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## PPM Project Report - Group Kii

Magnus Frater System

Callum Axon (N0727303), Callum Carney (N0741707),  
Jordan Brightmore (N0732961), Finlay McKinnon  
(N0743587), Vital Harachka (N0731739), Wing Chiang  
(T0086366)



## Abstract

Magnus Frater (or Big Brother) has been created to help tackle the ongoing issue of security within large open campuses and premises, these sorts of locations inherently have an increased potential for intrusion through unmonitored sections of land. The group analysed the recent spree of attacks on schools and offices - for example the shooting that occurred at the YouTube headquarters in 2018 (Staff and Agencies 2018) - and found that in a large amount of these attacks there were open doors and spaces that allowed the attacker to enter with ease. As a consequence to this, the idea of creating a facial recognition system to analyse and report known and unknown people within a campus/large open setting was conceived.

As mentioned, the main purpose of the project was to create a system that would accurately detect and report people walking around an area to the associated security team, this data would differentiate between employees or authorised users and unknown people by linking into the companies employee/student database. Not only would this allow a security team to monitor who is within a set area at any one time, but it would also allow administrative users to track any persons movements and activities within a set time frame, through tracking of the targets face across multiple cameras. Another advantage to this project is that administrative users can view analytics in relation to the usage of campus properties, an example use case for this would be within a University. Admins could check what buildings within the campus are being utilised most by students.

After the main purpose behind the project was defined, the group decided on how to proceed in regards to the requirements for the project, most importantly how we should proceed with splitting up the individual hardware and software components so that the system could function within any scenario or environment. It was decided that there will be 4 different modules, these being:

1. A Raspberry Pi that would be responsible for processing any facial data that is captured by the camera
2. A Camera module that would connect directly to the Raspberry Pi and provide images to the Raspberry Pi
3. A website created for administrators and security personnel to administer and manage hits/rejections.
4. An API (Application Programming Interface) used within the website and the Raspberry Pi for collation and provision of data.

These modules will work together to create the Cameras that report facial data and the web interface that is used to manage the data received by the camera, the connection between these modules was outlined in the design documentation (for example the Data Flow Diagram and Entity Relationship Diagram).

Once the components and requirements were completed, the group began to consider which program-

ming languages and setups would be best suited for the type of project this is (Facial Recognition with Web Related components). It was clear that Python should be used for the facial recognition section of the project due to its strong existing libraries. NodeJS would be used for the Web Frontend, PHP would be used to power the backend API that links all of the components together and the API would be using a MySQL database to hold all of the data. The system would work in the following way:

1. The Camera feeds data to the Raspberry Pi
2. The Python application on the Raspberry Pi calculates if a face is present
3. Any potential face found is sent to the API where corresponding facial data is requested from the database
4. If no corresponding data is found, then the face is unknown, otherwise the image will be linked to the person the face associates with.
5. The Website will update using data from the API to show new detections, known or unknown.

Once the product had been developed, testing took place to ensure that the facial recognition software worked from a variety of different distances and in unfavourable circumstances (heavy rain, fog, etc). While some of the tests passed, others failed to detect faces when they were present, however this only occurred in extreme circumstances. We made small enhancements to the facial detection algorithm to improve its effectiveness during these scenarios.

Due to the nature of this system, there are a lot of potential legal and ethical issues, people may not consent to the recording of their faces, people may not wish to have their faces processed and stored by this system. Therefore it was important for us to implement a blacklist system that would stop the system from performing facial data processing, however, this is a complex system because we first need to process a persons face to understand what to blacklist, which could cause further legal or ethical issues.

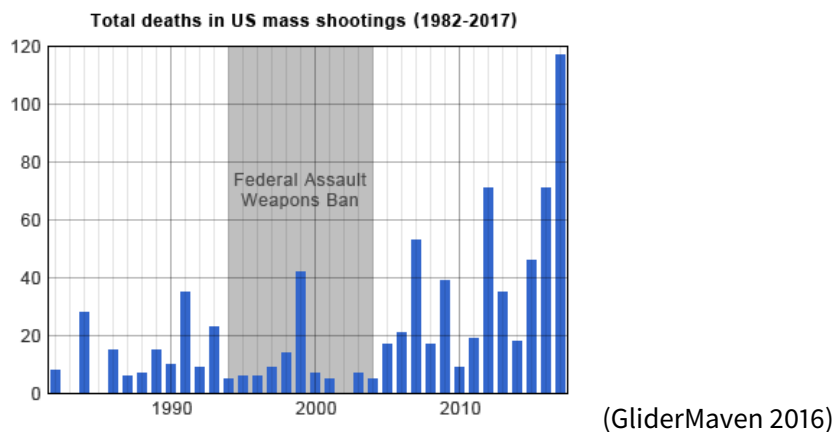
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## Introduction

Over recent years, especially in the United States, attacks on schools or open campus locations have been increasing at an alarming rate.



As you can see in the image above, there is a clear increase in mass shootings over the past few years, with a large percentage of these happening within schools or large open spaces. Current technology to prevent school shootings relies on hardening access to portions of the school or alerting people inside of an attack (through door barriers or locks and SMS messaging), however, this occurs after the shooting has begun and does not help to prevent the attack occurring in the first place.

Based on these findings, it can be deduced that there needs to be technology implemented that helps to prevent an attack happening, rather than lessening the impact of an attack. This is where our projects objectives come into play, our technology will help to identify unknown people within a school or campus, before they even enter the building. Automatically alerting security personnel so that they can investigate further.

We believe that this technology could greatly decrease the amount of potential attacks and could serve as a deterrent to people who want to commit a crime within an establishment that has the system installer.

Furthermore, the system could be improved to link with local police facial databases in order to identify known criminals who are attempting to enter a school or other location.

## Project Aims

The main aim of the project is to provide organisations with open campus settings a way to effectively track and monitor who is on campus and where they are located at any time of day. This is to help reduce or prevent intrusions and attacks that occur on these types of locations.

## Objectives

To ensure clear and appropriate objectives have been created for the project, the S.M.A.R.T. (specific, measurable, achievable/appropriate, realistic, time-constrained) goals (Doran 1981) were used. SMART allows us to create objectives that provide the project with lots of functionality, that will be meaningful to the objects, and still stay within the projects deadlines. For the project to be successful the following objectives should be met:

Staff Members should be able to:

- Add new faces or people to the system through a simple yet effective web interface
- Monitor the movements of people across buildings and campuses, whether they are registered as people or not
- Manage alerts of unknown people entering the campus
- Provide temporary passes to unknown people to authorize them for a set amount of time;

As a requirement to this, the camera and associated Raspberry Pi module should be able to provide the following:

- A stream of video that can be analysed by the algorithm on the Pi in order to find faces;
- A constant stream of face detections to the central server that manages all hits;

In general the following objective should be met:

- The camera and web interface should be able to talk to each other through an API (Application Programming Interface)

To meet the objectives set out for Staff Members, the group will be creating a web interface using NodeJS, this interface will have the functionality set out above and will interface with the API to get and set data. It was mentioned that the interface should be simple yet effective, we could easily bombard the user with a lot of metadata from the cameras, however, the web interface will only show the required information and actions to ensure that a staff member can quickly and easily identify if there is an intruder currently on campus. All of the outlines objectives are achievable and can be implemented in a timely manner.

To meet the requirements set out for the Raspberry Pi and API, we will have to ensure substantial testing of the facial detection algorithm takes place, the group wants to avoid experiencing a scenario in which multiple people are not identified. However, the algorithm cannot be 100% effective, there will always be scenarios in which the algorithm misses a person, or mis-identifies them, it would be unrealistic and a waste of development time to be chasing after a 100% success rate. We will also have to ensure that the API is tested thoroughly, not only for functionality, but for security purposes, if an attacker gained access to another users facial data then this would be a breach of GDPR, therefore we will be implementing multiple security procedures to ensure that the API is secure, including the use of security based unit testing and manual testing.



## Existing Solutions

Due to how niche this product is, there are few products available on the market, however there is one product available in the United States that has been implemented in various locations and links with Police Databases (which is a further goal for our product). You can find some more information relating to the features, strengths and weaknesses of this product below

Product	Features	Strengths	Weaknesses
FaceFirst (facefirst)	Facial Recognition Abilities, Police Database Link, Real Time Alerting	Links into Police Databases allowing for detection of Criminals, Multiple use case scenarios (Casinos, Campus Security, Authentication), Has an API/SDK Available	Expensive, Only available in the United States

## Product Demand

### Organisations

While there is no direct demand for this product, this could just be down to the fact that organisations and people do not know that this technology is possible and that it can be easily installed into their campuses. With more visibility around this product we believe that there would be significant interest, especially from Universities and Companies with open campuses in the United States. After conducting market research, it was discovered that some organisations in China have adopted the facial recognition approach for identifying users (Sharma 2018) and that it is working well for the organisations in question. (Gan 2018)

The unfortunate upward trend of school shooting and attacks on open campuses will lead to more interest in facial recognition software to help prevent, rather than lessen the impact of an attack.

### Consumers

Due to the potential ethical issues that could arise from an organisation using this type of product, the group was interested in seeing if consumers would approve of this type of technology being used. We released a form which asked the following questions

1. Would you personally consent to having your face scanned when entering a location?
2. Would you personally consent to having your location tracked in real-time by a human being through the use of facial recognition?

3. Would you feel safer at a location if you knew that Facial Detection was occurring (where faces are compared to known people and unknown people are flagged)
4. Would you personally consent to your tracking data being aggregated and used for statistical purposes?

In regards to question 1, 91% of respondents agreed to having their face scanned when entering a location, this is a great response rate because without consumer support, this product would not be able to work effectively for an organisation.

In regards to question 2, 83% of respondents agreed to having their location tracked by a human being, this is a decrease from the previous question, and was expected by the group due to the privacy violations that could be argued when tracking someones location constantly.

In regards to question 3, 95% of respondents agreed that they would feel safer at a location if they knew that Facial Detection is occurring, this is excellent to see as it shows that the product would have a profound difference to consumer safety.

In regards to question 4, 87% of respondents agreed to having their data aggregated and used for statistical purposes, this is an interesting difference from question 2 and shows that consumers are happier to have their information aggregated and used but not while being targeted specifically.

You can see the full results in the Questionnaire Responses section of the document.

## **Project Management**

### **Meetings**

Group meetings should occur at least once a week during term time. This may be altered and increased dependent on any deadlines that the group decide are enough of an impact to call extra meetings. The current meetings have an estimated length of 30 minutes to an hour, being held in a work-appropriate environment, such as a meeting room. IT can be useful to utilise software which allows the use of voice communication to enable remote working. It is possible that there will be instances in which not all the group will be able to meet. This may be caused through a great many scenario, each of which should be able to be resolved, given consideration and following a standard procedure. Some of the scenarios, and correct procedures to take in the event of said scenario, can be seen below:

#### **General Absence**

In the case of a general absence, being that a member of the group is absent without meaningful reason, the group may have to consider the situation the absent member may be in. The consideration being the current group position, the importance of the absent member's role, or contribution that may have been needed in the current session. In this event, the group may need to note down the general absence and keep track of the amount each member has committed, as many of these may show a lack of commitment to the project. A given example of this scenario is - "Marcus missed the meeting because he went to go see a movie."

#### **Authorised Absence**

In the event of an authorised absence, in which the member who is absent has given compelling reason and possibly proof if required, the member would be excused from the current session. For this scenario to be distinguishable from a general absence is down to a few possibilities: forewarning of absence with given reasoning and a group consensus to pass this absence, an event in which the member would not be able to attend due to reasoning outside of their control, or an unavoidable event where the member has no real ability to alter. A given example of this scenario is - "Jess couldn't make it to the meeting as she had a medical appointment."

#### **Absence Procedure**

In either of the circumstances mentioned above, the same procedure is taken. This is to ensure that the missing member will be able to catch up on the meeting that they missed, allowing for minimal

drawbacks from the absence. For a team member to be considered 'fully informed, for the meeting of absence, the team must follow the stages below. A team member(s) who was present in said meeting must contact the absentee, giving a small briefing as well as the minutes of the meeting. This should be followed with any decisions or changes decided within the meeting, if not already noted down in the minutes. Furthermore, the absentee should be asked if they have any questions about the information given to them, to ensure that they are sound minded on the group's current position, as well as each individual's tasks.

