DR. YANGA'S COLLEGES, INC.

TITLE OF THE STUDY

LibriGuard

A Smart Library Monitoring System Using Posture Detection and Voice Recognition for Rule Enforcement at DYCI

A Capstone Project Presented to the

College of Computer Studies

Dr. Yanga's Colleges, Inc.

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May 2025

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I. INTRODUCTION

In a time when digital solutions are reshaping every aspect of education, it is essential that even behavioral regulation within schools adapts to technological advancement. The library, a vital part of academic life, must uphold discipline to maintain its environment for study and reflection. However, this is often compromised by limited personnel and inconsistent enforcement of rules, allowing frequent violations such as excessive talking or poor posture to go unchecked.

Technological breakthroughs in artificial intelligence (AI), computer vision, and biometrics offer new opportunities for improving rule enforcement. Tools such as posture detection and voice recognition—originally developed for healthcare, security, and accessibility—can now be applied to academic settings to help maintain discipline automatically and impartially.

LibriGuard, the proposed system in this study, utilizes these innovations to transform the way student behavior is monitored in the library. With real-time tracking of voice activity and posture, LibriGuard aims to promote self-awareness, minimize distractions, and foster a productive learning environment for all students at Dr. Yanga's Colleges, Inc. (DYCI).

Background of the Study

The academic library plays a crucial role in the learning journey of students, offering a quiet and resourceful space for reading, research, and academic collaboration. However, maintaining discipline in the library remains a widespread issue globally. Inappropriate behavior such as speaking in silent zones, slouching, or sleeping during study hours disrupts the environment and negatively impacts the focus and performance of students.

Despite established regulations, many schools—including DYCI—continue to depend heavily on manual monitoring by staff. This approach is not only inconsistent but also unsustainable in the long term due to limited personnel and high student volume. In situations where no immediate staff member is present, violations often go unnoticed or unaddressed, weakening the enforcement of institutional rules.

Emerging technologies such as artificial intelligence, computer vision, and biometric voice analysis offer promising tools for behavior monitoring. In particular, posture detection systems and voice recognition models have proven effective in other domains such as healthcare and security. These same tools can be adapted to academic settings to automate the identification of violations like sleeping or unnecessary talking.

Although some institutions have adopted sound level monitors or closed-circuit television (CCTV), these systems often lack real-time feedback and analytical capabilities. Most lack the ability to associate violations with specific students, making accountability difficult to enforce. At DYCI, no such integrated system currently exists.

This study proposes LibriGuard—a smart behavioral monitoring system that uses real-time posture and voice analysis to detect and document violations automatically. The system's mobile app notifies students when they breach library rules, while the Office of Student Affairs (OSA) receives detailed logs of violations for administrative action. LibriGuard aims to foster a more respectful, focused academic atmosphere while reducing the burden on staff through automation.

Project Context

The rising demand for a conducive and respectful academic environment at DYCI has underscored the limitations of traditional library monitoring methods. Currently, the institution relies on manual observation and enforcement of rules, which proves insufficient and inconsistent. Staff shortages and high student volume further exacerbate the issue, resulting in overlooked violations and an undisciplined atmosphere.

In today's academic landscape, students are expected to maintain appropriate behavior without constant supervision. However, without proper monitoring tools, enforcing discipline remains a challenge. Common issues such as unnecessary noise and improper posture during study hours disrupt the concentration of other students and affect the overall learning experience.

This scenario reflects a broader challenge across many educational institutions. While some have adopted isolated tools like noise level detectors or surveillance cameras, these solutions lack the capability to associate behavior with individual students and provide immediate corrective feedback.

To address this, LibriGuard introduces a data-driven solution that integrates posture detection and voice recognition technologies into a cohesive system. The platform automates behavioral monitoring within the library, issuing instant alerts to students and logging infractions for the Office of Student Affairs (OSA). The goal is to foster a more disciplined and self-regulating student community while reducing the administrative burden on staff.

By enabling real-time rule enforcement and enhancing accountability, LibriGuard bridges the gap between traditional disciplinary practices and modern educational standards.

Purpose and Desciption

LibriGuard is a web-based behavioral monitoring system designed to uphold discipline in academic libraries through the use of posture detection and voice recognition technologies. It addresses frequent issues such as students talking in silent zones, slouching, or sleeping at study desks—behaviors that undermine the learning environment. By automating the identification and documentation of these violations, LibriGuard significantly reduces the need for manual intervention by library staff.

The system features three core modules:

The Administrator Module is intended for the Office of Student Affairs (OSA). It provides full access to manage, review, and intervene based on real-time data and

violation logs. Admins can view a detailed history of infractions, issue digital warnings, and generate summary reports to track student behavior trends. Admin-level access includes user account management and system configuration.

The Detection and Notification Module consists of posture detection powered by Mediapipe/OpenCV and voice recognition using TensorFlow/Keras. Once a violation is detected, it is automatically logged and linked to the corresponding student profile. Simultaneously, the system sends a notification to the student and records the incident for review by OSA.

The Student Mobile App Module is designed to keep students informed. It delivers immediate push notifications about violations and displays a summary of current infraction counts. Students do not have access to detailed logs but can see the reason behind each warning. This promotes self-awareness and encourages behavioral correction without manual confrontation.

LibriGuard aims to modernize and streamline discipline enforcement in libraries by ensuring consistency, accountability, and efficiency. It empowers both students and staff through accessible, data-driven tools that support a focused academic atmosphere.

Objectives of the Study

This study aims to evaluate the effectiveness of LibriGuard—a web-based behavioral monitoring system with posture and voice violation tracking—in addressing the enforcement gaps within academic libraries. It seeks to determine how LibriGuard

can promote better student behavior by reducing reliance on manual monitoring, increasing awareness through instant alerts, and reinforcing discipline through real-time biometric analysis.

The study will analyze the impact of LibriGuard's centralized violation logging and automated alerts on behavior consistency, specifically focusing on behavior changes before and after deployment. It will further assess the system's capacity to identify violations using posture and voice patterns, and how this correlates to improved student self-regulation. Additionally, the research will explore user perceptions—both students and administrators—regarding the system's usability, efficiency, and reliability.

The main objective of this study is to understand the overall usability and effectiveness of LibriGuard in fostering student discipline and reducing behavioral distractions. This will involve the collection of feedback from the Office of Student Affairs and the student body to refine the system's deployment and long-term functionality. The outcome will guide further system improvements and ensure LibriGuard meets the behavioral monitoring needs of DYCI.

LibriGuard embodies the DYCIan core value of **Discipline**, which emphasizes respect for rules, self-control, and responsible citizenship. In academic settings, discipline ensures that students can learn and grow in environments that support focus, respect, and personal development.

Through LibriGuard, students become more accountable for their actions by receiving immediate feedback and warnings. The system provides structured

reinforcement of library policies, ensuring that the principles of discipline are not only stated but consistently practiced. By applying this value through smart technologies, DYCI promotes a forward-thinking culture grounded in integrity and order.

DYCIAN Philosophy

In line with the DYCIan value of Sapientia, which embodies the pursuit of wisdom and informed decision-making, LibriGuard encourages both students and administrators to engage with technology not just for surveillance, but for education and character development. The system promotes mindfulness and self-regulation by delivering timely and accurate behavioral feedback such as violation alerts for speaking or improper posture.

This pursuit of Sapientia is reflected in LibriGuard's real-time monitoring modules, its student-centered mobile app, and its data-driven administrator dashboard—all designed to support personal accountability and a disciplined academic environment. By embracing Sapientia, the project empowers students to become more responsible and reflective, transforming discipline into a learning opportunity. LibriGuard aims not just to monitor behavior, but to foster wise, thoughtful action aligned with DYCI's mission to educate with integrity and vision.

Project Objectives

The objectives of this project define the core features and functionalities that LibriGuard aims to deliver in response to the challenges identified in library discipline enforcement. Each objective is designed to address a specific aspect of the problem,

ensuring that the system is comprehensive, student-centered, and technologically robust. These objectives serve as a roadmap for the development and evaluation of the system, emphasizing integration, efficiency, security, and user accountability.

1. To create a posture detection module using camera input and pose estimation techniques that can identify slouching, lying down, or improper seating.
2. To develop a voice recognition module capable of detecting and linking unauthorized speaking to student profiles in restricted silent zones.
3. To integrate both modules into a unified, real-time monitoring platform that automates violation detection and notification.
4. To implement a student mobile app that provides real-time alerts and displays violation counts and reasons to promote behavioral awareness.
5. To build an administrator dashboard for the Office of Student Affairs (OSA) that includes violation logs, trend analytics, and student monitoring tools.
6. To enforce data security and role-based access through encryption protocols that ensure ethical management of behavioral data.

II. PROJECT FRAMEWORK ANALYSIS

Theoretical Framework

This study is anchored on two foundational models in information systems and behavioral science to guide the development, adoption, and implementation of LibriGuard.

Behavioral Reinforcement Theory

Skinner's Behavioral Reinforcement Theory is applied in LibriGuard by using real-time, automated feedback to reinforce positive behavior. Whenever a student is detected speaking in a restricted zone or exhibiting poor posture (e.g., slouching, lying down), the system provides immediate warnings and logs the violation to discourage repetition. These consistent reinforcements condition students to adopt acceptable conduct within the library.

Biometric Recognition Theory

This theory supports the use of physiological and behavioral data to verify identity. LibriGuard integrates **voice biometrics** and **computer vision posture analysis** to recognize and associate specific behaviors with individual student accounts. This approach allows for a more accountable and data-driven enforcement of library discipline rules.

Together, these theories establish a dual-layered foundation for LibriGuard: one that influences behavioral change and one that ensures accurate, automated identification.

