and F301:3 were plotted accurately as shown in Figures 8(b) to 8(d).



(a) (b) (c) (d)

Figure 8. Visualization results for four conditions *i.e.,* for four books placed at different locations (a) location A201:4, (b) location B302:2, (c) location D405:1, and (d) location F301:3

### 4.2. Testing of IoT enabled LED addressing technique-based book shelf

To evaluate the practical effectiveness and operational performance of the proposed IoT-based book localization system *i.e.,* developed IoT enabled LED addressing technique, the experimental setup is tested for 20 different real-world conditions using a web application developed, out of which 4 cases are shown in Figure 9. During experimental testing, multiple cases were tested by observing the respective LED indicator’s performance followed by entering related queries using search option in a web application developed. These LED will indicate the corresponding physical shelf location of the book to be retrieved. The experiments were conducted across repeated trials to evaluate system behavior under continuous operation. Key testing parameters included LED activation response, localization accuracy of the indicated shelf position, and system reliability during sequential search requests. For assisting automated book identification and retrieval tasks, these experiments were designed to simulate multiple practical book retrieval cases and to validate the effectiveness of the proposed framework.

For the first case, initially the required book (*i.e.,* placed on first row of the shelf from bottom and at the first position from left side) from a bookshelf is selected using the checkbox. After clicking on select option provided in a web application, the related details such as row number (*i.e.,* first from bottom) and book number from left side (*i.e.,* first from left side) are stored in local storage of a browser and those details are provided to the Arduino microcontroller module ESP32 using Wi-Fi hotspot connection. Those details are used to glow the respective LED (*i.e.,* first LED from left side placed in a first row from bottom) on a physical book shelf as shown in Figure 9(a), similar to the interactive visualization on a web application developed. On a similar line, all the remaining three conditions as shown in Figures 9(b), 9(c) and 9(d) are correctly tested on the developed experimental setup. Summary of the statistical results are discussed in Table 3, which are observed based on experimental testing and microcontroller system performance.

(a) (b) (c) (d)

Figure 9. Experimental testing results for four conditions *i.e.,* for four books placed at different locations, (a) row-1, LED from left side – 1, (b) row-1, LED from left side – 2, (c) row-2, LED from left side-5, and (d) row-3, LED from left side-4

Table 3. Statistical results based on experimental testing

| Sr. No. | Parameter | Nature of test result | Observed value |
|---|---|---|---|
| 1 | Structured conformance tests for testing web application *i.e.,* interactive visualization tool (Refer Table 2) | Qualitative | 9 trials |
| 2 | Experimental Testing of proposed and developed prototype of IoT enabled book localization framework using LED addressing technique (See Figure 9) | Qualitative | 20 trials |
| 3 | Average LED activation time | Quantitative | 95 ms |

The experimental evaluation in this study aimed to confirm the operation of the proposed IoT-enabled LED addressing technique for book localization. Researchers tested the prototype system in several retrieval scenarios that included different shelf rows and book positions. In all cases, the system activated the correct LED indicator based on the chosen book location. This showed that the web interface, ESP32 controller, and LED addressing mechanism communicated effectively. While the trials showed reliable performance under the tested conditions, it is essential to understand that this evaluation is a prototype-scale functional check, not a large-scale reliability analysis. In real library settings, factors like network response delay, database size, user interaction frequency, and shelf density could affect how well the system performs. Therefore, future studies will involve large-scale tests with extensive datasets and repeated retrievals. This will help evaluate localization accuracy, response times, and overall system reliability.

### 4.3. Significance and automation implications

Proposed and developed prototype model of IoT based LED addressing technique showed the potential as a cost effective and alternate solution to the available techniques for book detection and localization in a conventional library system such as RFID and barcode-based techniques. Integration of web application used for book search/selection and IoT enabled LED addressable shelf, showed the future scalability automation ready architecture that improves reliability of the book localization and ease of book retrieval using service robots. Compared to that of barcode and RFID based conventional frameworks for book localization and detection, this proposed framework provides a physical confirmation mechanism using LED activation, which will reduce the ambiguity during automatic book retrieval.

From the automation point of view, the proposed and developed prototype can be useful as a foundational smart infrastructure for future autonomous service robots in various industries where storage and retrieval are of utmost important function. The combination of deterministic localization information provided from the database of a web application and feedback in the form of respective LED activation, can assist service robots for accurately detecting the required book for its effective retrieval operation from the shelf. This proposed framework can be extended for multiple other applications such as warehouse inventory management, smart automated storage and retrieval system (AS/RS) applications and many other applications where storage and retrieval functions are associated. Therefore, the integration of interactive visualization with IoT-based physical localization presents a practical pathway toward intelligent automation in inventory-intensive environments.

## 5. CONCLUSION

The present work introduces a novel IoT-enabled interactive visualization system for efficient book and bookshelf identification. “LED addressing” technique based physical localization technique with an integration of web-based interface passed all the 9 tests conducted for its conformance in identifying the required book locations across 20 distinct test conditions during experimental evaluation. These results show its usability, reliability and feasibility for real life applications such as automated warehouse management systems. The development and testing of the interactive visualization tool and IoT system have demonstrated promising results, indicating the effectiveness and feasibility of the approach. The novelty and uniqueness of this work is a hybrid integration of virtual interactive visualization of book localization and IoT driven physical localization. It is offering a cost-effective, user centric and feasible solution, as compared to the traditional methods of barcode or RFID.

The proposed prototype model of web application based, IoT enabled and LED addressable book localization system demonstrated reliable performance during experimental validation, but several limitations associated need to be acknowledged. The present implementation represents a laboratory-scale prototype and has not yet been deployed in a large-scale operational library environment. In addition, the system relies on Wi-Fi communication between the web application and the ESP32 controller, which may introduce performance variations under unstable network conditions. The current framework also does not incorporate machine vision or sensor-based verification mechanisms for automatic detection of book placement.

Further, in future smart libraries, integration of additional tools such as machine vision, advanced IoT sensors and AI driven analytics may run the automated service robots for creating fully automated book management ecosystems. Future research work will focus on addressing these limitations by incorporating artificial intelligence-based machine vision techniques for automated book detection. Further studies will also explore multi-shelf scalability for library having large quantum of books and shelf. Also, it can be the focus of future research work that the integration of the proposed book identification and localization framework with autonomous service robots capable of performing fully automated book retrieval operations. In addition, large-scale performance testing and system reliability evaluation under realistic environmental and operational conditions will be conducted to assess the suitability of the system for deployment in real-world smart library environments.

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## AUTHOR CONTRIBUTIONS STATEMENT

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sagar S. Ajanalkar | | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | | |
| Harshadeep S. Joshi | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓ |

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

## DATA AVAILABILITY

The data presented in this study are available on request from the corresponding author.

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