## **Management**

### **Project Manager**

A member should be elected as Project Manager (PM), the role responsible to tracking information on the group members, as well as being the first to act on any events which may disrupt the project. PM will handle the attendance of the group during all forms of meetings, as well as the punctuality of tasks from each of the group. It will be the PM's duty to talk to any members who show deviation from a consistent work ethic, ensuring that the member knows their tasks and is on track. If the PM finds the need to call a discussion with the group on a member's behaviour and commitment toward the project they can initiate a vote to exclude the member from the group, with warning and consultation. The PM may find it useful to pass off a secondary role to another team member to ensure that the project is being fully watched. The deputy should report back to the PM with any extra information they have found to be added to their current information on the group.

### **Task Allocation**

For the group to work as well as they can with minimal conflict, when a task is presented to the group they will be asked to whom would like to take on said task. If there is a conflict on the task allocation, it may be able to split the task into smaller subtasks; thus, allowing for multiple members to work on it. However, if the situation does not allow for this then a fair discussion will be made to decide which member will be assigned the task. Upon being assigned a task, the member will be given a deadline for the task to be complete, the deadline may be flexible, allowing for the member to negotiate and discuss with the team. When each member of the team is working on a task, the PM will ask for progress reports at intervals throughout each task. The PM will report to the team if any anomalies occur, allowing the team to propose ideas to ensure completion before its deadline.

## Team Members, Responsibility & Skills

**Project Manager:** Callum Axon

Name	Responsible For	Relevant Skills
Callum Axon	Backend Database & API	- PHP - MySQL - UML Tooling - Testing - Server Management
Callum Carney	Monitoring Application	- HTML & CSS - JavaScript, Testing
Finlay McKinnon	Monitoring Application	- HTML & CSS - Screen & Graphic Design
Jordan Brightmore	Facial Recognition Software	Python - Machine Learning - Raspbian - Computer Vision
Vital Harachka	Backend Database	SQL - PHP
Wing Lam Chiang	Documentation & Database	SQL - PHP - Project Management Software

## Risk Assessment

ID	Description	Impact	Probability	Response
RE1	Team member is ill, injured or cannot work on project due to personal reasons	High	Medium	Reorganise workload to cover team member.
RE2	Team member does not attend meetings due to a busy university schedule	Medium	Low	Organise more meetings at a common available time. Alternatively, use a digital solution
RE3	Team member consistently not doing work, time schedule falls at least a week behind	High	Medium	Assign multiple members to the same task - enabling redundancy
RE4	Data Loss	High	Low	Ensure a regular backup of work is taken. Use version control systems (VCS) for code & store in cloud.
RE5	Deadline Changes	Medium	Low	If deadline is earlier than before, change work schedule to account for it.
RE6	Missed Internal Deadlines	Very High	Low	Workload reorganised to complete project ahead of schedule, meetings to identify problems causing missed deadlines.
RE7	Team member leaves module/course	Very High	Low	Assign multiple members the same task, enabling redundancy, also ensure that all team members have open communication methods so that an early warning can be provided
RE8	Domineering personalities	Low	Low	If there is a dominant personality in the group which causes other members to feel unable to contribute, then limits could be made on individual contributions, also it is important that when members are speaking they have no interruption. Remind all the members of the group that it is important to hear and respect all opinions in relation to the topic.

ID	Description	Impact	Probability	Response
RE	Working with team members during non-term time	Medium	Low	If it is required for us to work with team members during non-term time then it will be important for us to have good communication so that all the team members still know what their roles are and what work need to be completed.
RE	ICT resources may not be adequate or appropriately available for the demands of the project	Medium	Low	If ICT resources are inadequate then consider using external sources to reach the goals needed to complete the project to a good standard.
RE	Team members finding topics or concepts difficult to grasp	Medium	Medium	Try help the team member to understand the topic they're working on, however if they still don't understand suggest a switch of topic or role on the project.

## Requirements

### Functional Requirements

FR#	Function	Goal	Actor	Justification	Importance Rating (out of 5)
1	Face Scanning	A stationary camera is able to detect a face and scan certain data points for analysis	Stationary Camera	In order to provide a product that tracks people on a large campus, we must have an effective face scanning algorithm to track people across cameras	5 - This functionality is required for the system to work
2	Position Reports can be filed	Once a person has been identified all of the associated metadata is compiled and submitted as a report to the API	Camera - Rasp-Pi	In order to provide person tracking functionality the Rasp-API must receive compiled position reports to query at a later date, without these the application would lose a large portion of functionality.	5 - This functionality is required for the system to work properly
3	New facial data can be added to the system	An administrative user must be able to upload new facial data to be detected at a later point in time	Admin User	In order to match new faces to current people, an original image of a person's face must be uploaded to the system so that the two images can be compared at a later date	5 - FR4 requires this function to exist



FR#	Function	Goal	Actor	Justification	Importance Rating (out of 5)
4	New facial data is processed when uploaded to the web interface	Once an image of a person has been uploaded the associated facial data points are created and stored	API	In order to compare two faces, the system needs to generate data points from the two images and then compare the data points to calculate who has been detected	5 - Without this functionality the system would not be able to discover people
5	A person can be discovered when they have a valid position report	If a member of the security team is looking for a person, they can search and find the related position reports	Security Personnel	A person must have position reports associated with them to allow the security team to search for them and discover their past or present location	3 - The application will still function without this, however a large piece of functionality would be missing
6	A person can be located within a Campus/Location	A person must be able to be located within a campus setting.	Security Personnel	In order to allow security personnel to find people within a certain location, there must be functionality to discover a person.	3 - The application will still function without this, however a large piece of functionality would be missing
7	A temporary pass can be assigned to a person	In order to be able to allow unknown users to walk around a campus without causing alerts a temporary pass can be assigned	Security Personnel	In order to lower the amount of False Negatives within a system, administrators can assign temporary passes that will allow unknown people to walk around the campus without causing alerts	4 - The application will still function without this, however a very important feature would be missing

FR#	Function	Goal	Actor	Justification	Importance Rating (out of 5)
8	List Campuses	Display a list of Campuses	Web Interface	In order to display required information to users of the system, there must be functionality to display added campuses	4 - The application will still function without this, however a very important feature would be missing
9	Add Campuses	Add a Campus	Web Interface	In order to manage buildings, campuses must be added so that buildings can then be associated with them	5 - This functionality is required for the system to work properly
10	Remove Campuses	Remove a campus	Web Interface	A campus may no longer be required or may be phased out, therefore the ability to remove campuses must be included	4 - The application will still function without this, however a very important feature would be missing
11	List Buildings	Display a list of buildings	Web Interface	In order to display required information to users of the system, there must be functionality to display added buildings	4 - The application will still function without this, however a very important feature would be missing
12	Add Buildings	Add a building	Web Interface	In order to manage cameras, buildings must be added so that cameras can then be associated with them	5 - This functionality is required for the system to work properly
13	Remove Buildings	Remove a building	Web Interface	A building may no longer be required or may be phased out, therefore the ability to remove buildings must be included	4 - The application will still function without this, however a very important feature would be missing

FR#	Function	Goal	Actor	Justification	Importance Rating (out of 5)
14	Add Cameras	Add a camera	Raspberry Pi	In order to link person discovered with cameras a camera must first be enrolled onto the system, this occurs within the Python applications code	5 - This functionality is required for the system to work properly
15	List Cameras	Display a list of Cameras	Web Interface	In order to display required information to users of the system, there must be functionality to display added cameras	4 - The application will still function without this, however a very important feature would be missing
16	Update Cameras	Update a camera	Web Interface	A camera may have its location or information changed therefore, there must be functionality to update added cameras	4 - The application will still function without this, however a very important feature would be missing
17	Remove Cameras	Remove a camera	Web Interface	A camera may no longer be required or may have been phased out therefore, there must be functionality to delete added cameras	4 - The application will still function without this, however a very important feature would be missing
18	List Users	List Users	Web Interface	Administrators need to be able to list users to see who is administrating their system and what people have been registered	4 - The application will still function without this, however a very important feature would be missing
19	View Users	View Users	Web Interface	Administrators should be able to view user profiles which should include statistics in regards to current and previous locations	3 - If possible, the system should have this implemented as it would be an excellent feature to have, however it is not critical to the functioning of the system

FR#	Function	Goal	Actor	Justification	Importance Rating (out of 5)
20	Add Users	Add Users	Web Interface	Administrators need to be able to add users to the system, this could be for administrative purposes or just adding a low level user	4 - The application will still function without this, however a very important feature would be missing
21	Remove Users	Remove Users	Web Interface	Administrators need to be able to list users to see who is administrating their system and what people have been registered	4 - The application will still function without this, however a very important feature would be missing
22	List Statistics	List Statistics	Web Interface	Administrators should be able to look at statistics of their systems for example, what location is most popular, etc	2 - The application does not need or require this functionality, it is purely a quality of life improvement, however it would be a great advantage for administrators of the system
23	React to Alerts	React to Alerts	Web Interface	Administrators and security personnel must be able to react (false negative, resolved) to alerts of unknown users on Campus in order to remove an unknown user listing	5 - The core objective of this system is that organisations can react to unknown people activity, therefore this functionality needs to be included

## Non-Functional Requirements

NFR# | Function | Goal | Actor | Importance Rating (out of 5) |

--- | ---- | --- | --- | ----- ||

1 | Be usable | The system should be usable by any users with varying levels of computer proficiencies | Administrators | 5 |

2 | Performance | The system should be fast and responsive when administrators are using the Web Interface | Administrators | 4 |

3 | Be easy to setup | Cameras should be easy to setup and link into the web interface | System Installer | 3 |

4 | Automated Backup | The system should have an automated backup for the facial data to prevent loss of authorised users | Administrators | 3 |

5 | Language | The system should have a variety of languages available in order to cater for non english speakers | Administrators | 2 |

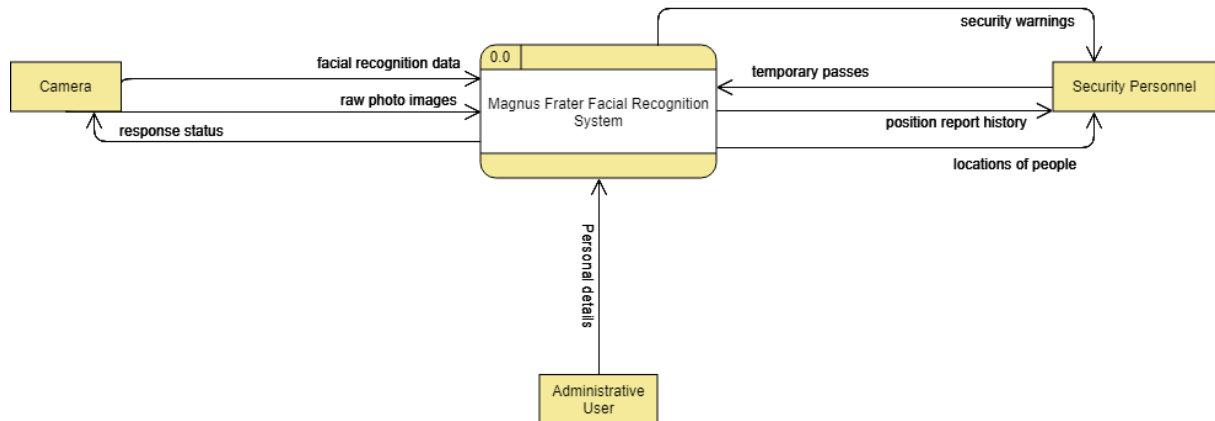
6 | Security | The system should be inherently secure and all data should be held in a secure facility/location | Administrators | 5 |

## Normalisation

UNF	1NF	2NF & 3NF
*Person ID	<b>Person</b>	<b>Person</b>
Person First Name	*Person ID	*Person ID
Person Last Name	First Name	First Name
Date of Birth	Last Name	Last Name
Gender	Date of Birth	Date of Birth
Camera ID	Gender	Gender
Camera Name		
Camera Address	<b>Camera</b>	<b>Camera</b>
Camera Active Flag	*Camera ID	*Camera ID
Campus Name	Camera Name	#Building ID
Campus Address	Camera Address	Name
Campus City	Camera Active Flag	Address
Campus County	Campus Name	Active Flag
Campus Postcode	Campus Address	
Building Name	Campus City	<b>Campus</b>
Position Report ID	Campus County	*Campus ID
Position Report Camera	Campus Postcode	Name
Position Report Building	Building Name	Address
Position Report Campus	Position Report ID	City
Security Alert ID	Security Alert ID	County
Security Alert Camera	Security Alert Timestamp	Postcode
Security Alert Timestamp	Security Alert Actioned Flag	
Security Alert Actioned Flag		<b>Building</b>
		*Building ID
		#Campus ID
		Name