Conceptual Framework

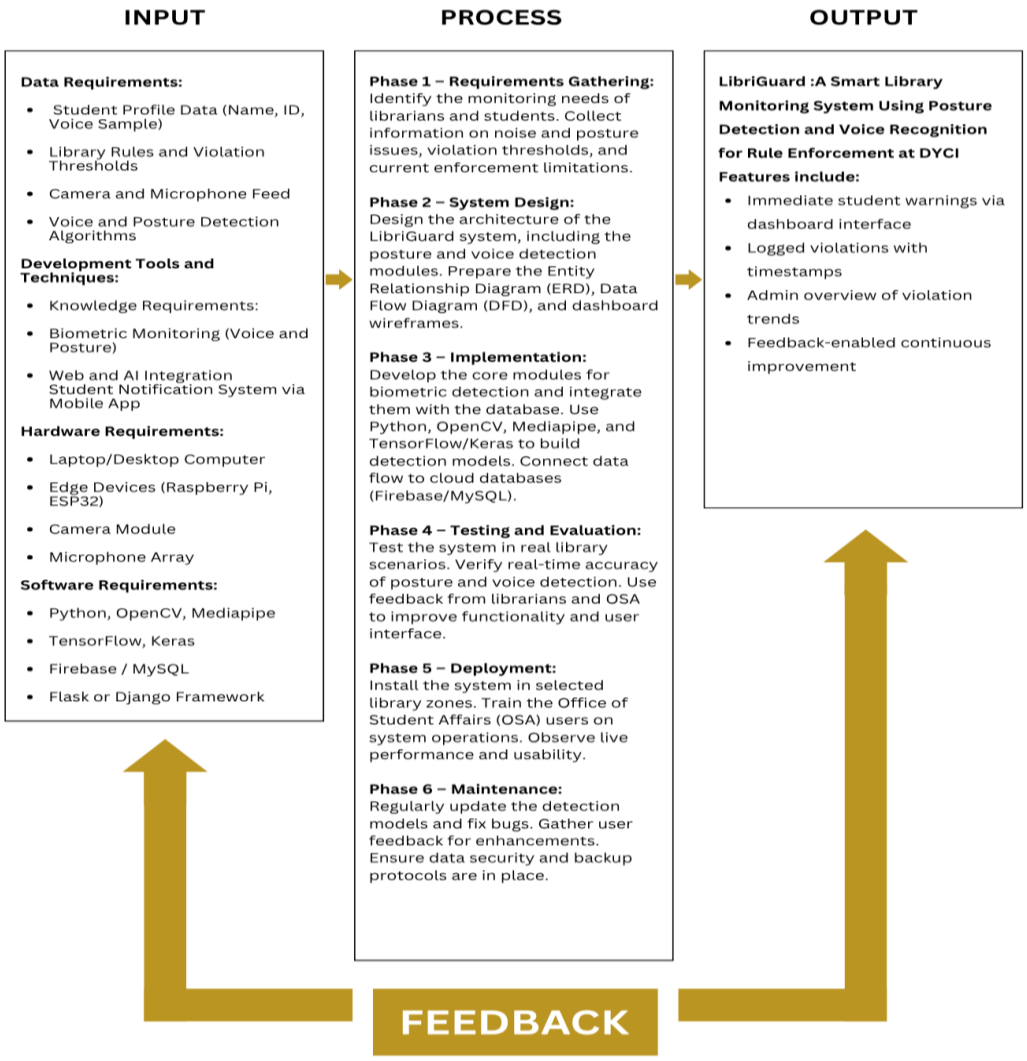


Figure 2.1. Conceptual Framework Using the Input-Process-Output (IPO) Model with Waterfall Model

Scope and Delimitations

LibriGuard is a web-based library monitoring system designed to improve student discipline and promote a quiet, focused study environment by automating the detection and logging of rule violations related to posture and voice. The system leverages biometric technologies such as voice recognition and posture detection to monitor student conduct within designated silent zones of the DYCI library. LibriGuard includes the following modules:

Posture Detection Module

This module uses camera input and pose estimation algorithms to detect improper sitting behavior, such as slouching, lying down, or sleeping. It continuously monitors body positioning and sends data for violation assessment.

Voice Recognition Module

This module captures audio input through a microphone and uses biometric voice data to identify students speaking in restricted areas. It distinguishes authorized users from background noise and links violations to registered profiles.

Violation Logging System

All confirmed violations are automatically recorded with timestamps and student identification. These logs are stored in a centralized database and contribute to student behavior history.

Admin Dashboard Module

This module allows **librarians and the Office of Student Affairs (OSA)** to view live violations, monitor student behavior trends, and access detailed logs of student infractions. The OSA specifically oversees violation handling, including issuing formal warnings, tracking repeat offenders, and implementing behavior-related interventions. The dashboard provides real-time alerts and reports to support data-driven discipline management.

Student Mobile App Module

Students receive real-time notifications through a dedicated mobile application whenever a posture or voice violation is detected. The app shows the current total of violation counts and sends alerts that include the reason for each violation and a warning message. This allows students to stay informed about their conduct and understand the specific rule they violated, promoting awareness and self-discipline without giving access to detailed system logs.

Notification Module

Provides real-time alerting to students when violations are detected. Alerts are shown on-screen, and system logs are updated accordingly. Admins are also notified of repeated offenses or high-risk behavior patterns.

Account Management Module

Allows students and staff to manage user credentials securely. Administrators oversee account creation, role assignment, password resets, and enforcement of usage permissions.

Security Module

LibriGuard enforces role-based access control and implements security features such as encrypted data storage and secure login to protect student information and violation records.

Delimitations of the Study

This study was conducted within defined parameters to ensure feasibility and alignment with academic timelines, available resources, and system limitations. Certain features were intentionally excluded to keep the LibriGuard system focused on its core functions. The system is intended only for use within DYCI's library and does not support multi-location or campus-wide monitoring. It is designed as a web-based platform and does not include native mobile applications, as browser accessibility fulfills the current user needs.

The system's biometric detection is limited to voice and posture recognition. Advanced surveillance tools such as facial recognition or gesture tracking are not implemented due to complexity and privacy concerns. The system does not cover non-behavioral infractions such as food violations, vandalism, or improper use of library facilities. Furthermore, only registered users with valid profiles are monitored; guests or unregistered individuals are not tracked to preserve data privacy and system security.

Since LibriGuard relies on camera and microphone input, system performance is subject to hardware quality, environmental conditions (e.g., lighting and noise), and network stability. In the event of connectivity loss, system operations may temporarily

pause, but resume once the connection is restored. All biometric matching and data processing require functional devices and system calibration to ensure accuracy. These delimitations ensure that the system remains practical, secure, and effective in achieving its core objective: enhancing library discipline through smart, data-driven monitoring.

Statement of the Problem

The DYCI library lacks an automated enforcement system for maintaining proper posture and silence among students. Relying on manual staff monitoring results in inconsistent enforcement, missed violations, and no centralized record of offenses.

This study seeks to answer the following:

1. How can voice and posture violations be detected automatically in real time?
2. How can biometric recognition be used to identify violators and track behavior patterns?
3. What improvements in student discipline can be achieved through automated enforcement?
4. How can the system ensure accurate logging of violations and enable data-driven interventions?
5. What are the perceptions of students and librarians regarding the system's usability, performance, and reliability?

Significance of the Study

This study highlights the importance of integrating smart monitoring technologies—such as posture detection and voice recognition—into academic spaces to promote discipline, improve learning environments, and support data-driven student management. The following stakeholders are expected to benefit from this study:

The **Office of Student Affairs (OSA)** will have exclusive access to student violation records, allowing them to monitor behavior trends, issue formal warnings, and implement corrective actions. With access to real-time data and violation history, the OSA can ensure consistent rule enforcement and maintain discipline within library study zones.

Students will become more self-aware and disciplined through automated alerts and visible reminders. Even though they do not access violation logs, immediate notifications serve as behavioral feedback, promoting adherence to library rules without manual confrontation.

Proponents will gain hands-on experience in developing AI-powered systems that involve real-time detection, biometric verification, database integration, and secure access control. This will enhance their technical competencies and research application skills.

Future researchers may use this project as a foundation for studies exploring advanced disciplinary systems, mobile accessibility, or the integration of

additional biometric data such as facial recognition or gesture-based monitoring, while upholding ethical and privacy standards.

Definition of Terms

Posture Detection

Conceptual Definition: Posture detection refers to the use of computer vision techniques to analyze body position and determine whether a subject is maintaining an appropriate posture (Cheng et al., 2021).

Operational Definition: In LibriGuard, posture detection is performed through a camera feed using Mediapipe and OpenCV to recognize slouching, lying down, or sleeping postures that violate library behavior rules.

Voice Recognition

Conceptual Definition: Voice recognition is a biometric authentication method that identifies individuals based on the unique features of their voice (Kinnunen & Li, 2010).

Operational Definition: LibriGuard uses pre-recorded voice samples and TensorFlow-based models to detect and identify students who speak in library silent zones.

Biometric Monitoring

Conceptual Definition: Biometric monitoring involves the continuous or event-based tracking of human characteristics for identification or behavioral analysis (Jain et al., 2007).

Operational Definition: The system applies biometric monitoring through voice and posture recognition to ensure rule enforcement is specific to the individual and logged accurately.

Violation Logging

Conceptual Definition: Violation logging refers to the act of recording a incidents that break established rules or policies into a digital system for tracking and review.

Operational Definition: LibriGuard logs each behavioral violation with timestamp, violation type, and student identity, and stores them securely in a database for OSA access only.

Admin Dashboard

Conceptual Definition: An admin dashboard is a digital interface that provides authorized users with an overview of system activities, analytics, and management controls.

Operational Definition: The LibriGuard admin dashboard, accessible exclusively by the OSA, displays real-time alerts, violation logs, and trend data to support policy enforcement and behavioral interventions.

Student Mobile App

Conceptual Definition: A student mobile app is a lightweight application designed to provide users with timely access to relevant alerts, updates, or summaries of personal activity within a system. **Operational Definition**: In LibriGuard, the student mobile app delivers real-time notifications when a violation is detected. It displays the student's current violation count and includes the specific reason for each alert. This ensures students are immediately informed of their infractions and helps them understand which rule was broken, fostering accountability without exposing detailed system logs.

