Smart Library Management System: Monitoring Capacity and Noise Levels using Arduino

Butron, Loyd Vincent, Batistis Rico, Aliwanag Nicka, Vallespin, John Edward and Kitt Cymonne Japson

IMAGINATIVE ABSTRACT

The Smart Library Management System: Monitoring Capacity and Noise Levels with Arduino Uno is a novel solution for libraries that allows them to efficiently control the number of people inside while also monitoring noise levels. This Arduino-based system counts the number of people entering and exiting the library using infrared sensors, while a sound sensor detects excessive loudness. The device has an LCD monitor that shows the current number of persons inside. When the noise threshold is surpassed, a buzzer is activated. This project includes a full installation, hardware setup, configuration, and usage documentation to ensure a user-friendly experience. There are also troubleshooting procedures offered to resolve any potential difficulties that may emerge. The Smart Library Management System offers libraries an automated and intelligent approach to optimize their operations and provide a peaceful environment for study and research.

INTRODUCTION

Smart Library Management System: Monitoring Capacity and Noise Levels with Arduino Uno is an Arduino-based system that can count the number of students entering and leaving the library using an infrared sensor, while also detecting any noise above a certain threshold level using a sound sensor. The system will incorporate an LCD display to show the current number of students in the library. The project will involve the use of Arduino, infrared sensor, sound sensor, LCD display, and other electronic components.

REVIEW RELATED LITERATURE

The use of smart technology in libraries, focusing on monitoring capacity and noise levels to improve the library experience. By leveraging advanced sensors and real-time information systems, libraries can provide up-to-date information on available seating and manage noise levels effectively. Admins can access real-time seat availability information, optimizing their study sessions, while noise level sensors enable staff to maintain a quiet environment. The integration of smart systems with existing library management software streamlines operations and enhances efficiency. Overall, smart technology enhances resource management, creates a conducive study environment, and contributes to an enhanced library experience for the student.

1. Benefits of Smart Library Management Systems:

a. Improved Space Utilization: Smart library systems utilize sensors to monitor occupancy, allowing libraries to optimize space usage and ensure a comfortable environment for visitors.

b. Real-time Data and Analytics: These systems provide libraries with valuable insights into visitor patterns, peak hours, and resource utilization, enabling better decision-making and resource allocation.

c. Efficient Resource Management: By automating processes such as check-ins, check-outs, and inventory management, smart library systems free up staff time, enabling them to focus on user assistance and other essential tasks.

2. Technological Components:

a. **IR Sensors**: infrared sensors are used to track the number of people entering and exiting the library. They help determine

the occupancy level and provide real-time data.

b. **Noise Level Sensors**: Noise level sensors or microphones are used to measure the ambient noise levels within the library. They can detect excessive noise and trigger alerts or actions when predefined thresholds are exceeded.
c. **Alerts**: When the library reaches its capacity limit or noise levels exceed acceptable thresholds, the buzzer generate alerts.
d. **Display Systems**: Liquid Crystal Display is used to display the library's capacity status. These displays can show real-time information of the library's space.

3. Challenges and Considerations:

a. Implementation Costs: While the long-term benefits are evident, the initial investment required for implementing a smart library system may pose a financial challenge for some libraries.

b. Accuracy and Reliability: The accuracy and reliability of the people counting sensors and noise level sensors are critical. Regular maintenance and calibration of these sensors are necessary to ensure their reliability over time.

c. Sensor Placement and Coverage: Proper placement and coverage of sensors are crucial for accurate data collection. Careful consideration should be given to the positioning of people counting sensors to accurately capture entries and exits. Similarly, noise level sensors should be strategically placed to measure noise levels in different areas of the library effectively.

c. Technical Infrastructure: Libraries need to assess their existing infrastructure and consider upgrades or modifications to support the integration of smart technologies.

4. Impact on Library Operations:

a. User Experience: Smart library systems enhance the overall experience for library visitors by providing convenient services, such as self-checkout stations and personalized recommendations based on user preferences.

b. Staff Roles and Training: Implementation of smart systems may require staff training and adjustments to roles and responsibilities, focusing more on user assistance, data analysis, and system maintenance.

c. Resource Allocation: The data collected by smart library systems can aid in informed decision-making regarding resource allocation, collection development, and space planning.

PROPOSED METHODOLOGY

This chapter describes how the researchers gathered the necessary data and information used in the entire study and present the reliable technique that this study used to ensure that the objectives of this study were met.

The Smart Library Management System aims to address the specific requirements and objectives of the project. A comprehensive requirement gathering phase is conducted to understand the functionalities needed, such as capacity monitoring, noise level detection, and user interface. Based on the gathered requirements, the system architecture and functionality are designed and planned. The next step is the development of the hardware components, including the Arduino Uno board, infrared sensors, sound sensor, LCD display, and buzzer. The software code is developed to program the Arduino Uno board and integrate the sensors, display, and buzzer.

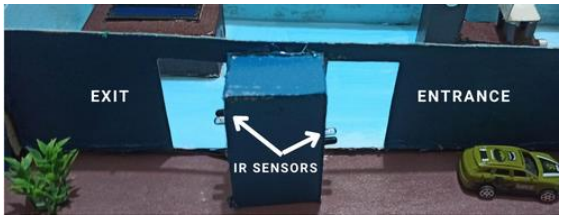
Advanced features like real-time monitoring and data analytics are also incorporated to enhance the system's effectiveness. Once the prototype is developed, rigorous testing is conducted in a controlled environment. Various scenarios are simulated to evaluate the accuracy of people counting and noise level detection. Feedback from library staff and users is gathered to assess the system's usability and performance. Based on the test results and user feedback, necessary refinements and optimizations are made to enhance the

accuracy, reliability, and user experience of the Smart Library Management System.

