

GOLDSMITHS, UNIVERSITY OF LONDON

SOFTWARE PROJECT FINAL REPORT

iLost

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1 Introduction

Losing belongings is a common problem, roughly 70 worth of items are lost in public each year. ^[1] We conducted a survey about lost items to find out if we could create a useful application based on this concern. Following our survey, this statement was found to relate to university students as 89% of our participants claimed to be susceptible to losing items. This information motivated us to reduce the loss of personal belongings; leading to the development of an item tracking application and a portable tracking device. Our app aims to circumvent the loss of bags and valuables. The user will attach the portable tracker to their bag, allowing it to be tracked using our app. The app will notify the user when the distance between the app and tracker reaches 30m.

This report will cover five main categories:

- **Development Record** We explain the methodology used by our group to decide the technology with which to implement the apps functionality and the development methods we used. We also describe the way that the development was handled by the team and provide a reflection on its efficiency.
- **Formative Evaluation** This section of the report describes our assessment with users during development. The formative evaluation details what we did during user testing and its outcomes.
- **Design and Implementation** An overview of our final design and implementation, including any changes from our initial ideas with justifications for the significant decisions we made.
- **Quality Assurance** We detail our approach to Quality Assurance and the testing carried out, including our results. An assessment of how well our final system imitates our initial requirements with Justifications of any changes we made to the requirements.
- **Summative Evaluation** A descriptive evaluation of the methods, results and conclusions of our final software.

2 Development Record

2.1 Teams

During in the implementation stage, we setup a organisation **GSoft** on Github and we were divided into three teams, **iOS app**, **Android app** and **Backend/Tracker team**, which shows on the figure 1. Each team was grouped by 2 to 3 people who were more interested in that topic or technology. Some of us were interested in more than two areas then he would join two of the teams. The list of the team members can be found in table 1

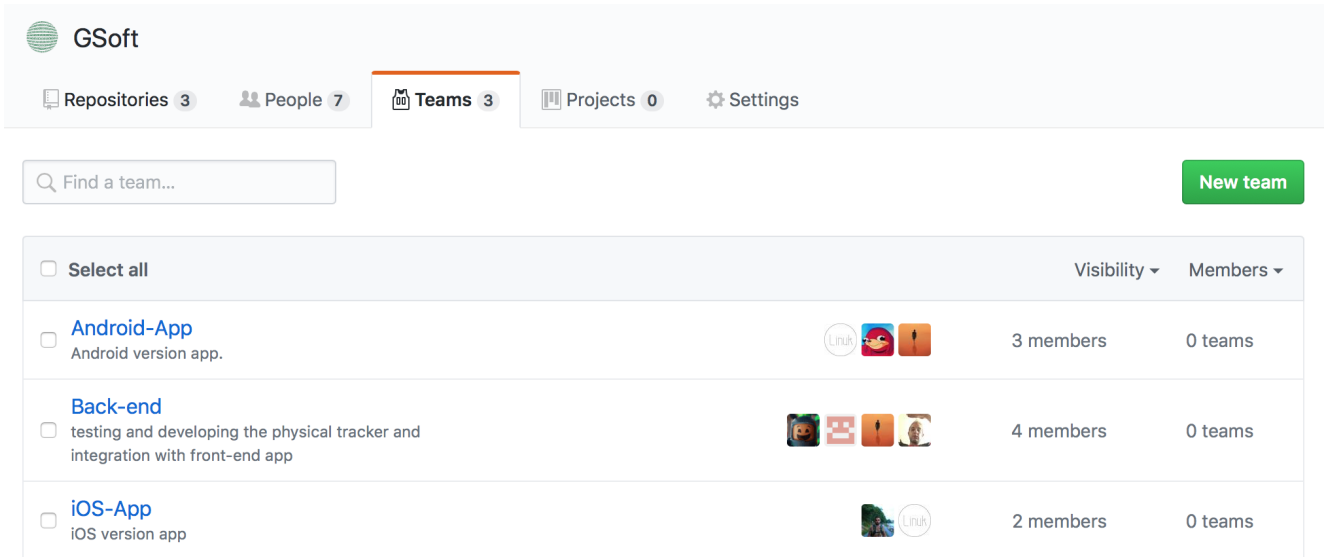


Figure 1: Development Teams on Github

Team	Members
iOS app	Jheng-Hao(leader), Muhammad
Android app	Dyland(leader), Mahmudul, Jheng-Hao
Backend/Tracker	Hussein(leader), Thairan, Mahmudul, Mariano

Table 1: Teams

2.2 Technology Selection

Development Teams Each team was responsible for how and what technology to use as long as the production could be made on time. We believed this methodology had these advantages in terms of the limited development time:

- React Agilely: Compare to have a poll with all members of our group, it was agiler to come to the decision within 2 or 3 people within one team. Since each team could react to the situation and resolve the issues in a more efficient way.
- Specialities differs: Our group was divided by our interests and specialities, we trusted each team could make the best decision for the whole team with their research and experience. For example, the iOS app team would not interfere how tracker team implemented the physical components at all, and how Android app was implemented would not be the backend/tracker team's concern. All teams were trusted that they would make the best decisions.

