International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s, 2025
https://www.theaspd.com/ijes.php

IOT-Enabled Smart Library Seat Management For Improved Resource Allocation

Dr. Ch. Bhupati[1], Meghana Donthi Reddy[2], Syed Kaleemuddin[3], Vedicherla Devi Priyanka[4]
[1]Department of Internet of Things Koneru Lakshmaiah University Vijayawada, India bhupati@kluniversity.in
[2]Department of Internet of Things Koneru Lakshmaiah University Vijayawada, India 2100100050iot@gmail.com
[3]Department of Internet of Things Koneru Lakshmaiah University Vijayawada, India 2100100060iot@gmail.com
[4]Department of Internet of Things, Koneru Lakshmaiah University, Vijayawada, India, 2100100015iot@gmail.com

***Abstract*—** *Libraries often have difficulty in effective regulation of sitting arrangement, resulting in a seat monopolization and obstacles to locating free seats. Conventional manual techniques are laborious and ineffective, leading to suboptimal allocation of resources and user inconvenience. We design intelligent library -based libraries that automates seat monitoring, optimizes the use of the library and increases the user experience. This technology uses resistors to detect strength to detect seat occupancy in real time and ensure precise and automatic monitoring. This solution uses IoT technology to connect traditional seat management methods using current automated systems, which improves efficiency and availability. The web interface allows students and librarians to remotely verify the availability of seats, minimize unwanted questions and increase operating efficiency. This research increases the topic of intelligent infrastructure using IoT management of the library. The system provides a scalable and economic solution that modernizes configurations of sessions, increases availability and comfort, while creating the basis for future developments in automated library systems.*

"Index Terms–IoT (Internet of Things), Library Management System, Seat Occupancy Detection, Automated Seat Monitoring, Real-time Tracking"

INTRODUCTION

At the current age of digital transformation, libraries adapt to integrating intelligent technology for increased management of resources and user comfort. An important obstacle that it encounters in academic and public libraries is the ineffective distribution of seats, which results in students' problems with finding unoccupied chairs and librarians who have problems with the monitoring of occupancy. Problems such as "Hogging seats" when people place their belongings to claim their seats, worsen the problem, leading to frustration and inefficient use of space. The absence of a systematic method for checking the availability of seats leads to inefficiency, because students are forced to manually look for unoccupied chairs, so the disturbance of the atmosphere of the library. In addition, librarians often lack the necessary resources to effectively implement restrictions on the use of seats, which complicates the ensuring fair access to all users. The potential solution for solving these difficulties is the system of intelligent seat library with IoT support. This system combines sensor technologies with cloud computing and provides information about seat occupancy in real time. Pressure sensors will be integrated into the chairs of the library for monitoring use.

and passing information to the cloud platform. The collected data is then analyzed and displayed on the digital display at the entrance to the library, allowing students to effectively identify the available seats without external movement. This excludes the need for real seats, reduces disorders and improves the overall experience of the library. The system works using a systematic algorithmic methodology. After filling the seat equipped sensor, the system identifies the status and transmits data to the cloud server. Data is examined using established algorithms to determine the formulas in the use of the seat, helping librarians to detect trends and increase the distribution of resources. This technology not only displays the availability of real -time seats, but also launches automatic announcements that inform librarians about extended seat reserves or not use the occupied seats and therefore ensure fair access to all patrons of the library. This solution improves operational efficiency, guarantees fair access to seats and maximizes the

use of space using IoT and automation. Real -time analysts allows library managers to observe seating formulas and select informed about data, such as adjusting the arrangement of sessions or measures to prevent the seat monopolization. In addition, the use of machine learning algorithms can facilitate the prediction of a period of high use and propose an improvement in the seating system, which improves both comfort and efficiency. The implementation of such an intelligent system increases the user experience while helping libraries in maintaining an organized and available educational environment. Students have reduced waiting times and increased productivity, while librarians get an improvement in the management of seating regulations and general library functions. In addition, the system can be extended with additional capabilities such as connecting mobile applications, allowing students to verify the availability of seats remotely before they arrive at the library. This optimizes the procedure and increases the ease of consumer. Smart Library Seating Setup Settings means significant progress in the modernization of the library infrastructure and increasing the allocation of resources.

LITERATURE REVIEW

Mohadud Rashid Mohamud is an intelligent library system using PIR, MCU node and web interfaces for reservations, occupancy monitoring and resource optimization. It predicts occupancy using a random forest model, improves space use and energy efficiency [1]. AZAD Shokrollahi This research analyzes the occupancy of the occupancy of intelligent buildings using PIR sensors for counting people, detection of activity and localization. They emphasize their cost efficiency, privacy benefits and minimal processing. The report examines the research of machine learning and sensor configuration 2015–2023 [2]. Mohammad Syahmi Hilmi Zaharuddin's Smart Chair monitors the posture with four ultrasonic sensors and the occupancy with four FSR sensors, which provides real -time announcements through BLYnk. Three volunteers have verified their health reliability in health [3]. Magauwane Reneilwe Maepa Industry 4.0, AI and IoT changes the library practices, but their impact on seat management is inconsistent. The contribution is reviewed by a SLSORS study using taxonomy about reservation, reservation of seats, selection and availability for comparison of evaluation methods and emphasizing challenges in accurate reservations and monitoring of occupancy in real time [4]. Taraneh aminosharieh najafi eight pressure sensors and a special signal collection plate send data via Wi-Fi to GUI in the Smart Chair of Paper. The Echo Memory network has achieved 91.68% accuracy with 40 participants and seven deep learning models, which facilitated posture detection, cheap and adaptable [5]. Author: Pavol Kucha'r, this research examines 146 contributions on vehicle occupancy and passenger identification. Invasive procedures are accurate and cheap, while non -invasive methods protect privacy but work badly. Future research will include windows and vehicle types [6].