ESP32 / Raspberry Pi

Conceptual Definition: ESP32 and Raspberry Pi are programmable microcontroller boards used in embedded systems and edge computing (Upton & Halfacree, 2014). **Operational Definition**: LibriGuard uses these boards to connect cameras and microphones to the system, process sensor data, and transmit inputs to the backend for posture and voice detection.

OpenCV / Mediapipe

Conceptual Definition: OpenCV is an open-source library for image processing, while Mediapipe is a framework for real-time perception pipelines

(Google, 2020).

Operational Definition: LibriGuard integrates OpenCV and Mediapipe to detect and analyze students' postures through real-time video streams from library cameras.

TensorFlow / Keras

Conceptual Definition: TensorFlow and Keras are open-source libraries used for building and deploying deep learning models, particularly in image and speech recognition tasks (Abadi et al., 2016).

Operational Definition: LibriGuard uses TensorFlow/Keras to implement speaker recognition models that verify a student's voice against a pre-recorded biometric sample.

Security Module

Conceptual Definition: A security module is a system component that manages authentication, access control, and data protection to prevent unauthorized use.

Operational Definition: LibriGuard enforces data security by applying encrypted user sessions, role-based access control, and admin-only permissions to protect sensitive violation records.

Account Management

Conceptual Definition: Account management refers to the administration of user access credentials, roles, and permissions within a digital platform (Dunn, 2021).

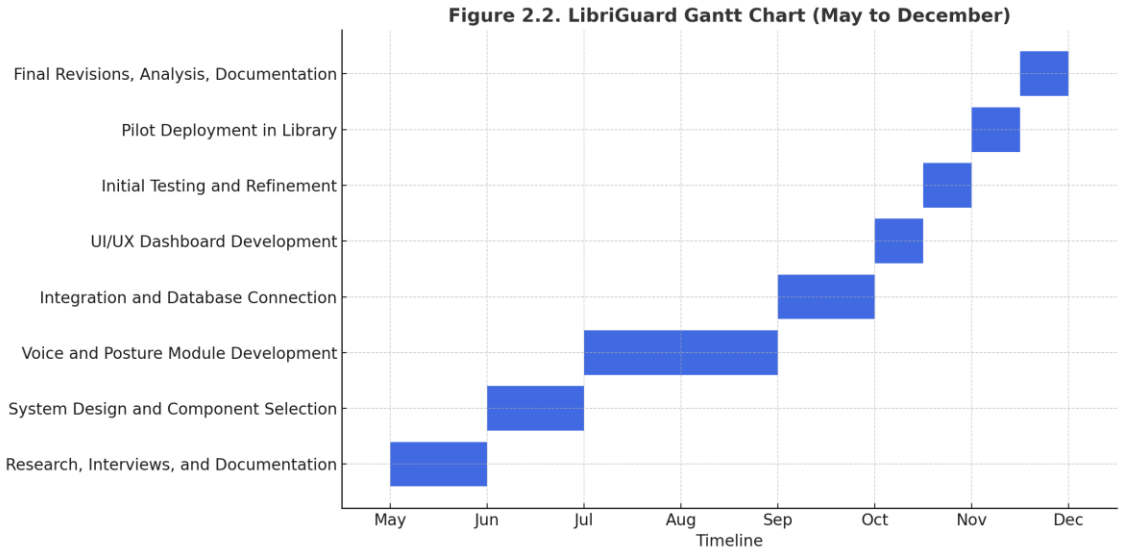
Operational Definition: The system allows administrators to create, verify, and manage user accounts for students and staff, including role assignment and password recovery.

Hardware and Software Specifications

Laptop/Desktop Computer	Used by developers and administrators for system development and access.
Smartphone	Used by students to receive notifications and view violation summaries through the mobile app.
Camera Module	Captures posture input from students in real time for behavioral analysis.
Microphone Array	Records voice for identity verification and detection of noise violations.
Raspberry Pi / ESP32	Edge computing devices that capture, process, and transmit real-time data from sensors.

Python	**Primary programming language used for backend logic and AI – based detection**
Mediapipe / OpenCV	Libraries used for real-time video processing and posture estimation.
TensorFlow / Keras	**Machine learning framneworks used to train and run speaker recognition models.**
Firebase / MySQL	Databases used to store user accounts, behavior logs, and violation records.
HTML/CSS/JavaScript	Languages used to build the web interfaces for system dashboards.
Flask / Django	Backend web frameworks used to handle detection processing and system responses.

Gantt Chart



III. REVIEW OF RELATED LITERATURE

This section presents the researchers' review of related literature that will provide evidence to the significance of conducting the study as well provide founding concepts to realize the given objectives. The contents of the related studies to be discussed revolves around the concept of integrating IoT technology to the current library maintenance protocols particularly with posture and noise monitoring. The succeeding contents of this chapter will only be limited to the available resources from a span of five (5) years preceding the current year 2025 focusing on the integration of IoT in noise and posture monitoring systems in libraries.

Library as an Effective Learning Environment

The library is considered as a place for students to read, study, review for exams, do school-related activities, and even recreational activities. Considering its true nature that it is an environment for academic activities, order within the premises should be maintained. However, school libraries such as at DYCI Elida Campus are facing difficulties in maintaining order because most students are not behaving as intended for the environment. Group study sessions that sometimes produce noise, irresponsible usage of smart devices, and even improper posture are factors affecting the order maintenance in the area.

Studies explore the challenges and impacts of these factors in library environments as well as the strategies for maintaining an effective learning space. Merga (2021) examines libraries as well being-supportive spaces in schools. Abulude et al. (2024) analyze the negative effects of noise pollution on library users and propose a comprehensive noise management plan. Damián-Chávez et al. (2021) investigate the impact of environmental noise on student performance. Additionally, Jabeen et al. (2023) investigated the consequences of prolonged sitting on students' posture.

According to an article written by Merga (2021) titled "Libraries as Well Being Supportive Spaces in Contemporary Schools," libraries are increasingly being recognized as well being supportive spaces within schools. The goal of the research is to explore how students make use of the school library and how this relates to the library as a safe space. The research uses a qualitative approach that includes interviews and surveys with students, teachers and librarians to gather insights on the role of libraries in promoting wellbeing. The research finds that school libraries can be greatly appreciated for their ability to promote a sense of community and safety as well as for providing access to books and reading opportunities. Students also valued how libraries offered a place to unwind and recharge, fostering both quiet and vibrant social activities.

A study by Abulude et al. (2024) titled "Noise Pollution in Libraries: Impacts, Strategies, and Recommendations" was conducted to analyze the negative impacts of noise pollution on library users, evaluate existing noise management strategies and

propose a comprehensive noise management plan for libraries. The study adopted a systematic approach, utilizing multiple academic databases to gather relevant research. It included studies concerning the harmful impacts of noise pollution in libraries, published in peer-reviewed journals over the last ten years. On the basis of the results from this study, it is suggested that maintaining a satisfactory level of noise in the libraries should be incorporated in the goals of improvement of the learning environment in the libraries. This study highlights the importance of regular noise measurement exercises, obtaining user feedback and data analysis with the purpose of evaluating the success of existing noise control measures applied and required modifications.

In the research paper by Damián-Chávez et al. (2021) titled "Environmental noise at library learning commons affects student performance and electrophysiological functioning.", that aims to investigate how EN affects students at learning commons, where EN increases between 70 and 90 dBA, and which levels disturb psycho-physiologically. For the method that they used, the researchers recruited 16 students to measure their performance and electrophysiological responses under different noise conditions. This study found that academic work is difficult to undertake in learning commons when EN is above the permissible limit, and what diminishes the performance of students and alters their electrophysiological functioning.

Besides increase in noise levels in school libraries, another factor affecting students are instances of staying in poor posture for an extended period. According to a study conducted by Jabeen et al. (2023) which was focused on investigating the consequences of prolonged sitting on the students' posture in a Cambridge school, it was found that students were aware of the potential effects of prolonged sitting and had a desire for interventions to improve comfort. The study also inquired to look for possible solutions to amend the consequences which affects students' posture and health, suggestions were proposed such as physical exercise, breaks, and use of ergonomic furniture (Jabeen et al., 2023). This suggests that students are aware of the effects of improper sitting positions and would encourage them to try possible solutions to face such issues.

The studies showcased in this section collectively emphasize the significance of providing a healthy environment in school libraries to support the well-being of students which would then affect their academic performance. Merga (2021) suggested that students value quiet areas for learning and recreation, that maintaining a calm environment is essential for students' comfort in library settings. Abulude et al. (2024) and Damián-Chávez et al. (2021) both revealed that increase in noise levels in libraries

not only affect student's concentration but also their cognitive and physiological functions. These findings support the need for regular noise monitoring to help students in their studies. In addition to this, Jabeen et al. (2023) emphasized physical discomfort caused by poor posture which revealed that students are aware of the consequences and have expressed interest in solutions. Drawing from these studies, regular monitoring of noise levels and posture would provide assistance to library maintenance to preserve its nature as a place for students to do school-related activities in peace.

Impact of Factors Affecting Noise Level

Classrooms, laboratories, free spaces, and libraries especially are academic spaces where noise levels are typically high, these increasing amounts play a crucial role in the effectiveness of academic performance and preparation of students. In libraries, wherein it's considered to be a place for quiet learning and recreational tasks, are now facing challenges with noise levels. Elevated noise levels not only are contributing factors to distractions, stress levels, and the like but also to students' cognitive performance and academic performance highlighting the need for proper academic noise management frameworks and implementation.

The studies gathered in this section highlights the correlation of noise level factors and impacts to library occupants. Factors such as unregulated speaking, library layout, non-compliance to library regulations, presence of digital devices, and lack of noise awareness were the leaders affecting the quiet environment of the space (Kallankandy and Deswal, 2024; Damián-Chávez et al., 2021). Additionally cognitive, psychological, and physiological attributes were significantly affected (Abulude et al., 2024; Bradshaw et al., 2024).