The hardware and software components are adjusted to ensure seamless integration and effective functionality. A comprehensive report is prepared, summarizing the proposed methodology, prototype functionality, testing results, and recommendations for further development or implementation. The system will contribute to creating an organized and user-friendly library environment, saving time and effort for library staff while improving the overall library experience for users.

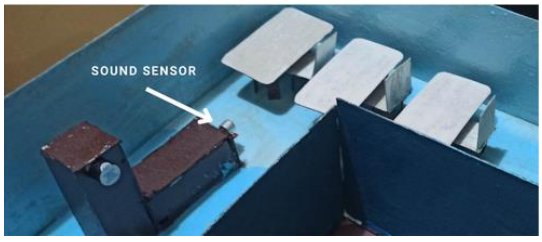
Functionality

1. Capacity Monitoring:



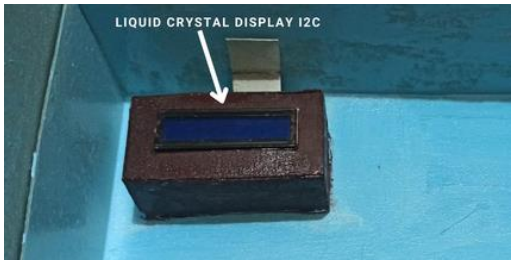
The system utilizes infrared sensors to accurately count the number of people entering and leaving the library. It provides real-time information on the current occupancy level, allowing library staff to monitor and manage the library's capacity effectively. This helps prevent overcrowding and ensures a comfortable environment for library users.

2. Noise Level Detection:



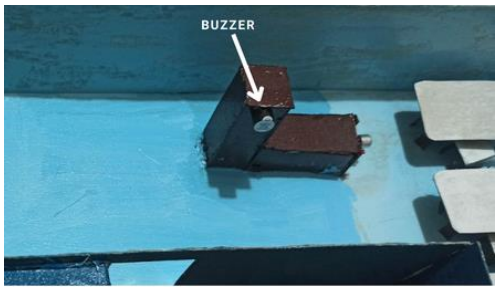
By incorporating a sound sensor, the system can detect the noise levels within the library. It continuously monitors the ambient noise and alerts library staff if the noise exceeds a predefined threshold.

3. Display of People Inside



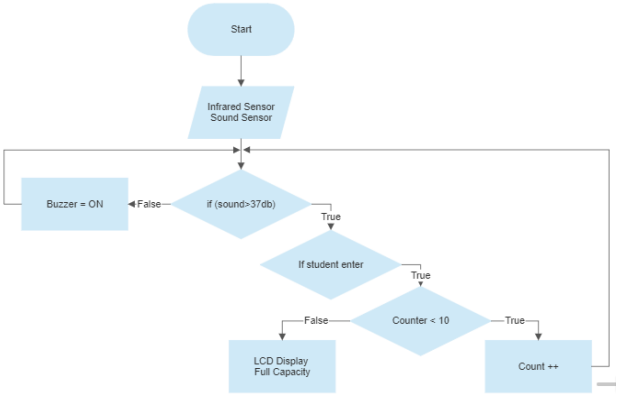
The system incorporates an LCD display that shows the current number of people inside the library. This information is updated in real-time, providing library staff with instant visibility into the library's status.

4. Buzzer Activation:



When the noise level exceeds the predefined threshold, the system activates a buzzer to alert library users and remind them to maintain a quieter environment. This feature helps in controlling noise levels and promoting a conducive atmosphere for studying and reading.

Flowchart



Arduino Code

```
const int irPin1 = 7;
const int irPin2 = 8;
const int soundSensorPin = A0;
const int buzzerPin = 9;

int count = 0;
boolean state1 = true;
boolean state2 = true;
boolean outsideIr = false;
boolean isPeopleExiting = false;
int i = 1;
boolean isCountUpdated = false;
boolean isFullCapacity = false;

void setup() {
Serial.begin(9600);
pinMode(irPin1, INPUT);
pinMode(irPin2, INPUT);
pinMode(buzzerPin, OUTPUT);
          }
void loop() {
// IR Sensor Logic
 if (!digitalRead(irPin1) && i == 1 && state1) {
outsideIr = true;
delay(100);
i++;
state1 = false;
}

if (!digitalRead(irPin2) && i == 2 && state2) {
outsideIr = true;
delay(100);
i = 1;

if (count < 10) {
count++;
Serial.print("People Inside: ");
Serial.println(count);
          }

if (count == 10) {
isFullCapacity = true;
Serial.println("Full Capacity");
          }
state2 = false;
          }

if (!digitalRead(irPin2) && i == 1 && state2) {
outsideIr = true;
delay(100);
i = 2;
state2 = false;
          }
if (!digitalRead(irPin1) && i == 2 && state1) {
outsideIr = true;
delay(100);
if (count > 0) {
count--;
Serial.print("People Inside: ");
Serial.println(count);
          }
i = 1;
state1 = false;
          }
if (digitalRead(irPin1)) {
state1 = true;
          }
if (digitalRead(irPin2)) {
state2 = true;
          }

// Sound Sensor Logic
int soundLevel = analogRead(soundSensorPin);

if (soundLevel > 36) {
for (int i = 0; i < 3000; i += 100) {
tone(buzzerPin, 1000);
delay(100);
noTone(buzzerPin);
delay(100);
           }
          }
delay(100);
          }
```

REFERENCES

Jones, A. (2018). The use of smart technology in libraries. Library Trends, 66(4), 646-662.