The Garcia-Granja study emphasizes the advantages of using BIM in a real-time occupancy control system for the University Library in Spain Malaga. The survey indicates that consumers evaluate the quality of the system of the system highly and considered better than current reservation systems, with the potential to regulate the social department and minimize energy use [7]. Bingxin Du offers a VCG-based restaurant reservation system, which optimally assigns clients and maximizes social value in response to the COVID-19 influence on a restaurant seating. This technology promotes rational behavior of clients, increases the revenue of the restaurant and monitors preventive COVID-19 methods [8]. Magauwane Reneilwe Maep is a system of occupancy and reservation of seats based on IoT for Tshwane University of Technology (TUT) in South Africa using RFID and FSR technologies. This technology provides real -time tickets and online booking tickets, which makes it easy to find seats. The prototype evaluation showed

99% accuracy shows its effectiveness and viability for academic libraries [9]. To analyze the selection of seats for passengers in this SHUAI Shaoc study for air reservation (ASR), it is used to analyze seat seats in this SHUAI Shaoc study to analyze seat seats in this SHUA Shaoc to analyze passenger seats in this study. The model means that the price, distribution, timing and seasonality affect the likelihood of ASR and that the front seats are preferred over middle seats. This knowledge enables product diversification and variable prices and methodology can be expanded to other auxiliary services [10]. Beril Sirmacek offers a low -cost, low -energy method of prediction with low -resolution of thermal sensors. Comparison of the occupancy of computer vision and machine learning. Computer vision adapts to noise, while machine learning shines with clean data. The results show that the noise artifacts and recordings with empty rooms

that could be used in geriatric care determine by approach [11]. The Anshu Prakash Murdan bus information technology system employs IoT, infrared sensors, resistors to forces, GPS and raspberry pi to measure the occupancy of the vehicle in real time. Data sent to the Internet platform and visualized using a mobile application and improve public transport interfaces by showing dynamic seat availability. Following real -time slots and vehicle position accuracy were tested on a 20 -digit bus [12].

Haidar's research is an optimization method based on the energy management charts and integrates the prediction of the behavior of passengers with monitoring of occupancy in real time. It optimizes the HVAC pre -cooled/cooling by predicting room movements and repairing forecasts. It reduced energy consumption by 39.09% while maintaining 99.39% of passenger comfort [13]. Ana Torres, this article describes how the Bern Dibner library in Nyu-Tandon used a low-cost evaluation approach to occupancy analysis and identification of problems. The collected data have improved services, learning and reach design, improve user experience [14]. Okoronkwo Chinomso Daniel, this document represents a system that integrates pressure sensors, RFID and web application to provide real -time seat occupancy and minimize hogging seats, free seating and unnecessary phone calls. The prototype reached an accuracy of 99% and the web application showed 90% of the seat use, showing its efficiency and feasibility [15]. Yuhao Jing, research examines Arduino microcontroller, which monitors seat occupancy using real -time sensors and data transfer. It prevents disproportionate reservations and manages vacancies to maximize the use of seats. Tests reveal reliable operation and good seat management [16]. Jianghan University used the WeChat Public Number Seat Reservation system to solve long -term seat occupancy, according to Donghua Zhou.

problems. The method increased the efficiency and availability of space management for self -study [17]. Yihan Wanga's research examines the intelligent system management system, namely the public space reservation system. The management of the Intelligent Library requires optimized seat management and zoning methods for the library as the entry grows [18]. This article Bibi Raissah Odereth creates a mobile application for improved library management, including seat availability, cabinet automation and receiving control. Students are informed about free chairs, administrators can manage the lighting and data of employees and Raspberry Pi and Wi-Fi work smoothly. Testing verified its reliability and sensitivity [19]. The Kehinde Williams reservation system uses database management, HTML and PHP to automate booking and management, eliminating human records. Object -oriented development increases efficiency, reliability and scalability [20]. Peter Benjamin Cooper, this work optimizes the allocation table with Hot-DESKING using the occupancy sensing model. It improves productivity in the workplace of seat distributions depending on the noise levels, the length of stay, the requirements for equipment and the proximity of cooperation using IoT data [21]. Michelle Breen, this research examines students who book library seats by leaving things unattended by a waste of space. The table initiative has been analyzed by means of data on questionnaires and quotes and access data. The students liked the intervention because it reduced the community reservation of the headquarters based on trust [22]. Nguyen Huy Hoang Huy, this study describes a system of occupancy occupancy of seats based on the university library. Sensors on 36 chairs have been accuracy of 91.2% in eight weeks despite hardware failure and signal interference. The contribution describes the design and changes of the real world reliability system [23]. NURSYEHA YAHAYA, this study uses thermal maps in the library Li Ka Shing to measure occupancy in real time and users' involvement. It examines sources of data on libraries and experience of students to innovate library services [24]. Huy Hoang Nguyen provides cost -effective capacity and method of infrared sensor to detect the occupancy of seats in shared public areas. The system reliably detects when the seat is occupied, unoccupied or occupied objects dealing with the library seat with minimal work [25]. A. Larsan Aro Brian, this research is a solution to an intelligent IoT library that circumvents RFID restrictions for loans and book return. The system uses Library Management System (LMS) and NFC-based Wi-Fi to help users find books in the library [26]. This article presents a library management system based on RFID with user -friendly GUI, optimized antennas with 100% readability of brands and brand readability, and C. Polycarpou.

