Exam Invigilator Communications System
Interim Report

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January 25, 2014

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Contents

Chapter 1

Introduction

Despite the high uptake of technology through the university education system, one aspect remains very manual: Exam Invigilation.

During each exam session, it is common to have invigilators spread across multiple rooms, either due to the popularity of certain courses, timetable collisions, or having students with extra time.

There are many reasons for which invigilators may need to communicate during these sessions. For example, examination start and finish times need to be coordinated, clarifications or corrections need sharing amongst exam rooms, and students may need escorting to the bathroom. This can be particularly troublesome for rooms with single invigilators.

Whilst most invigilators carry a mobile phone which could be used for communicating with other rooms, this is not a reliable solution to the communication issue. Not all invigilators do carry a phone, and invigilators do not necessarily know the number of all other invigilators in other rooms. Furthermore, it is necessary for all mobile phones to be placed in silent mode, leading to communications being missed.

Improving ease and speed of communication between exam invigilators is highly desirable as, ultimately, it will improve the quality of the student exam experience. Quick and efficient communication will mean problems can be identified, shared and resolved more quickly, meaning students can receive corrections, visit the bathroom or obtain more paper sooner. This allows the students to spend their time focussed on the task at hand; answering the paper in front of them.

The project is to create an easy to use and effective real-time communication system.

Chapter 2

Background

In this chapter I will describe the background research done before any design or implementation decisions were made.

2.1 System Requirements

In this section I will describe the initial investigation done to establish the requirements of the system.

2.1.1 Initial Research

Before beginning development, it was essential to identify the requirements of the system additional to those outlined in the project specification. Ultimately, the success of the system would be judged by those it was intended for; invigilators, and so I approached and interviewed an Imperial Department of Computing invigilator to establish the aspects of a prospective system which would influence his opinion of its success.

A number of areas were identified:

- Ease of Use
  The interface must be simple enough to operate quickly and accurately.
- Security
  Examination information is often confidential and so access must be restricted to those with the appropriate permissions.
- Reliability
  Exams are critical components of the university education process and so it is imperative that any computerised system would be completely

reliable. All information must be shared in real-time and shared with any and all necessary members of staff. Any cause to resort to traditional communication methods would render the system a failure.

- Discretion
  The operation of the communication system must not disturb the students who are being examined in the room. It is, however, important that the system be effective at drawing the users attention to any alerts and messages broadcast, to avoid information being missed.

- Functionality
  There are a certain number of functionalities which the system must offer to be considered useful to those invigilating:

  - Show at a glance which room(s) need assistance.
  - Allow an invigilator to notify others when the exam(s) in their room have started or stopped.
  - Request an examiner come to their room, for example to answer a student's question.
  - Request assistance from another invigilator, for example to escort a student to the bathroom.
  - The requesting invigilator is able to see that someone is on the way to help, however, it is important that this information is shared such that a room is not over-serviced.
  - Broadcast an announcement to be made in all rooms of a certain exam, with acknowledgement of receipt.

2.1.2 Further Research

With the initial requirements discussed with an invigilator, I made the decision to reach out to other invigilators for more input with a short web survey which was shared via e-mail to the Department of Computing alias for all teaching fellows. I also received interest from the Electrical and Electronic Engineering department and so shared the survey with the staff there to gather more opinions and information to assist with the direction the project should take.

The full results of the web survey can be found in appendix A.

2.1.3 Research Results Analysis and Requirements

In the online survey answered by the staff of both the Department of Computing and Electrical and Electronic Engineering, I asked a number of questions regarding the preference of device and feature specification.

By far the most prolific devices were phones running the Android operating system, owned by half of all respondents, followed by the iPhone, owned by 20%. iPhone combined with the iPad made up 9 devices owned by staff, with Android phones and tablets making 15.

When offered the choice of using an Android powered device, owned by the Department of Computing, or using their own device, 58% of respondents indicated a preference of using a provided departmental device, however, when asked whether they would prefer the system to use a web interface or be a native application, 62% indicated that they would prefer a web interface, with 12.5% preferring a native application.

The preference for a web interface was discussed during the initial interview where, it was expressed that a native application running on a departmental tablet device would be best. Whilst many invigilators take a laptop to exams, they generally spend the time working in full screen applications. As a result, if a web interface were to be implemented for the system, they would likely have the system open in a background browser window while they work. This would make any attempt at notifying of a message near impossible and would rely on them frequently checking the status of the system. This would inconvenience them while they work, decreasing the likelihood of them checking regularly, making the system hard to justify. Use of a tablet, however, would mean that extra functions such as a device vibrator and manipulation of the display could be used to attract attention of the invigilator and the device could also be left in a prominent position alongside them working to be seen. This goes with the extra mobility of the device, allowing them to carry it whilst responding to students with raised hands, allowing them to advertise if assistance is needed instantly. As a result, I have made the decision that an Android application should be the priority in development, with a web interface being a stretch goal that can be investigated if time permits as the project progresses.

