ACS233 Requirements & Design Documentation

Security Control System for the Anteroom of an Infectious Disease Ward

Dirc-Robert Wortley Connor Farnell Joshua Ellershaw

Will Sartin Simon Lennox

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1 Introduction and Context

1.1 Introduction

Access control systems (ACS) must meet specific criteria that are highly dependent on their individual use cases. For this reason, turnkey solutions for highly critical access control systems are simply not available. In this document, we outline the design and specific considerations of an ACS for a hospital infectious disease ward that will provide both security and infection control.

The anteroom of the infectious disease ward serves as a buffer zone between the potentially contaminated patient area and the clean external environment. This anteroom is designed to minimize the spread of infectious agents and cross-contamination. It will also provide traceability through the retention of access logs, which is critical to the security of the entire system.

1.2 Initial Design

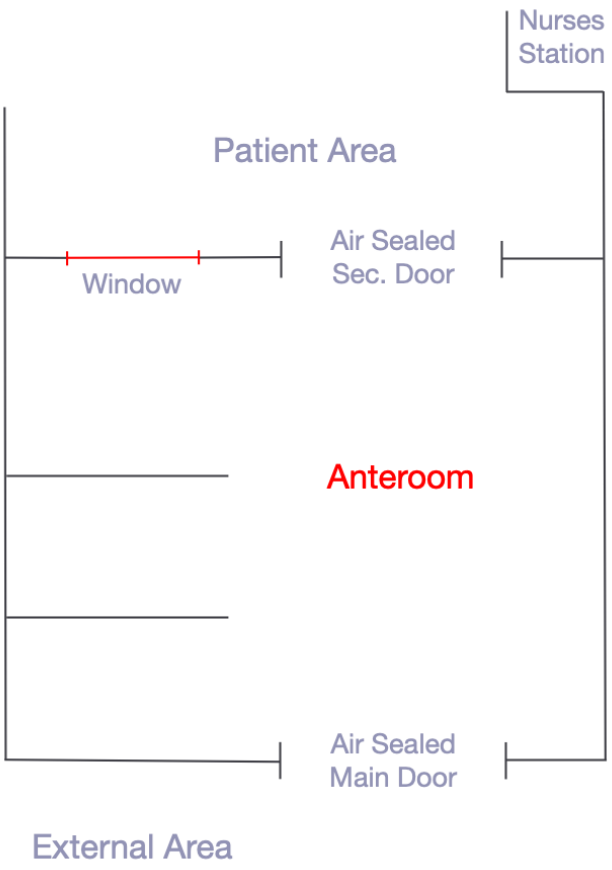

Figure 1: Initial Design Schematic.