Reduction of interference, improved efficiency in low SAR environments [27]. Safarini Osama, this article emphasizes the need for contemporary, adaptable and efficient hotel booking systems, including databases. A well -integrated system optimizes reservations, provides accounting consistency and helps

manage hotel and decision -making [28]. Boby George, this study represents a low -cost occupancy occupancy detector on induction. It reliably identifies people and conductive things such as laptops under the seat cushions. The occupancy detection system for the safety of airbags and other applications is simple for implementation [29]. Nariaki Nishino proposes a system of seat reservation based on auction to overcome fixed price limits. The model better represents the value of the content of the film by merging VCG and GSG. Simulations based on agents and experiments with people evaluate the technique [30].

GAP ANALYSIS

The gap analysis emphasizes significant inefficiency in conventional library systems, in particular the absence of effective communication channels for the availability of the seat, control of transport flow and optimize resources. Current intelligent library systems prefer to monitor the occupancy of the seat and booking books, but neglect problems such as ineffective seat use, as students leave personal belongings without supervision and unnecessary work needed to check the seats. The Covid-19 epidemic emphasized the need for an improved protocol for managing spatial and social distance. IoT systems that use RFID, FSR, pressure sensors and passive infrared (PIR) sensors have increased seating monitoring in real time and occupancy monitoring; Problems such as hardware disorders, signal interference and precise time prediction remain reservation. Contemporary reservation systems often show deficiencies in justice and efficiency, so they require sophisticated tactics such as Vicky-Clarke-Groves (VCG) and Gale-Shapey (GS) to increase seat allocation. In addition, they are economic, the techniques of assessment of privacy occupancy have not yet been written and functional zoning planning for increased spatial use remains the domain for progress. In addition to space management, libraries have obstacles with the comfort of the user, because the widespread sedentary behavior and insufficient attitudes to sitting lead to health complications. Although intelligent sitting solutions are available, including real -time posture and remedial feedback, their acceptance is still limited. To solve these shortcomings, libraries must use advanced reservation systems, effective real -time monitoring solutions, optimized space use techniques and top seating technology that emphasize user comfort and resource efficiency.

TABLE I

S.no	Year	Author	Article Title	Key Findings
1	2025	Mohamud Rashid Mohamud et.al	Optimizing Smart Library Spaces: Integrating PIR Sensors, Credit-Based Booking Systems, and Advanced Algorithms for Efficient Resource Management and Space Allocation	• Traditional libraries lack efficient communication channels for seat availability, traffic flow management, and resource optimization. A smart library system using PIR sensors, a node MCU, and a web app enables real-time seat booking, occupancy prediction, and resource optimization through machine learning models like Random Forest.
2	2024	Azad Shokrollah et.al	Passive Infrared Sensor-Based Occupancy Monitoring in Smart Buildings: A Review of Methodologies and Machine Learning Approaches	• Effective building digitization requires accurate occupancy monitoring for services like energy efficiency, security, and user comfort, but challenges exist in achieving reliable tracking. Passive Infrared (PIR) sensors provide a cost-effective and privacy- conscious solution for occupancy detection, with advancements in machine learning improving accuracy in people counting, activity detection and localization.
3	2024	Mohamad Syahm Hilmi Zaharuddin et.al	A Smart Chair for Sitting Postures Monitoring and Seat Occupancy Detection	• Prolonged sedentary activities and incorrect sitting postures lead to health issues like muscular imbalances and spinal misalignment. A Smart Chair with ultrasonic and Force Sensing Resistor (FSR) sensors monitors sitting posture and seat occupancy, sending real-time alerts via the Blynk app to improve user health and seating efficiency.
4	2023	Magauwane Reneilwe Maepa et.al	A Systematic Review on IoT-Based Smart Technologies for Seat Occupancy and Reservation Needs in Smart Libraries at Institution of Higher Learning	• Challenges in Smart Library Seat Occupancy and Reservation Systems (SLSORS) include inaccurate reservations, real-time tracking issues, and unreliable reservation time estimation. A comprehensive taxonomy and technical analysis of existing studies provide clarity on SLSORS challenges, solutions, and evaluation methodologies.
5	2022	Taraneh Aminosharieh Najafi et.al	Development of a Smart Chair Sensors System and Classification of Sitting Postures with Deep Learning Algorithms	• Prolonged sedentary behavior and poor sitting posture contribute to health issues, necessitating intelligent seating solutions. A smart chair equipped with eight pressure sensors and Wi-Fi connectivity enables real-time posture monitoring and data acquisition.
6	2022	Pavol Kuchár et.al	Passenger Occupancy Estimation in Vehicles: A Review of Current Methods and Research Challenges	• Invasive methods offer high accuracy at a lower cost, while noninvasive methods protect privacy but have lower accuracy. Future research will focus on overcoming challenges posed by window tinting and electromagnetic interference in different vehicle types.