A study conducted by Kallankandy and Deswal (2024) titled "Assessment of Noise Pollution Levels in an Academic Area of an Engineering Institute in India" was conducted to generate assessments on the noise levels of different college academic areas within the National Institute of Technology Kurukshetra in India. In the said study, academic locations such as: classrooms, lecture hall complexes, laboratories, library rooms, corridors, workshop rooms, and open spaces were monitored by measuring the

loudness on a logarithmic decibel scale using a precision grade sound level meter (Model: Casella CEL-620B1 Type 1) with a frequency response range of 6 Hz - 20 kHz that can measure noise levels from 0 - 140.2 dB(A). In addition, two sampling periods were selected: one during academic hours in day time (8:30 am - 4:30 pm) and second during non-academic hours in night time (10:00 pm - 1:00 am), both on weekdays and weekends. The study found an increase with the equivalent continuous noise level in different academic areas during different time periods averaging a total of 65.88 dB during day time (weekday), 47.70 dB during night time (weekday), 57.73 dB during weekend day time, and 45.77 dB during weekend night time. The measured data were observed to be higher than the prescribed standards for academic institutions (50 dB during day time and 40 dB during night time) (Kallankandy & Deswal, 2024). In the study, the main causes of noise pollution came from various sources such as people speaking loud, low awareness of people, and non-compliance with legal obligations. These factors affecting the noise pollution/level in academic areas will provide insights on the solutions to be formulated in order to mitigate the effects thus maintaining the prescribed environment in academic institutions.

"Environmental Noise at Library Learning Commons Affects Student Performance and Electrophysiological Functioning", a study by Damián-Chávez et al. (2021) was conducted to investigate the effects of environmental noise (EN) to students' psychophysiological attribute at learning commons at Tecnologico de Monterrey in Mexico. 16 students (9 men and 7 women) were recruited and divided into 4 groups to do 2 activities: solve a 300-piece puzzle without and with EN at 75 dB. In both activities, an evaluation based on puzzle completeness, electrophysiological monitoring of heart and blink rate, and neural electrical activity were done. The results have showcased a 4% higher student performance in quieter rooms than in learning commons; 3.48%, 22.91% increase both in heart rate and blink rate in EN exposed activity variation respectively; while a 3% reduction in neural electrical activity regardless of tasks (Damián-Chávez et al., 2021). This study suggests that an optimal environment is necessary to maintain the learning stability of students in doing activities and that an increase in EN will be a significant factor affecting student performance.

A study review was conducted by Abulude et al. (2024) titled "Noise Pollution in Libraries: Impacts, Strategies, and Recommendations" using existing research studies on the detrimental psychological, cognitive, and physiological impacts of noise pollution to library occupants, highlighting the lack of optimal environments for academic activities. The goal of the study was to develop a detailed framework to help libraries generate noise

management plans by evaluating the negative impacts of noise pollution on library occupants and assessing the effectiveness of existing noise management frameworks. Upon reviewing existing articles, the researchers have found that several factors can affect the noise levels in libraries such as: library structure, layout and type of furniture; and external sources (construction and renovation activities). Additionally, it was shown that noise pollution can negatively affect reading comprehension; increase level of stress and anxiety; increase in heart rate and blood pressure; hinder an individual's ability to manipulate information in their short-term memory; and motivation in learning activities (Abulude et al., 2024). Providing a systematic review of existing research studies such as the said study will provide insights on the impacts of increase on noise level in libraries to cognitive, psychological, and physiological attributes of students.

"The Impact of Ambient Noise on Patron Stress Levels While Studying in the Library", a correlational study investigating the association between noise and stress levels of library patrons conducted by Bradshaw et al. (2024). In the study, heart rate variability (HRV) and skin temperature measures were used as stress indicators and were measured using a wearable device (Garmin Vivosmart 5); 68 participants were recruited through flyers and word by mouth in the Brigham Young University, USA, among which 68 have successfully completed surveys and were measured. Results gathered showed observed heartbeats totaled to 12,870,879; the RMSSD (Root Mean Square of Successive Differences) for the participation pool had a mean of 43.52 and standard deviation of 12.13, indicating variability in HRV. The study concluded that there was not a significant difference in patron stress levels while studying in loud and quiet library areas (Bradshaw et al., 2024). The insights acquired in study, in correlation with other studies included in this chapter suggests that there is a variability factor among library patrons in different academic institutions indicating that results may vary based on the nature of participants.

In conclusion, the collection of studies given in this section provides insights on the factors affecting the noise levels in academic spaces such as the school library as well as the factors that are being affected by the increase of noise levels. Factors such as unmodulated speaking of people; low awareness; non-compliance to library regulations; library structure, layout and type of furniture; external sources; student demographics; and digital devices were increasing the noise levels in the library (Kallankandy & Deswal (2024); Abulude et al. (2024); Chaputula (2021)). The factors stated, through the given studies have significantly impacted the psychophysiological, psychological, cognitive, reading comprehension, stress levels, anxiety, heart rate, and blood pressure of library occupants signifying that increase in noise levels affects the learning effectiveness of

students (Damián-Chávez et al. (2021). By analyzing these insights and utilizing the given related studies, potential effective systematic frameworks can be done in order to develop viable solutions for academic noise management.

Posture as a Factor Affecting Students' Health

Educational environments such as libraries are often areas where students spend periods of time seated either doing schoolworks or using their electronic devices. This prolonged sitting may lead to unattended poor posture positions that can raise concerns on their physical health and academic performance. In response to these issues, research has been increasingly conducted to explore students' knowledge, behaviors, and the consequences of improper sitting posture.

The studies examined and evaluated in this section explore various topics concerning students' knowledge, attitudes, and behaviors towards the concept of posture (Feng & Zhang, 2023). Another study analyzed sitting postures among nursing students which emphasized the role of ergonomics in preventing discomfort (Azizah et al., 2025). There are also studies presenting the impact of mobile device usage on musculoskeletal health, identifying affected areas of discomfort (Elghomati, 2025). Furthermore, there are also studies investigating the correlation between ergonomic sitting position and academic performance (Ojo and Tajudeen Gbenga, 2023).

A study titled "College Students' Knowledge, attitudes, and practices regarding body posture: A cross-sectional survey--Taking a university in Wuhu City as an example" by Feng and Zhang (2023) conducted an analysis of knowledge, attitudes, and behaviors related to body posture among college and university students. Online questionnaires were handed out to 1012 students aged 18-21 years old at Anhui Polytechnic University, the questionnaires surveyed the students' knowledge, attitudes, and behaviors related to healthy body posture where descriptive analytics were used to analyze response rates. Results revealed that 66.8% were clear about the definition of body posture; 71.9% needed a posture assessment for them to understand issues with their body posture; and 27% would want to improve their poor body posture through exercise programs (Feng & Zhang, 2023). Relating to this study is the idea that students are aware of the effects of

poor body posture and even if some do not fully understand the consequences, they still are eager to understand the issue.

Another study contributing to the awareness of students on the consequences of poor posture is a study by Azizah et al. (2025) in their study titled "The Analysis of Nordic Body Map of Sitting Position and Duration Among Nursing Students at Faculty of Medicine and Health Sciences, Universitas Lambung Mangkurat", musculoskeletal disorders such as muscle pain are common conditions caused by prolonged sitting and posture. Their aim was to analyze the Nordic Body Map of Sitting Position and Duration among Nursing Students at the Faculty of Medicine and Health Sciences, Universitas Lambung Mangkurat. In their study, 136 respondents underwent quantitative, analytical, observational, cross-sectional approach utilizing survey questionnaires. Out of all the respondents, a total of 104 students (77.5%) sat in an ergonomic position while the remaining 32 students (22.5%) sat in a non-ergonomic position. They have suggested that students who were sitting in an ergonomic posture were aware of the importance of correct posture (Azizah et al., 2025).

In addition to these, it is observed that students use smartphones and other devices for recreational activities in the library, thus posture is being unattended which may lead to potential musculoskeletal symptoms. In a study titled "Risk Assessment of Musculoskeletal Disorder Symptoms for Touch Screen Mobile Devices Users by Failure Mode and Effect Analysis Method: A Data Envelopment Analysis approach", risks of musculoskeletal disorders were assessed and identified using the Cornell Musculoskeletal Disorder Questionnaire (CMDQ) with a total of 340 university students. Failure Mode and Effects Analysis (FMEA) was used to identify potential musculoskeletal discomfort and effects. As a result of this method, it was found that the highest frequency of musculoskeletal discomfort symptoms originated from the neck (73.53%) and in the lower back (67.94%), followed by the upper back and the right shoulder with 56.47% and 46.178% respectively. Furthermore, they have emphasized that it is essential to raise awareness among students on the signs and risks of musculoskeletal symptoms to help them potential issues in using mobile devices (Elghomati, 2025).

Furthermore, a study by Ojo and Tajudeen Gbenga (2023) investigated the effects of sitting posture and handwriting on the academic performance of science students with the utilization of an inquiry-based pedagogical teaching approach. In their study, a sample of high school science students underwent a mixed-methods approach, incorporating

quantitative assessments through standard tests and qualitative observations of posture during classroom activities. In the course of their study, they have found that students who maintained ergonomic sitting positions showed better concentration, reduced discomfort, and enhanced engagement during lessons (Ojo & Tajudeen Gbenga, 2023). This study greatly emphasizes the correlational effects of maintaining good posture to the academic performance of students.

In conclusion to these studies, while many students are aware of the effects of proper posture and so is improper posture, there still remains a need for regular assessments, behavior checks, and potential interventions as presented by Feng and Zhang (2023) and Azizah et al. (2025). Elghomati (2025) have also emphasized a factor leading to unattended poor posture which are mobile devices and the areas that can be affected which are mainly the neck and the back. Ultimately, Ojo and Tajudeen Gbenga (2023) have provided suggestions that may correlate good posture to the academic performance of students. The existence of these studies supports the need to find and develop solutions that can prevent poor posture on students that may lead to potential physical issues affecting their well-being.