1.2.1 Schematic Including Security Components

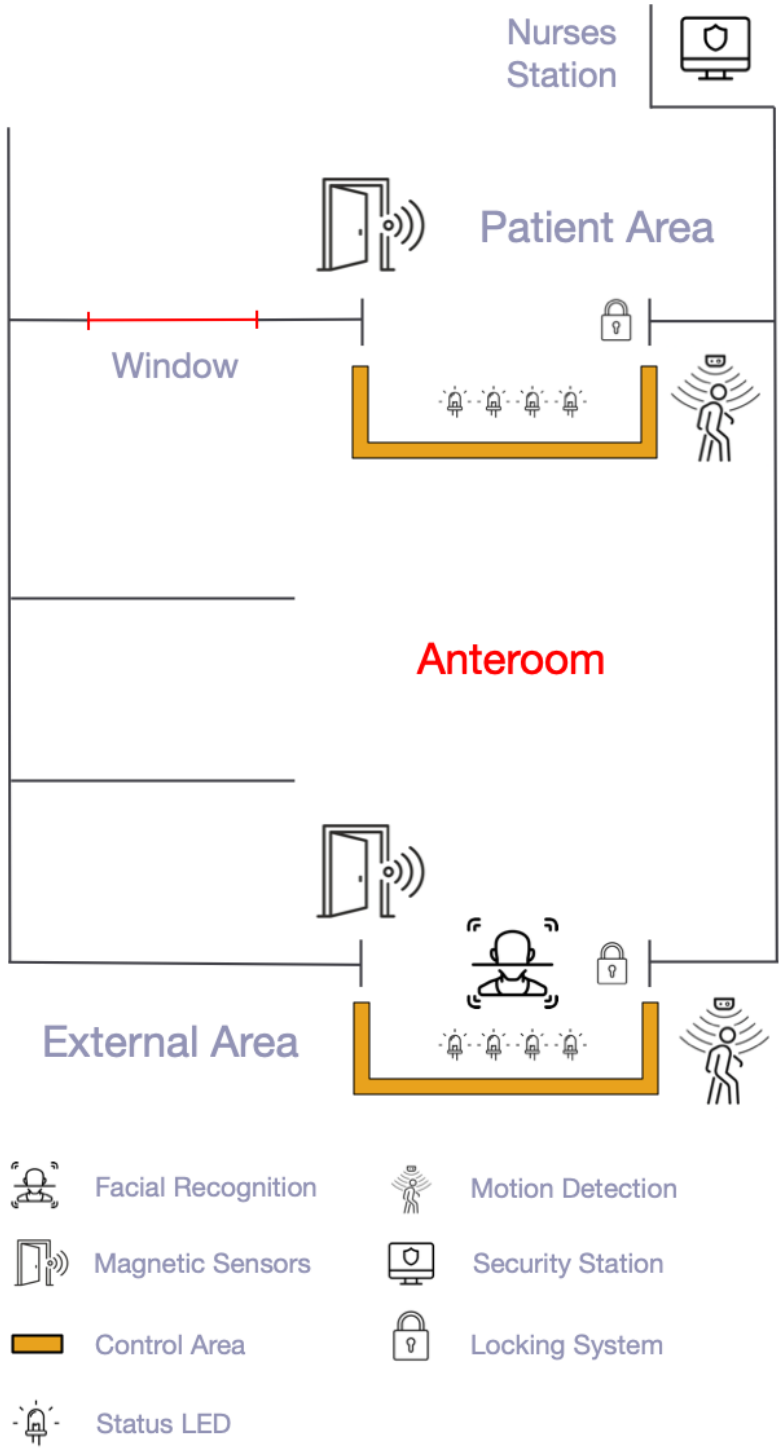

Figure 2: Revised Schematic.

1.3 Access to Anteroom and Patient Area

Components:

- Facial Recognition
- Motion Sensor
- Solenoid
- LEDs

Facial recognition technology, combined with motion sensors, can effectively control access to both the anteroom and the patient area of an infectious disease ward.

For access to the anteroom, a motion sensor detects users standing in a designated control area and activates facial recognition, ensuring efficient energy use and contactless operation. Once activated, personnel stand in a designated control area where the system verifies their identity and grants access, unlocking, and opening the main door to the anteroom. This ensures that only authorized personnel enter the decontamination area to don PPE.

Once inside the anteroom, a motion sensor installed inside the anteroom for the inner door, automates door operation to provide a contactless entry for authorized personnel once the anteroom door has been sealed. By detecting movement within a designated control area, the sensor triggers the unlocking and opening of the door to the patient area only when someone is ready to proceed, reducing the need for contact and enhancing infection control measures.

This system ensures that workflows remain efficient while maintaining a sterile environment.

LED Indicators:

- **Red:** Door is locked
- **Green:** Access is granted
- **Orange:** System error
- **All lights flashing:** System override in place

Benefits:

1. **Pre-PPE Authentication:** Facial recognition operates unobstructed by masks or PPE, avoiding disruption at later stages.
2. **Controlled Access to Sensitive Zones:** Logs entry for security, accountability, or contact tracing.
3. **Reduced Cross-Contamination:** Contactless system minimizes contamination risks compared to physical access methods.
4. **Contactless Operation:** Reduces cross-contamination and streamlines movement.
5. **Real-Time Monitored Access:** Logs activity for compliance and ensures alignment with infection control protocols.