Even though the team was separated, it was important to keep everyone on the same page. So each technological decision or propose was documented as an architecture decision record(ADR), which enabled us to have an overview of all the technological changes. According to Michael Nygard, each ADR contains five columns[1]:

- Title: brief description of the propose.
- Context: **Why** do we need to make the decision or change.

- Decision: **What** is the response toward the decision.
- Status: current status of the decision which, should be **accepted**, **rejected** or **deprecated**.
- Consequences: **What** become better or worse because of the decision.

Please find more complete architecture decision record in A.2.

To keep the whole group has the latest information, We used several channels on Slack to keep everyone updated. Such as the **iOS channel** was the place containing all updates related to iOS application development, which shows in figure 2.

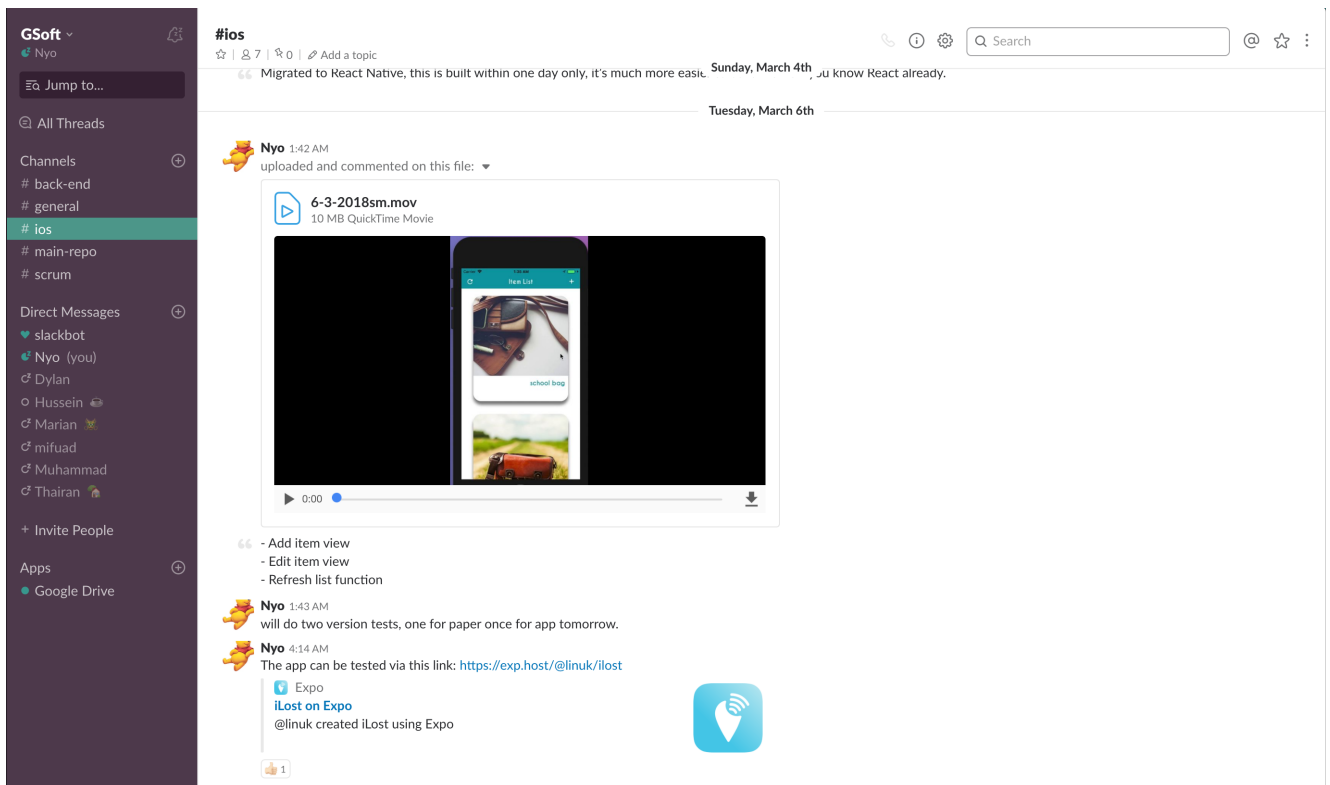


Figure 2: Slack iOS Channel

2.3 Agile Development

Our team tried out two agile development methodology, **Scrum** and **Kanban**.