UNF	1NF	2NF & 3NF
		<b>Security Alert</b>
		*Security Alert ID
		#Camera ID
		Timestamp
		Actioned Flag

## Context Diagram



**Figure 1:** Context Diagram



## Level 0 DFD

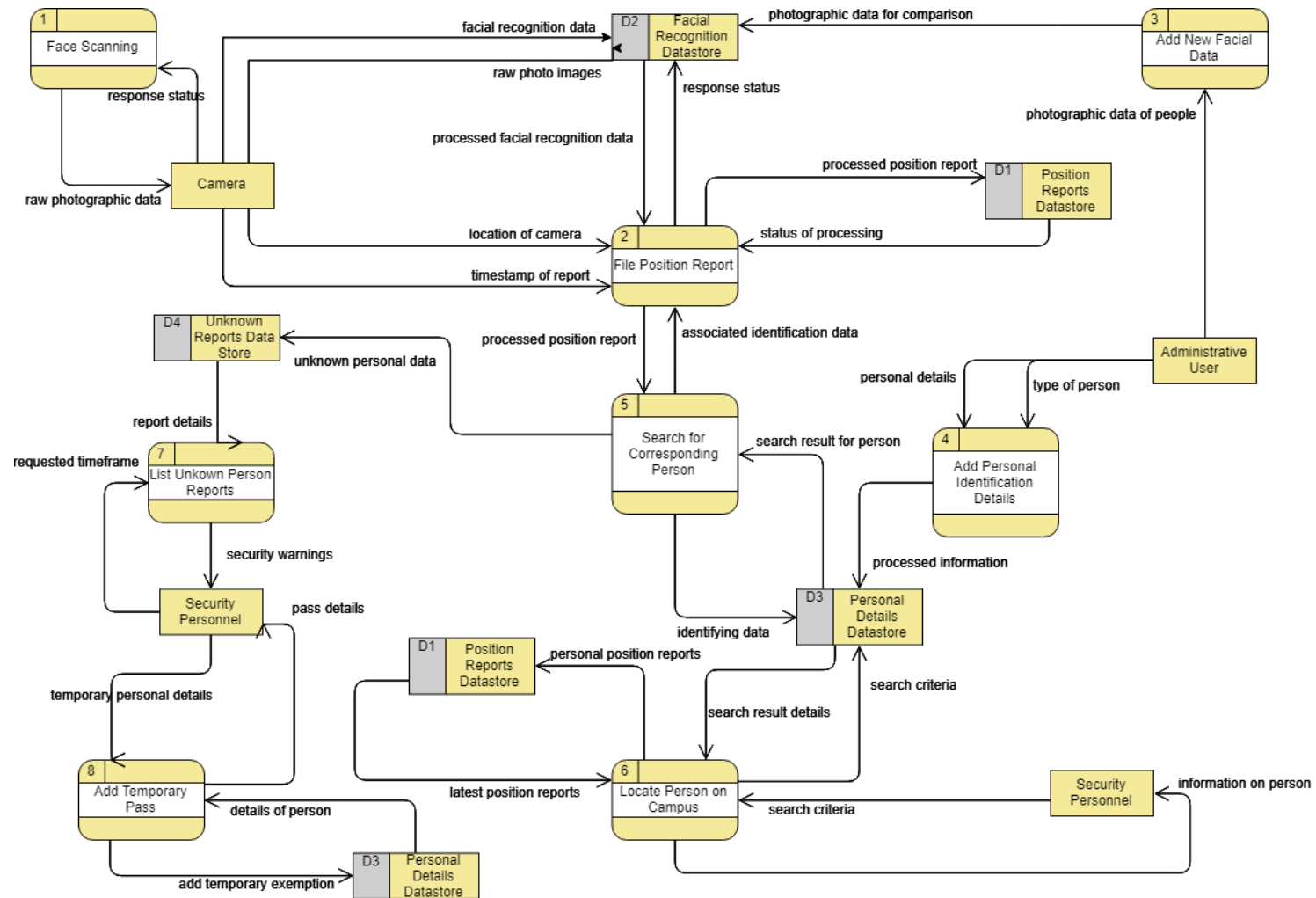


Figure 2: Level 0 DFD

## Concept Map

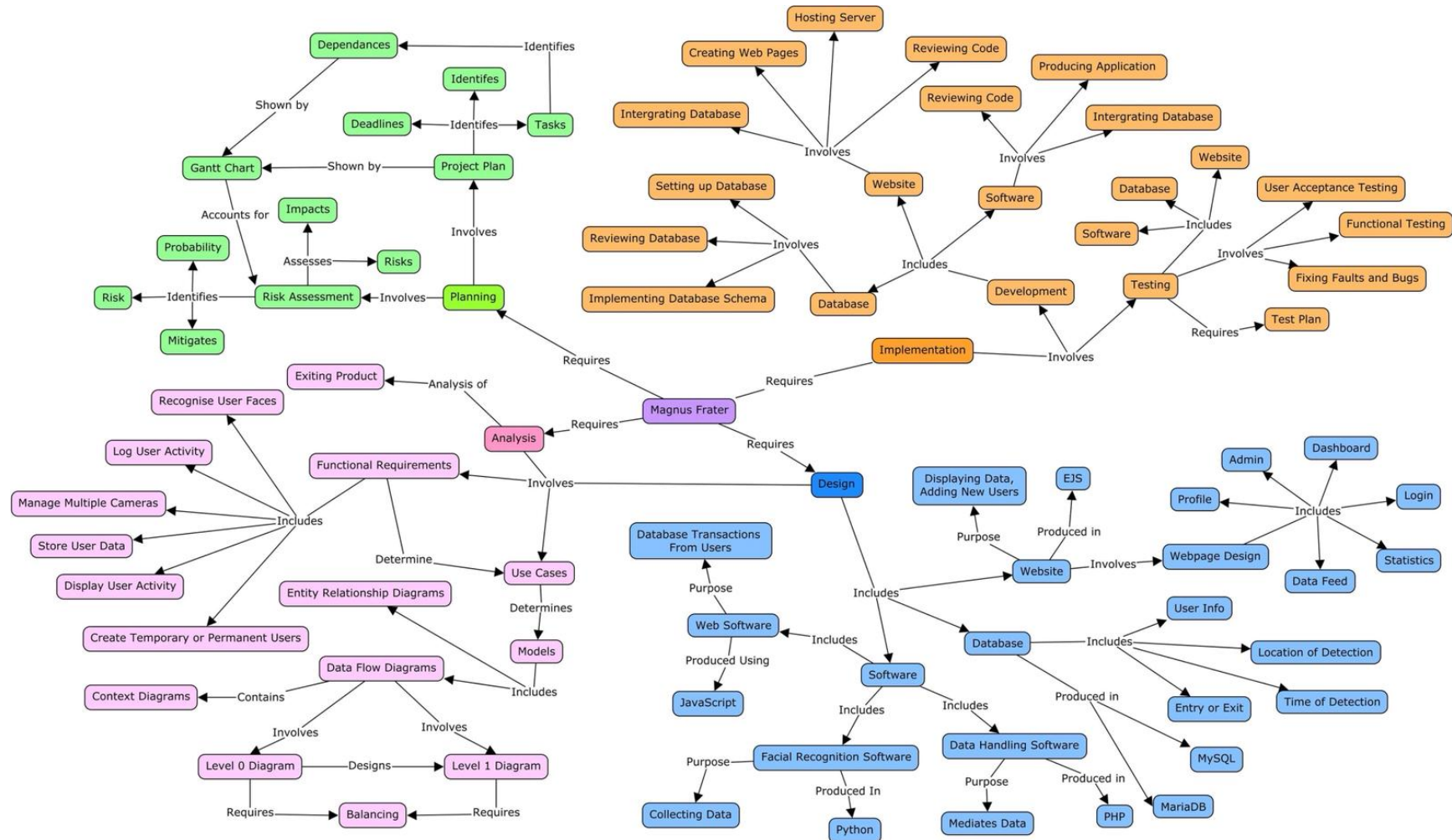
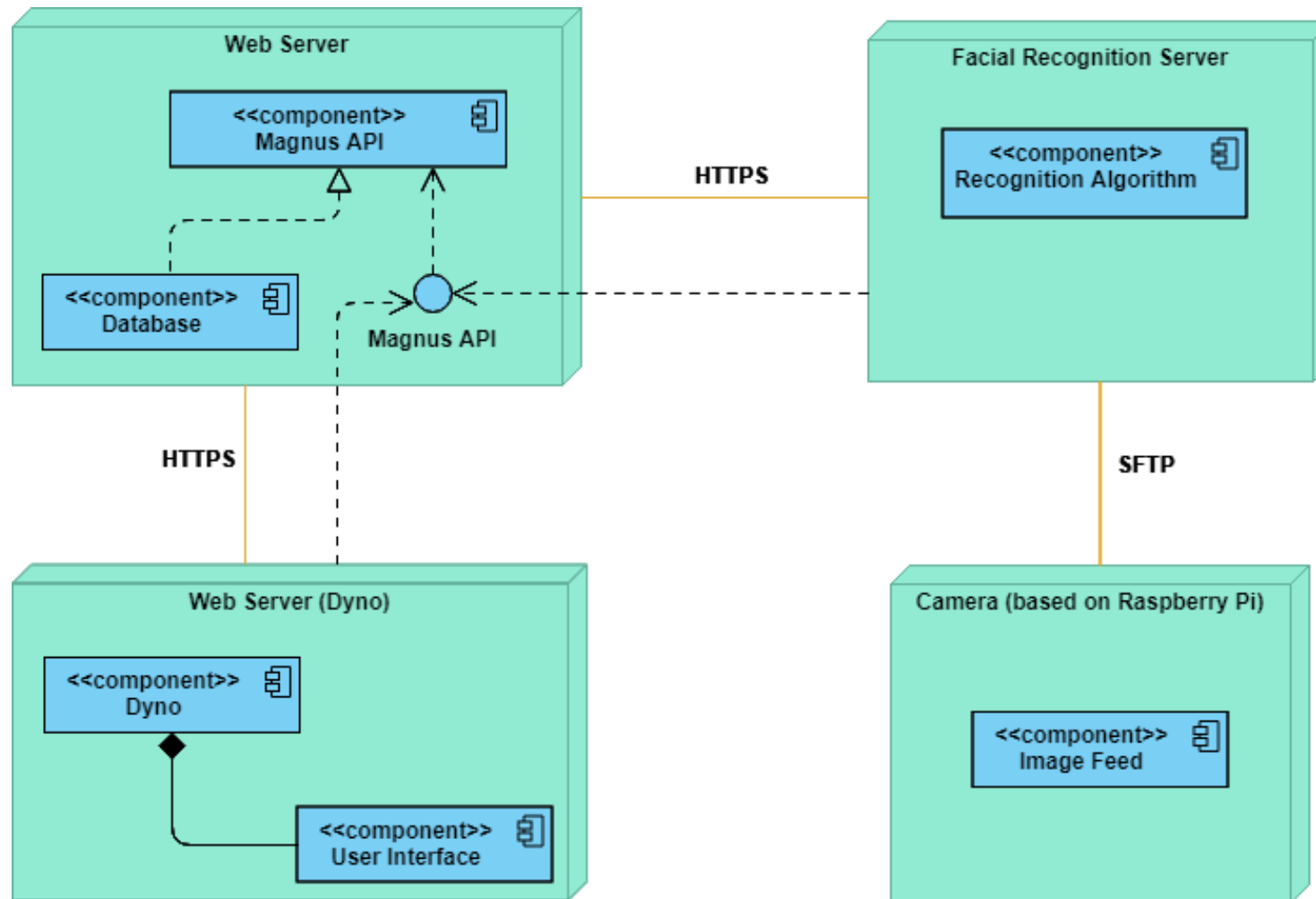