1.4 Door Sealing

Components:

- Magnetic Sensor

Magnetic sensors ensure doors are closed and correctly sealed, improving security and supporting infection control by containing airborne pathogens.

Benefits:

1. **Infection Control:** Maintains pressure environments and triggers alarms if doors fail to seal.
2. **Enhanced Security:** Detects and alerts if doors are left ajar or forced open.
3. **Improved Workflow Monitoring:** Tracks door usage for protocol compliance.
4. **Energy Efficiency:** Prevents loss of conditioned air.

1.5 Ward Security Station

Components:

- Keypad (Virtual)
- Computer
- Monitor
- Push-button

A security monitor and keypad at the nurses' station provide centralized control of access to and from the anteroom.

Benefits:

1. **Centralized Control:** Allows nurses to oversee access and intervene when needed.
2. **Real-Time Monitoring:** Ensures proper use of protocols through visual confirmation.
3. **Accountability and Compliance:** Supports infection prevention efforts by monitoring adherence to access protocols.

2 Design Considerations

2.1 General Considerations

- Varying access levels for different staff categories.
- Robust measures against accidental and malicious access attempts.
- Ensures rapid access during emergencies while maintaining security.

2.2 Facial Recognition Accuracy and Privacy

- Performance under various conditions.
- Non-discriminatory design.
- Compliance with privacy regulations.

2.3 Redundancy and Backup Systems

- Secondary identification methods.
- Power backup via UPS.

2.4 Training and Familiarization

- Staff training for effective use and troubleshooting.
- Adaptability to new protocols.

2.5 Simplicity and Ease of Use

- User-friendly interface.
- Error recovery steps.

2.6 Audit Trails and Reporting

- Detailed access logs.
- Real-time reporting for security breaches.

2.7 Tamper Resistance

- Measures to prevent tampering with sensors or keypads.

2.8 Temporary Credentials

- Mechanism for granting limited permissions to visitors.
- Enforcement of scheduled access timelines.

3 Additional Sections

3.1 Stakeholder Analysis

https://docs.google.com/spreadsheets/d/140cqVl5ZM1R9FAib8Rb0csyrd425JppmpNtE4zCSsYg/edit?usp=sharing#gid=789989842#gid=789989842

3.2 User Requirements

https://docs.google.com/spreadsheets/d/140cqVl5ZM1R9FAib8Rb0csyrd425JppmpNtE4zCSsYg/edit?usp=sharing#gid=1552522416#gid=1552522416

3.3 System Requirements

https://docs.google.com/spreadsheets/d/140cqVl5ZM1R9FAib8Rb0csyrd425JppmpNtE4zCSsYg/edit?usp=sharing#gid=2109004334#gid=2109004334

3.4 UML Use Case Diagram

https://drive.google.com/file/d/1l8jBUQu92hrIp1AwGylTrHnVlyglOBDE/view?usp=sharing

3.5 UML State Diagram

https://drive.google.com/file/d/1L-wf7PQKT6WSGL_DWLIQuJQLzwFmhz9u/view?usp=sharing

3.6 UML Activity Diagram

https://drive.google.com/file/d/14sWCK9Wz5IRMYuh5wODulOBLh1IIN13Z/view?usp=sharing

