



UNIVERSITY OF  
BIRMINGHAM

## BIRMINGHAM – DUBAI DIGITAL WALL

Group: Make SE Great Again

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## Scope of System

The 'Birmingham-Dubai Digital Wall' is a proposed service that will encourage integration of students, teachers and visitors from both the Edgbaston and Dubai University of Birmingham campuses. The service will aim to do this by the sharing of cultural, social and learning content, delivered via multiple screens across each campus. The screens have been envisioned to be connected via a system so that, whilst maintaining independence of one another, it will be possible that content can be simultaneously shown on all screens when needed. The three core features that our team is proposing for the system are: a system that supports Gesture Control for users as the primary means of interacting with screens, the displaying of Real Time Content, and the Live Streaming of public and private events.

Gesture Control is expected to be the main method of interaction between the wall and the actor. Anticipated reasons for interaction are expected to be: searching for items on the general content page, the setting up of live streaming, or interaction with actors on 'the other side' of the wall, for example students and societies in Dubai. Whilst we expect Gesture Control to be the main form of interaction and navigation, we propose to supplement this with a touchpad that will mirror the content of the screen whilst also functioning as another form of being able to navigate screen content and interaction. This touchscreen will not support other functionalities external to navigating and interacting with the screen, and is expected to be a device such as an iPad.

The core 'Real Time Content' will be displayed on screens that are not being used for other purposes, such as the live streaming of content/events. This core content will include, but is not necessarily limited to, appropriate campus announcements, the current date and time, a loop of events happening during this week, any notable events that are scheduled or advertised on the timetable, weather information, news headlines, as well as social media trends associated with the University of Birmingham (such as hashtags, "tweets" or "Facebook" interactions). In addition to this core content, the screens will be used to display 'feature content', notably there are specific activities and events, including Live Streams, conferences, breaking news and other high importance announcements, personal information e.g personal time tables and being able to purchase through the screen. All core and feature content is expected to be stored in a central database that will be accessible by both campuses, with each piece of content given its own unique QR code that can be scanned via the cameras on the screen to easily access it.

The Live Streaming feature will provide two different kinds of streams: event live streaming from different online platforms, and live cameras from other walls across both campuses. Thus, the wall should have cameras, speakers and network connection of an appropriate quality. We are envisioning that Live Streams can be declared public or private, and this will depend on the purpose of the event. Public Live Streams will be accessible across all screens and are also planned to be uploaded to the University webpages of both campuses, meaning that all students, staff and visitors are able to watch the stream regardless of authorisation. Live Streams that are declared as private will only make use of the screen that has been designated for the event, and the content must be uploaded to a location that is invite-only and thus generally inaccessible.

The information displayed on the screen will need to be moderated to ensure it is safe to show within the University environment, however moderation will not be considered part of the main system, and instead classified as a separate sub system. It is also likely that, in the future, the system will be extensible to other

devices such as mobile phones and Virtual Reality (VR) headsets, but this is not anticipated to be part of the current proposed system.

The screens are anticipated to measure 2x2m, composed from multiple smaller LED screens, and are expected to be weather and vandal resistant. Each screen is expected to be linked with a HD, hi-resolution camera, a sound or speaker system, a card-reader system that allows users to identify themselves to the screen, an iPad that is connected to each screen, along with other smart technologies that aid the connectivity and support of gesture control as a means of interacting with the screens. The hardware is expected to be contextual, that is to say that the speakers for screens located inside will not be equipped with large and powerful speakers, whilst screens located outside may need to make use of this functionality. The location of each screen is assumed to have considered external factors such as lighting and lines of sight, although we propose that each screen should have manually adjustable sound and brightness.

Finally, we are also advocating the founding of a dedicated society, at both Birmingham and Dubai, which will be composed of voluntary students who will manage and develop content, between both campuses for the interactive screen system. This society will act as a first point of contact for students who wish to submit content for showing on the wall, to organise events that make use of the screen's functionalities, or to generally submit suggestions and changes to be made to the wall to admins or content moderators.

## Functional Requirements

ID	Requirement	Priority
1	<p><b>Both campuses must be able to access mutual resources from a secure, central location called the content database.</b></p> <p>The content database must be able to store approved content</p> <p>The content database must be backed up every 3 days</p> <p>The content database must be able to be restored</p> <p>The content database must allow the uploading and downloading of content</p> <p>The content database must interact with approved external content</p> <p>The content database must respond to upload and download requests within 30 seconds</p> <p>The content database must generate a unique QR-code for each piece of content entered into the database.</p>	High
2	<p><b>The screens must be able to display real time content from both campuses.</b></p> <p>The screens should display contextual information</p> <p>The screens must display content from the system</p> <p>The screens must be connected to the Birmingham-Dubai wall at all times</p> <p>The screens must be connected to hardware that facilitates gesture control</p> <p>The screens must be connected to hardware that facilitates the live-streaming of real-time events</p>	Medium
3	<p><b>The system and the screens must offer flexible configuration</b></p> <p>The system must be able to update screen content displayed on all screens</p> <p>The system must allow admins to modify the layout of the screens</p> <p>The screens must support content from multiple sources to be displayed</p> <p>The screens must update within 5 minutes of an admin commanding a change</p> <p>The screens must be able to maintain independence from each other</p>	High

4	<p style="text-align: center;"><b>The screens must facilitate Live Streaming events.</b></p> <p>The system must support live streaming events</p> <p>The system must offer the user a choice to host a public or private live stream</p> <p>The system must allocate an appropriate location for live streaming events to be uploaded</p> <p>The system should be able to support a live streaming delay feature</p> <p>The system should be able to uniformly apply livestreams settings to all screens</p> <p>The screens must be able to support and display external live streams</p> <p>The screens must be equipped with hardware facilitating internal live streams</p>	Medium
5	<p style="text-align: center;"><b>The screens must support Gesture Control.</b></p> <p>The screens must use gesture control as a method for assisting user interaction</p> <p>The screens must be able to identify a user's movements</p> <p>The screens must be able to interpret depth</p> <p>The screens must be able to identify a primary user</p> <p>The screens must display gesture commands to the user</p> <p>The screens must display the user's body position in real time</p> <p>The screens must be able to interpret a user's movements as commands for navigating the system</p> <p>The screens should prompt user's when commands are unrecognised</p>	High
6	<p style="text-align: center;"><b>Actor Requirements: Admins</b></p> <p>Admins must be able to modify and manage system</p> <p>Admins must be able to modify and manage content</p> <p>Admins must be able to manage and modify the content database</p> <p>Admins must ensure the content database is secure</p> <p>Admins must ensure the system is secure</p> <p>Admins must be able to upload and download content to the system</p> <p>Admins must be able to modify content displayed by all screens</p> <p>Admins must maintain the system</p>	High

	<p>Admins must be responsible for maintaining hardware and the screens</p> <p>Admins must be responsible for maintaining the content database</p> <p>Admins must be responsible for maintaining the system</p> <p>Admins must maintain and create a content schedule</p> <p>Admins must be able to specify what content is for what region</p>	
7	<p style="text-align: center;"><b>Actor Requirements: Teachers</b></p> <p>Teachers must be able to interact with the system via the screens</p> <p>Teachers must be able to purchase items using the screens</p> <p>Teachers must be able to provide identification to the system via the screens</p> <p>Teachers must be able to access all core content displayed by the screens</p> <p>Teachers must be able to access all feature content</p> <p>Teachers must be able to access their personal informations via the screens</p> <p>Teachers must be able to add notices to the screens</p> <p>Teachers must be able to propose content to admins to be displayed on screens</p> <p>Teachers must be able to create livestreams from the screens</p> <p>Teachers must be able to navigate screens using gesture control or connected touchpad</p>	Low
8	<p style="text-align: center;"><b>Actor Requirements: Students</b></p> <p>Students must be able to interact with the system via the screens</p> <p>Students must be able to purchase items from the screens</p> <p>Students must be able to access all core content displayed by the screens</p> <p>Students must be able to access their personal information from the screens</p> <p>Students must be able to access feature content from the screens</p> <p>Students must be able to provide identification to the system via the screens</p> <p>Students must be able to propose content to admins to be displayed on screens</p> <p>Students should be able to create live streams from the screens when approved</p> <p>Students must be able to navigate the screen using gesture control or connected touchpad</p>	Low

9	<p align="center"><b>Actor Requirements: General</b></p> <p>General users must be able to interact with the system via the screens</p> <p>General users must be able to navigate the screen using gesture control</p> <p>General users must be able to access public core content displayed by the screens</p> <p>General users must be able to identify themselves to the system</p>	High
10	<p align="center"><b>Content displayed on screens must be approved and moderated</b></p> <p>Content displayed on screens must be approved and moderated</p> <p>The content displayed on screens must be moderated by an external actor</p> <p>The content database should be moderated automatically</p> <p>Admins should be informed with regards to moderation requirements Admins should be involved in discussions with regards to content moderation</p>	High
11	<p align="center"><b>The system must be able to verify users</b></p> <p>The screens must be able to recognise that a user is requesting interaction</p> <p>The screens must be equipped with a University ID Card Scanner</p> <p>The screens must not make attempts to identify a user prior to verification</p> <p>The screens must be able to identify a primary user</p> <p>The system must be able to verify a University ID Card</p> <p>The system must be able to identify a user from the presented ID card</p> <p>The system must allocate verify the user as either an Admin/Teacher/Student</p> <p>The system must logout the user upon request or after 60 seconds of inactivity</p>	High
13	<p align="center"><b>The system should facilitate integration with Social Media</b></p> <p>The system must be able to display relevant social media content</p> <p>The system must be able to display statistics regarding social media activity</p> <p>The system should offer an interactive public chat for verified users</p> <p>The Admins should identify what social media trends can be interacted with</p>	Low



