Project Schedule and Cost

E Cubed Group (P2)

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Abstract

This Deliverable will focus on the prototyping aspect of our project. It will cover the design drawing that summarizes our project idea. Then, we will cover the prototyping schedule and the bill of materials. We will also have a complete list of equipment needed, as well as covering the risks associated with our design. Finally, we will have a test plan to prepare to build our first prototype.

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Introduction

From Deliverable D and the client meeting we have gathered information that will help us implement a plan for prototyping. From the client meeting we now have a unique solution that we will implement.

In this Deliverable we will be covering the following

1. A detailed drawing of our solution
2. How the prototype will look like and how we will test our client's solution.
3. Prototype schedule
4. All parts and their cost for our material budget.
5. The handwear and software needed for our solution
6. Outline test plan

The aspects covered in this document will serve as the basis for the series of prototypes and will guide us to the final prototype we will present on Design Day.

Overall Concept

We will implement a NetAware security system that centers around facial recognition and GPS location. Optimizing a phones sim card we will track the employee as they are in the Entreprises building. Specific areas will be restricted or accessible, which the administration will be able to define using our system. When an employee is approaching a door, it will automatically open for them if two conditions are being met. The first being if the area is permittable. The second being if the camera's facial recognition information matches the information from the SIM card. Below we have a figure indicating how the building’s doors and cameras will interact. The green color represents a permitted area and red being restricted. While the blue triangles represent facial recognition cameras.