3.7 Traceability Table

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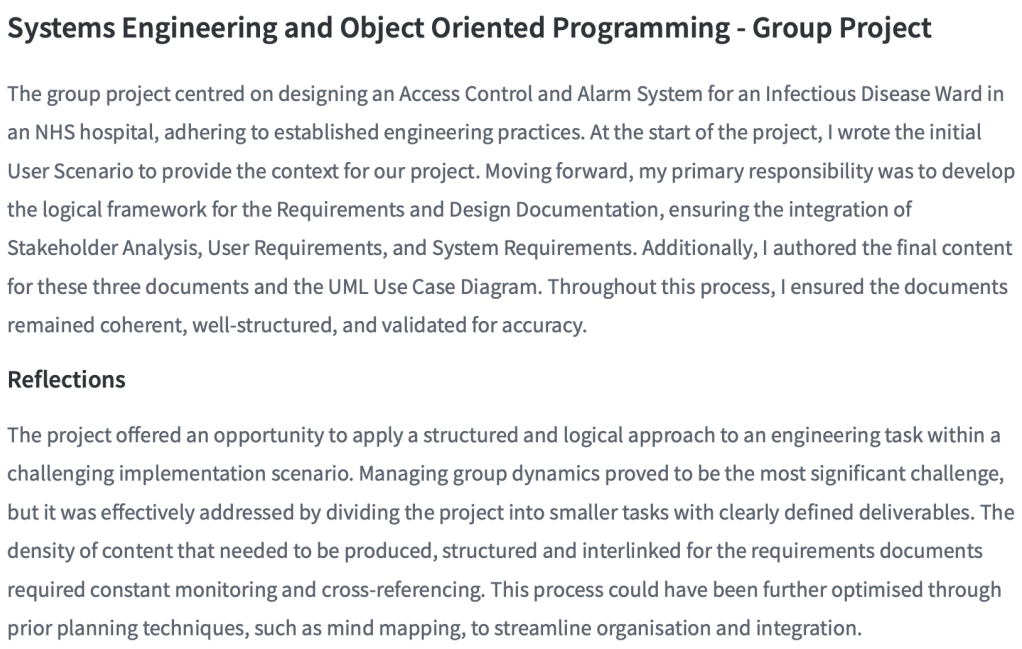
4 Individual Contributions

4.1 Dirc-Robert Wortley



Systems Engineering and Object Oriented Programming - Group Project

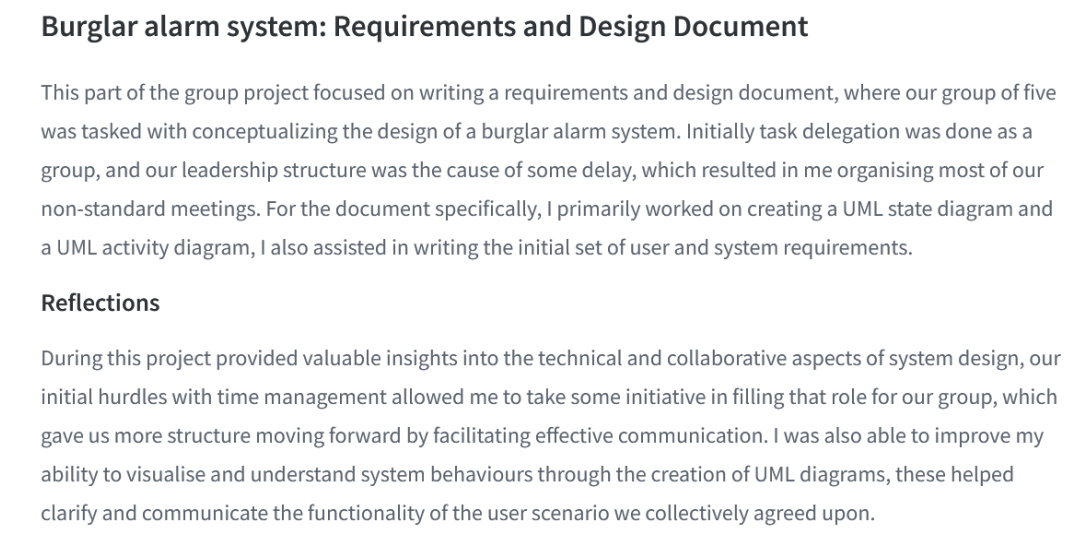
The group project centred on designing an Access Control and Alarm System for an Infectious Disease Ward in an NHS hospital, adhering to established engineering practices. At the start of the project, I wrote the initial User Scenario to provide the context for our project. Moving forward, my primary responsibility was to develop the logical framework for the Requirements and Design Documentation, ensuring the integration of Stakeholder Analysis, User Requirements, and System Requirements. Additionally, I authored the final content for these three documents and the UML Use Case Diagram. Throughout this process, I ensured the documents remained coherent, well-structured, and validated for accuracy.