7	2022	M. J. Garcia Granja et.al	Development of an Innovative Seat Reservation System for University Buildings Based on BIM Technology	• Lack of real-time seat availability information in public university spaces leads to capacity issues and inefficient seat utilization. A BIM based real-time seat occupancy management system improves reservation processes, enhances user experience, and helps control social distancing and energy consumption.
8	2021	Bingxin Du et.al	Restaurant Reservation System Allocating Customers with Space Management Under the Impact of COVID- 19	• The COVID-19 pandemic significantly reduced restaurant attendance, necessitating efficient space management and social distancing measures. A new reservation system utilizing the VCG mechanism was designed to ensure truthful customer reporting, optimize table allocation, and maximize restaurant revenue while maintaining COVID-19 safety protocols.
9	2021	Magauwane Reneilwe Maepa et.al	IoT-Based Smart Library Seat Occupancy and Reservation System using RFID and FSR Technologies for South African Universities of Technology	• Library users face difficulty in finding vacant seats, as existing smart library systems mainly focus on seat occupancy detection and book reservations, with limited development in South Africa. An IoT based Smart Library Seat Occupancy and Reservation (IoT-SLSOR) prototype using RFID and FSR technologies enables real-time seat tracking and online reservations, achieving 99% accuracy in pilot testing at Tshwane University of Technology.
10	2020	Shuai Shaoc et.al	Whether, when and which: Modelling advanced seat reservations by airline passengers	• Passengers exhibit strong preferences for front seats and avoidance of middle seats, with significant seat-specific variations influencing Advanced Seat Reservation (ASR) choices. ASR likelihood is affected by factors like relative price to ticket cost, booking channel, time to departure, and seasonal trends, enabling product differentiation and dynamic pricing strategies.

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s, 2025
https://www.theaspd.com/ijes.php

METHODOLOGY

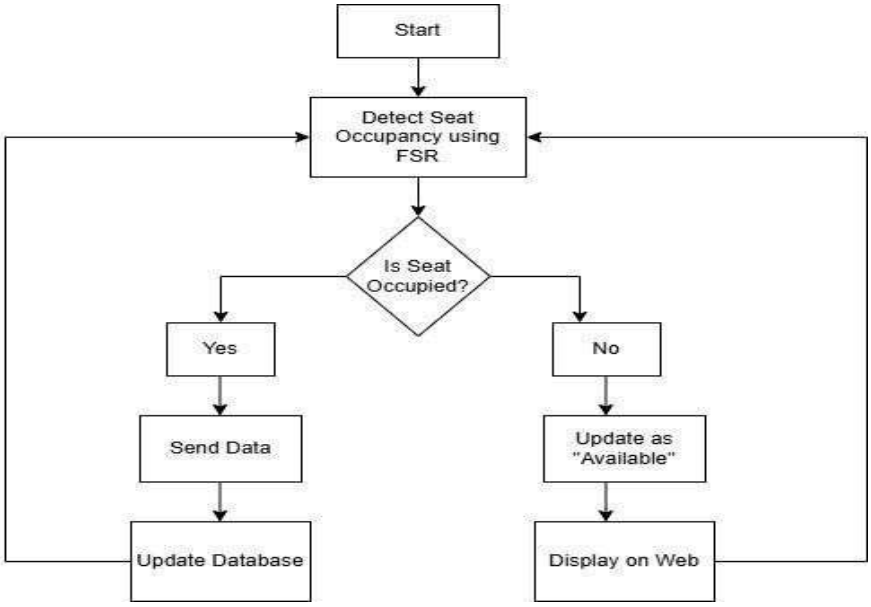

Fig. 1. Block diagram of the seat occupancy sytem.

1. Start the System
2. Detect Seat Occupancy
3. Check Seat Occupancy Status

3.1. If Seat is Occupied

· Send occupancy data to the cloud database (Fire- base/MySQL).
· Update the database with "Occupied" status.

3.2. If Seat is Vacant

· Send availability data to the cloud database.
· Update the database with "Available" status.

4. Update Web Dashboard
5. Repeat Monitoring (go to STEP-2)

1. System Initialization

IoT components are activated to establish a system. The Force-Sensing Resistors (FSRS) and the ESP32 microprocessor are activated. The microcontroller operates a program that constantly monitors seat occupancy status. To enable data transfer in real time, the system creates a connection with the Wi-Fi network.

2. Detecting Seat Occupancy Using FSR Sensors

Each seat is equipped with a FSR sensor that quantifies pressure to determine the presence of an individual. The FSR sensor changes its resistance in response to pressure developed when the individual sits. The microcontroller acquires an electrical signal due to this change. The microcontroller continuously reads and analyzes the sensor values to determine the occupancy of the seat.

3. Evaluating Seat Occupancy Status

The microcontroller compares the obtained sensor value with a predefined threshold. The technology identifies the occupancy of the seat when the pressure measurement exceeds the threshold. The system perceives the seat as unoccupied if the sensor value falls below the threshold. The system then changes the condition of the seat on the basis of this evaluation.

Case 1: If the Seat is Occupied

1. Sending Data to Cloud Database: The microcontroller transmits the occupancy of seats in real time to the cloud database, such as Firebase or MySQL.

2. **Updating the Database**: The database registers the status of the seat as "occupied", so it guarantees that the most up -to -date information about the occupancy is maintained.
3. **Refreshing the Web Dashboard:** The web interface gets new data from the cloud and shows the seat of the seat. This helps users in recognizing occupied armchairs and circumventing excess search.
4. **User Notifications (Optional):** If notifications are activated, users are waiting for a seat that can get alerts using SMS, E -mail or application notifications when the seat gets available.

