



TED UNIVERSITY

CMPE491

Computer Engineering

Library Occupancy Detector

Project Requirements Specification Document

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1. Introduction

1.1. Description

The objective of the "Library Occupancy Monitor" project is to develop a computer vision model to detect seat/desk occupancy in libraries and to predict occupancy rates for students. The prototype will use computer vision techniques to identify empty tables, chairs, and other seating areas within the TEDU library environment. Its main goal is to enhance the learning experience by providing real-time information about library availability. The model will continuously run on the camera installed in the library and will calculate instantaneous occupancy at tables based on the camera data. It will also detect items left on desks or students sitting in chairs or without anything on the desk.

1.2. Constraints

1.2.1. Economic Constraints

The project must operate within a defined budget, considering costs related to hardware acquisition (such as cameras and processing units), software development, maintenance, and potential scalability, while also aligning with the school's financial resources.

1.2.2. Environmental Constraints

The system design should consider environmental impact, such as energy consumption of deployed hardware and responsible disposal of electronic components at the end of their lifecycle, in line with the school's sustainability policies.

1.2.3. Social Constraints

The system's implementation should respect student and staff privacy, ensuring that data collected is anonymized and used solely for occupancy detection purposes, with clear consent procedures in place.

1.2.4. Ethical Constraints

The project must uphold ethical standards, including transparency in data usage, protection of student and staff privacy, and adherence to ethical guidelines set by educational institutions.

1.3. Professional and Ethical Issues

The "Library Occupancy Detector" project raises significant professional and ethical considerations that must be carefully managed. Privacy protection is essential, requiring data encryption, and strict access controls to protect user information. Data handling and security protocols must ensure responsible storage, transmission, and prevention of unauthorized access or breaches.

The system's accuracy and reliability are critical for providing reliable occupancy information. Transparent communication with users about data collection purposes and consent mechanisms is essential to uphold privacy rights. Addressing biases in algorithms, adhering to ethical guidelines are key responsibilities throughout the project lifecycle.

2. Requirements

2.1. Functional Requirements

2.1.1. REQ-1: Real-time Seat/Desk Occupancy Detection

Using computer vision techniques, the system must accurately detect seat and desk occupancy in real-time.

2.1.2. REQ-2: Occupancy Rate Calculation

The system shall calculate and display the occupancy rate of the library or specified desk to students.

2.1.3. REQ-3: Detection of Unoccupied Areas

In addition to the occupancy detection requirement, the system must accurately identify unoccupied desk places and chairs.

2.1.4. REQ-4: Item Detection

The system should be able to detect items left on tables or desks to differentiate between occupied and unoccupied spaces. For instance, a student may leave their items to hold a seat on a desk.

2.1.5. REQ-5: User Notification

The system must notify students about available seating areas in the library through a user-friendly interface or an already-developed university application such as TeduPortal or TEDU App.

2.2. Non-Functional Requirements

2.2.1. REQ-1: Accuracy

The system must achieve a high level of accuracy in detecting seat and desk occupancy to provide reliable information to students. Also, the system must adapt to lighting changes and items that have the same color as the desk.

2.2.2. REQ-2: Performance

The system shall perform efficiently, with minimal latency in processing and displaying occupancy information. Also, the system must not require too much processing power to support a full-time working detection system.

2.2.3. REQ-3: Privacy

The system must prioritize user privacy by anonymizing data and not storing personally identifiable information.

2.2.4. REQ-4: Security

The system shall have robust security measures to protect against unauthorized access and data breaches.

2.2.5. REQ-5: Scalability

The system should be scalable to accommodate future expansions or upgrades without significant rework. The system may be expanded into a whole application to display past occupancy stats and forecast the future occupancy stats.

3. References

- [1] ACM Code of Ethics and Professional Conduct. (2022). Association for Computing Machinery (ACM). Retrieved from <https://www.acm.org/code-of-ethics>.
- [2] IEEE Code of Ethics. (2022). Institute of Electrical and Electronics Engineers (IEEE). Retrieved from <https://www.ieee.org/about/ethics.html>.