Figure 3: Concept Map

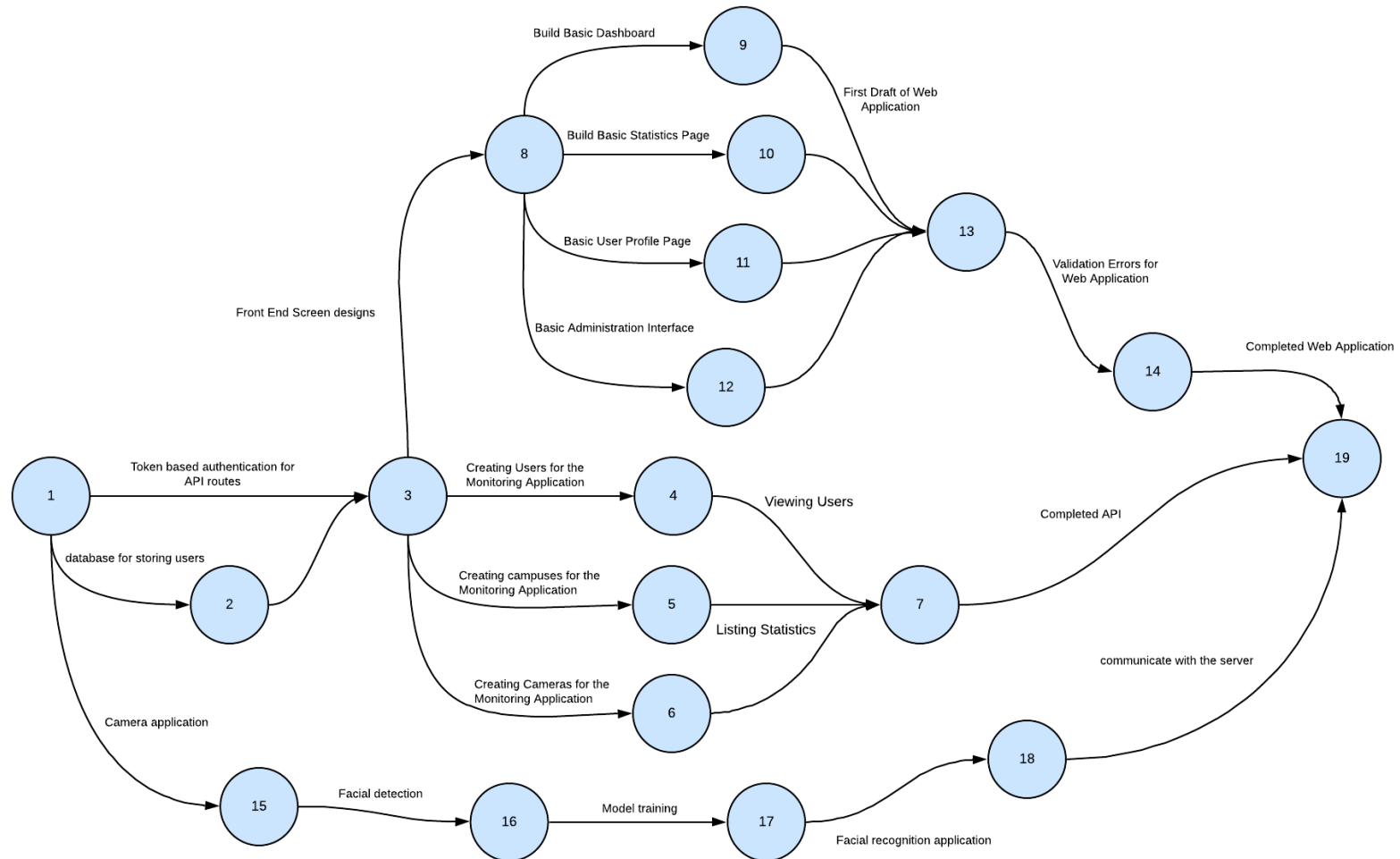
## Deployment Diagram



**Figure 4:** Deployment Diagram

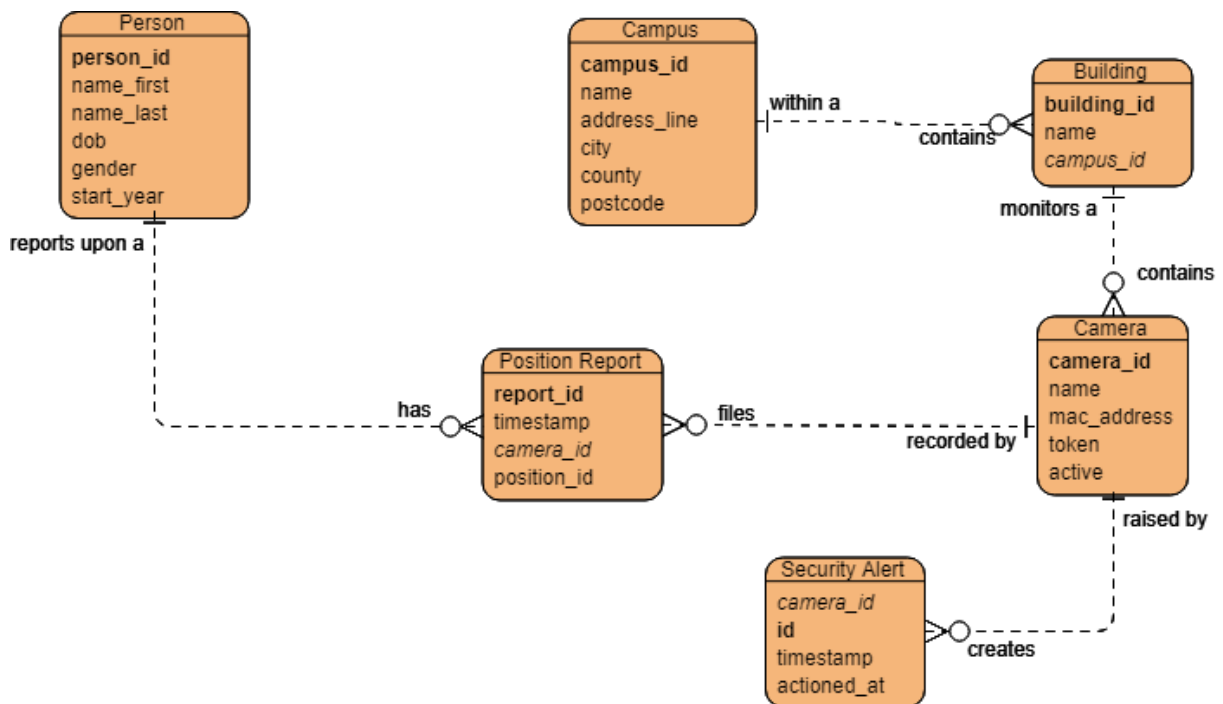
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## PERT Chart



**Figure 6:** PERT Chart

## Logical ERD



The ERD represents the database structure with the data in the third normalised form. It shows the relationship between the entities within the application, in addition to the keys and cardinalities.

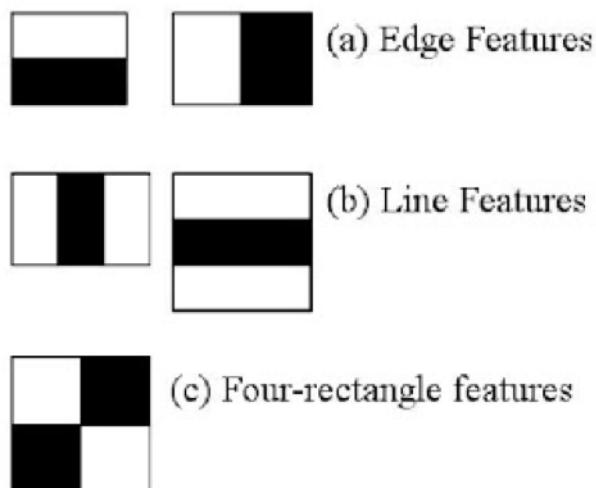
## Process flow for Camera



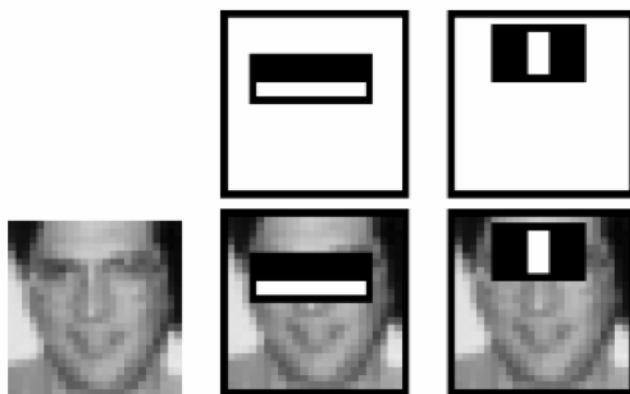
## Algorithm Explanation

### Facial Detection

For the facial detection portion of the program the haar cascading classifiers is used, with a pre trained model of faces. Haars works by extracting all useful filters from an image, it does this with the below image. Each feature is a value obtained by subtracting a sum of pixels from under the white section from



the sum of pictures under the black section.

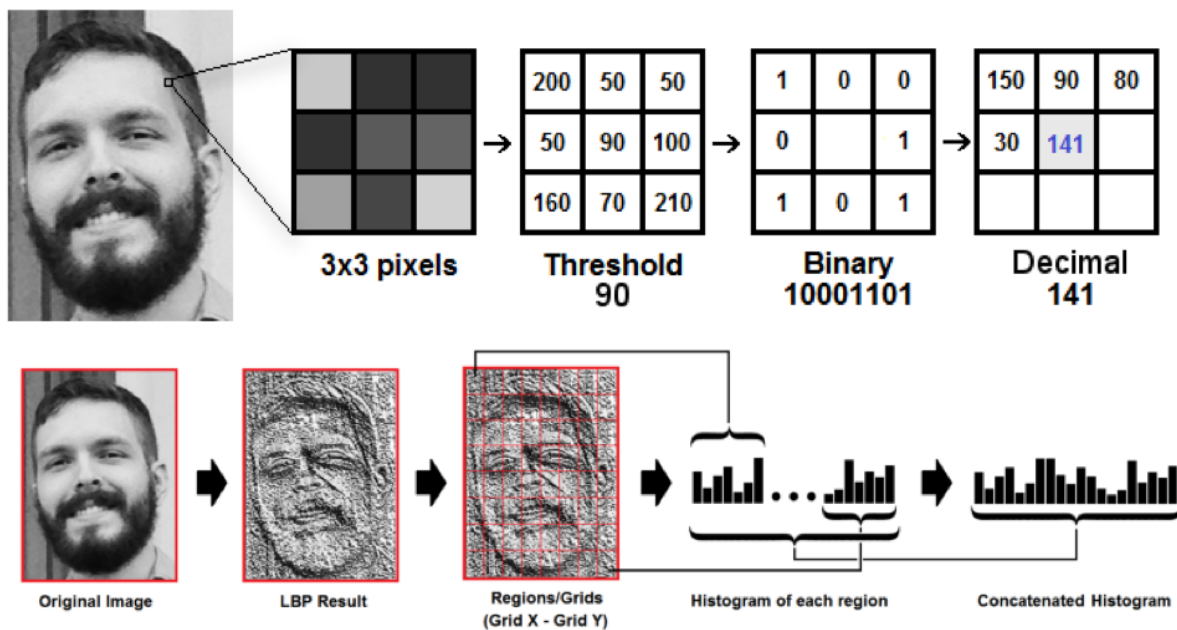


Each filter will be placed at every available size of the image some will be useful other won't be, but this is where the problems start, doing this for a 24x24 pixel image will use over 160000 features. This is very time consuming which is where the power of haar comes in. It applies the filters in a cascading fashion. Applying one set and if all of the comeback positive, the next set will be used this is very beneficial as it help weed out areas that aren't faces quicker. An image that passes all states of the cascade will be returned with the information of the region the contains the space. ("Face Detection Using Haar Cascades," n.d.)



## Facial Recognition

For the facial recognition the Local Binary Pattern Histograms (LBPH) was used. This method excels at its efficiency in terms of computational power, working by taking in a grayscale image and for every pixel gets the 8 neighbors' pixel values. If there below a threshold then the cell is given a zero - else it's given a one, a binary number is then constructed from the cells and this is that positions new color value.



This new image better represents the features of the original image, as it stores a histogram for how many occurrences there are of each brightness value. This is then compared with a trained model and the closest neighbor is found. A match will always be given back this is why a threshold need to be implemented as a value too far away from the original is unlikely to be a positive match. (Salton et al. 2017)

## Discussion / Conclusion & Evaluation

As a result of this project, the group has created a basic facial recognition system which records the location of a “hit” (where the camera has successfully recognised a person based upon a pre-defined database of pictures). The cameras are designed to run on a lightweight device (demonstrated as a proof-of-concept on a Raspberry Pi) to allow the system to be cost-effective and for cameras to be in potentially secretive locations (depending on the use case). To monitor the data, a dashboard presenting all this information to relevant security personnel has also been created. From here, users of the dashboard can administer those people whom are known to the system, monitor activity in a specific location and action alerts of unknown reports in the places.