Case 2: If the Seat is Vacant

1. **Updating the Database**: When the seat is unoccupied, the system changes the cloud database to mark it as "available".
2. **Refreshing the Web Dashboard:** Seat availability is displayed on the web interface, allowing users to see free seats in real time. This allows students to quickly find available places before they arrive at the library.

Components and Their Functions

1. Force-Sensing Resistors (FSRs)

This project uses components sensitive to pressure known as Force-Sensing Resistors (FSR) to determine the occupancy of the seat. The force developed by an individual sitting in a seat equipped with a resistor sensitive resistor modifies the sensor resistance. The microcontroller (ESP32) interprets the electrical signal generated by this modification. The system constantly monitors these signals to determine whether the seat is filled or unoccupied. FSR are ideal for monitoring seats in real time in public areas such as libraries and schools, where space management and occupancy monitoring are necessary because they provide reliable and cost -effective means of detecting pressure changes.

2. Microcontroller (ESP32)

The unit of processing the core of the seat occupancy detection system is the ESP32 microcontroller. He constantly obtains data from the FSR to determine the state of the seat occupancy. To pass on changes in the cloud database in real time, the Wi-Fi network is created. ESP32 was selected for efficient data processing, built-in Wi-Fi and minimal energy consumption. IT Enables Smooth Communication Between the Sensors and the Cloud, Ensuring That Users May Get the Most Current Seat Availability Information VIA and Web Dashboard. The microcontroller manages optional user alerts to increase seat allocation.

3. Cloud-Based Server / Database (e.g., Firebase, MySQL)

Real -time occupancy data in real time must be stored and processed by a cloud server or database such as Firebase or MySQL. The ESP32 microcontroller transmits updated seat status to the database to maintain current data. The web dashboard provides customers with information about available and occupied seats in real time. Librarians and students can effectively monitor seating patterns. To optimize resource management in libraries and study areas, the database stores historical data that can be used to predict session formulas and improve space efficiency.

4. Web-Based Interface (Dashboard for Users & Librar- ians)

Students and librarians can detect the occupation of seats in real time using an intuitive dating panel offered by a web interface. It makes it easier to identify available seats by accessing data from the cloud database and graphically displaying seat availability. The control panel is accessible through computers or mobile devices and minimizes unnecessary seat search. Librarians can improve space management through an analysis of consumption trends. Upon availability of the seat, the system can warn customers with e -mail, SMS or applications notifications provided that these options are activated. This feature increases the user experience by ensuring effective seat allocation and shortening the waiting time in a busy educational environment.

RESULT AND DISCUSSIONS

1. Hardware Setup Overview

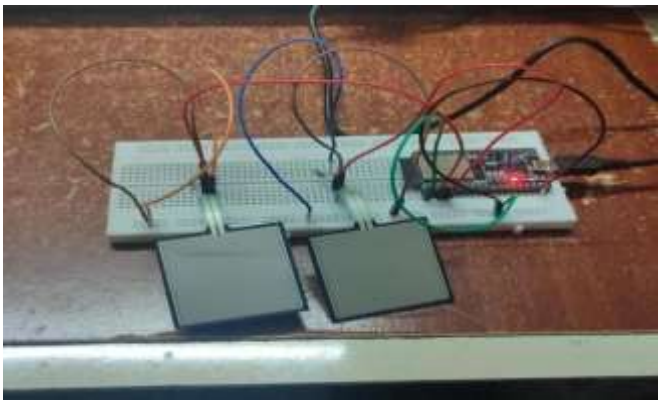

Fig 2: Hardware connections

The purpose of the FSR sensor is to detect the pressure exerted by the user while sitting in a library chair. The ESP32 analog input pin receives a signal that is then processed for comparison of Prague. The following step includes data recording to Firebase cloud, led by the results of this reasoning. This configuration uses multi-channel analog values or more microcontrollers associated with Wi-Fi Mesh, resulting in a compact, portable and easily scalable system to suit more seats.

2. Web Interface for Seat Visualization

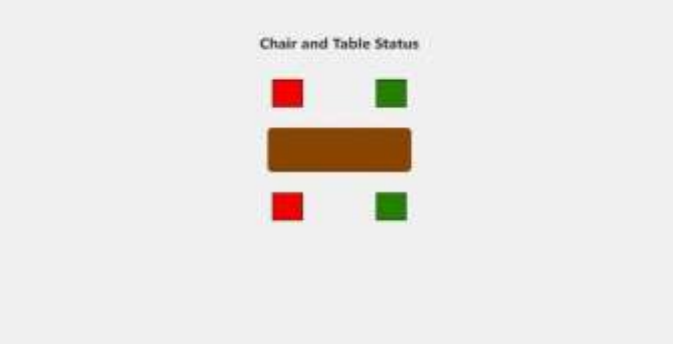

Fig 3: Seat Availability Display on the Web Dashboard with 2 vacant seats

The control panel offers explicit visual indicators and is intuitive to use. Among the four seats displayed, two are represented in red, which means they are filled, and the other two are illustrated green, which means their availability. This minimizes interruption in the library and facilitates students at immediate location.