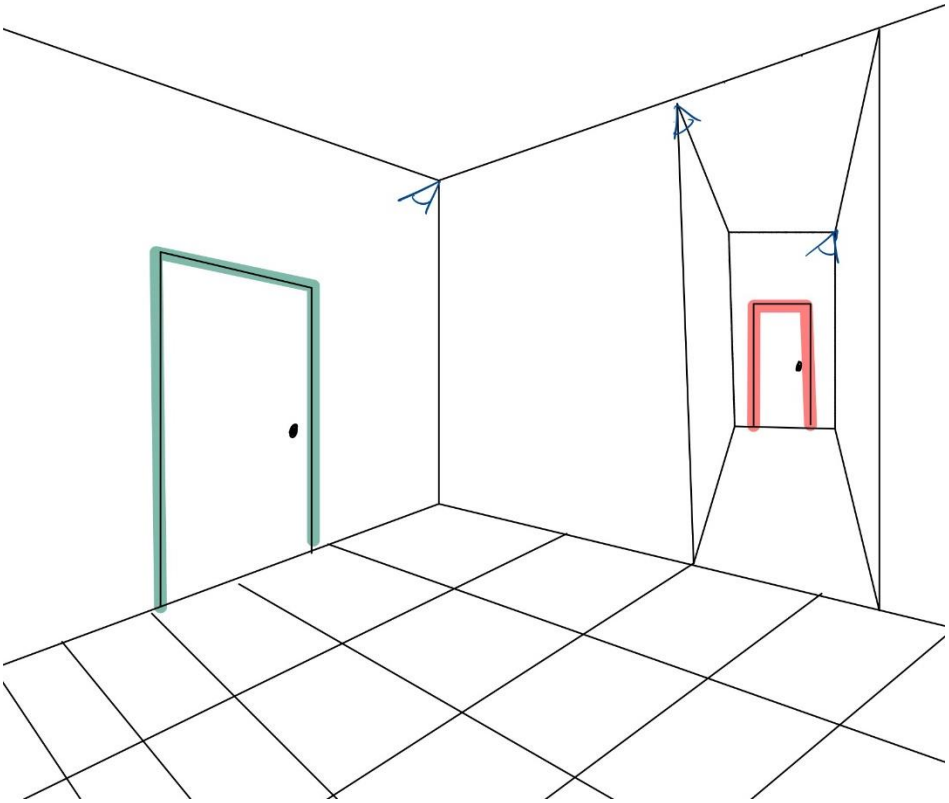


Figure 1: Restricted Door and Camera in Building

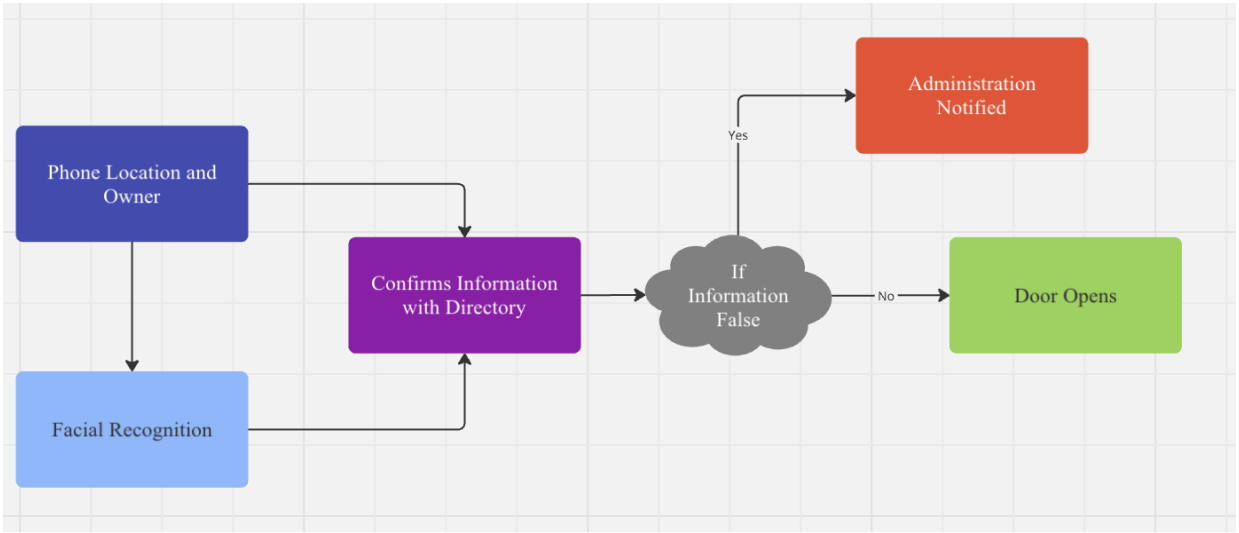


Figure 2: How all Systems Interact and Process Data

Software Design drawings

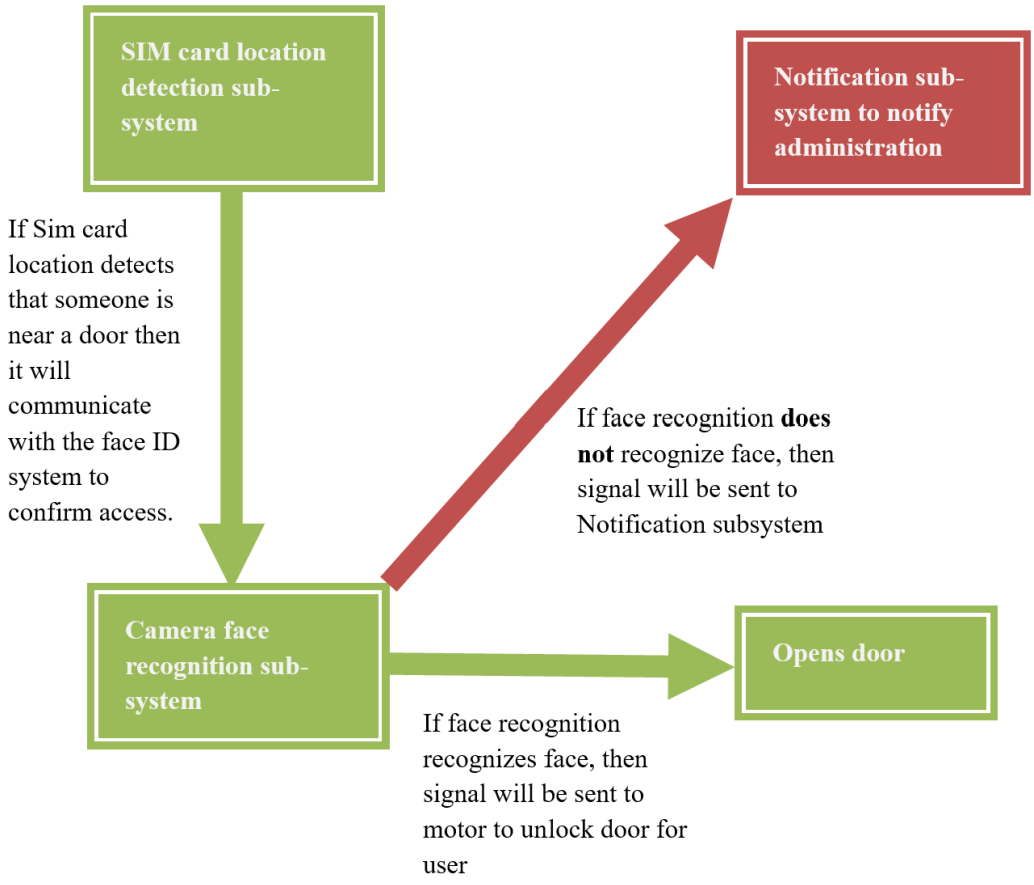


Figure 3: Opening Door Scenario

Hardware Required:

1. Camera
2. Bluetooth Transceiver
3. Jumper Cables
4. LED Light
5. Raspberry Pi 2
6. Resistor
7. Breadboard
8. Phone

Software Required:

1. Shabodi's APIs
2. Shabodi's Sandbox
3. OpenCV
4. VSCode
5. PIP Libraries

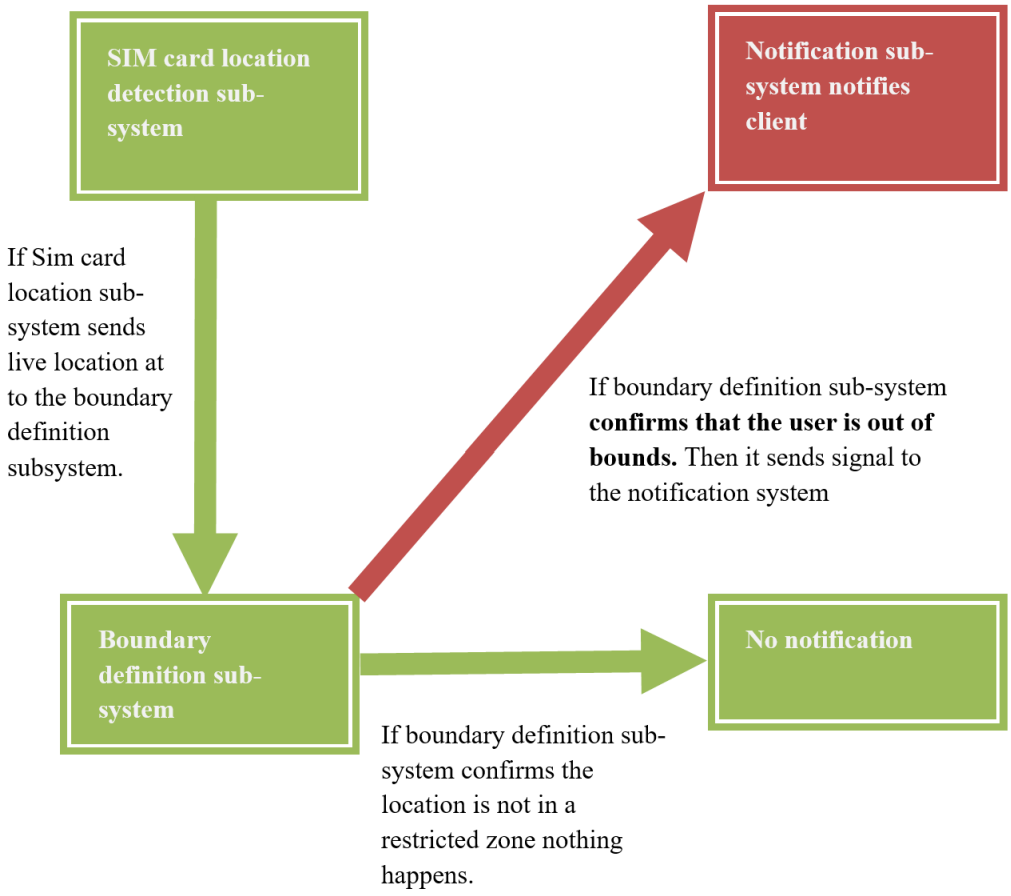


Figure 4: Tracking case with boundary definition

Hardware Required:

1. Phone
2. Laptop

Software Required:

1. Shabodi's APIs
2. Shabodi's Sandbox
3. OpenCV
4. VSCode
5. PIP libraries

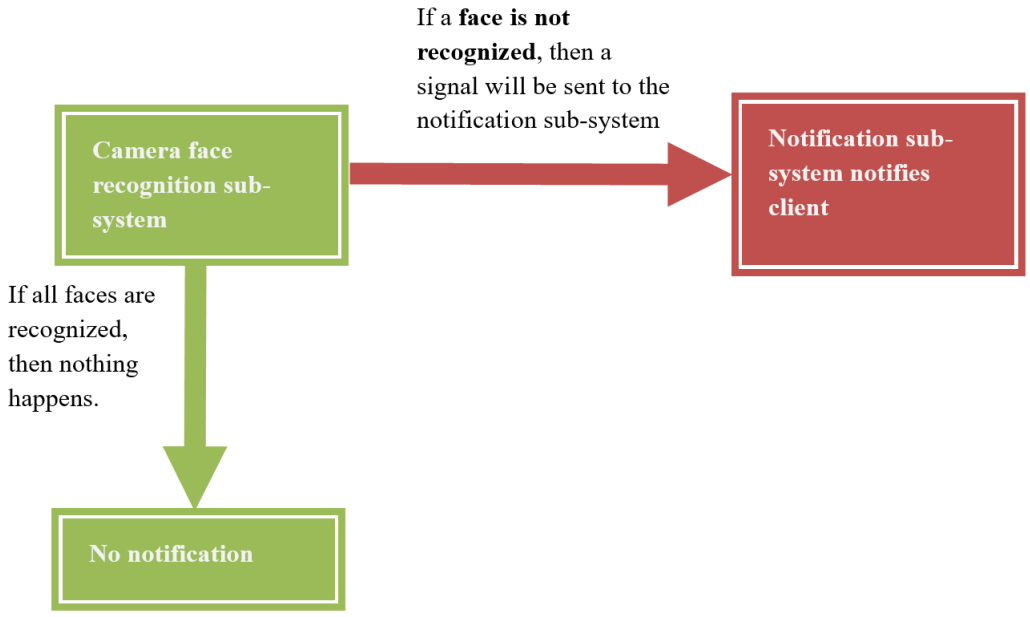


Figure 5: Security Camera that Detects Unfamiliar Faces (Optional)

Hardware Required:

1. Camera
2. Laptop

Software Required:

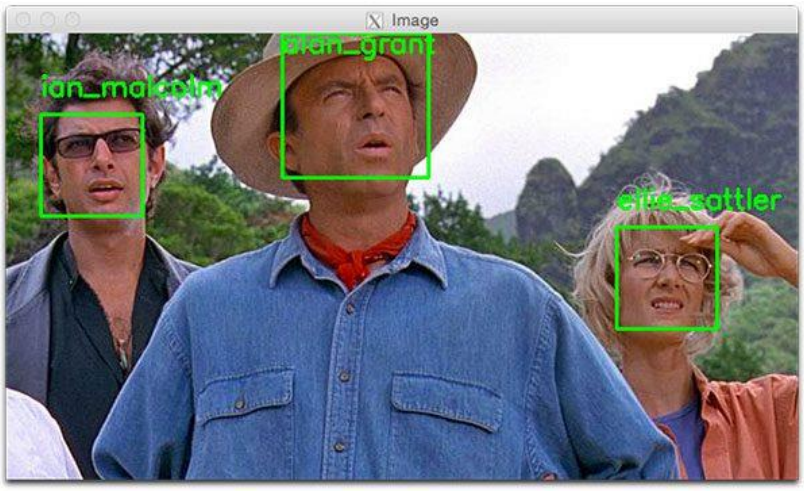
1. Shabodi's APIs
2. Shabodi's Sandbox
3. OpenCV
4. VSCode
5. PIP libraries

Prototypes

Before testing the final solution, we must make each sub-sections work correctly. Therefore, we must make a prototype for each of the subsections to test each one. The prototype code should be able to locate a phone within a meter and the prototypes for each subsection.

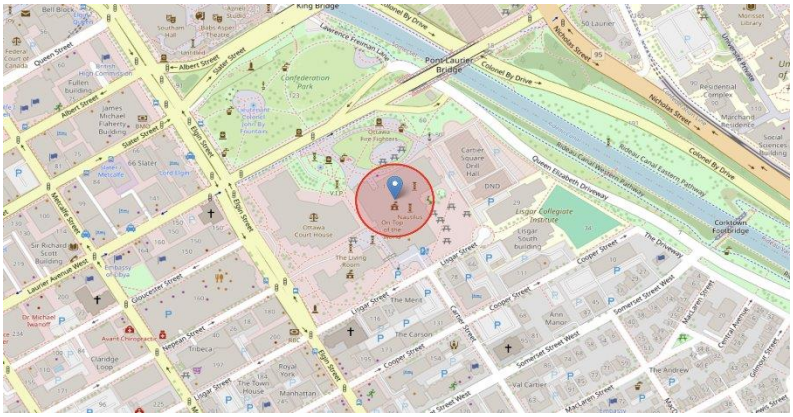
1. **Face ID subsystem**

We will have to upload our face identification program which uses OpenCV to Shabodi sandbox. When we run the subsystem, it should open the commuter camera on the user's laptop demonstrating it can recognize at least three people's faces and will identify unknown faces. This test will allow us to see if the face recognition system works properly. If the code works properly it should look like the image[1] below.