IoT-Based Real-Time Monitoring System for Enhancing Comfort in Library Premisses

The Internet of Things (IoT) is a globally new concept that has been transforming the livelihood of the people, introducing ways of interconnecting devices to provide services and accomplish tasks. IoT provides exchange and linkage between low-energy devices and interactions through the Internet (Khoa et al., 2020). The main benefit of utilizing IoT devices is the transmission area of data that is superior to those that require human interventions. Between 1969 and 2019, the development of IoT devices and

products was enhanced because of the effective use of these devices (Alqahtani et al., 2020). IoT has made it possible to connect almost every device to the internet and monitor it from a distance. Smart sensors gather information from the surroundings, including temperature, moisture reading, object movement monitoring, control systems in houses, vehicles on the road, and much more. Almost every sector has adopted IoT, opening the door to a wide range of applications.

Many existing studies support the growing significance of adopting IoT technology in libraries. An IoT-based device was developed by Vanitha et al. (2021) using Arduino Nano along with voice recognition, which is working amazingly to detect the noise

pollution and alert the users in real-time. Badruddin et al. (2020) developed an IoT system called NOMOS for a real-time noise monitoring system designed for an educational environment that analyzes the existing noise and advocates the suitable time for study of students. A literature review by Odesola et al. (2024) revealed studies incorporating IoT devices to monitor postures and classifying posture types using machine learning models. Furthermore, Gupta and Sharma (2025) developed a device which monitors the spinal posture of users and provides feedback to help them correct their posture.

According to the study of Vanitha et al. (2021), entitled "Automation of Noise Detection Using Internet of Things", population growth may further increase the noise pollution issue in the modern world. The objective of their study was to design an IoT-based device that detects noise pollution and manages it effectively in enclosed areas with human voices at a reasonable and efficient cost. They've utilized an Arduino Nano, an LCD panel, a battery, and buttons, utilizing voice recognition technology to identify human speech and it sends alert messages to the users upon detecting it via smartphones. The system was programmed in C and was implemented using tools such as Pick2kit and PROTEUS. A voice model was established by analyzing human speech characteristics, processing the input signals, comparing them to the voice templates,

and providing accurate recognition and response. It also has a secure database which allows easy retrieval of data or voice records. Based on the results, the system reduced noise pollution effectively by detecting loud voices and alerting users. This device was likely to be used in other environments to control noise, particularly given the scalable and reliable voice-based automation solution it provided (Vanitha et al. 2021).

According to the study of Badruddin et al. (2020), entitled "IoT Based Noise Monitoring System (NOMOS)", IoT is suitable to be implemented in monitoring noise level in some areas such as from industrial infrastructures, transport vehicles, defence equipment and construction. The study's objective was to design an IoT-based system for real-time noise monitoring, which will evaluate a comfortable study environment for students by real-time noise monitoring levels. Electronic devices used were LM 393 sound sensor, NodeMCU microcontroller, and visual output devices such as LCD and LEDs are assimilated for the capture, display, and alerting of users regarding noise levels. The data will be transmitted to a Firebase cloud server and will be able to be accessed by the Android app, where it actually gives the readings and warnings according to its level of sound intensity. The app will further categorize the recorded intensities to be "low", "normal", "high", and "very high", and it will suggest optimal

time periods to study. The study was conducted both on weekdays and weekends at the University of Technology, Malaysia (UTM), recording noise levels at different time intervals of the day. The findings of the study showed that on weekends, students can comfortably sit and study throughout the day since the noise levels are still within the comfort range of 60 dBA permissible for the day as set by the Chartered Institution of Building Service Engineers. However, in the case of weekdays, most parts of the day experience a noise level above 60 dBA, and the only comfortable time that students can study is in the middle of the night. This identifies the major sources of noise so that the environment can further be studied. Even though it is effective, it only applies to the UTM campus and also requires internet connectivity for it to become operational. Its future potential may include expanding it to application in other environments, such as schools and airports (Badruddin et al. 2020).

Apart from noise monitoring systems, studies introducing posture monitoring systems were also existent. A literature review of "smart-sensing chairs" was conducted by D. F. Odesola et al. (2024) to evaluate the current existence of smart chairs, with the main focus on strategies used for posture detection as well as the effectiveness of these applied approaches. According to the researchers, prolonged maintenance of incorrect posture can impact well-being and contribute to the development of spinal deformities

and musculoskeletal disorders. A total of 34 studies across multiple online platforms (IEEE, MDPI, and Google Scholar) were evaluated, which have used non-invasive methods for posture monitoring. The study revealed that Force Sensing Resistors (FSR) are the leading sensors utilized in posture detection (among other sensors found: textile pressure sensors, load cells, and image sensors), whereas Convolutional Neural Networks (CNN) and Artificial Neural Networks (ANN) were the leading machine learning model for posture classification (D. F. Odesola et al., 2024).

In another study titled "Cervical Spine Posture Monitoring using Flex and IMU Sensors with Long Short Term Memory Networks", conducted by Gupta and Sharma (2025), neck pain or cervicalgia is the discomfort in or around the cervical spine which is the region of spine located just below the head. One of the main causes of neck pain is poor posture contributed by prolonged usage of electronic devices like computers, smartphones, etc. while posture is being neglected. The study aimed at the development of a device that monitors cervical spine posture and provides alerts to users to help maintain a good neck posture. The devices utilized in the development were: flex sensors, MPU6050 IMU sensor, ERM motor, and HC-05 Bluetooth modules. Flex sensors were

used to measure neck bending; the IMU sensor for measuring acceleration and rotation of neck movements; an ERM motor to provide feedback to users about their neck posture; and Bluetooth modules to communicate data wirelessly; all powered by a LiPo battery. The system used python scripts for the Long Short Term Memory (LSTM) to predict users' neck posture type. With over 20 participants, the user testing revealed an overall 79% accuracy in distinguishing between good and bad posture: 81% at desk, 82% while walking, and 78% while sitting at different postures. Additionally, 80% of the participants found the device feedback helped them correct their neck posture (Gupta & Sharma, 2025).

Utilizing IoT devices, as showcased by Vanitha et al. (2021) and Badruddin et al. (2020), provided evidence in effective noise level monitoring using systems of sound sensors embedded on microcontrollers for real-time alerts and analyses. Relevant to these studies are researches done by Odesola et al. (2024) and Gupta and Sharma (2025), which showcased posture detection systems through various sensors such as FSR and IMU, as well as machine learning models for posture classification and feedback. The concepts provided by these existing studies will provide insights to researchers of this study to increase their knowledge on existing devices used for both noise and posture monitoring, enabling the system to be developed to combine noise and posture monitoring, utilizing electronic devices while also incorporating machine learning models and providing feedback for poor posture.

Data Optimization Through Software Development

The volume of raw data generates the need for simple and user-friendly platforms that can process and simplify these data into forms that can be understood by users. In accordance with a statement by Manwar (2024), many devices are now designed and developed to display information on websites such as from embedded systems, laptops, home appliances, etc. (Manwar, 2024). This idea puts emphasis on the need for web development in systems such as noise and posture monitoring through user-friendly interfaces.

The studies published by Luo et al. (2020) and Estrella et al. (2024) were focused on the development of noise monitoring systems. A study by La Mura et al. (2023)

showcased a low-cost system using FSR sensors in a seat cushion incorporated with a Java software for real-time asymmetric posture detection. Relevant to this is an IoT-driven smart chair device by M and MPhil (2025) using ESP32 sensors to monitor user vital signs (BMI, heart rate, etc.).

The study of Luo et al. (2020) titled "Wireless Sensor Networks for Noise Measurement and Acoustic Event Recognitions in Urban Environments" integrates website development in creating a user-friendly interface for monitoring and recognizing specific acoustic events collected through a wireless sensor network. The process used sensor nodes in urban areas to gather noise data to be used in complex algorithms to visualize and categorize the different noise events. The web application provides real-time noise levels, historical data, and receives notifications that could be accessed by the user. It used Android Studio to develop the application, which also includes Eclipse for receiving audio data from the embedded processing board, MySQL for storing and managing noise data, and Sublime Text for constructing the monitoring application. "The data captured by the sensor network was transferred to a central server for data post-processing and a web-based application allows for various real-time visualization of noise distribution." (Luo et al., 2020). The findings showed the system can monitor urban noise, identify the events and classify them as traffic noise, construction noise and human noise which will be significant in urban planning and noise control.

An article titled "Tackling Noise: Technology Integration for Improved Noise Pollution Monitoring" of Estrella et al. (2024) aimed to bring better ways in monitoring and reducing noises in the cities. The main goal is to develop a web-based system that would allow effective and timely assessment of the noisy areas and levels in order to make timely decisions. "Web-based systems have emerged as highly effective tools for monitoring, analyzing and controlling noise levels in urban environments and sensitive areas" (Estrella et al., 2024) The process includes the use of different technologies for example the Internet of Things (IoT) devices, smartphone applications and data presentation tools to gather noise levels across the regions. This system enabled the faster processing of data, assisting in better defining areas of noise pollution sources especially in places that might experience more traffic and commercial areas. It was found that traffic, events and noisy construction work were some of the primary sources of noise pollution that affected the general well being of the public resulting in stress and hearing problems. The application of such technological solutions made it easier and helped in making accurate and fast responses by the local authorities and involved the community in awareness.

A study titled "IoT System for Real-Time Posture Asymmetry Detection" by La Mura et al. (2023) proposed a low-cost IoT measurement system for monitoring sitting posture symmetry and generating visual alerts to users. The system included FSR sensors embedded on a seat cushion with 3D-printed PLA pressure scaling adapters that detected sitting posture. The sensors are connected to an Arduino Mega microcontroller which transmits data via serial communication to a computer. A java-based software processes the acquired data to generate analyses for symmetry detection and alerts. The shifts in position are recorded in a database together with the user's registration information. The system starts with sensor calibrations by making the user sit for reference data for the next readings which will happen every new session. A view tab of the sensors show the status of each FSR labelled as green for correct and red if there are issues. A 'Real Time Monitoring' tab gets activated which displays the status of the sensors and database connection. A detected shift from symmetric to asymmetric of the sitting position will generate warnings which automatically closes once the user corrects their posture (La Mura et al., 2023). The ideas presented in this paper showcased viable low-cost options to be used in the design and development of a product that will provide monitoring assistance to user posture.