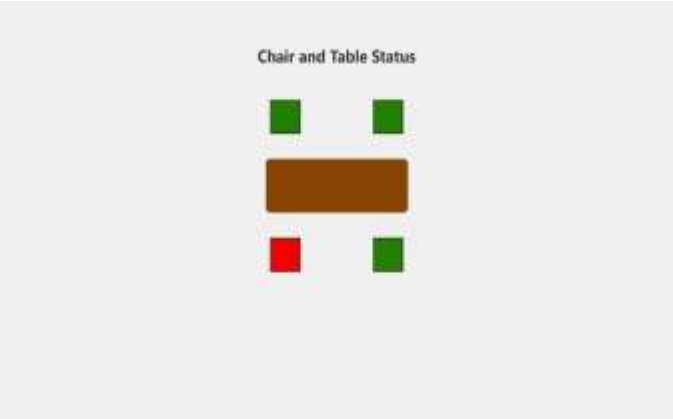

Fig 4: Availability Display on the Web Dashboard with 3 vacant seats

The control panel offers excellent visual indicators and is intuitive to use. Among the four seats shown is one marked in red, which means it is occupied, while the other three are marked with green, which shows their availability. This transparent visual system reduces the library failures and facilitates rapid identification of the suitable site of students.

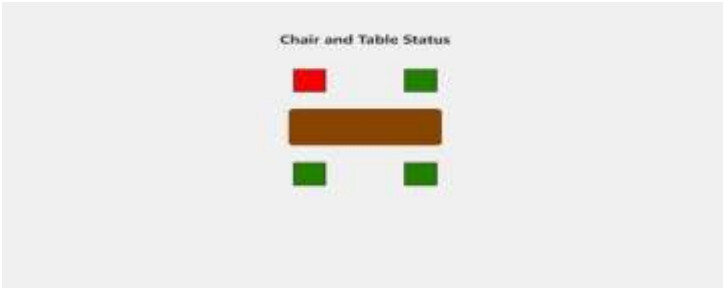

Fig 5: Seat Availability Display on the Web Dashboard with 3 vacant seats

The control panel offers excellent visual indicators and is intuitive to use. Among the four seats exposed, one is shown in red, which means it is occupied, while the other three are illustrated green, showing their availability. This transparent visual system reduces the library failures and facilitates fast search for students.

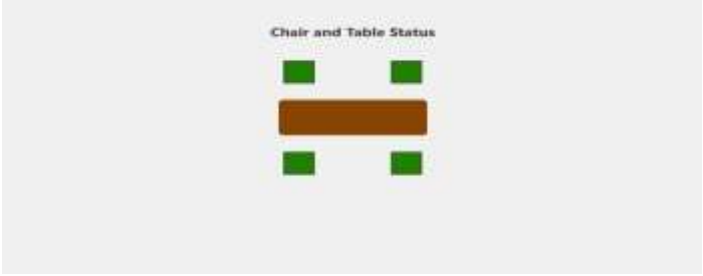

Fig 5: Seat Availability Display on the Web Dashboard with 4 vacant seats

The control panel is intuitive, with different visual indicators. Now all four seats are displayed green, which means their availability. This minimizes interruption in the library and facilitates the location of a suitable seat quickly.

3. Serial Monitor Logs

The serial monitor was a key tool for solving problems and observing the system's behavior during testing and first deployment. ESP32 consistently generated analog values from the FSR sensor and at the same time showed a comparison with an established threshold. This made it easier to verify the accuracy and reliability of the sensor data. The justification for determining the seat transition from the empty to the occupied and, on the contrary, the developers can be verified by analyzing patterns in serial protocols.

Fig 6: Default serial monitor values when seats are available

```
0 -> Available
Sensor value updated: 0
Last served sensor value = 0 -> Available
0 -> Available
Sensor value updated: 0
Last served sensor value = 0 -> Available
0 -> Available
Sensor value updated: 0
Last served sensor value = 0 -> Available
0 -> Available
Sensor value updated: 0
Last served sensor value = 0 -> Available
0 -> Available
```

To ensure clarity, we displayed confirmation messages on the serial display after each Firebase update. This made it easier to assess whether data recording data was successful or an error occurred. This allowed us to immediately identify any problems and maintain the certainty that all operations work smoothly.

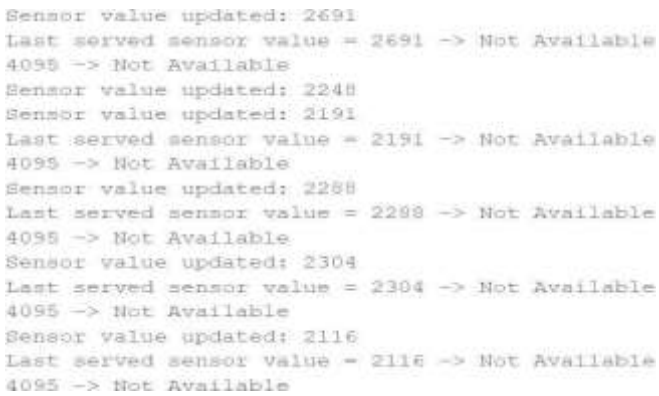

Fig 7: Serial monitor values based on availability

These protocols are essential for increasing the accuracy and reliability of the system. During tuning, the serial monitor indicated that the sensor could not detect pressure due to incorrect location or connection. Technology efficiently monitored seat occupancy in real time. Pressure fluctuations were precisely detected sensors, allowing the microcontroller to immediately update the cloud database. The online dating panel precisely, indicating "occupied" or "available" as relevant. The project has developed a reliable and efficient system management system in high -traffic areas such as libraries. Users benefit from the effort to locate the available seat via real -time updates on the dashboard. The use of IoT components (ESP32 and FSR sensors) in conjunction with cloud storage to guarantee the consistency of data associated with optional alerts, increasing the user experience by informing users about the availability of the seat. The design optimized space use and alleviated the inconvenience associated with locating available seats.