The big challenge and learning experience with this project were producing a system which wasn't just an academic exercise. Producing a system which had the potential to be used to improve the safety and security of our peers and the staff on campus was a rewarding concept when the group first agreed on the proposal. It required for a large pool of skills to be brought together and managed in a way which provided the best results based upon our aims and requirements. With other modules at university often taking varying degrees of priority through the course of the project, it was important to set reasonable goals and help people manage their workloads. Much of the group were in the same group so could empathise with the conflict between this project and other assignments at university. We prepared for this well using the risk assessment responses and producing a clear list of tasks using a GANTT chart and other methods such as a shared to-do list between our intra-project “teams”. Planning a lot of the tasks out in advance allowed members to manage their workloads effectively.

Facial recognition technology, coupled with artificial intelligence and machine learning, are very much emerging technologies which are at the cutting edge of research. For a group of undergraduate students, despite the collective experience of the group the system we have produced in just 5 months only scratches the surface as to what this concept can do. Learning skills in this field could be useful for future employment as companies may seek to utilise these technologies at a greater rate.

## Social, Legal & Ethical Issues

This technology could be perceived as being highly invasive on people and their civil liberties. By storing the location of people, including exact timestamps, not to mention their photograph to cross-reference, causes some ethical issues.

Data on the whereabouts of people in the wrong hands could lead to the safety of people and their homes (e.g. a burglary) could be compromised. If this project was to enter the real world on the scale to make it useful, there would have to be significant consideration and training given to the personnel whom use the system to ensure that this scenario doesn't occur. People also might not feel comfortable

making such a binary decision as whether they are perceived as a “threat” due to them not being known to the system. Therefore, the project still carries a human element with respect to flagging potentially harmful situations, to ensure the computer is not making all of the decisions but supporting that of the human by providing more in-depth information on a given scenario.

Technologies for facial recognition (FRS) require machine-learning algorithms that have been trained with data to recognise facial features’. Many factors play into account that affect the match like the quality of the database image (pixel, size, lighting, etc.), the quality of the captured image, the algorithmic performance and more. The important aspect of the use of this technology is the operator and their response. The software itself does nothing but output its matches, it is the operator that will decide what to do with the information. The concern here is that if the software results in an inaccurate output and generates many matches the operator might act without verifying the accuracy of the match. Therefore, ethical principles must be in place. (Porter and Uncategorized, n.d.)

UK Government guidelines relating to the use of facial recognition software (Porter and Uncategorized, n.d.) state that ethical issues include, but are not limited to: - The use of the software can be used only if it benefits and serves the public interest. - The use of the software can be used only if it is a reliable tool to identify people. - If the software has unequal and discriminatory results should be open to careful examination and effective oversight. - Images and information should have appropriate security measures to prevent unauthorised access and use.

The group believes these principles should be followed with future developments of the system by improving the reliability of the recognition algorithm. Keeping those people on areas such as a campus serves in the public interest but some work might still be required to optimise its uses in other use cases and locations. The images are transferred between areas of the system using secure methods of communication HTTPS to ensure that the data doesn’t get intercepted.

## **Future Work**

As previously mentioned, this could be considered to be a basic implementation of both the facial recognition algorithms and the way the data about identification is recorded. Optimisations for the future could include improving the speed, reliability and scalability of the algorithm and camera feeds. These variables are still unknown given the limited scale of this project but has been developed in such a way which would make these things feasible.

In terms of work not complete, the group would like to have integrated this system with the ability to capture attendance for academic sessions within the university. This was defined as one of our stretch goals at the start of the project but due to limited time and technical limitations, this was not attainable in the given timeframe.

In the future, the system could also be integrated with the local police facial recognition database

in order to identify unknown people automatically, not only would this allow security personnel to understand who is on campus without having to manually intervene (providing the person exists in the Police database), but it would also allow for security personnel to immediately identify criminals or unwanted people that are on campus.

## **BCS Code of Conduct**

In order to make our project as efficient as possible, the group decided that it will essential to use the British Computer Society's (BCS) code of conduct, so it can guide us with professional standards and be aware of our responsibilities to each other and the public.

All of our decisions were made with the BCS code of conduct in mind. In order to keep our work professional, with competence and integrity, we made sure to thoroughly research and be up to date with the latest technology and techniques for our respective parts in this project. As it states in the BCS code of conduct "develop your professional knowledge, skills and competence on a continuing basis, maintaining awareness of technological developments, procedures, and standards that are relevant to your field." ("BCS Code of Conduct" 2015).

Because of the nature of this project, working in a group, we ensured that everyone in the group had the same rights and authority toward the project. Everyone's thoughts and opinions were taken into account, no matter the content, everyone had a voice and no one could contradict that, not only it is immoral it is enforced by the (BCS) code of conduct "respect and value alternative viewpoints and, seek, accept and offer honest criticisms of work." ("BCS Code of Conduct" 2015).

With that said this brings us to another matter, any form of discrimination was prohibited, not only it's immoral, it is also illegal. The Equality Act 2010 and the BCS code of conduct state that any kind of discrimination is not allowed "conduct your professional activities without discrimination on the grounds of sex, sexual orientation, marital status, nationality, colour, race, ethnic origin, religion, age or disability, or of any other condition or requirement" ("BCS Code of Conduct" 2015).

It is important to say that we worked on this project for the public interest. We wanted to provide security and efficiency. With this product we want to save time for the public and make their lives easier. Of course, the privacy of the public is our priority, we implemented restricted access to our product, so only personal that have a username and password can access the private data. With the BCS code of conduct stating, "You shall have due regard for public health, privacy, security and wellbeing of others and the environment." ("BCS Code of Conduct" 2015).

## Appendix

### Use Cases

#### Use Case – FR1: Face Scanning

<b>Use Case Name:</b>	Face Scanning	<b>ID:</b> 1	<b>Priority:</b> High
<b>Actor:</b>	Stationary Camera		
<b>Description:</b>	The camera detects a face and scans it.		
<b>Trigger:</b>	Person walks in range of the camera		
<b>Type:</b>	External / Temporal (time-based)		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. Face is within range and is scan able based on the current environment/quality of the image.</li> </ol>		
<b>Normal Course:</b>	<ol style="list-style-type: none"> <li>1. Person approaches stationary camera</li> <li>2. Camera scans face to generate data for further processing</li> </ol>		
<b>Postconditions:</b>	<ol style="list-style-type: none"> <li>1. The final face scan is valid</li> <li>2. The Raspberry Pi is connected to the internet</li> </ol>		
<b>Exceptions:</b>	<ol style="list-style-type: none"> <li>1. Face scan fails due to external interference</li> <li>2. Camera fails to begin scanning/grab focus</li> </ol>		

**Use Case – FR2: Position Reports can be filed**

<b>Use Case Name:</b>	Face Scan Data Upload	<b>ID:</b> 2	<b>Priority:</b> High
<b>Actor:</b>	Camera - Raspberry Pi		
<b>Description:</b>	The camera algorithm, upon detecting a person that it recognises, will store a record of this report, storing information on the person identified, the time of the report and its location based upon the camera.		
<b>Trigger:</b>	A successful detection by a Camera within the system.		
<b>Type:</b>	External / Temporal (time-based)		
<b>Preconditions:</b>	<ol style="list-style-type: none"><li>1. Facial recognition data</li><li>2. Location of Camera</li><li>3. Processed Identification Data</li></ol>		
<b>Normal Course:</b>	<ol style="list-style-type: none"><li>1. Camera receives the image from the camera</li><li>2. Camera begins to calculate the data points of the face</li><li>3. Camera uploads the resulting data points to the position reports data store</li></ol>		
<b>Postconditions:</b>	<ol style="list-style-type: none"><li>1. The Camera is successfully connected to the data store</li><li>2. The facial recognition data is uploaded to the position reports data store</li></ol>		
<b>Exceptions:</b>	<ol style="list-style-type: none"><li>1. Data point processing fails</li><li>2. Camera is not connected to the data store</li><li>3. Data store rejects the resulting facial recognition data</li><li>4. Data store is not online/is inaccessible</li></ol>		

**Use Case – FR3: New Facial Data can be added to system**

<b>Use Case Name:</b>	New Face and Personal Identification Upload	<b>ID:</b> 3	<b>Priority:</b> High
<b>Actor:</b>	Administrative User		
<b>Description:</b>	The web interface receives an image of a new face to be processed along with information that can uniquely identify the person (name, course, address etc), this data is then sent to the API to be processed.		
<b>Trigger:</b>	Web interface receives a new face upload		
<b>Type:</b>	External / Temporal (time-based)		
<b>Preconditions:</b>	<ol style="list-style-type: none"><li>1. The user is logged in and has permissions to create new profiles.</li></ol>		
<b>Normal Course:</b>	<ol style="list-style-type: none"><li>1. A png/jpg of a persons face is uploaded through the Web interface</li><li>2. A JSON array of data is sent to the API generated through the Web Interface</li><li>3. The data is sent to the API for processing and storage.</li></ol>		
<b>Postconditions:</b>	<ol style="list-style-type: none"><li>1. The uploaded file is accepted by the API</li><li>2. The data is valid and does not violate the validation rules in place.</li></ol>		
<b>Exceptions:</b>	<ol style="list-style-type: none"><li>1. The uploaded file is not a png/jpg</li><li>2. The API rejects the uploaded file <u>eventhough</u> it is a png/jpg</li><li>3. The API rejects the personal information due to a violation in the validation rules (ex, a valid phone number must be provided)</li></ol>		



**Use Case – FR4: New Face Upload Processing**

<b>Use Case Name:</b>	New Face Upload Processing	<b>ID:</b> 4	<b>Priority:</b> High
<b>Actor:</b>	API		
<b>Description:</b>	The API receives the uploaded png/jpg data from the Web interface and begins processing the image to calculate the data points for storage.		
<b>Trigger:</b>	Web interface receives a new face upload		
<b>Type:</b>	External / Temporal (time-based)		
<b>Preconditions:</b>	<ol style="list-style-type: none"><li>1. The image uploaded is clear enough to calculate the required data points.</li><li>2. The uploaded image is not corrupted.</li></ol>		
<b>Normal Course:</b>	<ol style="list-style-type: none"><li>1. A png/jpg of a persons face is received from the Web interface</li><li>2. The data points of the face are calculated and compared to the current face logs.</li><li>3. If the face is new then the data points are saved, otherwise no action is taken.</li></ol>		
<b>Postconditions:</b>	<ol style="list-style-type: none"><li>1. The generated data points are valid.</li></ol>		
<b>Exceptions:</b>	<ol style="list-style-type: none"><li>1. The generated data points are not valid.</li><li>2. The image is not valid.</li></ol>		

**Use Case – FR5: A person can be discovered when they have a valid position report**

<b>Use Case Name:</b>	A person can be discovered when they have a valid position report	<b>ID:</b> 5	<b>Priority:</b> High
<b>Actor:</b>	Security Personnel		
<b>Description:</b> A member of the Security team can search for a person and retrieve their related position reports after they have at least one valid position report in the database.			
<b>Trigger:</b> A search request through the Web Interface			
<b>Type:</b>	<b>External / Temporal (time-based)</b>		
<b>Preconditions:</b> <ol style="list-style-type: none"><li>1. The person being queried exists</li><li>2. The person being queried has a valid position report</li><li>3. The user searching has permission to view the person and their position data</li></ol>			
<b>Normal Course:</b> <ol style="list-style-type: none"><li>1. A member of the security team inserts a search query into the web interface</li><li>2. The web interface queries the API for a related person and their associated position reports</li></ol>			
<b>Postconditions:</b> <ol style="list-style-type: none"><li>1. The web interface displays the person and their associated position reports, if found.</li></ol>			
<b>Exceptions:</b> <ol style="list-style-type: none"><li>1. The requested person was not found</li><li>2. The requested person was found, but there are no associated position reports for that person</li><li>3. The web interface is unable to contact the API due to it being unavailable</li><li>4. The user requesting data does not have permission to look at that person or view position reports</li></ol>			

**Use Case – FR6: A person can be located within a Campus/Location**

<b>Use Case Name:</b>	A person can be located within a Campus/Location	<b>ID:</b> 6	<b>Priority:</b> High
<b>Actor:</b>	Security Personnel		
<b>Description:</b> A member of the Security team can search for a person and retrieve their current location on campus/within a specific area.			
<b>Trigger:</b>	A search request through the Web Interface		
<b>Type:</b>	<del>External / Temporal (time-based)</del>		
<b>Preconditions:</b> <ol style="list-style-type: none"><li>1. The person being queried exists</li><li>2. The person being queried is currently on campus</li><li>3. The user searching has permission to view the person and their position data</li></ol>			
<b>Normal Course:</b> <ol style="list-style-type: none"><li>1. A member of the security team inserts a search query into the web interface</li><li>2. The web interface queries the API for the related persons current position.</li></ol>			
<b>Postconditions:</b> <ol style="list-style-type: none"><li>1. The web interface displays the person and their associated position reports, if found.</li></ol>			
<b>Exceptions:</b> <ol style="list-style-type: none"><li>1. The requested person was not found</li><li>2. The requested person was found, but they are not currently on campus</li><li>3. The web interface is unable to contact the API due to it being unavailable</li><li>4. The user requesting data does not have permission to look at that person</li></ol>			