2.3.1 Scrum Development

Since we could not actually devote all of our time to develop the application, so it would not be reasonable to do the daily scrum and have a meeting day-to-day for all of us. So in the beginning, we tried to set up a routine to simulate the daily scrum with Slack.

We defined 3 days as one sprint and whenever a sprint was finished, the team needed to answer three questions in the Scrum channel on Slack:

- What did I complete last time that contributed to the team meeting our sprint goal?

- What do I plan to complete this time to contribute to the team meeting our sprint goal?
- Do I see any impediment that could prevent me or the team from meeting our sprint goal?

Unfortunately, not every team could follow the sprint process and make any progress every three days. Sometimes a team might work for a sprint then stopped for two sprints since other modules might have a deadline or coursework. Hence, this scrum process was not actually conducted properly and stopped after few weeks after started. The example records show in figure 3.

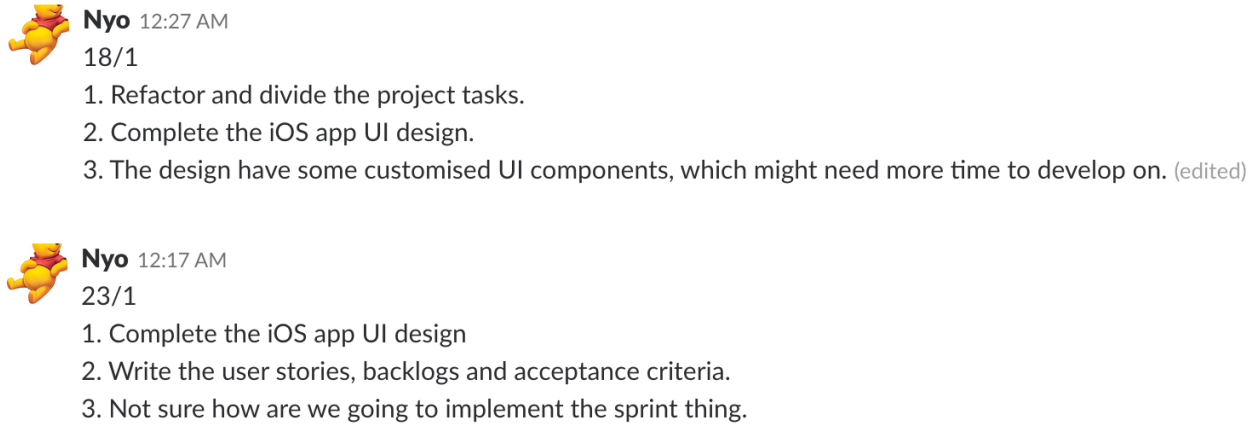


Figure 3: Slack Scrum Channel

At the middle of the development stage, our supervisor suggested us to meet 2 hours a day and 2 to 4 days a week, work and team and engage the team building, since the progress tracking form showed that the working hours were really unbalanced and some people apparently did not put enough effort into the project.

We made a daily sprint schedule, shows in figure 4, and followed the time to do work together. Everyone should follow the schedule and spend at least two days a week to work together as a team. It went well and most of us were able to follow the schedule. We worked in RHB306a, 35 Cafe or the whitehead building lab. But since the strike started, the daily sprint stopped again because not all of us were coming to the campus due to the long distance between home and the university.

	START	END	Dylan	Marian	Mifuad	Hussein	Thairan	Jheng-Hao		
Monday	14:00	16:00	X	X	Δ	X	O	X		
Tuesday	17:00	19:00	O	O	O	O	X	O		whitehead building lab: 18:00 to 19:00
Wednesday	14:00	16:00	Δ	X	Δ	X	O	Δ		
Thursday	11:00	13:00	X	X	X	O	O	O		
Friday	17:00	19:00	O	O	O	O	X	Δ		
									Legends	Availability
									O	Sure
									Δ	Either one
									X	No

2.3.2 Kanban

Apart from the Scrum, Kanban was also implemented with the backlogs in our development to demonstrate the development progress. We tried to keep our project management tool simple and easy to approach, so we not only used Github for version control but also for the project feature, which we used it as the Kanban. The iOS development kanban was shown in 5.