CONCLUSION

The use of intelligent seats with IoT support in libraries significantly increases user experience and efficiency. The system uses technology based on sensors and cloud computing to eliminate the inconvenience of manual seat search, making it easier to identify vacancies in real time. It helps students in immediate searching of seats and at the same time allows librarians to monitor the use, recovery of fair regulations and make educated judgments to optimize space use. This advancement in digital growth ensures a better organized, accessible and efficient environment for the library for all.

REFERENCES

[1] **Mohamud Rashid Mohamud, H. Chege Nganga and Stephen Kiambi. "**Optimizing Smart Library Spaces: Integrating PIR Sensors, Credit-Based Booking Systems, and Advanced Algorithms for Efficient Resource Management and Space Allocation**"**, International Journal of Computer Applications (0975 – 8887) Volume 186- No.63, January 2025. pg.no:55-60,
DOI:http://dx.doi.org/10.5120/ijca202592445510.5120/ijca2025924455.
Journal of Physics: Conference Series Volume 1176 032010, 2019 pg.no:1-6, **DOI:** 10.1088/1742-6596/1176/3/032010

[2] **Bibi Raissah ODERUTH, Kosheta RAMKISSOON and Roopesh Kevin SUNGKUR,** "Smart Campus Library System", IEEE Transaction Volume 2019 pages:6, DOI: 10.1109/NEXTCOMP.2019.8883636

[3] **Kehinde Williams and Ajinaja Micheal,** "Design and Imple- mentation of Reservation Management System Case Study: Grand Ville Hotels", Journal of Information Technology & Software Engi- neering Volume: 8(4), January 2018 pg.no:1-8, DOI: 10.4172/2165- 7866.1000243

[4] **Peter Benjamin Cooper, Konstantinos Maraslis, Theo Tryfonas and George Oikonomou**, "An intelligent hot-desking model harnessing the power of occupancy sensing data", EmeraldInsight Volume: 35, Is- sue 13/14, **ISSN:** 02632772, October 3 2017 pg.no:766 - 786, **DOI:** 10.1108/F-01-2016-0014

[5] **Michelle Breen, Mary Dundon and Ciara McCaffrey,** "Making every seat count: space management at peak times in a university library", New Review of Academic Librarianship Volume: 24, 2018 pg.no:105- 118,
DOI: https://doi.org/10.1080/13614533.2017.1414066

[6] **Nguyen Huy Hoang Huy, Gihan Hettiarachchi, Youngki Lee and Rajesh Krishna Balan,** "Small Scale Deployment of Seat Oc- cupancy Detectors" WPA '16: Proceedings of the 3rd International on Workshop on Physical Analytics Volume 2016 pg.no:25-30, DOI: http://dx.doi.org/10.1145/2935651.2935660

[7] **Nursyeha Yahaya, Devika Sangaram, Salihin Mohammed Ali and Aaron Tay,** "SMU Libraries: Sensory in library spaces" Singapore Journal of Library and Information Management Volume: 45, 2016 pg.no:61-73, https://ink.library.smu.edu.sg/library research/96

[8] **Huy Hoang Nguyen, Nakul Gulati, Youngki Lee and Rajesh Krishna Balan,** "Real-time Detection Of Seat Occupancy & Hogging", IoT- App '15: Proceedings of the 2015 International Workshop on Inter- net of Things towards Applications Volume 2015 pg.no:29-34, DOI: https://doi.org/10.1145/2820975.282098

[9] **A. Larsan Aro Brian, L. Arockiam and P. D. Sheba Kezia Malarchelvi**, "AN IOT BASED SECURED SMART LIBRARY SYS-
TEM WITH NFC BASED BOOK TRACKING", International Journal of Emerging Technology in Computer Science & Electronics ISSN: 0976-1353 Volume 11 Issue 5,NOVEMBER 2014 pg.no:18-21, DOI:
https://rb.gy/hsknsq

[10] **Anastasis C. Polycarpou, Theodoros Samaras and John N. Sahalos,** "An RFID-Based Library Management System Using Smart Cabinets: A Pilot Project", IEEE Transaction Volume 2014 pg.no:2954- 2955 **DOI:** 10.1109/EuCAP.2014.6902447

[11] **Dr. Safarini Osama,** "Integrated Information System for re- serving rooms in Hotels", International Journal of Advanced Com- puter Science and Application Volume: 2, No. 10, 2011 pg.no:48-52
,DOI:10.14569/IJACSA.2011.021008

[12] **Boby George, Hubert Zangl, Thomas Bretterklieber and Georg Brasseur,** "A Combined Inductive–Capacitive Proximity Sensor for Seat Occupancy Detection", IEEE Transaction Volume: 59 Issue:5, March 2010 pg.no:1463-1470, **DOI:** 10.1109/TIM.2010.2040910

[13] **Nariaki Nishino, Koji Fukuya and Kanji Ueda,** "Service Design in Movie Theaters using Auction Mechanism with Seat Reservations", IEEE Transaction Volume 2009 pg.no:528-533, DOI**:** 10.1109/SoC-
PaR.2009.106