The survey respondents were asked which information they felt it was important to have visible on the screen instantly accessible, and which functionality they felt would be important for a successful communication system. The survey website attributed each response a value from 1-4 with increasing importance which was then divided by the number of respondents to give a response average value which the list could then be sorted by, as seen in the results tables in appendix A. Respondents were further given the opportunity

to give their own suggestions of functionality of notification methods.

Core Functionality

Having analysed the predetermined system requirements and the responses of all web survey respondents, the suggested features have been split into three functionality groups; the essential core functionality, and two stretch goal groups which can be attempted with sufficient time. The system will be designed in such a way that inclusion of the stretch goal functionality will not require complete re-engineering of the core system.

Core Requirements:

- Allow Invigilators and Examiners to sign into the system and assign themselves to a specific room, or as floating staff
- Provide the ability to update the room a user is in and reflect this change across the system
- Offer a means of electronic text communication between invigilators and examiners
  - Nature of Recipients
    - Send to all
    - Send to all in specific room
    - Send to all examiners
    - Send to an individual
  - Nature of Message
    - Preset generic assistance needed message
    - Preset specific assistance needed message, i.e. Bathroom Escort
    - Allow typing of custom messages
  - Acknowledgement of Message
    - Provide a positive response to the individual requesting help
    - Dismiss notification on other users' screens so that the request is not over serviced
    - Append response to the communication log
  - Provide a log to browse the history of all communications

- Allow users to view and control exam timings in their own room, and view the status of other rooms
  - Exam start time
  - Time remaining
  - Exam finish time
  - Extra Time finish time
- Provide a listing of active users on the system, and their locations.
- Effectively alert users to new incoming messages in a way not distracting to students sitting the exam.

Stretch Goals

Beyond the core functionality specified above, the remaining ideas for functionality can be split into two categories of decreasing importance. These requirements differ from the core list in that if not successfully implemented into the system, the system could be deemed a success as inter invigilator/examiner communication will be possible.

In the case that the project progresses in good time ahead of schedule, first group 1 then group 2 stretch goals will be implemented.

1. More Important
   - Include information for each examination, including the examiner responsible for asking each question of a paper.
   - Include critical contact numbers for each exam paper.
   - Provide student seating plans mapping student names to numbers, and vice versa.
   - The ability to customize notification methods, e.g. Toggle device vibration on message received.
2. Less Important
   - Implement a client web interface for the system.
   - Include additional information such as student ID photo in student list.
   - Add the ability to scan student IDs to automate up the ID checking process.
   - Use of the system to replace current pen and paper administration such as student count.

2.2 Available Data

In the Department of Computing, all examination information and timetables, seating plans and invigilation schedules are already computerised and available via internal APIs. This project will seek to build upon these available APIs to fetch and receive information as required, for example, to find the examiner for a specific question on a paper.

If it is found that the available APIs are incapable of providing adequate levels of detail necessary for the desired functionality of the system, I will engage with the Department to discuss the possibility of extending or improving the existing APIs, or investigate hosting information central to the Communication system which can then expose APIs for external use instead, if necessary.

2.2.1 Confidentiality of Data

As previously stated, the exam scheduling, seating plans and invigilator information contains sensitive data protected by the data protection act. As a result, during the development of the system, I will make use of mock data.

2.3 Existing Infrastructure

2.3.1 Server Hosting

As it is necessary to centralise access to the existing APIs offering information about the exam timetables and other information, it will be necessary to make use of a server to which clients can connect and which hosts the information about ongoing exams. Use a central server will also avoid complexities associated with peer to peer network discovery and communication.

Imperial College offers a Virtual Cloud Server Hosting service providing the ability for staff and members of research groups to provision their own virtual servers on demand for hosting their specialised applications.

The servers can be provisioned with either Windows Server or Redhat Enterprise Linux distributions. Full administrative privileges are granted to the user providing complete control over the install and configuration of the system as required.

2.3.2 Network Communication

The Department of Computing is already fitted with a widely accessible wireless local area network which interfaces the Virtual Cloud Server host-

ing. Client server connection will therefore be possible via connection to the Imperial-WPA wifi connection, or via VPN.