Reflections

The project offered an opportunity to apply a structured and logical approach to an engineering task within a challenging implementation scenario. Managing group dynamics proved to be the most significant challenge, but it was effectively addressed by dividing the project into smaller tasks with clearly defined deliverables. The density of content that needed to be produced, structured and interlinked for the requirements documents required constant monitoring and cross-referencing. This process could have been further optimised through prior planning techniques, such as mind mapping, to streamline organisation and integration.

Figure 3: MySkills Screenshot - DRW

4.2 Connor Farnell



Burglar alarm system: Requirements and Design Document

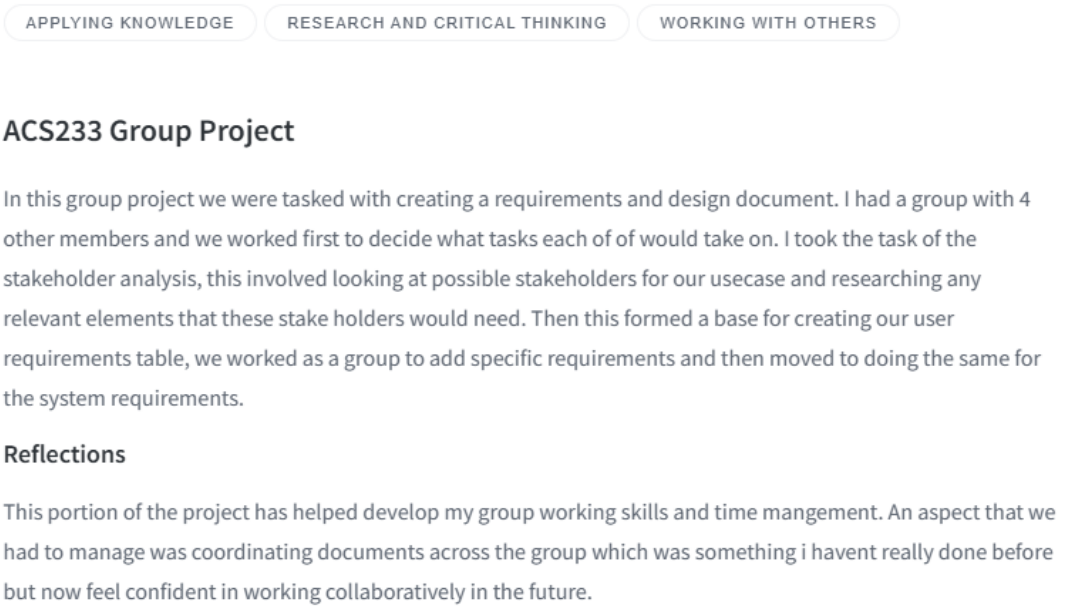
This part of the group project focused on writing a requirements and design document, where our group of five was tasked with conceptualizing the design of a burglar alarm system. Initially task delegation was done as a group, and our leadership structure was the cause of some delay, which resulted in me organising most of our non-standard meetings. For the document specifically, I primarily worked on creating a UML state diagram and a UML activity diagram, I also assisted in writing the initial set of user and system requirements.

Reflections

During this project provided valuable insights into the technical and collaborative aspects of system design, our initial hurdles with time management allowed me to take some initiative in filling that role for our group, which gave us more structure moving forward by facilitating effective communication. I was also able to improve my ability to visualise and understand system behaviours through the creation of UML diagrams, these helped clarify and communicate the functionality of the user scenario we collectively agreed upon.

Figure 4: MySkills Screenshot - Connor

4.3 Joshua Ellershaw



APPLYING KNOWLEDGE | RESEARCH AND CRITICAL THINKING | WORKING WITH OTHERS

ACS233 Group Project

In this group project we were tasked with creating a requirements and design document. I had a group with 4 other members and we worked first to decide what tasks each of of would take on. I took the task of the stakeholder analysis, this involved looking at possible stakeholders for our usecase and researching any relevant elements that these stake holders would need. Then this formed a base for creating our user requirements table, we worked as a group to add specific requirements and then moved to doing the same for the system requirements.