[14] **Ana Torres and Gavin Paul,** "Reaching maximum occupancy: What the numbers tell us about space and ways to improve services", Journal of Access Services ISSN: 1536-7975, Volume 2019 pg.no:78- 93,DOI: https://doi.org/10.1080/15367967.2019.1614931

[15] **Okoronkwo Chinomso Daniel, Visham Ramsurrun and Amar Kumar Seeam,** "Smart Library Seat, Occupant and Occupancy Infor- mation System, using Pressure and RFID Sensors", IEEE Transaction Volume 2019 pg.no:1-5, DOI: 10.1109/NEXTCOMP.2019.8883610

[16] **Yuhao Jing, Limin Mao and Jiaqi Xu**, "Research on a library seat management system", IEEE Transaction Volume 2019 pg.no:297- 301,
DOI: 10.1109/ICISCAE48440.2019.221639

[17] **Donghua Zhou**, "Case Study on Seat Management of University Library Based on WeChat Public Number Client—Taking Jianghan University Library as an Example", IEEE Transaction Volume 2019 pg.no:630-633, DOI: 10.1109/ICMCCE48743.2019.00146

[18] **Yihan Wang and Yangyang Wei,** "Research on Library functional layout based on Intelligent occupying system", IOPScience Conf. Series:Journal of Physics: Conference Series Volume 1176 032010, 2019 pg.no:1-6, **DOI:** 10.1088/1742-6596/1176/3/032010

[19] **Bibi Raissah ODERUTH**, Kosheta RAMKISSOON and Roopesh Kevin SUNGKUR, "Smart Campus Library System", IEEE Transaction Volume 2019 pages:6, DOI: 10.1109/NEXTCOMP.2019.8883636

[20] **Kehinde Williams and Ajinaja Micheal**, "Design and Imple- mentation of Reservation Management System Case Study: Grand Ville Hotels", Journal of Information Technology & Software Engi- neering Volume: 8(4), January 2018 pg.no:1-8, DOI: 10.4172/2165- 7866.1000243

[21] **Peter Benjamin Cooper, Konstantinos Maraslis, Theo Tryfonas and George Oikonomou**, "An intelligent hot-desking model harnessing the power of occupancy sensing data", EmeraldInsight Volume: 35, Is- sue 13/14, **ISSN:** 02632772, October 3 2017 pg.no:766 - 786, **DOI:**
10.1108/F-01-2016-0014

[22] **Michelle Breen, Mary Dundon and Ciara McCaffrey,** "Making every seat count: space management at peak times in a university library", New Review of Academic Librarianship Volume: 24, 2018 pg.no:105- 118, DOI: https://doi.org/10.1080/13614533.2017.1414066

[23] **Nguyen Huy Hoang Huy, Gihan Hettiarachchi, Youngki Lee and Rajesh Krishna Balan,** "Small Scale Deployment of Seat Oc- cupancy Detectors" WPA '16: Proceedings of the 3rd International on Workshop on Physical Analytics Volume 2016 pg.no:25-30, DOI: http://dx.doi.org/10.1145/2935651.293566

[24] **Nursyeha Yahaya, Devika Sangaram, Salihin Mohammed Ali and Aaron Tay,** "SMU Libraries: Sensory in library spaces" Singapore Journal of Library and Information Management Volume: 45, 2016 pg.no:61-73, https://ink.library.smu.edu.sg/library research/96

[25] **Huy Hoang Nguyen, Nakul Gulati, Youngki Lee and Rajesh Krishna Balan,** "Real-time Detection Of Seat Occupancy & Hogging", IoT- App '15: Proceedings of the 2015 International Workshop on Inter- net of Things towards Applications Volume 2015 pg.no:29-34, DOI: https://doi.org/10.1145/2820975.282098

[26] **A. Larsan Aro Brian, L. Arockiam and P. D. Sheba Kezia Malarchelvi**, "AN IOT BASED SECURED SMART LIBRARY SYSTEM WITH NFC BASED BOOK TRACKING", International
Journal of Emerging Technology in Computer Science & Electronics ISSN: 0976-1353 Volume 11 Issue 5,NOVEMBER 2014 pg.no:18-21,
DOI:https://rb.gy/hsknsq

[27] Anastasis C. Polycarpou, Theodoros Samaras and John N. Sahalos, "An RFID-Based Library Management System Using Smart Cabinets: A Pilot Project", IEEE Transaction Volume 2014 pg.no:2954- 2955 DOI: 10.1109/EuCAP.2014.6902447

[28] Dr. Safarini Osama, "Integrated Information System for re- serving rooms in Hotels", International Journal of Advanced Com- puter Science and Application Volume: 2, No. 10, 2011 pg.no:48- 52,DOI:10.14569/IJACSA.2011.021008

[29] **Boby George, Hubert Zangl, Thomas Bretterklieber and Georg Brasseur,** "A Combined Inductive–Capacitive Proximity Sensor for Seat Occupancy Detection", IEEE Transaction Volume: 59 Issue:5, March 2010 pg.no:1463-1470, **DOI:** 10.1109/TIM.2010.2040910

[30] **Nariaki Nishino, Koji Fukuya and Kanji Ueda,** "Service Design in Movie Theaters using Auction Mechanism with Seat Reservations", IEEE Transaction Volume 2009 pg.no:528-533, **DOI:** 10.1109/SoC- PaR.2009.106