## Non-Functional Requirements

ID	Requirement	Priority
1	<p><b>Hardware</b></p> <p>All screens, measuring 2m x 2m, should be constructed using a modular system of smaller screens with narrow borders</p> <p>All screens should be of an industry standard to improve reliability and safety</p> <p>All screens must comply with national and international safety regulations.</p> <p>All screens must be weather and vandal resistant</p> <p>All screens must be able to connect with other necessary appliances: speakers, microphone, HD camera, touchpad, ID card sensor and hardware that will facilitate quality gesture control</p> <p>All speaker systems connected to screens must have adjustable volume</p> <p>All microphones connected to screens should provide clear and quality audio</p> <p>All HD cameras should record and display clear content at minimum of 60fps</p> <p>All touchpads must be durable as well as weather and vandal resistant</p> <p>The screens must be able to show content at an appropriate resolution</p> <p>The screens should ensure a comfortable viewing experience</p> <p>The screens must support adjustable brightness to enable content to be visible</p>	High
2	<p><b>Security</b></p> <p>The content database must be secure</p> <p>The content database must be kept up to date</p> <p>The system must verify a user before giving access to Non-General privileges</p> <p>The system must ensure only verified users can interact with content database</p> <p>The system must offer a way of securely handling payments (via PayPass)</p> <p>The system must ensure accessing identifying information is secure</p> <p>The Admins must ensure that only appropriate and approved content is shown on screen.</p>	High
3	<p><b>Availability</b></p> <p>The system must be available 24/7</p>	Medium

	<p>The content database must be available 24/7</p> <p>The screens should be available 24/7</p>	
<b>4</b>	<p style="text-align: center;"><b>Reliability</b></p> <p>The system must complete tasks presented by the primary user</p> <p>The system must respond to tasks presented by admins</p> <p>The system must be tested for bugs before it is released</p> <p>The system must be maintained and kept up to date</p> <p>The Gesture Control system must be functional and accurate</p> <p>The screens should use a default general layout so they are predictable</p> <p>The screens should be independent from each other</p> <p>The screens should be connected to hardware that is robust and of quality</p> <p>The screens and all associated hardware must work when connected to the system</p> <p>The content database must respond accurately to requests for information</p> <p>The content database must be tested for bugs before it is released</p> <p>The content database must be maintained and kept up to date</p>	High
<b>5</b>	<p style="text-align: center;"><b>Real-time performance</b></p> <p>The system must respond to user requests within 0.5 seconds</p> <p>The system must respond to Admin requests within 15 minutes</p> <p>The system must be usable by all actors</p> <p>The gesture control system must be calibrated</p> <p>The screens should not have latency</p> <p>The screens must clearly display content</p> <p>The content database must respond user requests within 30 seconds</p> <p>The content database must respond to Admin requests within 30 seconds</p>	Medium

6	<p style="text-align: center;"><b>Compliance</b></p> <p>The system must comply with UK and the UAE laws and regulations.</p> <p>The system must be implemented in a competent and safe manner.</p> <p>The screens must comply with UK and UAE laws and regulations respectively</p> <p>The screens must only display content that complies with UK and/or UAE law</p> <p>The screens must only display content that is 'safe for work'</p> <p>The screens and associated hardware must comply with health and safety regulations of the UK and the UAE</p> <p>The content database must comply with appropriate database standards</p> <p>The content database must comply with appropriate data handling standards</p> <p>The content database must comply with appropriate data protection laws</p> <p>The content database must comply with appropriate copyright laws</p>	High
7	<p style="text-align: center;"><b>Maintainability</b></p> <p>The system must be easily accessible by Admins</p> <p>The system must be easily modifiable by Admins</p> <p>The system must be easily upgradable by Admins</p> <p>The content database must be easily modifiable by Admins</p> <p>The content database must be easily upgradable by Admins</p> <p>The content database must be easily accessible by Admins</p> <p>The screens and associated hardware must replaceable or maintainable</p> <p>The screens and associated hardware must be durable and robust</p> <p>The screens and associated hardware must be logged and routinely checked</p>	High
8	<p style="text-align: center;"><b>Modifiability and Scalability</b></p> <p>The system must be modifiable by Admins</p> <p>The system must not be limited to the current number of screens</p> <p>The system must be able to accommodate hardware changes</p>	Medium

	<p>The system must be not be limited to the current number of campuses</p> <p>The screens and associated hardware should have versatile connectivity</p> <p>The content database must be modifiable by admins</p> <p>The content database must not be limited to the current number of screens</p> <p>The content database must not be limited to support the current number of campuses</p>	
9	<p style="text-align: center;"><b>Interoperability</b></p> <p>The system must be able to connect all screens</p> <p>The system must be able to connect to the content database</p> <p>The system must be able to request and submit content from the content satabase</p> <p>The system must be able to connect to social medias</p> <p>The system must be able to connect to external content</p> <p>The system should be able to connect to mobile phones</p> <p>The system should be able to connect to external devices in the future</p> <p>The screens must be connected to the system</p> <p>The content database must be able to connect with the system</p> <p>The content database must be able to connect with external content</p>	High
10	<p style="text-align: center;"><b>Ethical</b></p> <p>The screens must only display legal content that is categories as safe for work</p> <p>The screens must not contribute to noise pollution</p> <p>The screens must attempt to identify individuals prior to verification</p> <p>The screens should not display controversial content</p> <p>The screens should have a lower power mode during off-peak times</p> <p>The screens should not contribute to visual pollution</p> <p>The screens and associated hardware should not need to be replaced regularly</p> <p>The content database must comply with data handling regulations</p> <p>The content database must not breach data protection laws</p> <p>The content database must be moderated to ensure removal of illegal content</p>	High

	<p>The content database should not store personal or identifying information</p> <p>The Admins must not breach data protection laws</p>	
<b>11</b>	<p style="text-align: center;"><b>Delivery</b></p> <p>The system should be implemented before September 2018</p> <p>The system should be tested for bugs before September 2018</p> <p>The content database should be implemented before September 2018</p> <p>The screens and associated hardware should be implemented before Sept 2018</p>	Medium
<b>12</b>	<p style="text-align: center;"><b>Constraints</b></p> <p>Implementation of the system should take budget into consideration Implementation of the system should take time into consideration Implementation of the system should take location into consideration Implementation of the screens should take budget into consideration Implementation of the screens should take time into consideration Implementation of the screens should take location into consideration Implementation of the content database should take budget into consideration Implementation of the content database should take time into consideration Implementation of the content database should take location into consideration</p>	Medium
<b>13</b>	<p style="text-align: center;"><b>Design</b></p> <p>The screens and associated hardware should be aesthetically pleasing</p> <p>The screens and associated hardware should be environmentally friendly</p> <p>The screens should be intuitive to use</p> <p>The screens should have a default layout for core content</p> <p>The screens should display content in simplistic manner</p> <p>The screens should not display content in a busy or incoherent manner</p> <p>The system interface should be aesthetically pleasing</p>	High

	<p>The system should be easy and intuitive to use</p> <p>The Gesture Control system should be intuitive to use</p>	
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# Noun - Verb Analysis

## Scope of the system:

The 'Birmingham-Dubai Digital Wall' is a **proposed** service that will **encourage** integration of students, teachers and visitors from both the Edgbaston and Dubai University of Birmingham campuses. The service will **aim** to do this by the **sharing** of cultural, social and learning content, **delivered** via multiple screens across each campus. The screens have been **envisioned** to be **connected** via a system so that, whilst **maintaining** independence of one another, it will be possible that content can be simultaneously **shown** on all screens when needed. The three core features that our team is **proposing** for the system are: a system that **supports** Gesture Control for users as the primary means of **interacting** with screens, the **displaying** of Real Time Content, and the Live Streaming of public and private events.

Gesture Control is **expected** to be the main method of **interaction** between the wall and the actor. **Anticipated** reasons for **interaction** are **expected** to be: **searching** for items on the general content page, the **setting** up of live streaming, or **interaction** with actors on 'the other side' of the wall, for example students and societies in Dubai. Whilst we **expect** Gesture Control to be the main form of interaction and navigation, we **propose** to **supplement** this with a touchpad that will **mirror** the content of the screen whilst also **functioning** as another form of being able to **navigate** screen content and **interaction**. This touchscreen will not **support** other **functionalities** external to **navigating** and **interacting** with the screen, and is **expected** to be a device such as an iPad.

The core 'Real Time Content' will be **displayed** on screens that are not being used for other purposes, such as the live streaming of content/events. This core content will **include**, but is not necessarily **limited** to, appropriate campus announcements, the current date and time, a loop of events happening during this week, any notable events that are **scheduled** or **advertised** on the timetable, weather information, news headlines, as well as social media trends associated with the University of Birmingham (such as hashtags, "tweets" or "Facebook interactions"). In addition to this core content, the screens will be **used** to **display** 'feature content', notably activities and events, including Live Streams, conferences, breaking news and other high importance announcements. All core and feature content is **expected** to be **stored** in a central database that will be **accessible** by both campuses, with each piece of content given its own unique QR code that can be **scanned** via the cameras on the screen to easily **access** it.

The Live Streaming feature will **provide** two different kinds of streams: event live streaming from different online platforms, and live cameras from other screens across both campuses. Thus, the wall should have cameras, speakers and network connection of an appropriate quality. We are **envisioning** that Live Streams can be **declared** public or private, and this will **depend** on the purpose of the event. Public Live Streams will be **accessible** across all screens and are also **planned** to be **uploaded** to the University webpages of both campuses, **meaning** that all students, staff and visitors are able to **watch** the stream regardless of **authorisation**. Live Streams that are **declared** as private will only make use of the screen that has been **designated** for the event, and the content must be **uploaded** to a location that is invite-only and thus generally inaccessible.

The information **displayed** on the screen will need to be **moderated** to ensure it is safe to **show** within the University environment, however **moderation** will not be considered part of the main system, and instead **classified** as a separate sub system. It is also likely that, in the future, the system will be **extensible** to other devices such as mobile phones and Virtual Reality (VR) headsets, but this is not **anticipated** to be part of the current proposed system.