Reflections

This portion of the project has helped develop my group working skills and time mangement. An aspect that we had to manage was coordinating documents across the group which was something i havent really done before but now feel confident in working collaboratively in the future.

Figure 5: MySkills Screenshot Josh

4.4 Will Sartin

Object Oriented Programming Project

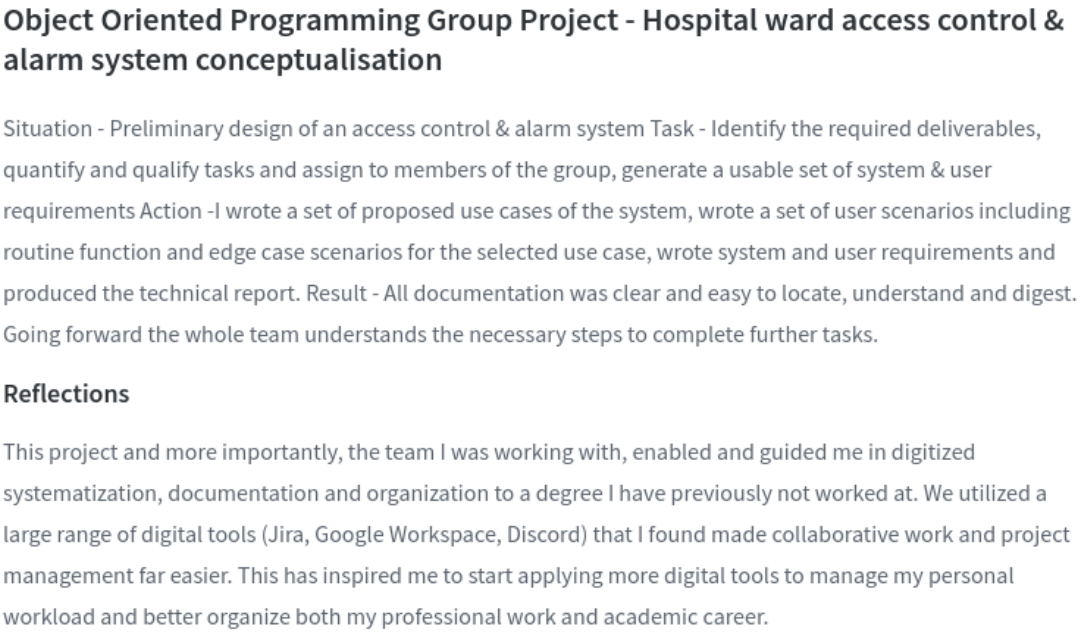
Within the group I was tasked with writing both user and system requirements. This involved filling out our shared group spreadsheet with requirements that specific stakeholders would need from our specified system, this included designated classification codes and other related stakeholders. After this I then helped to complete that same for system requirements which was similar but focused on the system side of the requirements, i.e. how to system would operate in order to fulfil the user requirements.

Reflections

This project has helped me build skills in working with others in a team and project co-ordination. Specifically, managing a document between multiple people and making sure we all know what it is we are working on and what we need to do to complete checklist tasks.

Figure 6: MySkills Screenshot Will

4.5 Simon Henry Lennox



Object Oriented Programming Group Project - Hospital ward access control & alarm system conceptualisation

Situation - Preliminary design of an access control & alarm system Task - Identify the required deliverables, quantify and qualify tasks and assign to members of the group, generate a usable set of system & user requirements Action -I wrote a set of proposed use cases of the system, wrote a set of user scenarios including routine function and edge case scenarios for the selected use case, wrote system and user requirements and produced the technical report. Result - All documentation was clear and easy to locate, understand and digest. Going forward the whole team understands the necessary steps to complete further tasks.

Reflections

This project and more importantly, the team I was working with, enabled and guided me in digitized systematization, documentation and organization to a degree I have previously not worked at. We utilized a large range of digital tools (Jira, Google Workspace, Discord) that I found made collaborative work and project management far easier. This has inspired me to start applying more digital tools to manage my personal workload and better organize both my professional work and academic career.

Figure 7: MySkills Entry Screenshot - SHR

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