Another study incorporating web development to posture monitoring was also published by M and MPhil (2025) titled "IOT Driven Smart Chair for Posture and Health Monitoring". In this study, they have emphasized that poor sitting and posture can contribute to musculoskeletal disorders, backache, etc. In response to this, they have developed an IoT-driven smart chair using ESP32-based sensors to check posture variations as well as Body Mass Index (BMI), heart rate, blood pressure, and oxygen levels. The collected measurements are then sent to a cloud-based platform for analysis; a web-based interface programmed in PHP enables users to monitor their health patterns, observe posture, and view system reports (M & MPhil, 2025). The findings showcased performance testing to be acceptable for users in terms of real-time monitoring of their current health status as well as successfully observing their posture history.

The reviewed studies showcased ideas on how to incorporate web and software development to develop user-friendly interfaces where users can monitor their current health status as well as their posture. Studies by Luo et al. (2020) and Estrella et al. (2024) were focused on utilizing web-based platforms to collect, analyze, and display acoustic

data from various IoT sensors which provided features such as event classification and historical tracking. On the other hand, La Mura et al. (2023) and M & MPhil (2025) developed devices that monitor posture using microcontrollers such as Arduino and ESP32 which transmits data to the cloud and be fetched, analyzed, and displayed on web-based platforms showing current user health status. Collectively, these provide insights on available options to be utilized in the design and development of a monitoring device using IoT devices and presenting valuable information using web-based platforms.

IV. Analytical structure and methodology

Research Design and Methodology

This research employed a qualitative-descriptive design with the objective of examining and describing the ways by which smart monitoring systems such as LibriGuard can shape rule adherence and behavior regulation in a library environment.

Methodological Procedures:

Contextual Inquiry: Researchers made initial observations and casual interviews with library staff to find out the most common kinds of behavioral issues and how these impacted the learning setting.

System Development (as Contextual Tool): The LibriGuard system was created not for experimental testing, but as a contextual discussion and reflection platform for the participants.

Data Acquisition:

In-depth interviews were conducted with selected students and library staff.

Naturalistic observation took place at regular library working hours to establish the manner in which people conduct themselves in observed and unobserved settings.

Data Analysis:

Interview data and field notes were coded thematically. These themes included privacy concerns, rules being enforced effectively, students' comfort levels, and perceived fairness, and were explored.

Statistical testing was not performed; instead, the trends in participant response and action were investigated and analyzed.

Ethical Concerns:

Participants were informed of the research aim and gave consent.

Confidentiality and anonymity were maintained in all data collection and reporting.

It was only used for observation purposes in the research process, and there were no punitive actions taken.

Respondent and Setting

This current qualitative research was conducted at the library of Dr. Yanga's Colleges Inc. (DYCI), a privately-owned college in Bocaue, Bulacan. The library is a focal location for learning activities, research studies, and academic interaction among learners. This was an extremely suitable environment for evaluating the implementation of LibriGuard—a high-tech surveillance system designed to enhance enforcement of rules through posture detection and voice recognition technology.

To gain meaningful results, the researchers used purposive sampling. It is among the most utilized methods in qualitative research that involves choosing participants according to their relevance to the research objectives. The participants were people who had directly experienced the LibriGuard system during its initial implementation phase. They were chosen from the following groups:

- Regular library users who came to the library to study, work on group projects, or read individually were monitored systematically and/or interviewed about their

experience with the facility and how it influenced their behavior and comfort levels.

- Library staff were responsible for operating and maintaining the library environment, and observing how effectively the system functioned in maintaining their efforts to keep things under control and reduce interference.

- School officials provided information about the far-reaching effects of the system in facilitating institutional policies, improving student discipline, and incorporating technology in campus operations.

The goal was not statistical generalizability of results but to gather rich, qualitative data that captures a range of user perspectives. By including library users and administrators, the range of experience was representative—spanning from direct use of the system to administrative management.

This mix of setting and respondent populations gave an authentic and contextual basis for understanding how LibriGuard operates in a real-world academic setting, and how it influences user behavior, perception, and adherence to library rules.

Data Gathering Procedure

The process of data collection was followed according to the qualitative research design, focusing on the attainment of detailed, descriptive answers from the participants who had direct interactions with the LibriGuard Smart Library Monitoring System. The aim was to obtain rich information about the usability, performance, and effect on user behavior and library cleanliness of the system. The following steps were followed as data collection progressed:

1. Cooperation with the Institution

- Permission to conduct the research was granted by Dr. Yanga's Colleges Inc. (DYCI), that is, the library administration and school administration.

- There was also an orientation session with library personnel and interested stakeholders to describe the rationale for the study, data gathering processes, and ethical issues.

- Informed consent was received from all the participants.

2. Recruitment of Participants

- Participants were recruited through purposive sampling, targeting those with first-hand experience of or use of the LibriGuard system.
- These included students, library staff, and education officials.
- All the participants were explained in detail about the voluntary nature of their participation and ensured that their answers would be kept confidential.

3. Instrument Preparation

- A semi-structured interview schedule and an observation checklist were prepared to facilitate data collection.
- The questions were directed toward the participants' usage of the system, behavior changes observed, usability, privacy concerns perceived, and the system's effectiveness.
- The equipment was tested and validated by the research adviser to verify clarity and compatibility with the research objectives.

4. Conduct of Observations and Interviews

- Non-participant observation was undertaken within specified library spaces where the system was deployed. Observers recorded user reaction to the system and changes in behavior (e.g., reduced noise levels, better posture).
- Personal interviews were conducted with chosen participants at times convenient to both parties not interfering with their academic or working schedules. The interviews took 20–30 minutes and were carried out in a quiet environment to promote concentration and relaxation.

5. Recordkeeping and Transcription

- With consent, interviews were tape-recorded and then transcribed word for word.

- Interview transcripts and observational notes were systematically organized to facilitate analysis.

- All data were kept carefully to maintain the confidentiality and privacy of the participants.

6. Initial Data Review

- The research team undertook an initial examination of all data gathered to ascertain completeness as well as accuracy.

- Where additional clarification was needed, short follow-up interviews were conducted with the participating participants.

- This stage helped to fine-tune the data and ensured that each detail that was important was recorded accurately.

Instrumentation and validation

This structured process ensured that the data gathered were thorough, significant, and pertinent to the purpose of the study of how users experienced and interacted with the deployment of the LibriGuard system in a real academic library setting.

Technology Acceptance Model (TAM)

The **Technology Acceptance Model (TAM)** provides a theoretical framework for understanding how users adopt and interact with a technological system. It emphasizes two primary factors that influence user acceptance: **perceived usefulness (PU)** and **perceived ease of use (PEOU)**. According to Davis (1989), perceived usefulness is "*the degree to which a person believes that using a particular system would enhance his or her job performance*," while perceived ease of use is defined as "*the degree to which a person believes that using a particular system would be free of effort*."

Student, staff, and administrative adoption of LibriGuard were both going to depend both on how much the system facilitates the library's essential functions—i.e., its discipline and its provision of a quiet, productive atmosphere—and on how easy and unobtrusive it is to use.

Operations like voice recognition for noise identification automatically and AI-assisted posture monitoring are essential in shaping perceived usefulness through reducing the effort on the side of library staff in applying regulations and improving the study environment in general for the students. At the same time, the intuitive nature of the system, automatic alerts, and subtle feedback mechanisms promote perceived ease of use, facilitating understanding and acceptance on the users' side with minimal training. All the above together yield positive behavioral intentions and bring long-term user acceptance.

ISO/IEC 25010: Software Quality Model

The **ISO/IEC 25010:2011** standard provides a comprehensive framework for evaluating software quality based on both product performance and user experience. It outlines eight key characteristics that help ensure a system meets the functional and non-functional requirements of its users and stakeholders. These characteristics include functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. In the context of **LibriGuard**, adherence to these quality attributes is essential in developing a monitoring system that is both technically sound and user-centered.

The functional suitability of LibriGuard ensures that its essential functionalities—such as real-time posture detection, voice recognition for noise detection, and automated rule enforcement—function as intended and serve their respective function within the library environment. Usability is the ease with which students and library personnel can interact with the system; an adequately designed interface and intuitive feedback structures ensure minimal learning time and frequent usage. The reliability and performance efficiency aspects are of the utmost importance because the system must operate continuously without interruption while providing timely alerts during peak usage times in the library. The security issue pertains to keeping sensitive information, such as captured audio and behavioral patterns, confidential and thereby ensuring privacy and adherence to institutional policies. In addition, maintainability allows future upgrades or extensions to the system to be implemented without disrupting operations, while portability allows the system to be adapted or deployed to different devices or facilities across the campus.

The research study, through the incorporation of the ISO/IEC 25010 attributes in the design of LibriGuard, guarantees the production of a stable, portable, and user-friendly

solution that is able to enforce discipline and improve the overall learning experience in Dr. Yanga's Colleges Inc.

Data Treatment and Analysis

This study utilized a qualitative approach in exploring students', library staff's, and administrators' experience and perception of the LibriGuard system. Rather than numerical data or statistical findings, the study prioritized the collection of detailed feedback through open-ended questionnaires and one-on-one interviews. Narrative feedback was analyzed with thematic analysis, a qualitative method used to uncover, categorize, and interpret patterns or themes that emerged in textual data.

The research continued in an orderly fashion to guarantee depth and validity in the interpretation of participants' comments:

1. Familiarization with the Data

– Researchers read and re-read thoroughly all the responses to gain an overall sense of how users experienced the LibriGuard system in the library environment.