The screens are **anticipated** to measure 2x2m, **composed** from multiple smaller LED screens, and are **expected** to be weather and vandal resistant. Each screen is **expected** to be **linked** with a HD, hi-resolution camera, a sound or speaker system, a card-reader system that **allows** users to **identify** themselves to the screen, an iPad that is **connected** to each screen, along with other smart technologies that aid the **connectivity** and **support** of gesture control as a means of **interacting** with the screens. The hardware is **expected** to be contextual, that is to say that the speakers for screens **located** inside will not be **equipped** with large and powerful speakers, whilst screens **located** outside may need to make use of this **functionality**. The location of each screen is **assumed** to have **considered** external factors such as lighting and lines of sight, although we **propose** that each screen should have manually **adjustable** sound and brightness.

Finally, we are also **advocating** the founding of a **dedicated** society, at both Birmingham and Dubai, which will be **composed** of voluntary students who will **manage** and **develop** content, between both campuses for the **interactive** screen system. This society will act as a first point of **contact** for students who wish to **submit** content for **showing** on the wall, to **organise** events that make use of the screen's functionalities, or to generally **submit** suggestions and changes to be made to the wall to admins or content moderators.

## Nouns

Nouns are identified by underlined words in the scope above

<b><u>Noun</u></b>	<b>In context</b>	<b>Should be a class?</b>
Bham-Dubai Digital Wall	The name of the proposed system	No
Service	The system / Bham-Dubai Digital Wall	No (duplicate of Bham-Dubai Digital Wall)
Students	Individuals studying at UoB	No
Teachers	Individuals that teach at UoB	No
Visitors	Individuals who are temporarily on campus whilst not a student or teacher	No (implemented as 'General')
Edgbaston	Location of UoB UK	No
Dubai	Location of new UoB campus	No
University of Birmingham	Name of university	No
Campuses	Of either UoB location (UK or Dubai)	No
Social Content	Content relating to connecting with others	No
Cultural Content	Content relating to the way of life in respective country	No
Learning Content	Content related to academic teaching and students learning	No
Screens	The hardware that displays content from the system	Yes
System	The general name for the Bham-Dubai Digital Wall	No
Content	Anything used for purposes of displaying on the screens	Yes
Feature	Aspects of the system	No
Team	This Software Engineering Team	No
Gesture Control	A method of facilitating interaction with the screen	Yes
Users	People who are interacting with the screen	No



Real Time Content	Content that is currently being displayed on the screen	No
Livestreaming	A stream that will display content from a camera in current time	Yes (as 'Livestream')
Public Events	Real events that are available to the general public	No
Private Events	Real events that are invite only	No
Wall	Bham-Dubai Digital Wall	No
QR Code	The unique code that is linked to each piece of content	No
Actor	The person currently interacting with the screen	No
Items	'Apps' or interactive parts of the screen (e.g. weather, time and date, event roll, news etc.)	No
General Content Page	A page that displays general information and content (e.g. weather, time, news, announcements)	No
Actors on the other side of the wall	People at the other end of the screen, in relation to livestreaming and being able to interact with each other	No
Societies	Student societies organised within UoB	No
We	This Software Engineering Team	No
Interaction	A person using the screen	No
Navigation	Searching or finding content using the screen	No
Touchpad	Assists with navigation of the screen, acts as an alternative	Yes (as 'TouchpadControl')
Device	A touchpad	No (duplicate of Touchpad)
iPad	A specific type of touchpad	No (duplicate of Touchpad)
Core Content	Content that is available to all users and is not personalised	No
Campus Announcements	Announcements displayed on the screens regarding the university	No
Date	Day, month, year	No

Time	The time of day	No
Week	The days of the week	No
Events	Things happening in the world	No
Timetable	A student or teacher's own personal UoB timetable	No
Weather Information	Information regarding weather	No
News Headlines	Headlines of articles on general news channels	No
Social Media	Interactions with social media sites, i.e Facebook, Twitter	No
Trends	What is currently popular on social media websites	No
Hashtags	A method of categorising information on Twitter	No
Tweets	Sending a message via the Twitter service	No
Facebook Interactions	Using Facebook to interact with other people	No
Activities	Similar to events	No
Conferences	Meetings between people to be displayed on the screens	No
Breaking news	Important news from general news sites	No
High important announcements	Important information from the University	No
Central database	A database that will allow both campuses to access content to be displayed on the screens	Yes (as ContentDB)
Streams	A particular livestream being displayed	Yes (as LiveStream)
Online Platforms	Websites that host livestreams	No
Live Cameras	Cameras attached to the screens (hardware) that are displaying live content for live streaming	No
Cameras	Cameras attached to the screens (hardware)	No
Speakers	Hardware that allows sound to be heard from the screens	No

Network Connection	A connection to the internet	No
Public Livestreams	Livestreams that are freely available to watch by all individuals	No
Private Livestreams	Livestreams that can only be accessed or watched by invitation	No
University Webpages	Pages of the UoB website	No
Invite only location	A private location that will host a private livestream (implied on UoB website)	No
Information	Content	No
University Environment	The University campus and general values	No
Sub System	Another part of the system that is not the main system (in relation to moderation)	No
Future	At a later date	No
Other Devices	Technology that could make use of the Bham-Dubai Digital Wall	No
Mobile Phones	Proposed to be connected to the Bham-Dubai Digital Wall at a later date	No
Virtual Reality Headsets	Proposed to be connected to the Bham-Dubai Digital Wall at a later date	No
Proposed System	The Bham-Dubai Digital Wall	No
Smaller LED Screens	Will be put together to build a larger screen (used on all screens)	No
Card Reader System	Will allow an individual interacting with the all to be recognised by the system if they show their UoB ID card	Yes (as 'IDVerifier')
Themselves	The individual interacting with the screen	No
Other Smart Technologies	Smart or Future Technology that could make use of the Bham-Dubai Digital Wall	No
Hardware	The screens and connected physical equipment	No

Society	A student screen society managed by UoB	No
Voluntary Students	Students part of the Screen Society that will aid managing and creating content	No
Admins	Manage, modify and maintain the system and its content	No
Content Moderators	Filter content so that it is safe for display	No

## Verbs

**Verbs** are indicated as **bold words** in the scope above

Verb	In Context	Should include as method?
Propose	The system this Software Engineering Team is putting forward	No
Encourage	To promote interaction between students	No
Integrate	To allow both campuses to share mutual experiences	No
Aim	The goal of the system	No
Share	Allowing both campuses to access the same content	No
Deliver	Delivering content, synonymous with displaying of content	No (but synonymous with display)
Envision	The final imagined product of our proposed system	No
Maintain	To allow each screen to be independent from others, allowing them to be used separately	No
Show	To show content to people via the screens	No (but synonymous with display)
Support	The screens will allow and aid the use of the Gesture Control feature for navigation of the system	No
Interact	An individual currently using the screen	Yes

Display	To show content via the screen	Yes
Expect	Gesture Control as the anticipated main method of using the screen	No
Scan	The QR code can be shown to the camera linked to the screen to quickly and directly access specific content.	Yes
Search	Navigating the system via the screen to locate content	No
Anticipate	Expected reasons for interaction with the wall	No
Set	Preparing for livestream events	No
Supplement	Use a touchpad as an alternative method of navigation for screens	No
Mirror	The touchscreen will copy the exact display of the screens	No
Function	Other purposes of the touchpad	No
Navigate	Search the system for content	Yes
Include	Features of the core content	No
Limit	The features listed for core content is not exhaustive	No
Schedule	Events that are planned and could be displayed	No
Advertise	To highlight key events happening around campus via screens	No
Use	The purposes of the screens, what they will be used for	No
Store	To retain and keep content via a database	Yes
Access	For both campuses to use this database and retrieve information and content	No
Provide	Livestreams will offer the choice of being public or private	No
Livestream	To record an event in real time and display it on screens	Yes (as start/stop)
Declare	To state to the system if the livestream is public or private	Yes (as change privacy)

Depend	Where the livestream is hosted will be determined by its type (public or private)	No
Plan	The expected location for hosting livestreams is the UoB website	No
Upload	To display the livestream directly on the UoB website in real time	Yes
Mean	Allowing individuals to watch the livestream	No
Watch	To view the live stream or content in general	No
Authroise	To allow an individual to watch a livestream at a particular location	No
Designate	The screen chosen to record the live stream event	Yes
Moderate	To filter content and ensure it is safe for displaying	Yes
Classify	To state that moderation is not explicitly a part of our main system and is instead a subsystem	No
Extend	To expand the system in the future to allow new aspects to be added and to support new technologies	No
Anticipate	New technologies and extensions are not expected to be part of the currently proposed system	No
Compose	All screens will be made from putting smaller LED screens together	No
Link	To connect each screen with other hardware	No
Allow	The card reader gives the opportunity for individuals to identify themselves	No
Identify	For an individual to scan their ID card to gain access to screen and content privileges	Yes
Connect	To allow smart technologies	No

	such as gesture control to be used as part of the system	
Locate	The screens' physical locations are expected to be appropriate	No
Equip	Hardware connected to the screens (i.e. the screens are equipped with speakers, cameras etc).	No
Function	To make full use of the capabilities of a particular hardware	No
Assume	Assuming screens have considered external physical location and context	No
Consider	To have thought about and made a reasoned decision for the location of the screens	No
Adjust	To allow the brightness and volume on the screen to be changed if needed	Yes
Advocate	Arguing for the creation of a Student Screen Society	No
Compose	This Screen Society will be made up of voluntary students	No
Manage	To manage, allocate, prepare and decide on appropriate content	No
Develop	To create content for the screens	No
Dedicate	A committed Student Screen Society	No
Contact	For individuals to contact admins or the Screen Society to propose ideas for content to be displayed	No
Submit	To hand over and allow use of created content to be used	No
Organise	To plan and prepare events that make use of the screens' functionalities and capabilities	No

## Class Responsibility Collaborator Cards

ContentDB	
Responsibilities Description	Collaborators
The responsibilities of this class are to store core and feature content, and respond to requests for information within 5 seconds.	Content ModeratorConnection AdminInterface

Screen	
Responsibilities Description	Collaborators
The responsibilities of this class are to display content.	Content ContentDB LiveStream Payment Interface Gesture Control TouchPadControl IDVerifier

TouchpadControl	
Responsibilities Description	Collaborators
NoThe responsibilities of this class are to provide touch control over the content of the wall and information input mean.	Screen