**Use Case – FR7: A temporary pass can be assigned to a person**

<b>Use Case Name:</b>	A temporary pass can be assigned to a person	<b>ID:</b> 7	<b>Priority:</b> High
<b>Actor:</b>	Security Personnel		
<b>Description:</b> A member of the Security team can assign a temporary pass to an unknown person on campus			
<b>Trigger:</b> A search request through the Web Interface			
<b>Type:</b>	External / Temporal (time-based)		
<b>Preconditions:</b> <ul style="list-style-type: none"><li>1. The staff member has permissions to assign temporary passes</li><li>2. The person they are assigning a temporary pass to does not have a full person profile (they are unknown)</li></ul>			
<b>Normal Course:</b> <ul style="list-style-type: none"><li>1. A member of the security team receives an unknown person report, or looks of the list of unknown people</li><li>2. A member of the security team assigns a temporary pass to that unknown person for a limited time frame.</li><li>3. The web interface contacts the API to assign a temporary pass and exclude that face from causing unknown person reports.</li></ul>			
<b>Postconditions:</b> <ul style="list-style-type: none"><li>1. The web interface confirms that the person has had a temporary pass assigned.</li></ul>			
<b>Exceptions:</b> <ul style="list-style-type: none"><li>1. The web interface is unable to contact the API due to it being unavailable</li><li>2. The user requesting data does not have permission to assign temporary passes</li></ul>			

## Test Plan

We have performed extensive testing on our application, whenever a new feature is pushed to GitHub all related group members perform testing before it is pushed to the master branch and released. We also have far reaching Unit Tests that ensure the APIs features are working correctly and that suitable data is being returned.

Below you can find testing results in relation to our Web Application

Test		Type of Test	Expected Result	Actual Result			Retest
No	Requirement			Worked	Failed		
1	Inputting correct login credentials logs into the website.	Valid	The website will load into the dashboard page.	As expected	N/A	N/A	
2	Inputting incorrect login credentials denies access to the website.	Valid	The user will receive a message informing them to correctly log in.	As expected	N/A	N/A	
3	Checking the remember me box will allow the site to remember the user.	Valid	Checking the remember me box will allow the site to remember the user.	As expected	N/A	N/A	
4	The dashboard button redirects the user to the dashboard page.	Valid	On activation of the dashboard button, the user will be taken to the dashboard.	As expected	N/A	N/A	
5	The dashboard loads and displays all required data correctly.	Valid	On load the dashboard populates all fields on the page from given resources.	As expected	N/A	N/A	
6	The dashboard displays relevant and current data of detection data.	Valid	The camera detections table is populated with relevant detection data.	As expected	N/A	N/A	

Test No	Requirement	Type of Test	Expected Result	Actual Result	Worked	Retest
7	The dashboard displays information on campus locations and buildings.	Valid	The campus capacities table will be populated with relevant locational data.	As expected	N/A	N/A
8	The statistics button will redirect the user to the statistics page.	Valid	On activation of the statistics button, the user will be taken to the statistics page.	As expected	N/A	N/A
9	The statistics page will display relevant activity data.	Valid	On load the statistics page will be populated with general data of the system.	As expected	N/A	N/A
10	The statistics page can show specifically student data.	Valid	On button press of the student button, the activity graph will change to specifically show student data.	As expected	N/A	N/A
11	The statistics page can show specifically staff data.	Valid	On button press of the staff button, the activity graph will change to specifically show staff data.	As expected	N/A	N/A
12	The statistics page can show specifically guest data.	Valid	On button press of the guest button, the activity graph will change to specifically show guest data.	As expected	N/A	N/A
13	The statistics page can show general data of the system.	Valid	On button press of the general button, the activity graph will change to show all user data.	As expected	N/A	N/A
14	The statistics page graph presents current and relevant data.	Valid	On draw the graph will display date by date information for each location for each user type.	As expected	N/A	N/A
15	The statistics graph can be used to view past data.	Valid	On load the graph presents the past 30 days of data, though after pressing the 30, 60 or 90-day button the corresponding data will be displayed.	As expected	N/A	N/A

Test No	Requirement	Type of Test	Expected Result	Actual Result	Worked	Retest
16	The statistics page shows current locational data.	Valid	On load the current campus activity table will be filled with current locational activity, showing the spread of people across the campus.	As expected	N/A	N/A
17	The Administration button will redirect the user to the admin page.	Valid	On activation, the button will take the user to their administration page, suited to their access level.	As expected	N/A	N/A
18	The admin page displays all current system users.	Valid	On activation, the button will take the user to their administration page, suited to their access level.	As expected	N/A	N/A
19	The admin page allows the user to find another users profile.	Valid	If the user has correct privileges, using the view profile button will take the user to the selected user's profile.	As expected	N/A	N/A
20	The admin page allows the user to edit another users profile.	Valid	The admin page allows the user to edit another users profile.	As expected	N/A	N/A
21	The admin page allows the user to delete another user.	Valid	If the user has correct privileges, using the edit button will allow the user to edit the selected user's information.	As expected	N/A	N/A
22	The admin page will show data relevant to buildings and locations.	Valid	On selecting the campuses and buildings tab the page will show connected buildings and campuses. This will also display their respective status.	As expected	N/A	N/A
23	The admin page allows the user to view data on locations and buildings.	Valid	If the user has correct privileges, on selected the view info button the user will be taken to a page containing data on the selected location.	As expected	N/A	N/A
24	The admin page allows the user to edit locations and buildings data.	Valid	If the user has correct privileges, on selecting the edit data button the user will be able to edit the selected locations data.	As expected	N/A	N/A

Test No	Requirement	Type of Test	Expected Result	Actual Result	Worked	Retest
25	The admin page will allow the user to delete locations and buildings.	Valid	If the user has correct privileges, on selecting the delete button, the selected location will be deleted from the system.	As expected	N/A	N/A
26	The admin page will show the camera and connection status of each location.	Valid	The campuses and buildings tab will automatically show the current status of the registered locations.	As expected	N/A	N/A
27	The admin page will allow the user to browse data of registered locations.	Valid	On selection of a location it will display all "sublocations" associated with the location.	As expected	N/A	N/A
28	The admin page will allow the user to view all registered cameras.	Valid	On selection of the cameras tab, the page will then show a table of all of the registered cameras.	As expected	N/A	N/A
29	The admin page will show all relevant data regarding cameras.	Valid	On selection of the cameras tab, the cameras table displays relevant technical information about each camera as well as its status.	As expected	N/A	N/A
30	The admin page will allow the user to inspect cameras.	Valid	If the user has correct privileges, on selection of the view camera button, the user will be able to view relevant data of the camera they selected.	As expected	N/A	N/A
31	The admin page will allow the user to edit camera data.	Valid	If the user has correct privileges, on selection of the edit button the user will be able to edit the selected cameras data.	As expected	N/A	N/A
32	The admin page will allow the user to remove cameras.	Valid	If the user has correct privileges, on selection of the delete button, the camera that has been selected will be removed from the system.	As expected	N/A	N/A

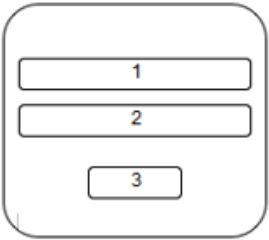


Test No	Requirement	Type of Test	Expected Result	Actual Result	Worked	Retest
33	The alerts button will navigate the user to the alerts page.	Valid	On activation of the alerts button the user will be taken to the alerts page of their permissions.	As expected	N/A	N/A
34	The alerts page will show information about alert events.	Valid	On load the alerts page will display all of the recent unacknowledged alerts of the system and relevant information.	As expected	N/A	N/A
35	The alerts page generates relevant and important alerts.	Valid	The alerts page will be updated whenever there is an unknown person detected by the cameras and remain until acknowledged.	As expected	N/A	N/A
36	The alerts page allows the user to acknowledge the alerts.	Valid	The user will be able to acknowledge each of the alerts through either pressing the false negative button or the resolved button.	As expected	N/A	N/A
37	The Profile button will take the user to their personal profile.	Valid	Upon activation of the button, the user will be taken to their personal profile page with their own data.	As expected	N/A	N/A
38	The profile page will display safe and relevant personal data of the user.	Valid	On load the profile page will display the users name, course or profession, and year.	As expected	N/A	N/A
39	The profile page will display the users positioning.	Valid	On load, the profile will display the users current and most favoured position, in the case that the user's current position is false.	As expected	N/A	N/A
40	The profile page will display the users past positioning.	Valid	On load, the page will load the most recent data regarding the users previous positioning. This will be displayed in the detections table.	As expected	N/A	N/A
41	The profile page will indicate a user's activity.	Valid	Within the detections table an academic column indicates if an action was academic related or not.	As expected	N/A	N/A

		Type of Test	Actual Result			
Test No	Requirement	Test	Expected Result	Worked	Failed	Retest
42	The profile page will show a user's habits.	Valid	On load the user's favoured location will be shown, as well as an activity table which shows a breakdown of the user's total recorded action locations.	As expected	N/A	N/A
43	The logout button will have the desired effect when used.	Valid	Upon activating the logout button, the logout protocol will begin.	As expected	N/A	N/A
44	The user will be able to safely log out of the system.	Valid	Upon use of the logout button the user's session will be ended and will need to re-login.	As expected	N/A	N/A

## Screen Designs

### Login

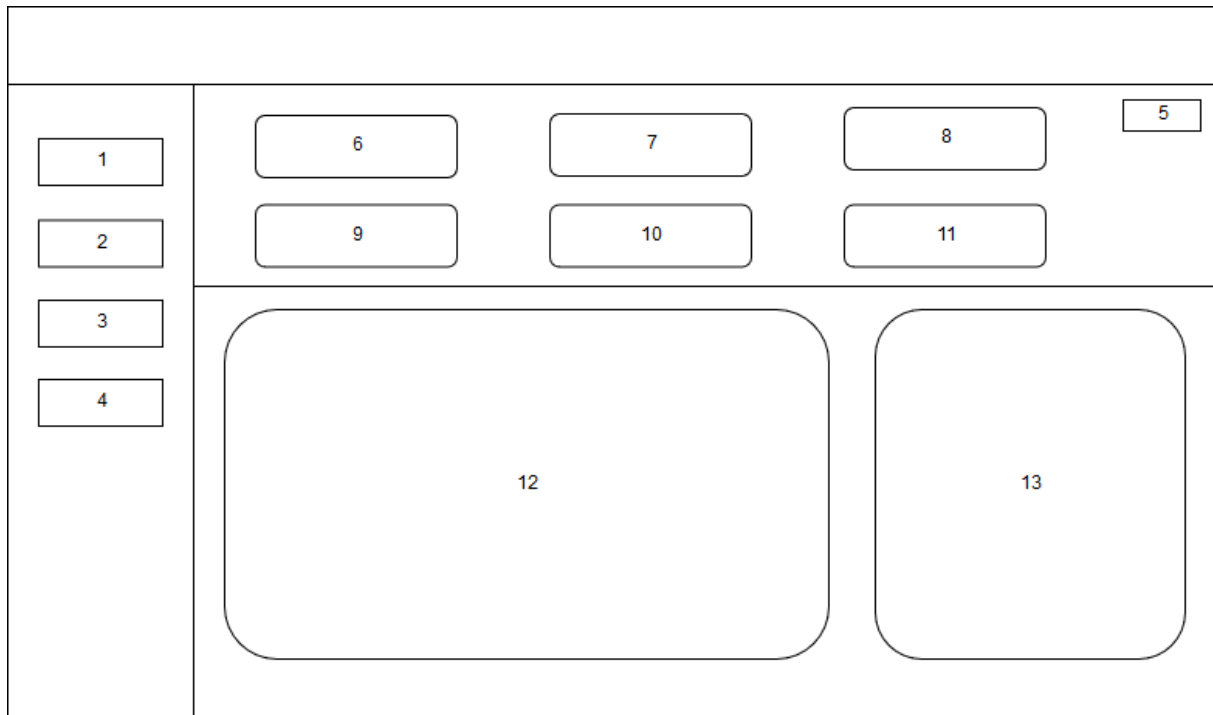


A wireframe of a login page. It features a large rectangular frame representing the page. Inside this frame, centered, is a rounded rectangle representing the login form. Within the form, there are three input fields: two stacked vertically at the top, labeled '1' and '2', and a single button-like field at the bottom labeled '3'.