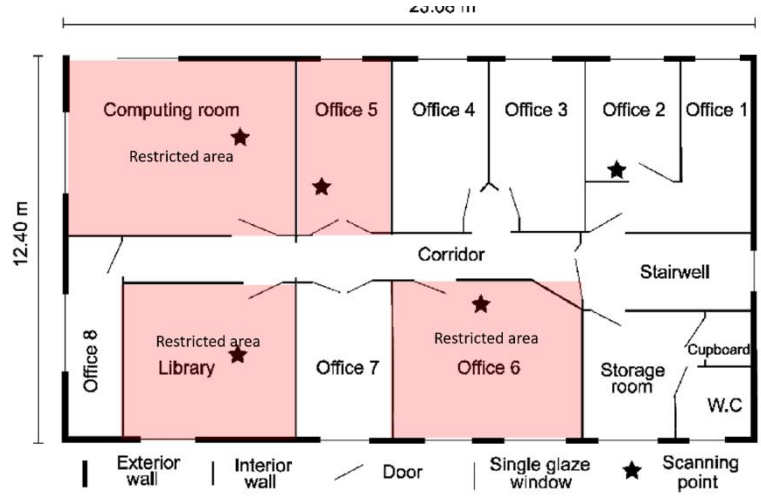
2. **SIM card location system**

We will use Shabodi SIM card location API to find the location of a cell phone and track its location. Our prototype code should be able to locate a phone within a $meter^2$ and the program should look like the following image.



3. **Boundary definition subsystem**

We will use Shabodi ‘s API network to identify where users can and cannot go. The prototype should be able to define a boundary of a real place by using longitude and latitude and be able to show a map of the defined boundaries[2].



4. **Notification subsystem**

We will use Shabodi’s API network to send notifications. To prototype this subsystem, we must write the code and see if it will send the notification to one of our emails or phone number using SMS.

Second Part of Prototyping

After we have prototyped each subsystem, we must make prototypes focused on how the subsystems will interact with each other. The prototypes are going to be simple versions of the Opening Door Scenario, tracking case with boundary definition, and security camera that detects unfamiliar faces.

Prototyping Schedule

	Week of October 21st	Week of October 28th	Week of November 4th	Week of November 11th	Week of November 18th	Week of November 25th
Louis-Philippe	Planning and start coding	Sub-system 1 must be coded and uploaded onto the sandbox	Opening Door Scenario Must be roughly done	Opening Door Scenario must be done	Opening Door Scenario must be debugged and polished	All systems must work perfectly for design day.
Emma		Sub-system 2 must be coded and uploaded onto the sandbox	Tracking case with boundary definition must be roughly done	Tracking case with boundary definition must be done	Tracking case with boundary definition must be debugged and polished	
Rares		Sub-system 3 must be coded and uploaded onto the sandbox	Security camera that detects unfamiliar faces must be roughly done	Security cameras that will detect unfamiliar faces must be done.	Security camera that detects unfamiliar faces must be debugged and polished	

Prototyping Test Plan

Test Number	Reason for Prototype	Evaluation Criteria/Determine Measurables	Level of Prototype	Kind of Prototype	Metrics	Test Description	Analysis Method
1	Performance Measurement	If the camera can recognize the same person, regardless of glasses, hats, facial accessories	LoFi Focused	Analytical	Boolean: True/False	Using a webcam to see if can recognize the correct person from a directory	Saving a photo of the person in a directory and see if the face is recognized correctly regardless of what's on the face
2	Learning/Understanding	If the sensor can accurately locate the person relative to the door	HiFi Focused	Numerical	Meters squared	We will test how close someone can get to sensor before the sensor registers a person	Using a SIM card, we will record the distance of the person approaching the sensor
3	Learning/Understanding	Testing to see if we can restrict access to a location to a specific SIM card	HiFi Focused	Analytical	Boolean: True/False	We will test if a SIM card registered phone can approach a sensor, and the sensor does not respond	Using an LED light, we will see if it remains off regardless of register SIM card approaches it to simulate the door unlocking. This will happen for 3 trials for 2 phones.