GestureControl	
Responsibilities Description	Collaborators
The responsibilities of this class are to identify a primary user, to accurately and reliably interpret their gestures and navigate the system accordingly.	Screen

Content	
Responsibilities Description	Collaborators
The responsibilities of this class are to store various external content. It could be social media tweets, weather forecast, newsfeed etc.	Screen LiveStream ModeratorConnection ContentDB UobSystemConnection

IDVerifier	
Responsibilities Description	Collaborators
The responsibilities of this class are to successfully scan the user's ID card and send this information to the University of Birmingham's database for authentication.	Screen UobSystemsConnection

UobSystemsConnection	
Responsibilities Description	Collaborators
The responsibilities of this class are to provide interface for system to interact with already existing university systems	Content Screen IDVerifier

ModeratorConnection	
Responsibilities Description	Collaborators
The responsibilities of this class are to check core and feature content against policies and regulations and to remove content that is not compliant	Content ContentDB

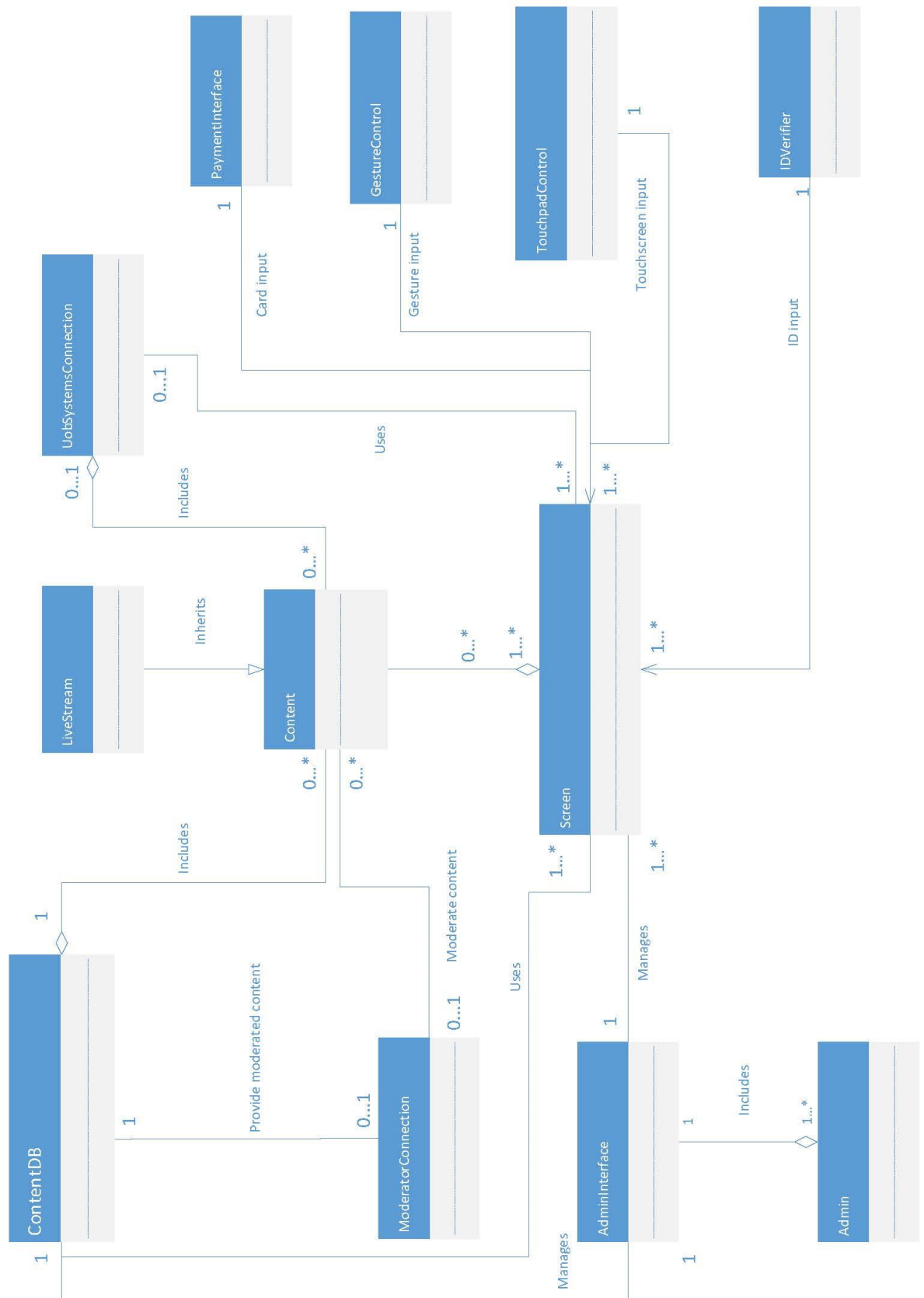
LiveStream	
Responsibilities Description	Collaborators
The responsibilities of this class are to perform live cam streams from the wall	Screen ModeratorConnection ContentDB UobSystemConnection

PaymentInterface	
Responsibilities Description	Collaborators
The responsibilities of this class are to handle payments for authorised users	Screen UobSystemsControl

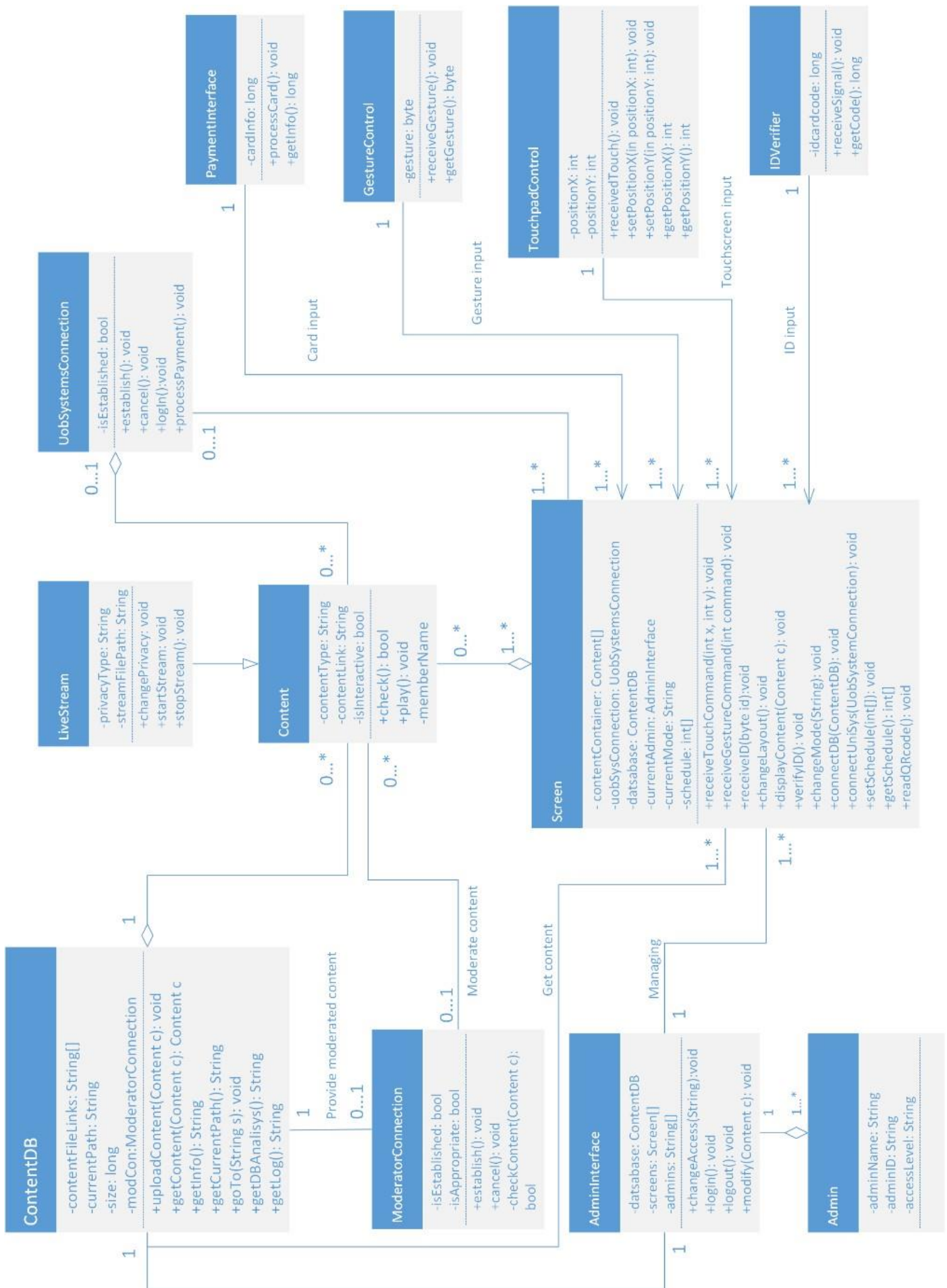
AdminInterface	
Responsibilities Description	Collaborators
Facilitates the Admin actor to manage, modify and maintain parts of the system.	ContentDB Screen Content UobConnection

Admin	
Responsibilities Description	Collaborators
Represents Admin actor and describes its main attributes.	AdminInterface