2. Preliminary Coding

Individual sentences or statements that expressed strong user feedback were tagged with labels that reflected their underlying meaning (e.g., "sense of discipline," "difficulty interpreting alerts," "quick system response").

3. Theme Development

Similar or related codes were grouped with the aim of creating emerging themes, which were system usability, perceived usefulness, technical barriers, and privacy concerns.

4. Assessment and Improvement

– The themes that were identified were reviewed and modified to ensure that they captured the essence of the participants' responses and were aligned with the research objectives.

5. Analysis

– The final themes were interpreted in terms of how the users perceived and engaged with LibriGuard, suggesting strengths and areas of probable improvement. The qualitative method applied in this study allowed the researchers to know more about the everyday practice and impact of LibriGuard. The themes that emerged from the analysis represented the lived experience of the users, with implications for increasing the usability, efficiency, and overall effectiveness of the system in the provision of an enabling library culture in Dr. Yanga's Colleges Inc.

System Methodology

Waterfall software development cycle

Phase 1 – Requirements Gathering:
This initial phase focuses on collecting and documenting the functional and non-functional requirements of LibriGuard. Input is gathered from library staff and students to identify enforcement needs such as posture violations, voice disturbances, and logging capabilities. Key features include real-time posture detection, voice recognition, behavior logging, notification delivery, and administrative control.

Phase 2 – System Design:
In this phase, system architecture is defined by designing a centralized database that manages student profiles, violation records, and system configurations. The user interface for both students and the Office of Student Affairs (OSA) is designed with usability and accessibility in mind. Tools like ER diagrams, DFDs, and wireframes are created to guide implementation.

Phase 3 – Implementation:
The system is developed using Python for backend AI modules (posture and voice detection) and Flask for server-side logic. OpenCV and Mediapipe libraries enable real-time posture monitoring, while TensorFlow/Keras power the voice recognition model. The mobile app and admin dashboard are coded using HTML, CSS, and JavaScript.

Phase 4 – Testing and Evaluation:
LibriGuard undergoes rigorous functionality and usability testing. Tests verify the accuracy of posture and voice detection, reliability of violation logging, and responsiveness of the notification system. User feedback from pilot runs is collected to identify bugs and areas for enhancement.

Phase 5 – Deployment:
The system is installed within designated silent zones of the DYCI library. Training sessions are conducted for the OSA and staff to ensure smooth operation. Students begin using the mobile app to receive real-time alerts. The deployment phase also includes continuous monitoring to ensure system stability.

Phase 6 – Maintenance:
Following deployment, continuous updates and improvements are made based on system logs, user feedback, and emerging needs. This phase ensures that LibriGuard remains effective, compatible with new devices, and responsive to changing user behavior.

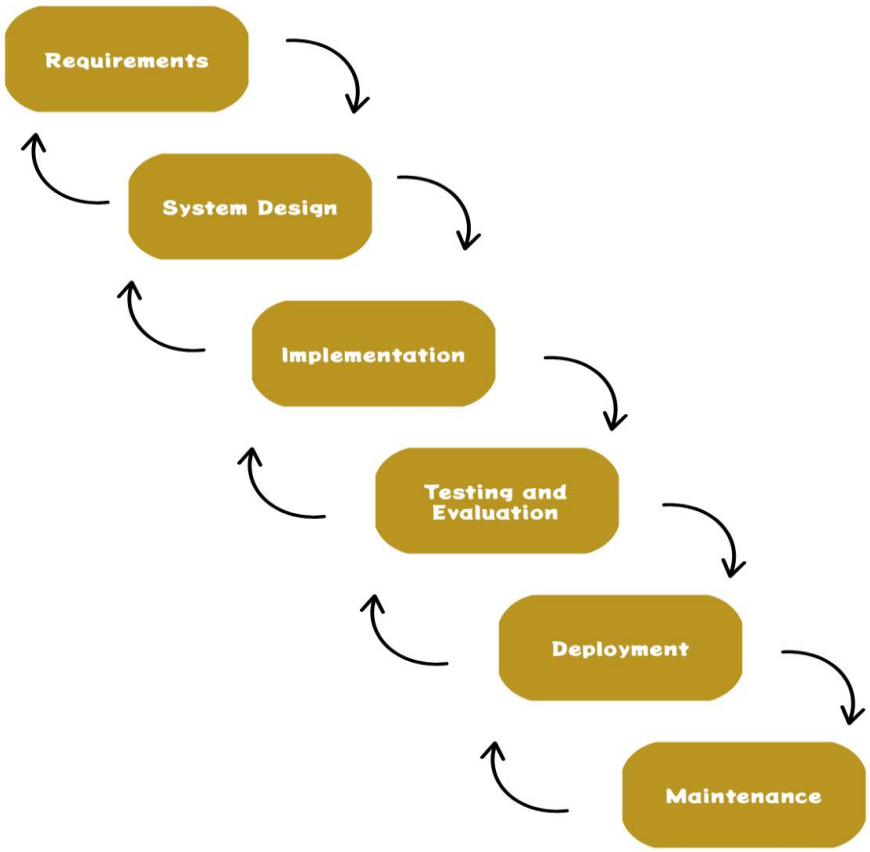
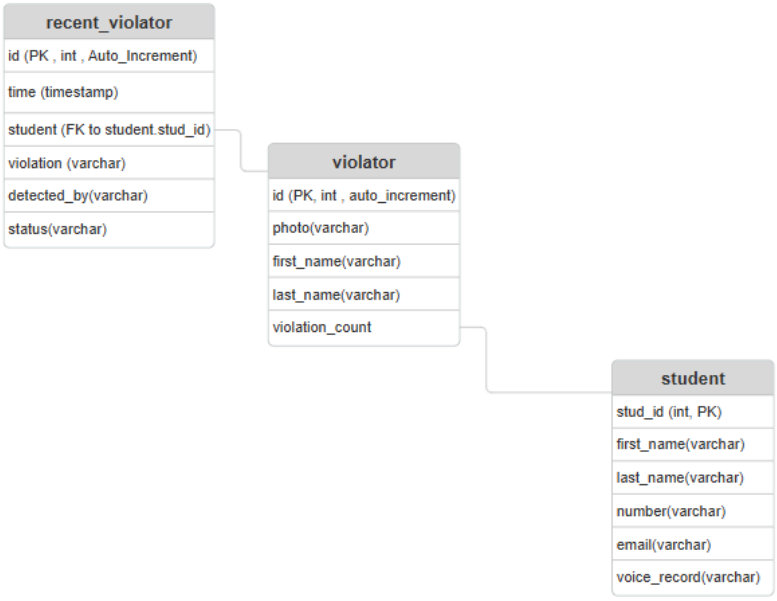