**Figure 7:** Login Page

The login page will be the first page that the user will interact with. This will require a username / email and password to be entered in order to access the website. This will also contain a “Forgotten Password” button to give extra assistance to the user.

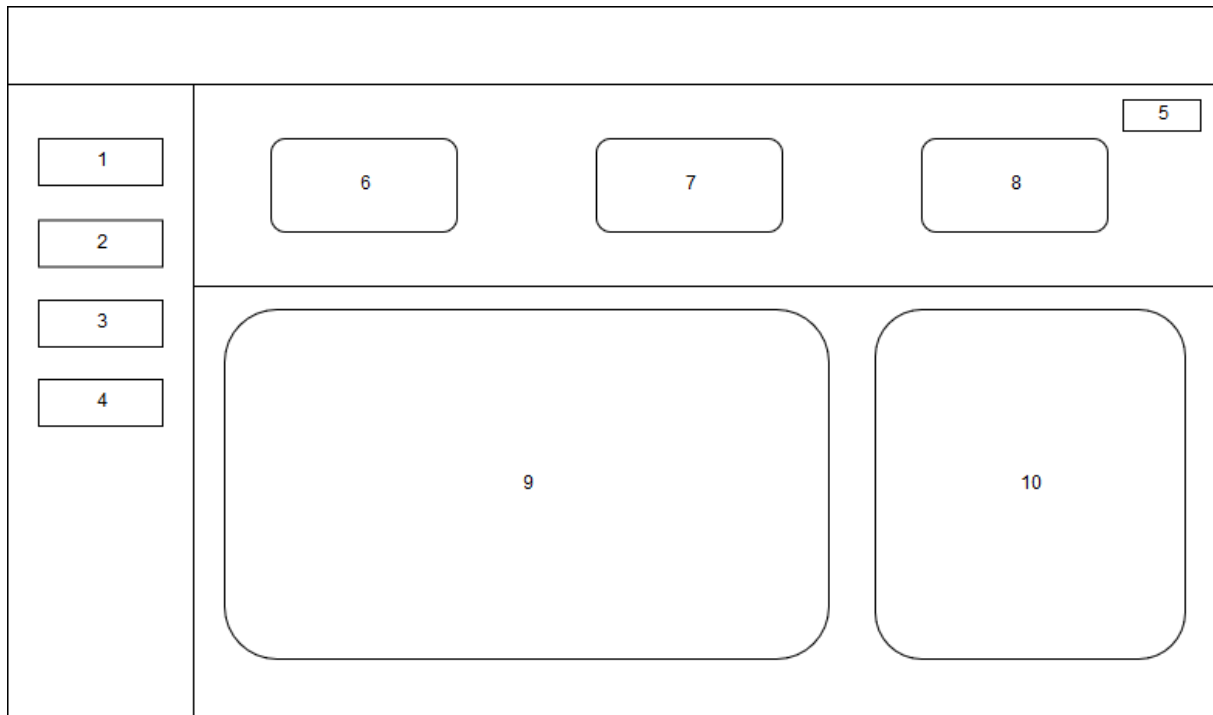
## Dashboard



**Figure 8:** Dashboard

The dashboard will be the first screen that the user views after logging in. This page will display general details about the system and how it is performing, giving specific updates on new users, detections, unknown detections, etc. This will also show specific data on camera activity, showing which cameras have detected what user type, or if it has detected an invalid user.

## Statistics



**Figure 9:** Statistics

The statistics page will show the user all of the relative data regarding user activity. This page includes a graph which will show specified user activity between campus locations. The specified user will be changeable by a set of buttons at the top of the screen. The statistics page will also display campus activity in specific buildings.

## Admin

The diagram illustrates the layout of an Admin page. It features a sidebar on the left with four buttons labeled 1, 2, 3, and 4. The main content area is divided into two sections. The top section contains three large rounded rectangular boxes labeled 6, 7, and 8, and a small box labeled 5 in the top right corner. The bottom section contains two smaller boxes labeled 9 and 10, and a large rounded rectangular container labeled 11. Inside container 11, there are six horizontal bars, with the top one labeled 11 and the others labeled 12.

**Figure 10:** Admin

The admin page will allow the user the create and edit data. This data may be regarding a permanent user, temporary user, or a camera. This page will be used in order to view users' profiles, add users, edit current user's data, find specific locational data and also find specific camera data.

## User Profile

The diagram illustrates the layout of a 'User Profile' form. It is divided into a header section and a main content area. The header section contains a large rectangular box (1) on the left, a circular profile picture placeholder (6) in the center, and a row of three rectangular boxes (7, 8, and 5) on the right. The main content area is divided into two columns. The left column contains four stacked rectangular boxes (2, 3, 4, and 11). The right column contains two stacked rectangular boxes (9 and 10) in the top row, and two larger stacked rectangular boxes (11 and 12) in the bottom row.

**Figure 11:** User Profile

The profile page will show the user the chosen user's profile information. This will contain basic information about the user, including name, course, year, attendance, location, and activity. The default user for this page will be the profile that is associated with the current log-in. Other user's will be able to be accessed by the admin page through selecting a user and then the profile button.

## Elements Appendix

### Login:

1. Username Input
2. Password Input
3. Sign in Button

### Dashboard:

1. Dashboard
2. Profile
3. Statistics
4. Admin
5. Logout
6. Total Users Detected
7. New Users
8. Valid Detections
9. Invalid Detections
10. Most Used Cameras
11. Current Campus Population
12. Camera Details (Detections)
13. Location Details (Population)

### Statistics:

1. Dashboard
2. Profile
3. Statistics
4. Admin
5. Logout
6. "Students" Button
7. "Teachers" Button
8. "Guests" Button
9. Specified User Activity Graph



## 10. Locational Data (Population %)

### Admin:

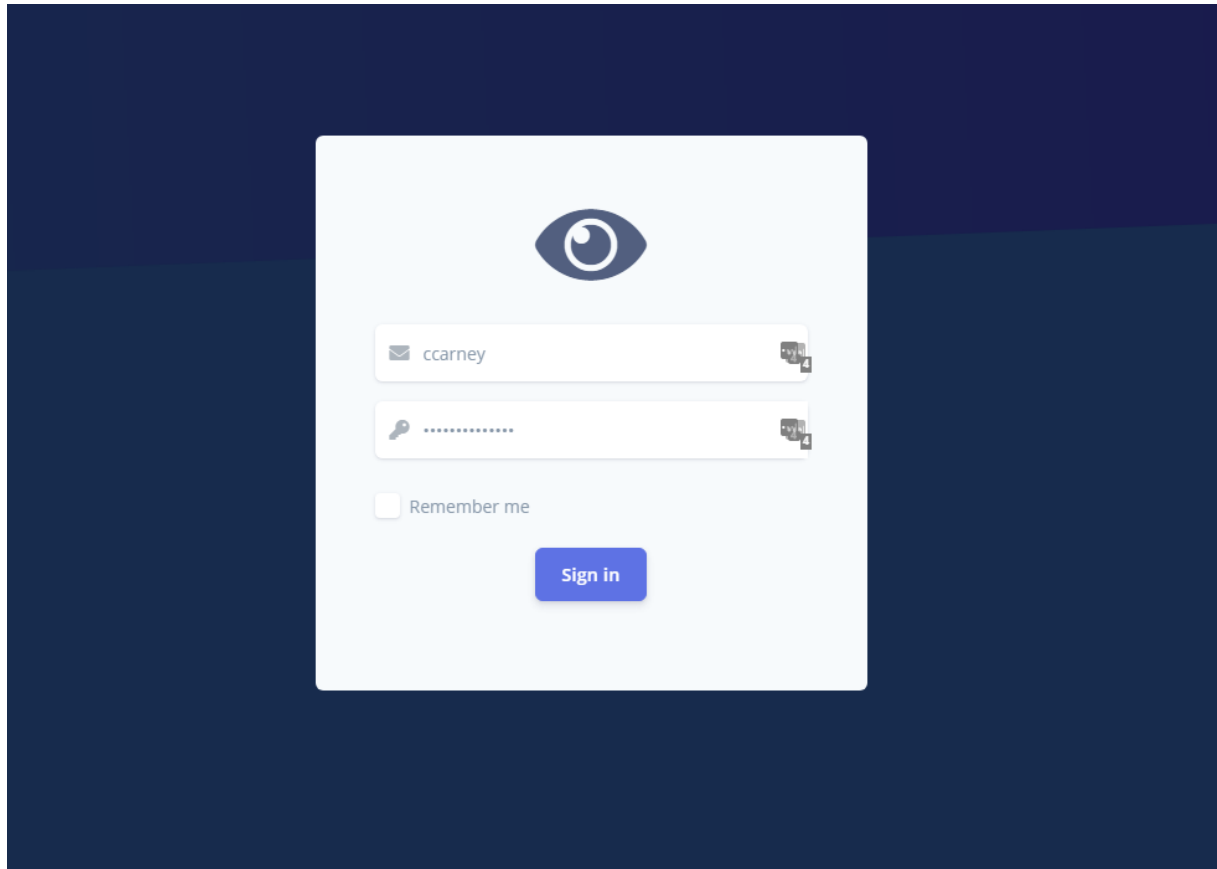
1. Dashboard
2. Profile
3. Statistics
4. Admin
5. Logout
6. Total Users
7. Current Population
8. Invalid Detections
9. Users Tab
10. Cameras and Locations Tab
11. Data Table Categories
12. Records of Data Table

### Profile:

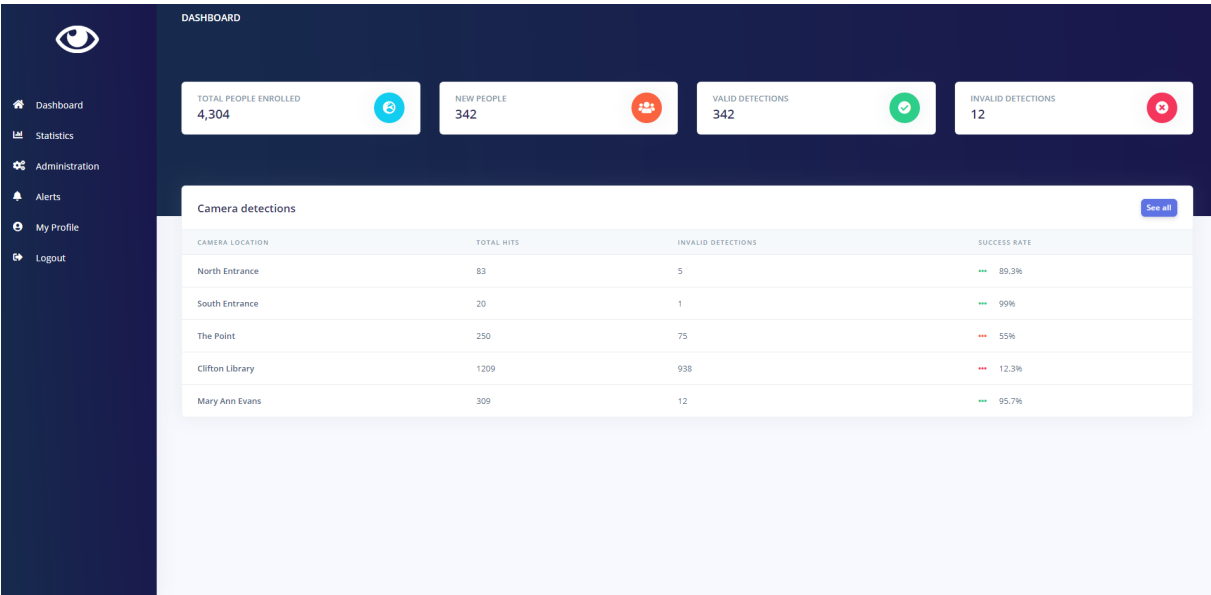
1. Dashboard
2. Profile
3. Statistics
4. Admin
5. Logout
6. Profile Image
7. Basic Data (Name, Course)
8. Attendance
9. Current Location
10. Favoured Location
11. Detections Table
12. Total Activity Breakdown