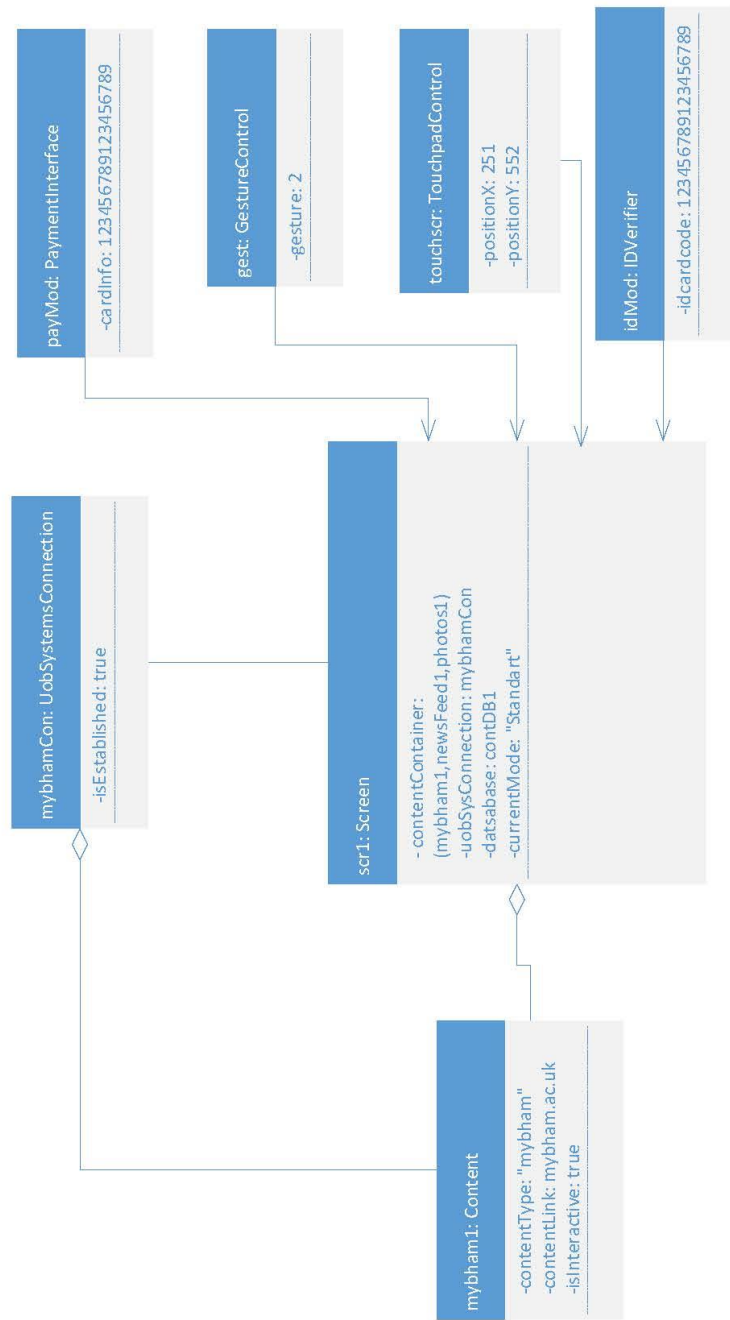
## First Cut Class Diagram



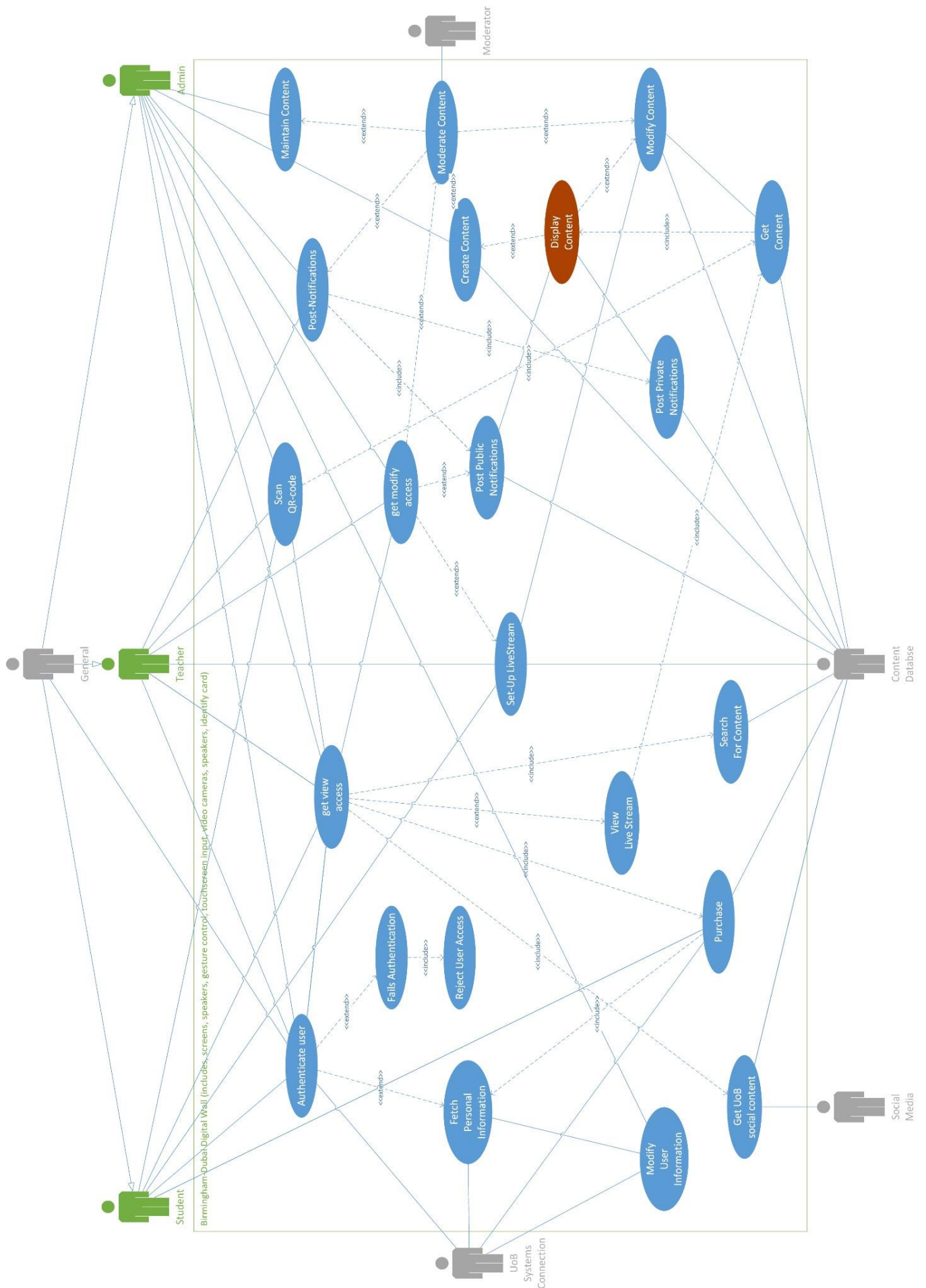
## Detail Class Diagram



# Object Diagram



## Use Case Diagram



# Authentication Use Case

The Authenticate use case demonstrates how users of the system will be classified provided that they scan their ID card to the ID Verifier that is connected to the screen. The information will be passed to “UoBSystemsConnection”, which will check information against UoB databases to confirm a user’s privileges (e.g. that they are either a Student or a Teacher). Whilst this is an optional use case, it is advantageous for the user to be authenticated, as this will allow the user to access “Feature Content” (such as personalised timetables and they will be able to purchase items through the screen), in addition to the “Core Content”.

## Preconditions

1. The user must not already be authenticated with the system.
2. The user must be a registered user of the system/of the university
3. It is assumed that the user is already classified as “General” (an actor that who has not yet been authenticated).
4. The user must be able to be classified as one of the three following actors;
  - a. Student.
  - b. Teacher.
  - c. Admin.
5. The user has a UoB ID Card ready
6. The ID Card Verifier is functioning correctly and not currently in session with another user
7. The user has been detected by the gesture control and is in distance for interaction

## Flow Of Events

1. The use case begins when a user wants to access Feature Content, and they present their UoB ID card to the ID Card Verifier attached to the screen.
2. The ID Card Reader will attempt to read the card.
  - a. If the ID Card is unreadable (such as an invalid format, or broken) the system will do nothing.
  - b. If the ID card is not recognised, the system will indicate this to the user and reject the card. Providing a solution (e.g. check if it’s the correct ID card).
3. If successful, the user’s information is sent to the UoBSystemsConnection.
4. The UoBSystemsConnection will access the appropriate resources that contain information reading to student or staff ID and check if the user’s details exists in this database.
5. The information is sent back to the same Card Reader.
6. The user is verified.
  - a. The user’s ID is not recognised and authentication is rejected (e.g. in the case of scanning an expired UoB ID Card).
7. The system opens a session for the specific user, associating an actor and applying privileges. A session is as valid for the time the system recognises a user in front of the system.

## Post Conditions

1. The system has authenticated a user.
2. If authentication has been rejected, the session will return to the state prior to the initiation of the Authentication Use Case

## Actors

- General
- Student OR Teacher OR Admin
- UoBSystemsConnection



## Scenarios

### *Scenario 1 - Verified successfully*

A student approaches the system and wants their personal timetable via the screen. The student places their UoB card onto the card reader, and the system authenticates the user correctly. After being authenticated, the student is presented with Feature Content, including being able to access their personal timetable. They select this option, where the system sends this message to the “UoBSystemsConnection” and this retrieves the student’s personal timetable from the UoB databases. The timetable is then displayed on the screen. The student ends the session by walking away from the system. As the system does not detect a user present, the session is terminated after 5 seconds, and consequently logs them out.

### *Scenario 2 - Card has expired*

An alumni from the University has returned on an open day and approach a screen as they find it interesting, but want to explore its further features. They still have their ID Card and scan it on the ID Card Verifier. Since it is a UoB ID card, the system correctly reads the card, however, when the information is checked against the UoB databases, authentication is rejected because they are not a current student and prompts the user to check if they are using a valid UoB ID card.

### *Scenario 3 - Card not recognised*

An individual from another university has been walking through the campus and notices that some students are scanning their ID cards and interacting with screens. Intrigued, they decide to walk up to a screen and start exploring it, and decided to scan their ID card to see what would happen. The system attempts to read the card. Although the individual presents a student ID card, since the information is checked against the UoB databases, it cannot locate the information and thus rejects the authentication of the individual. The screen presents an appropriate error. The user attempts this process again, and the screen returns the same error. The individual walks away from the system.