4	Learning/Understanding	Testing to see if we can define an area for restricted access.	HiFi Focused	Numerical	Meters squared	Using the program, we should be able to define a longitude and latitude where some users are not allowed to go.	By uploading our program to the Shabodi sandbox we will test the defined area by going to the restricted location and see whether the program recognizes that we entered a restricted area.

Bill of Materials

PART NUMBER	PART NAME	DESCRIPTION	LINK	QUANTITY	UNITS	SUPPLIER	UNIT COST	TOTAL PART COST
1	Laptop	coding software + webcam	Best Buy	1	NA	HP	$800	$0
2	Phone	SIM card	Best Buy	1	NA	Apple	$520	$0
3	Raspberry Pi 2	micro processor	Pi Shop	1	NA	Raspberry Pi	$50	$0
4	LED light	indicator (3mm)	Maker Store	1	Lumens	Maker Store	$0.60	$0.60
5	Resistor	470 Ohm	Amazon	1	Ohm	Amazon	$8.99	$8.99
6	Breadboard	half board	Maker Store	1	NA	Maker Store	$5.00	$5.00
7	OpenCV	API	OpenCV	1	NA	OpenCV	$0	$0
8	Shabodi APIs	sandbox + APIs	Shabodi	1	NA	Shabodi	$0	$0
9	PIP libraries	Library for python	Pip	1	NA	PIP	$0	$0
10	HC-05 Wireless Bluetooth Module (with AT Button)	Bluetooth module	Maker Store	1	NA	Maker Store	$9.00	$9.00
11	Jumper Cables	Pack of ten male-male	Maker Store	1	NA	Maker Store	$1.00	$1.00
12	Micro SD card	128 GB memory card	Amazon	1	NA	Amazon	$27.99	$0
			TOTAL PARTS	12		TOTAL		$24.59

Project Risks

1) Loss of files

Risk: All coding files could be lost due to software failing or hardware breaking.

Plan: We must make sure to execute regular backups. As well as storing the information in various places, to prevent local damage/disasters.

2) Location accuracy in buildings

Risk: Limited cell reception for SIM card.

Plan: Test cell reception in the building before implementing the system and optimize Wi-Fi access points in the building. Also, using Geofencing, we can trigger alerts when someone enters an unauthorized area, without really seeing the real-time location of the employee.

3) Loss of information/data

Risk: Hacking, limited encryption.

Plan: We will upload the data into the cloud and use Firewalls and a VPN to access the database. We can also implement Two-Factor Authentication on all the accounts associated with the camera systems and use strong passwords.

4) Camera Quality

Risk: Unable to accurately register a face.

Plan: Ensure we test the code on different laptops and try to upload many photos to our directory to compensate for poor camera quality. We will provide optimal camera placement and use adequate lighting. We could also implement different algorithms (e.g. contrast adjustment) to improve image quality before processing.

5) Wi-Fi dependency

Risk: Since the project is software based, we will need to rely on Wi-Fi networks

Plan: We can implement a secondary ISP to transfer between two networks in case one of them goes down. Also, implementing multiple access points in the building ensures coverage, even if one fails. If the Wi-Fi goes down because of loss of power, we can use a backup IPS, that gives us more time to act.

6) Camera maintenance

Risk: Neglected camera maintenance decreases image quality and can potentially cause system failures and increase reparation costs over time.

Plan: Perform regular inspections of camera performance and data management, as well as frequent cleansing of sensors and provide an adequate environment.

Conclusion

In this Deliverable we developed a suitable prototype for a restricted zone alerting system. We will leverage facial recognition to produce a unique product. There are detailed descriptions of each part of the system as well as the required hardware and software. We have also created a prototyping plan to ensure we can produce a viable product for Design Day. The bill of materials will help us keep track of expenses when developing the system and demonstratable aspects. A critical aspect of this Deliverable is risk assessment and management. Acknowledging the potential risks in this project can help us ensure we are exercising the right amount of caution. The risk assessment will aid in time management and having a management plan will aid in solving the issues.

References

[1]: https://pyimagesearch.com/2018/06/18/face-recognition-with-opencv-python-and-deep-learning/

[2] https://www.researchgate.net/figure/Laboratory-floor-plan_fig7_224199805