## UI Screenshots

### Login Page



Dashboard



Administrative Dashboard - Users

Dashboard

Statistics

Administration

Alerts

My Profile

Logout

ADMINISTRATION

Users

Campuses & Buildings

Cameras

DETAILS	ROLE(S)	ACTIONS
Callum Axon (caxon)	ADMINISTRATOR	
Callum Carney (ccarney)	ADMINISTRATOR SECURITY PERSONNEL	
Finn McKinnon (fmckinnon)	NO ROLES	
Jordan Brightmore (jbrightmore)	NO ROLES	

Administrative Dashboard - Buildings

Dashboard

Statistics

Administration

Alerts

My Profile

Logout

ADMINISTRATION

Users

Campuses & Buildings

Cameras

Mr. Kiley Hand

DETAILS	CAMERA STATUS	ACTIONS
Mary Anne Evans	CONTAINS CAMERAS	
Cody Kautzer DVM	CONTAINS CAMERAS	
Emerson Hand	CONTAINS CAMERAS	
Raleigh Bayer	NO CAMERAS	
Dorothy Schuster	NO CAMERAS	
Desiree Bartell		
Josh Nikolaus		
Ova Mueller		

Administrative Dashboard - Cameras

Dashboard

Statistics

Administration

Alerts

My Profile

Logout

ADMINISTRATION


Users

Campuses & Buildings

Cameras

DETAILS	STATUS	TAGS	ACTIONS
MAE Reception (F7:09:3F:52:D2:1B)	ONLINE	CLIFTON CAMPUS	
Ground Floor Open Area (D8:C2:54:7A:8B:5A)	ONLINE	CLIFTON CAMPUS	
First Floor Lobby (B6:85:EE:C0:32:83)	OFFLINE	CLIFTON CAMPUS	
(8B:BA:46:1D:7D:D1)	ONLINE	CLIFTON CAMPUS	
(2C:1F:61:54:46:B4)	ONLINE	CLIFTON CAMPUS	
(D0:88:48:3B:67:62)	ONLINE	CLIFTON CAMPUS	
(09:12:F2:FF:6B:5D)	ONLINE	CLIFTON CAMPUS	
(07:5B:D5:AF:D5:88)	ONLINE	CLIFTON CAMPUS	
(E1:85:0A:CS:A2:F5)	ONLINE	CLIFTON CAMPUS	

Alerts



Dashboard

Statistics

Administration

Alerts

My Profile

Logout

ALERTS

Search

+

Alerts

DETAILS	CAMERA	ACTIONS
Unknown person detected at - 2019-05-04 14:27:22	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:27:22	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:27:28	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:27:28	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:27:28	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:27:29	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:27:29	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-04 14:30:14	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-05 21:29:19	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-05 21:29:19	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-05 21:29:19	MAE Reception	<div><div></div><div></div></div>
Unknown person detected at - 2019-05-05 21:29:19	MAE Reception	<div><div></div><div></div></div>

User Profile

Dashboard

Statistics

Administration

Alerts

My Profile

Logout

USER PROFILE

Usman Wang

Biochemistry (PhD)

1st Year Student

CURRENT LOCATION :

Ada Byron King

ATTENDANCE

55.26%

-2.21% Since last month

FAVOURED LOCATION :

Mary Ann Evans

Camera detections

CAMERA LOCATION	TIME OF ENTRANCE	TIME OF EXIT	ACADEMIC
Ada Byron King	12:45	-	
John Clare	12:39	12:43	✗
Ada Byron King	11:22	12:34	✓
The Point	9:00	11:18	✗
Clifton Library	17:24	20:17	✓

Campus Activity

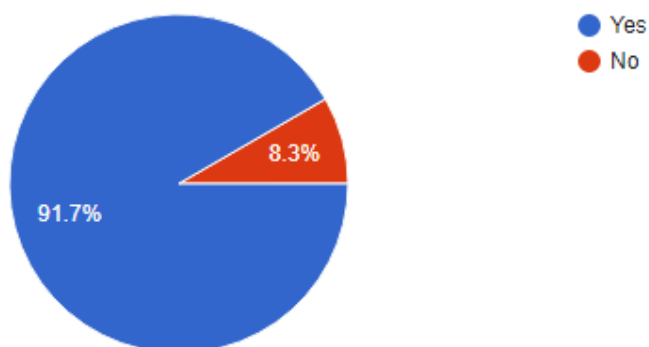
LOCATION	VISITS	TOTAL TIME
Mary Ann Evans	203	270hrs <div></div>
Clifton Library	168	224hrs <div></div>
Pavillion	168	224hrs <div></div>
John Clare	103	137hrs <div></div>
Erasmus Darwin	59	78 hrs <div></div>



## Questionnaire Responses

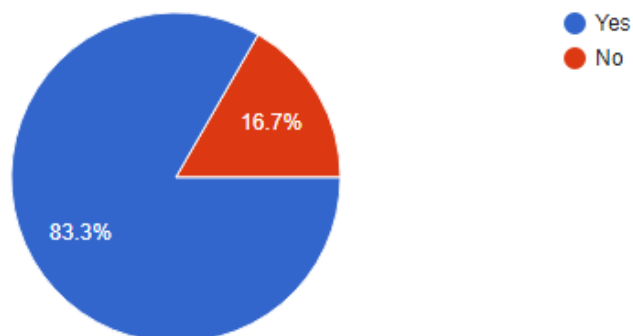
Would you personally consent to having your face scanned when entering a location?

24 responses



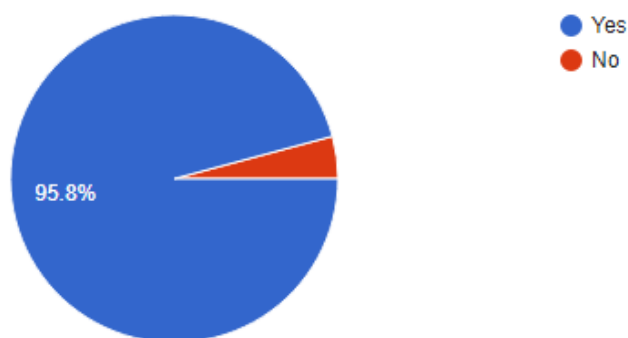
Would you personally consent to having your location tracked in real-time by a human being through the use of facial recognition?

24 responses



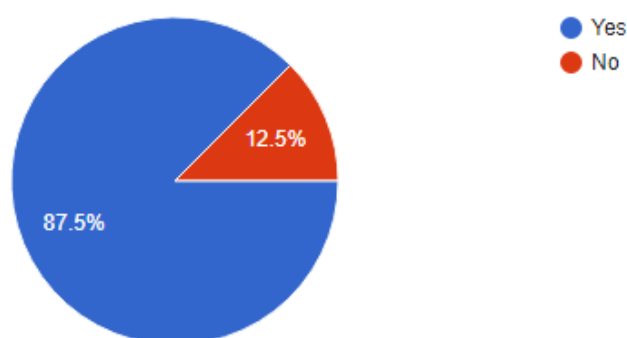
Would you feel safer at a location if you knew that Facial Detection was occurring (where faces are compared to known people and unknown people are flagged)

24 responses



Would you personally consent to your tracking data being aggregated and used for statistical purposes?

24 responses



Meetings

PPM Strand Group Meeting 1 | MINUTES

Meeting date   time 3 <sup>rd</sup> December   10:00am   Meeting location Clifton Library		
Type of meeting	Introduction	Callum Axon (CA) Callum Carney (CC) Jordan Brightmore (JB) Finlay McKinnon (FM) Wing Lam (WL) Vital Harachka (VH)

AGENDA TOPICS

Time allotted   1 hour   Agenda topic Introduction
CA opens the meeting with an introduction to the project and its requirements
CC brings up that we should start thinking about looking into a project idea as soon as possible in order to not waste any time.
All group members agree and CA creates a brainstorming document in order to note down ideas.
CC brought up the idea of a potential banking app with big data implementations
CA mentioned the possibility of having a system that detects faces within a campus setting
FM brought up the idea of creating a FakeNews predictor due to recent trends with fake news occurring.
WL mentioned the possibility of having a self driving car
VH brought up the idea of having a facial authentication system
After some deliberation, all group members agreed on making the system recommended by CA due to the recent increase in school shootings within the United States. We will reconvene next week.

Action items	Person responsible	Deadline
N/A	N/A	N/A

Meeting closed at 11:00 am.

## PPM Strand Group Meeting 2 | MINUTES

---

Meeting date | time 10<sup>th</sup> December | 10:00am | Meeting location Clifton Library

Type of meeting	Work Provision	Callum Axon (CA)
		Callum Carney (CC)
		Jordan Brightmore (JB)
		Finlay McKinnon (FM)
		Wing Lam (WL)
		Vital Harachka (VH)

### AGENDA TOPICS

---

Time allotted | 1 hour | Agenda topic Work Provision |

CC opens the meeting by mentioning that we should hash out the requirements, components and languages used before the end of the meeting in order to have a basic implementation ready after the Christmas break.

All group members agree, JB mentions that Python can be used for the Facial Recognition section of the application, CC mentions that NodeJS paired with HTML can be used for the Frontend and CA mentions that PHP could be used for the API

All group members agree, and a discussion is held around who possesses what skills and therefore who should be working with who.

CA, VH and WL will be working together on the API CC and FM will be working together on the

Frontend JB will be working on the Facial Recognition software

CA mentions that the definition document needs to be in after Christmas and t hat all members should be

looking at Whatsapp for assignments on what to write.

Action items	Person responsible	Deadline
Complete basic setup of each application component	All	Next meeting
Complete sections of Definition Document when assigned	All	Next meeting

Meeting closed at 11:00 am.

## PPM Strand Group Meeting 3 | MINUTES

---

Meeting date | time 14<sup>th</sup> January | 10:00am | Meeting location Clifton Library

Type of meeting	Checkup	Callum Axon (CA)
		Callum Carney (CC)
		Jordan Brightmore (JB)
		Finlay McKinnon (FM)
		Wing Lam (WL)
		Vital Harachka (VH)

### AGENDA TOPICS

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Time allotted | 1 hour | Agenda topic Checkup |

CA opens the meeting by going through the current definition document and ensuring that all present group members are happy with its content.

CC mentions that one of the tables are out of line and that it should be fixed before submission, CA agrees and notes the issue.

All group members are otherwise happy with the reports content.

JB reports good progress on the facial recognition software and demos a working application with some issues, however he mentions that these will be fixed as the application progresses.

CC shows an example user interface for the front end, all group members are happy with the design and style.

CA reports good progress on the API.

All group members agree to continue working as they are currently.

Action items	Person responsible	Deadline
Continue working on the assigned components	All	Next meeting

Meeting closed at 11:00 am.

## PPM Strand Group Meeting 4 | MINUTES

---

Meeting date | time 21<sup>th</sup> January | 10:00am | Meeting location Clifton Library

Type of meeting	Checkup	Callum Axon (CA)
		Callum Carney (CC)
		Jordan Brightmore (JB)
		Finlay McKinnon (FM)
		Wing Lam (WL)
		Vital Harachka (VH)

### AGENDA TOPICS

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Time allotted | 1 hour | Agenda topic Checkup |

CA opens the meeting by showing the progress that has been made on the API and backend Database.

All group members are happy with the progress and CC begins to show further progress made on the Front end, CC also mentions that the Trello has been created and all members of the group has been invited and that work will be assigned through Trello.

All group members are happy with this plan and all members agree that we should continue to work on developing the components required.

Action items	Person responsible	Deadline
Continue working on the assigned components	All	Next meeting

Meeting closed at 11:00 am.

## PPM Strand Group Meeting 5 | MINUTES

---

Meeting date | time 21<sup>th</sup> January | 10:00am | Meeting location Clifton Library

Type of meeting

Checkup

Callum Axon (CA)

Callum Carney (CC)

Jordan Brightmore (JB)

Finlay McKinnon (FM)

Wing Lam (WL)

Vital Harachka (VH)

### AGENDA TOPICS

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Time allotted | 1 hour | Agenda topic Checkup |

CA opens the meeting by thanking all group members for staying in touch over WhatsApp, including providing status updates on how the work is going, as a consequence to this CA mentions that he does not feel the need to meet every week anymore due to the good progress that is being made.

All group members agree that if work continues to be completed as planned then conversations can be held over WhatsApp rather than meeting in person.

CC mentions that we need to consider working on the documentation as it is worth a large chunk of the overall grade and that we can consider who will be completing what on WhatsApp.

All group members agree with this plan.

Action items	Person responsible	Deadline
Continue working on the assigned components	All	Submission Date
Keep checking WhatsApp for status updates and provide regular updates	All	Submission Date

Meeting closed at 10:30 am.

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