### *Scenario 4 - User presents a broken card*

A user approaches the system. They are a teacher of UOB. The teacher wishes to authenticate access their Feature Content page, from where they will be able to post a private notification for all other teachers. The teacher takes out the ID card, however finds that during their commute to work, the ID card had broken in half. Despite this, the teacher hopes that the ID card will still be recognised by the system. The teacher holds one half of the card to the card reader, however the card is not successfully read. The teacher attempts to hold both pieces of the card together (as if it is unbroken), but the reader still does not recognise the card and thus cannot be read. The authentication does not happen and the teacher walks away from the system.

### *Scenario 5 - User wants to search for content in ‘General’*

A user approaches the system. They are part of UOB but have not yet been authenticated. They are searching for a livestream they want to view, where they type it into the search bar. Because this particular livestream is not part of the core content, the system prompts the user to present their card to the card reader to gain access. They do not have their ID card on them, continue to access Core Content for a short time before walking away.

# Livestreaming Use Case

“Live-streaming” involves the means of using the system to capture an event or playback a recording. This allows the user to either record an event/lecture for consumption later (similar to panopto), or view to view a live stream. Further utilisation include the user of streaming to other systems distributed across the campus (or cross-campus).

## Preconditions

1. A live streaming event has already been scheduled and approved
2. It is currently the time of a scheduled event
3. The hardware is working correctly
4. A primary actor (of Student or Teacher) has been authenticated and is logged into the system
5. A camera connected to the Content Database is on standby

## Flow of Events

1. The Student or Teacher opens the Live Stream feature on the screen.
2. The system prompts the Student or Teacher to declare the livestream as public or private to the system.
  - a. If declared public, livestream is uploaded to The Wall / University webpage and can be seen by General Users. A public QR code is generated.
    - i. This will automatically be a single live stream and can only be shown on other screens.
  - b. If declared private, the livestream will only be uploaded to a private page of The Wall / University website. A private QR code will be generated to the initiator, who can manually distribute it to others.
    - i. The user can choose single live-stream, where it will be shown on other screens only.
    - ii. The user can also specify a dual live stream, which involves the use of two independent screens that view each other’s recording.
3. The LiveStream feature will prompt the user to begin recording.
4. The live stream will start recording when the user clicks record button.
5. The livestream is uploaded to the UoB website the appropriate location in addition to the Content Database.
6. The Live Stream can be viewed by users depending on their access.
  - a. If the live stream is public then the user will not need to authenticate to watch.
  - b. Individuals must be authenticated to view private livestream.
7. The live stream will stop when the user clicks the stop button.
8. The livestream upload feed stops.
9. The live stream is saved in the Content Database.
  - a. If it is a public live stream, then everyone will be able to view recording.
  - b. If it is a private live stream, then only specific users will be able to view the recording.
10. The actor logs out of the system.

## Postconditions

1. The Live Stream recording is stored in the Content Database.
2. If private livestream, the temporary upload location is removed.
3. The screens involved return to displaying core content.

- Public livestream events are available to re-watch to authenticated users on screens for 4 weeks after the event.

## Actors

- Student OR Teacher
- General
- Content Database
- UoBSystemConnection

## Scenarios

### *Scenario 1 - Teacher wants to Livestream an event they are hosting*

A Teacher has scheduled a public live stream event as they are hosting a guest lecturer for one of their classes. The class has been relocated so that it is now in an appropriate location where a screen that is connected to The Wall is present. The Teacher presents their University ID card to the scanner of the screen, is authenticated and confirms the livestream event. Because the livestream is public, it will be uploaded directly to the Wall / University Website as well as to the content database. Individuals are freely able to access this livestream from the university website, and authenticated users are able to access the stream via any of the screens connected to the campus if it is selected. The camera and microphone connected to the screen record the event.

### *Scenario 2 - Student live streaming a private event for a student society*

A Student is hosting a maths tutorial livestream event as part of an involvement with a student society. They are located inside a classroom that has a screen present. They scan their University ID card and are authenticated before confirming the livestream event as private. The screen presents the Student with a QR code that can be shared and disseminated by the Student, where in this case they post it onto the UoB Maths Society Facebook page, allowing others to easily access the livestream event using the screen. If viewed outside of the system, the QR code will act as a website link. The live stream is recorded as normal.

### *Scenario 3 - An important live stream that overrides all screens for duration*

An important university-wide announcement is to be made and the Vice Chancellor wants to livestream his speech. The system authenticates him as a primary user, and with the consent of the admins, he displays the live-stream event on all screens for the duration of the stream. This stops individual screen use and prevents others from interacting with the screens. As this is a public livestream event, it is uploaded to the content database and the university website simultaneously and recorded for future playback. After the event, the screens will resume back to their default state of showing core content.

### *Scenario 4 - Students from both UoB campuses interact via livestream*

Two groups of Students, one from Birmingham and one from Dubai, wish to use the screens to interact with each other for the purpose of studying. Each group is located at an appropriate screen at their respective campus and one student from each group must authenticate themselves to the system. The event is confirmed by one primary student (say from Birmingham) and declare the event as private, and they receive the QR code to distribute. This QR code is then manually sent to the other group (in Dubai), where only one student in the group must authenticate themselves to the system. The code will direct them to the livestream destination. The system will be able to identify that screens connected to the same system (the Birmingham-Dubai Wall) are accessing the live stream. This will trigger an option to display livestreams from both ends. From here, the livestream is treated as any other private livestream event.

*Scenario 5 - Authentication fails but scheduled live stream does not automatically start*

The Student who has scheduled a live stream event presents their University ID card to the scanner, however the authentication process fails. During these cases, the system will identify that the livestream has not been confirmed and so will not continue to use the screen's hardware to record the event. However, if an admin is contacted within 30 minutes, this scenario can be manually overridden, where the admin can confirm the livestream event from their end and the screen will use the hardware to record the event in its current state. Here the livestream can be declared as public or private to the admin accordingly, and resume as usual.

# Display Content Use Case

The “Display Content” use case demonstrates how content is appropriated for display on the screens by the Admin actor. This Use Case assumes that all content is stored dominantly in the Content Database, and if it is being displayed on the screen, then it is sent to the ‘Content Container’ of that screen. The Admin has access to the Admin Interface software which allows the Admin to access content directly from the Content Database and also the Content Container.

## Preconditions

1. The Admin has been authenticated and is currently using the “Admin Interface” software.
2. The Admin must already have the content to be displayed available. This content can be found in the Content Database in an unedited form, but has already been moderated.
3. The Admin has access to the system.
4. The software will allow the Admin modify content attributes, such as display privileges, amount of time to be displayed etc.
5. The system should also be able to accommodate modifications to design layouts.
6. The Admin Interface Software is connected to the Content Database and facilitates the admin with modifying the content attributes.

## Flow Of Events

1. The Admin uses the Interface Software to locate the target content in the ContentDB
2. The Administrator will then download the target content using the Admin Interface software so that it can be modified.
3. The admin then opens the same target content file in the software, and this allows the administrator to make appropriate adjustments to the content.
  - a. Admin can add new content to the unedited content.
  - b. Admin can replace old content with new content.
  - c. Admin can edit/make changes to current content, for example, they can change the boundaries of tables and panels in each section displayed on the page.
  - d. Admin can delete content, as they see appropriate. If they want to completely delete the content, the administrator can delete it from the page/class, as they see appropriate.
  - e. Admin can deactivate content, that does not need to be on the system currently, but may be needed in the future.
4. The Administrator then sets the privileges of this content.
  - a. Admin can set content as ‘Core’.
  - b. Admin can set content as ‘Feature’.
    - i. Admin can set content to be viewable by all Students.
    - ii. Admin can set content to be viewable by specific Students.
    - iii. Admin can set content to be viewable by all Teachers.
    - iv. Admin can set content to be viewable by specific Teachers.
    - v. Admin can set content to be viewable by all Admins.
5. The administrator then classifies the content
  - a. Admin can classify as read only.
  - b. Admin can classify as interactive.
6. The administrator can set display duration of the content.
  - a. Admin can set duration to be temporary.
  - b. Admin can set duration to be permanent.
7. Admin can set when the content should be uploaded to the content container.

8. This modified content is then re-uploaded to the Content Database.
  - a. The Admin can replace the old file.
  - b. The Admin can save as a new file.
  - c. The Admin can save as a draft.
9. The Admin logs out of the Admin Interface software.

## Post Conditions

1. The content is ready to be placed in the 'Content Container' of the screen
2. The content is displayed on screen(s).
3. All specified attributes will be set.

## Actors

- Content Database
- Admin

## Scenarios

### *Scenario 1 - Admin adds a new notification*

The Admin wants to add a new notification to be displayed on the system. The notification will say that the system will be down for 24 hours for emergency maintenance. The Admin logs into the Admin Interface Software and then opens the file which corresponds to "Announcements" in the Content Database. The Admin will edit the Announcement page by adding a new announcement, and set the content privilege to 'Core', meaning that it will be displayed on every home screen on all screens. They will then set this content to view-only, before setting the display duration of the announcement for 7 days, and set to be displayed immediately. The announcement is then saved to the Content database and then sent to the Content Container immediately. The Admin logs out of the Admin Interface.

### *Scenario 2 - Admin modifies content privileges from core to feature*

The Admin wants to move content displayed on the Core content page to the Feature page and wants it to only be viewed only by Students. To do this they will open up the file that contains this content from the Admin Interface software. They will then change the privileges of this content from Core to Feature. Then they will be able to specify that only Students will be able to view this content. All the other attributes that have not been changed will remain unmodified.

### *Scenario 3 - Admin wants to prepare Christmas content to be displayed in the future*

The Admin has been told to prepare some Christmas content in advance so that it is ready to be displayed on the screens on December 1st. The Admin opens the Admin Interface software and locates the target Christmas content in the Content Database. They then download it to the Interface Software so that it can be prepared. Firstly the Admin sets the privilege of the content to 'Core', meaning that it is accessible to all users without the need for authentication. As this content is intended to be interactive, he sets the classification to be interactive before declaring that the content should be uploaded for a temporary duration (1st Dec - 30th Dec) and should be sent to the Content Container on 30th November at 23:59. From here, the Admin then saves this now prepared content to the Content Database before closing the Interface software.