2.3.3 System Security

Chapter 3

Project Plan

Chapter 4

Evaluation Plan

Appendix A

Web Survey Results

1. Which devices do you take to an exam invigilation session?

Answer Choices	Responses
Android Mobile Phone	**50%** 12
iPhone	**20.83%** 5
Mac OS X Device	**16.67%** 4
iPad	**16.67%** 4
Android Tablet	**12.50%** 3
Blackberry 10 Device	**4.17%** 1
Windows Phone 7/7.5	**4.17%** 1
Windows 8/8.1 Device with Touchscreen	**4.17%** 1
Windows 7 (or Older) Device	**0%** 0
Windows 8/8.1 Device without Touchscreen	**0%** 0
Windows Phone 8+	**0%** 0

A dumb phone (Motorola Razr something - no real internet)

Nothing as invigilator

Paper

none

2. DoC has a supply of Android devices which could be used by invigilators. Would you be happy to make use of one of these devices or would you prefer to use your own?

Answer Choices	Responses
DoC Android Device	**58.33%** 14
My Own (Please specify which other device you would prefer to use) inc. OS version	**41.67%** 10
Total	24

iPad or Mac laptop
Sony phone android 4.1
Nokia
MAC machine
Mac laptop
Windows 8 laptop, or iPhone 4
Tablet (to have more info at hand)
iPAD

3. Would you rather the system be implemented using a web interface and so usable from any device, or in native code to access advanced device functionality?

Answer Choices	Responses
Web Interface	62.50% 15
Native Application	12.50% 3
Both	25% 6
Total	24

4. How important do you think the following information is to have immediately available on the screen during invigilation?

	Not at all important	Slightly important	Very important	Essential	Total	Average Rating
Exam Finish Time	4.35% 1	21.74% 5	26.09% 6	47.83% 11	23	3.17
Exam Time Remaining	4.35% 1	17.39% 4	39.13% 9	39.13% 9	23	3.13
Where other users on the system are based	4.35% 1	30.43% 7	47.83% 11	17.39% 4	23	2.78
Other rooms being used for exams	8.70% 2	21.74% 5	56.52% 13	13.04% 3	23	2.74
Exam Start Time	9.09% 2	36.36% 8	31.82% 7	22.73% 5	22	2.68
History of communications	18.18% 4	31.82% 7	45.45% 10	4.55% 1	22	2.36
Other users on the system	19.05% 4	38.10% 8	33.33% 7	9.52% 2	21	2.33

Is "users on the system" refering to the users connected to the exam system or the users that are ralated to the exam (i.e. they set the paper). Because if the "users on the system" only refers to the users connectd then, the information of who set the paper and location is also essential.

Ability to access from an office, if someone is on split duty, perhaps.

Numbers of the key people you might need to call if you need help (e.g., the exams coordinator, the year coordinator for the exam in question, the teaching fellow most closely related to the exam)

"Active" requests and their status? Additional time granted and why (i.e. for mistakes in paper etc.)
Who is in charge of what task (for this exam) - Qestion X is for examiner Y? Papers go to Z? Who invigilates special cases? Who could contact missing students? Where is the Iain or whoever decides ultimately on interrupting an exam etc.

the most important is knowing how to get in touch with the professors if any questions come up.
Status of each room (e.g., ok, help needed, question, etc...)

Contact information of people as necessary - maybe by clicking on the person, you can bring this up.