Figure 4.1. Modified Waterfall Model

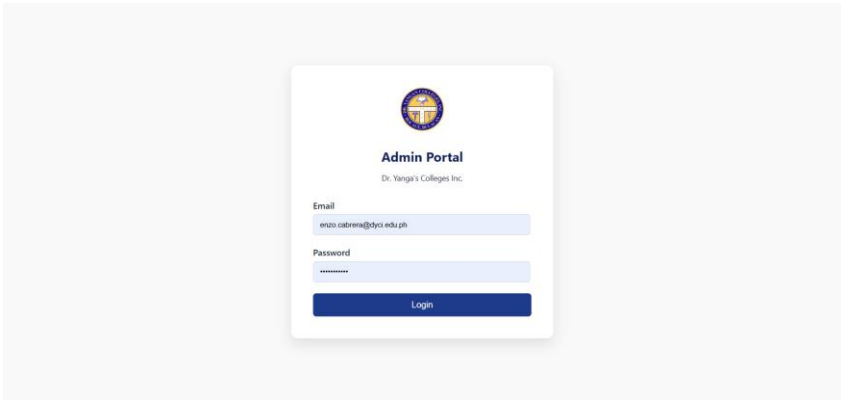
Entity **Relationship** **Diagram**

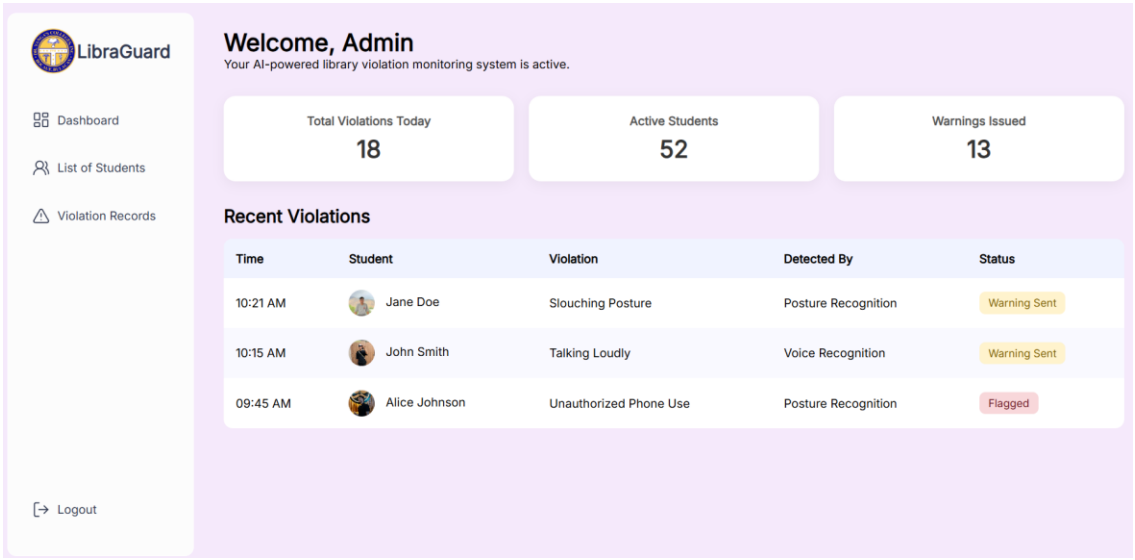


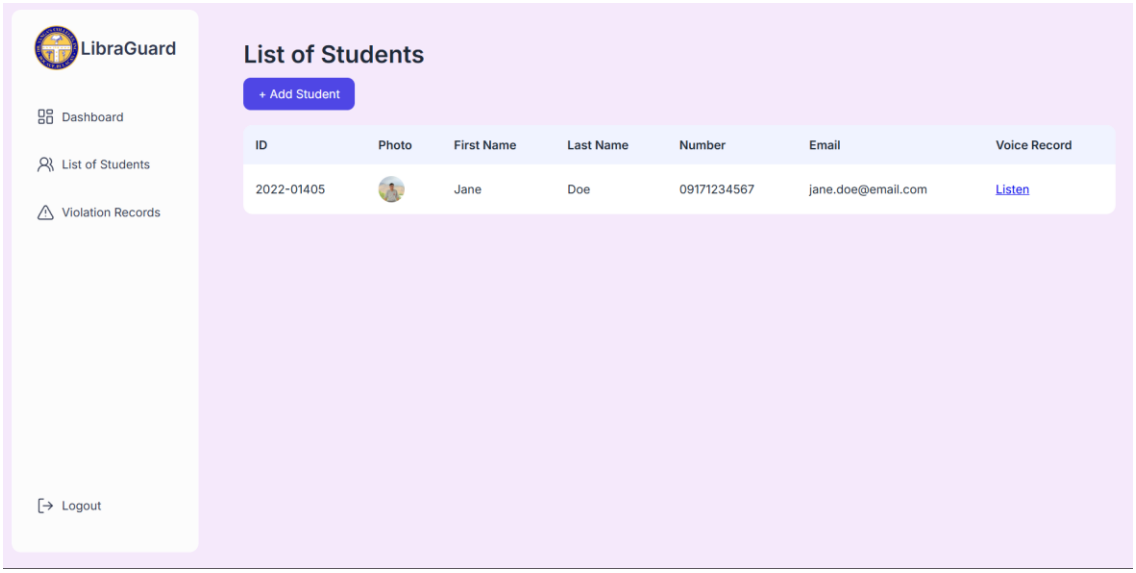
Modules/Functions	Student	Librarian	Admin
Dashboard Access	✓ (Personal View)	✓ (Monitoring View)	✓ (Full Overview)
View Own Violation Records	✓	✗	✓
Receive Real-Time Violation Alerts	✓	✗	✗
View Student Behavior Summary	✗	✓	✓
Posture Detection (Lying / Slouching)	(Auto-detected)	✓ (Can View Alerts)	✓ (System Control)
Noise Level Detection (Shouting / Talking Loud)	(Auto-detected)	✓ (Can View Alerts)	✓ (System Control)

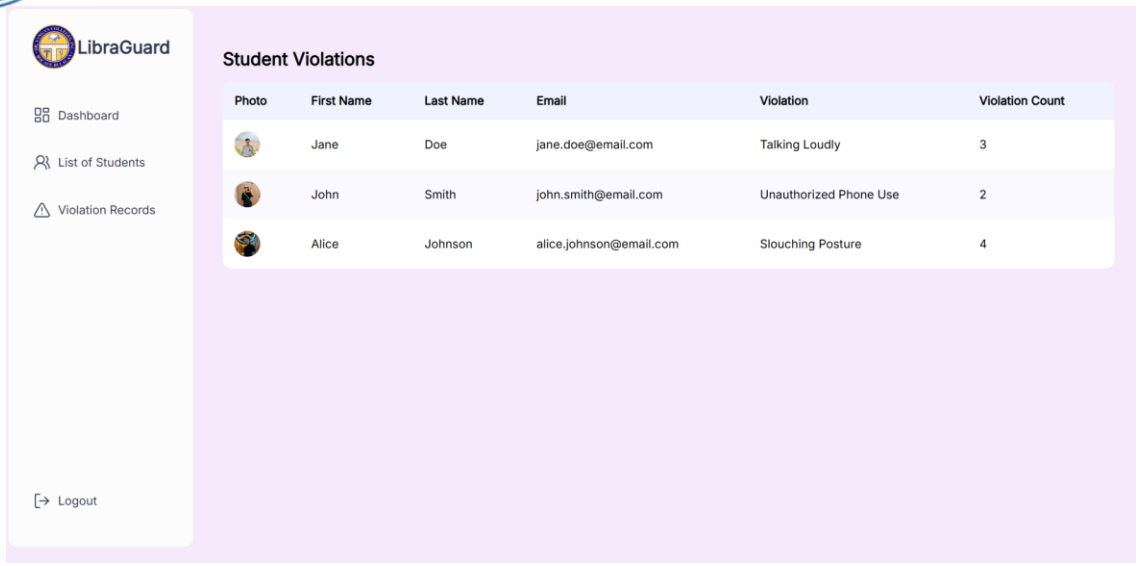
Receive Warning Notifications	✓	✗	✗
View List of Violators	✗	✓	✓
Access Violation History Logs	✓ (Personal Only)	✓ (Read-Only)	✓ (Full Access)
Biometric Recognition Support	(For Identification)	✓ (Can Validate Identity)	✓ (Access Logs)
Export Violation Data	✗	✗	✓
Feedback on System Usability	✓ (Optional Survey)	✓ (Optional Survey)	✓ (Reports View)
Update Profile / Account	✓	✓	✓

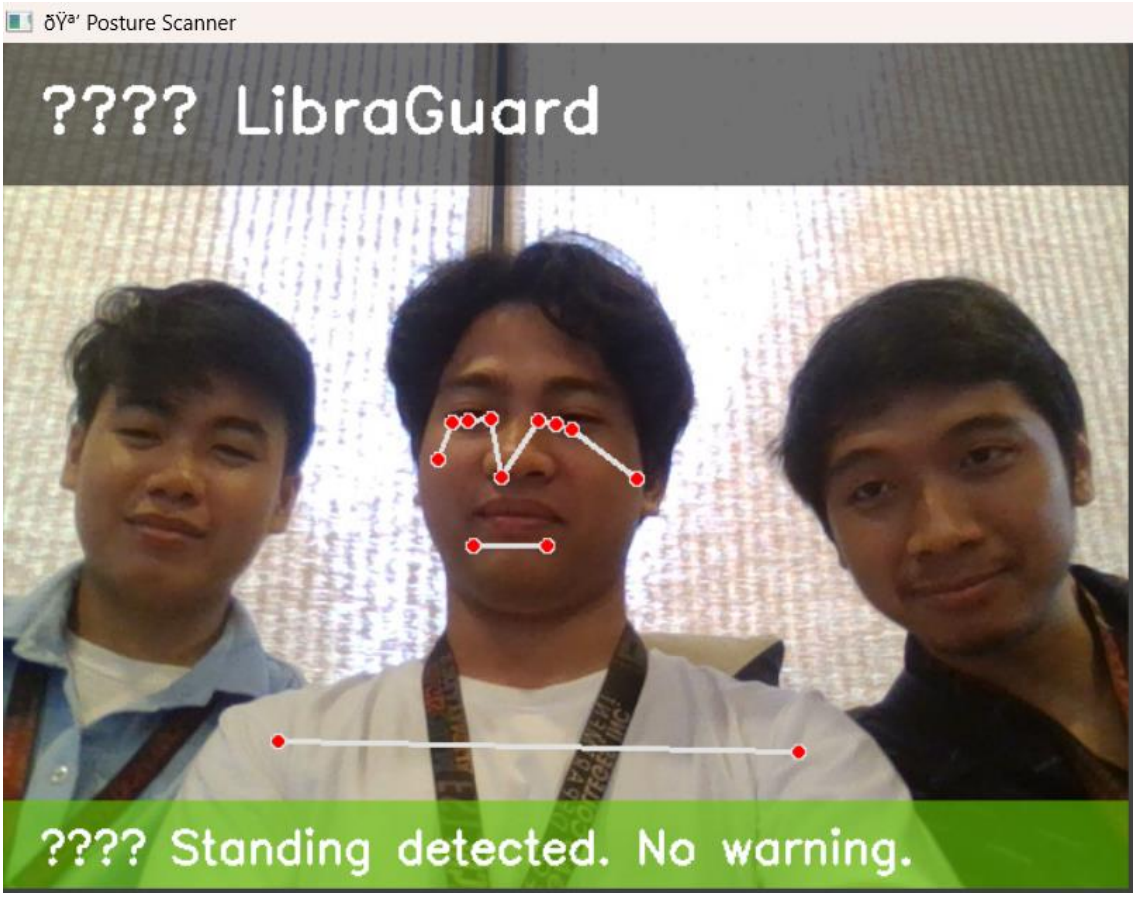
Admin Side


Admin Portal
Dr. Yanga's Colleges Inc.
Email
enzo.cabrera@dyci.edu.ph
Password
Login


LibraGuard
Dashboard
List of Students
Violation Records
Logout
Welcome, Admin
Your AI-powered library violation monitoring system is active.
Total Violations Today
18
Active Students
52
Warnings Issued
13
Recent Violations
Time
Student
Violation
Detected By
Status
10:21 AM
Jane Doe
Slouching Posture
Posture Recognition
Warning Sent
10:15 AM
John Smith
Talking Loudly
Voice Recognition
Warning Sent
09:45 AM
Alice Johnson
Unauthorized Phone Use
Posture Recognition
Flagged


LibraGuard
Dashboard
List of Students
Violation Records
Logout
List of Students
+ Add Student
ID
Photo
First Name
Last Name
Number
Email
Voice Record
2022-01405
Jane
Doe
09171234567
jane.doe@email.com
Listen


LibraGuard
Dashboard
List of Students
Violation Records
Logout
Student Violations
Photo
First Name
Last Name
Email
Violation
Violation Count
Jane
Doe
jane.doe@email.com
Talking Loudly
3
John
Smith
john.smith@email.com
Unauthorized Phone Use
2
Alice
Johnson
alice.johnson@email.com
Slouching Posture
4


ðŸ'ª Posture Scanner
???? LibraGuard
???? Standing detected. No warning.

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