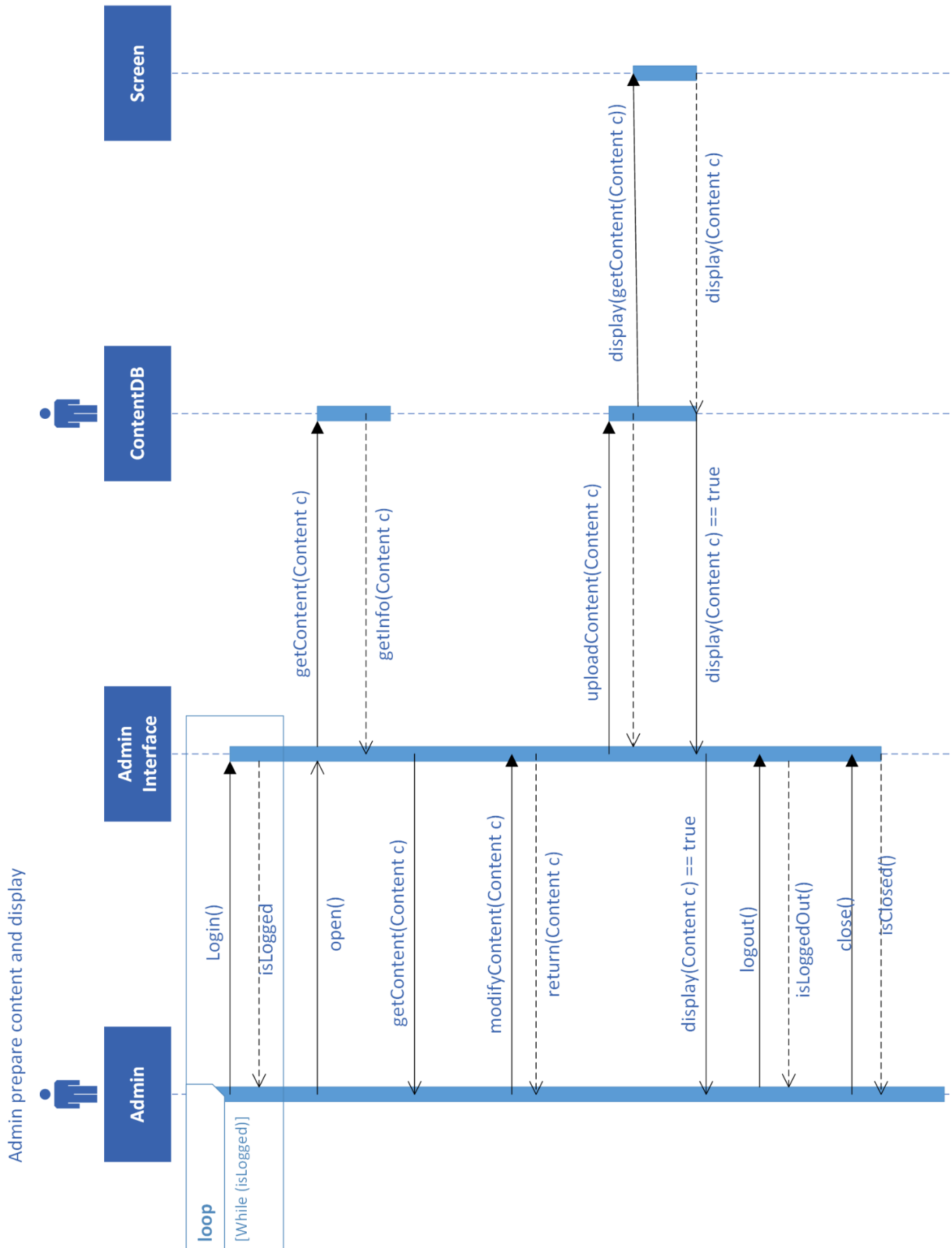
#### *Scenario 4 - Admin wants to make panels in the Core Content Page bigger*

University management has decided that Core Content page looks overcrowded and cluttered, and have tasked Admins to make adjustments although to not display this immediately. The admin will open the appropriate file on the Admin Interface and here they will be able to modify the layout of the sections in the core content page. They will then be able to save this as a new different file with the same privileges as previously set, this is to ensure that the current core content page will still be visible in the system. The Admin can save this as a draft so they will be able to show University management for approval before being sent to the Content Container.

#### *Scenario 5 - Delete content from the Content DB*

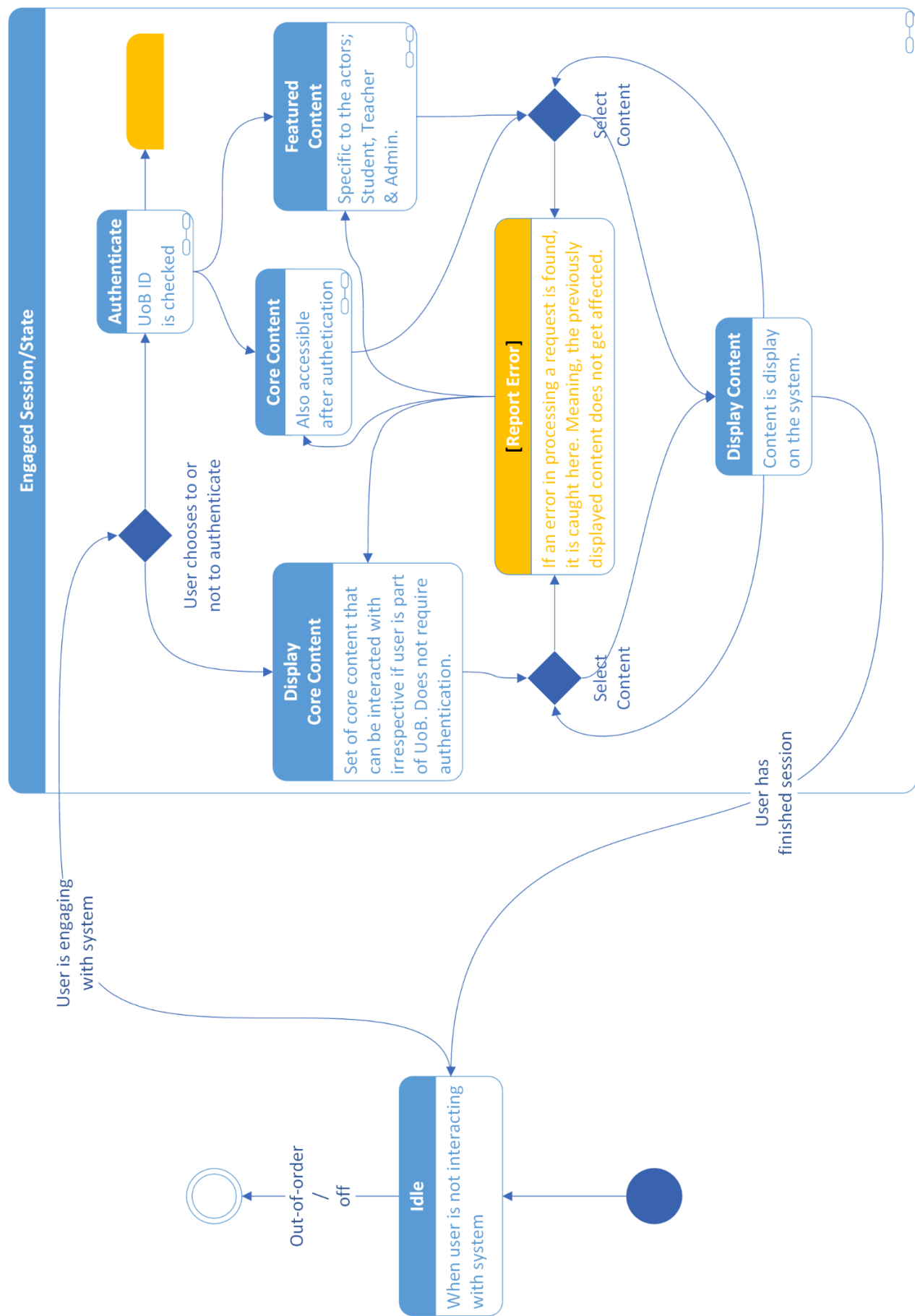
An individual finds that some content has been displayed on the screen by mistake. They contact an Admin who decided it is best for the content to be taken down and, because it is not functioning correctly, should be deleted. The Admin opens up the Admin Interface software and locates the target content in the "Content Container". From here, he selects this content to be removed so that it is no longer being displayed. The Admin then uses the Interface software to locate the file in the Content Database, where he then permanently deletes the specified file.