5. How important do you think the following functionalities are to make the system successful?

	Not at all important	Slightly important	Very important	Essential	Total	Average Rating
Send generic "assistance needed" message - e.g Help needed	**4.17%** 1	**8.33%** 2	**45.83%** 11	**41.67%** 10	24	3.25
Respond to generic "assistance needed" message - e.g On my way	**4.17%** 1	**8.33%** 2	**45.83%** 11	**41.67%** 10	24	3.25
Respond to preset "assistance needed" message - e.g On my way	**4.17%** 1	**20.83%** 5	**41.67%** 10	**33.33%** 8	24	3.04
Contact IT support/Admin staff	**8.33%** 2	**12.50%** 3	**50%** 12	**29.17%** 7	24	3.00
Send preset "assistance needed" message - e.g student needs toilet	**4.17%** 1	**20.83%** 5	**50%** 12	**25%** 6	24	2.96
View and control exam start/remaining/finish times	**8.33%** 2	**20.83%** 5	**45.83%** 11	**25%** 6	24	2.88
Ability to blanket message all invigilators	**8.70%** 2	**21.74%** 5	**47.83%** 11	**21.74%** 5	23	2.83
List of students in/should be in room	**13.04%** 3	**26.09%** 6	**26.09%** 6	**34.78%** 8	23	2.83
Customisable preset messages - e.g Problem with Paper X, question Y	**12.50%** 3	**25%** 6	**33.33%** 8	**29.17%** 7	24	2.79
Send detailed "assistance needed" message - e.g I'm having a problem with...	**8.70%** 2	**26.09%** 6	**52.17%** 12	**13.04%** 3	23	2.70
View other contact details of other Invigilators	**12.50%** 3	**25%** 6	**50%** 12	**12.50%** 3	24	2.63
View students who have not turned up to room/other rooms	**12.50%** 3	**33.33%** 8	**33.33%** 8	**20.83%** 5	24	2.63
Customisable notification types e.g Turn vibrate on/off	**13.04%** 3	**47.83%** 11	**8.70%** 2	**30.43%** 7	23	2.57
Respond to detailed "assistance needed"	**8.70%** 2	**39.13%** 9	**43.48%** 10	**8.70%** 2	23	2.52

	Not at all important	Slightly important	Very important	Essential	Total	Average Rating
message - e.g I don't think...						
Ability to direct message individual/room	**12.50%** 3	**41.67%** 10	**29.17%** 7	**16.67%** 4	24	2.50
View other exam room start/remaining/finish times	**16.67%** 4	**41.67%** 10	**29.17%** 7	**12.50%** 3	24	2.38
Barcode scan student IDs	**34.78%** 8	**26.09%** 6	**13.04%** 3	**26.09%** 6	23	2.30

- List of students with extra time - Ability to map student name or CID to seat number - Ability to map seat number to student name + CID - Photo of student appearing in student list

Student barcode scan for suspected infractions. Record of disturbances. Fixed assistance needed, other than example: Paper # , Q# etc. error on paper Q#, part #

Various kinds of timers or alerts (e.g., 30 minutes before exam start, 10 minutes to to, ...).

Emergency - Collapsing student, demonstration against an embassy or the world as it is, drilling or other noise in floor below/above or wherever (not just that someone wants to go to the toilet) - I had a case were due to demonstration an exam had to be interrupted and moved to another room - in this case a lot of checks have to be done quickly by different people (which room to move to, how much extra time, etc.). Alarm - There is a problem (typo) in question X, wait until examiner passes by to fix it (if there are several rooms). Examiner (who sets exam) invigilating in different room should be `called for help' on question X (as exams are set by several examiners, it is important to identify the right examiner (we had case of running back and forth because the wrong examiner was `called out'). Scheduled time is not so important but extra time give by examiner should be communicated fast. Note: Examiner (setting exam) is very different from invigilator (watching paint dry), should thus be treated differently.

6. How would you rate each of the following means of alerting you to new information on the system? (Answer for your ideal platform)

	Would not use	Poor	Good	Excellent	Total	Average Rating
Pop up message on device screen	**12.50%** 3	**20.83%** 5	**41.67%** 10	**25%** 6	24	2.79
Flashing Alert section of the screen	**21.74%** 5	**8.70%** 2	**39.13%** 9	**30.43%** 7	23	2.78
Device vibrates	**33.33%** 8	**8.33%** 2	**25%** 6	**33.33%** 8	24	2.58
Device screen flashes a colour	**16.67%** 4	**33.33%** 8	**29.17%** 7	**20.83%** 5	24	2.54
Device screen turns on and off	**16.67%** 4	**37.50%** 9	**37.50%** 9	**8.33%** 2	24	2.38
Device brightness increases	**29.17%** 7	**41.67%** 10	**16.67%** 4	**12.50%** 3	24	2.13
Scrolling title bar	**39.13%** 9	**43.48%** 10	**13.04%** 3	**4.35%** 1	23	1.83
Notification Sound	**70.83%** 17	**16.67%** 4	**12.50%** 3	**0%** 0	24	1.42

Text message. Email.

By announcement and blackboard

sound on a bluetooth enabled earpiece. The reason I think vibration is poor is because it can generate a distracting for the students sound.

Earphones?

A (quite short) sound would be acceptable for alarm or emergency cases (see above) - otherwise not (someone asking a question, toilet, etc.)

7. Are there any other insights or further information you could provide as to what you would find useful in an Exam Invigilator Communication system?

Not

Can this eventually supersede the paper records?

I have invigilated many exams in my time. Perhaps 100. I cannot remember a single occasion on which I would have found this facility useful.

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