## Sequence Diagram – Admin-End Display Content

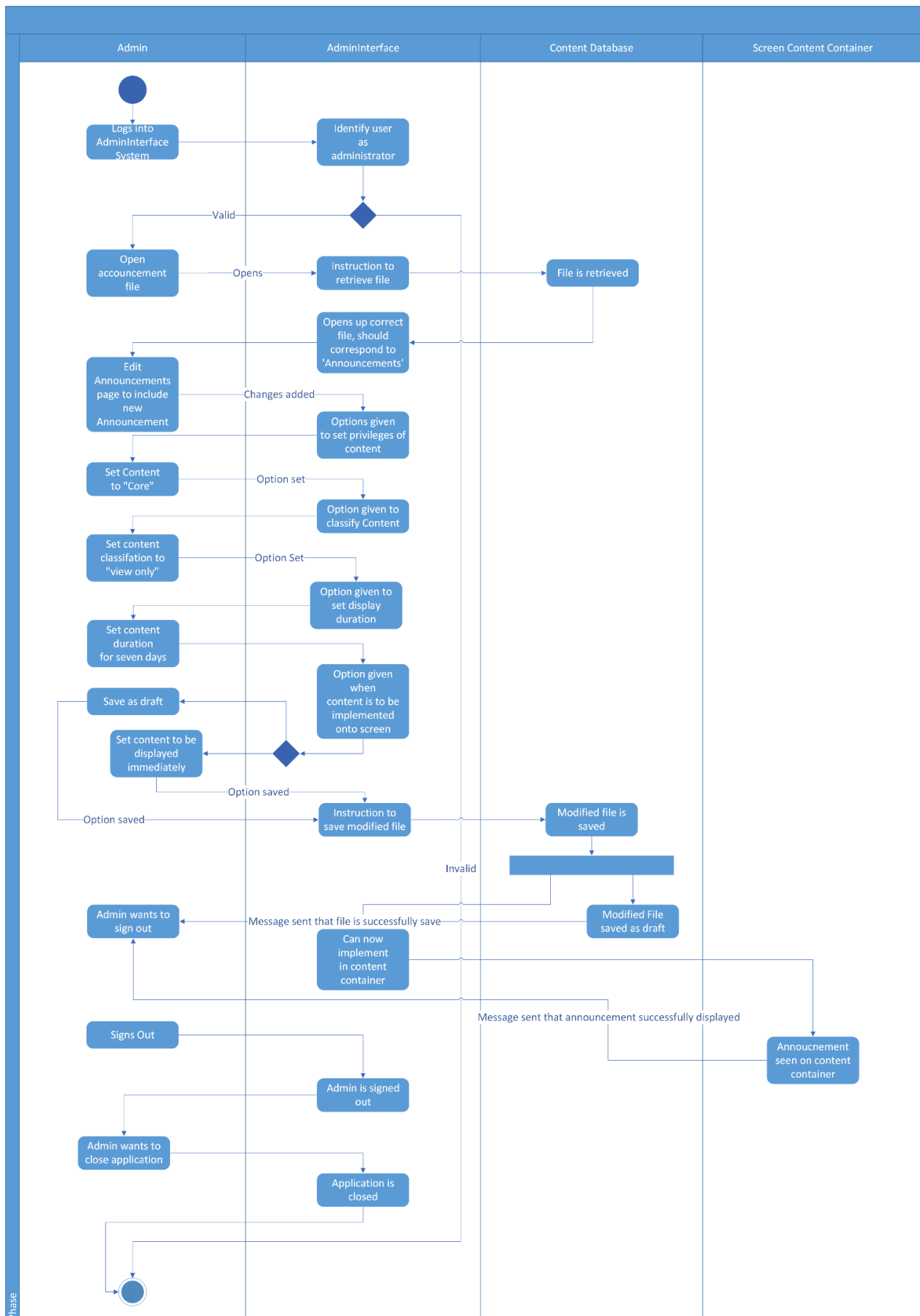




# State Diagram – Screen Displaying Content



### Activity Diagram - Admin wants to post content



## Architectural Evaluation

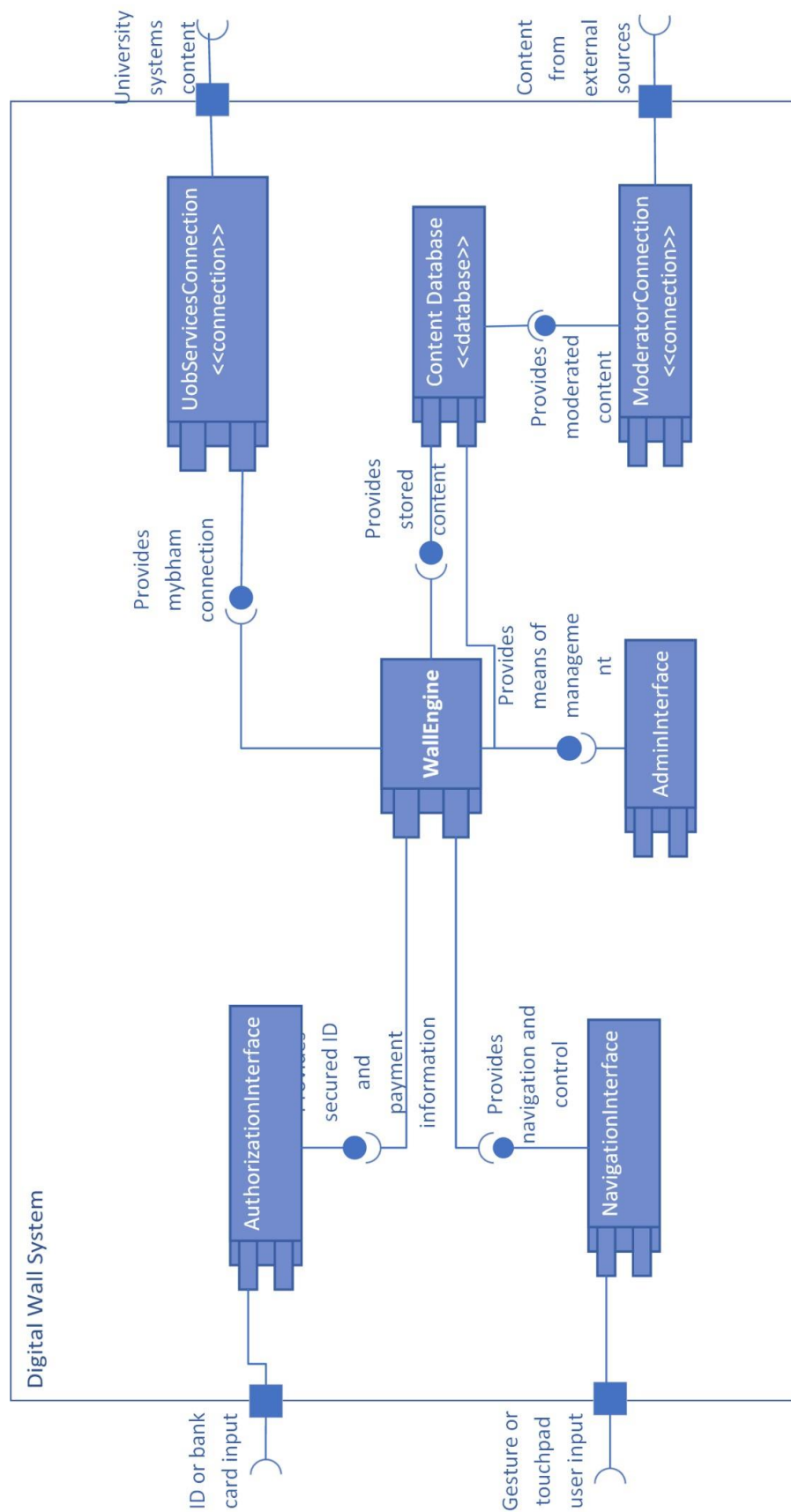
In terms of the proposed architecture for the Birmingham-Dubai Wall, we compared the Client-Server architecture against a three-tier architecture through appraising various non-functional attributes in order to make our decision. The attributes that we considered were: distribution, security, performance, scalability, availability, safety, reliability, maintainability, interoperability and practical constraints (including time, location, budget), where we present the summary of these evaluations below.

Attribute	Comment	
	Client-Server	Three-Tier
Distribution	Easier and cheaper to implement and distribute this architecture	More difficult to develop and much more expensive to distribute
Security	Uses one large server to host all information, making it more vulnerable to attack. Because relatively cheaper to implement, more money could be allocated to secure this system (assuming budget is fixed).	Adopts a micro-services perspective, implementing multiple servers. This increases security because a malicious attack on one component will not affect others. Can allocate security resources to protecting most important to defend components. Is much more expensive so if budget is fixed then could be problematic.
Performance	Higher performance because there are less connections to be made, thus latency will be limited for communication between components. However, increasing the number users will reduce performance.	More likely to have lesser performance because micro-services require more connections and communications between components. Higher likelihood to be affected by latency. Increasing the number of users will not affect performance.
Scalability	This architecture is more restricted with scalability, and involves the purchase and transfer for all data to the new server to scale the system. (Server has finite space)	This architecture is having much higher scalability because there are servers allocated to each component. These servers can be individually upgraded if under stress, and new servers can be easily connected to the system.
Availability	Server should be available, however if maliciously attacked or an error occurs on the server, the whole system will be offline, and as a result potentially affecting the availability.	Servers should always be available, however if one server is attacked or goes offline, only that component will be affected. This potentially increases the availability of the service in this scenario.

Reliability	Potentially higher reliability as only having one server will reduce the probability of an error occurring (as there a few number of connections and less communication needed). However, as above, if attacked then whole system will fail.	Relatively lower potential reliability as more communication and connections is needed. As a result, there is a higher chance that a communication error could occur. However, if as above, if successfully attacked then only one component will fail.
Maintainability	Easier to maintain due to lesser complexity. Only need to maintain one database.	More difficult to maintain due to nature of micro-services. However, it may be easier to specifically target areas that need maintaining.
Interoperability	More difficult to keep adding new connections due to the finite space of the server, which acts as a limiting factor.	Much easier to add connections because space on the server is less of a limiting factor. More connections can be added.
Constrains (time, location, budget)	Depending on how strict the restraints are, this architecture: <ul style="list-style-type: none"> <li>- Is quicker to deploy</li> <li>- Is easier to find location</li> <li>- Is a cheaper structure</li> </ul>	Depending on how strict the restraints are, this architecture: <ul style="list-style-type: none"> <li>- Is more difficult to deploy</li> <li>- Need to find a location for multiple servers</li> <li>- Is more expensive</li> </ul>

In sum, there are advantages and disadvantages of adopting either architectural design for the Birmingham-Dubai wall. The client-server architecture would be advantageous if the physical constraints are ridged and also there are no further plans to increase the scope of this system or make additions in the future. However, we are proposing the use of a three-tier architecture for this system under the assumption that this system will be implemented, maintained and used in the long term, as, despite being a more expensive structure, it has many advantages of security, reliability and scalability. Given the scope of this system, that it will be used to connect University of Birmingham campus from around the world, these attributes are of high priority because the efficacy of the system will be undermined if the University of Birmingham continues expansion but the system used to connect these will be limited by resources. Moreover, because this proposed system is not necessarily limited to the functionality and features outlined in this report, the three-tier architecture would support the addition of new features and functions in the future, for example extension to mobile phones, the use of virtual reality or implementation of video games using the screen.

# Component Diagram



## Deployment Diagram – Three Tier