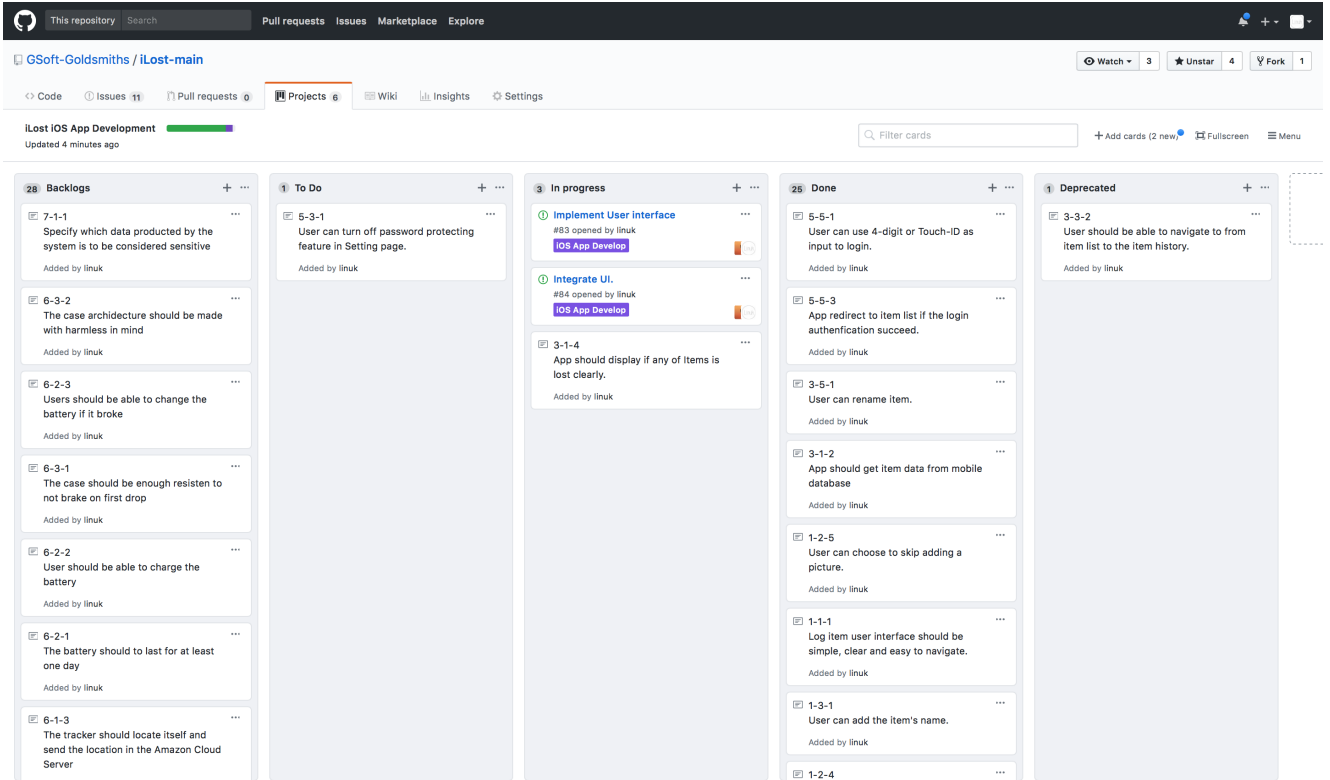


Figure 5: iOS app Kanban

Our kanban contained five columns which shows in Table 2:

Column	Description
Backlogs	The task is scheduled to be develop, but it is possible to be assigned deprecated if it is no longer needed.
To Do	The task is going to be develop.
In Progress	The task is currently developing
Done	The task has been completed.
Deprecated	The task no longer need to be developed.

Table 2: Kanban Columns

Apart from the normal columns: To Do, In Progress and Done, we also added **Deprecated** to store the features or tasks did not fit the needs anymore. Kanban gave a nice and clean overview of the current developing process, especially for people from other teams.

2.3.3 Behavior Driven Development

In order to produce the minimum viable product(MVP), we followed the Behavior Driven Development(BDD) to develop our product. To implement this methodology, we wrote the backlogs

of requirements specification at the beginning of the development stage. These requirements provided us with an overview of what was more urgent in what stage.

For example, displaying the item's position and historical locations was one of the most important functionality, so its' priority was **Must** and needed to be finished at the **MVP** stage. On the other hand, navigating to the item by triggering Google Map was helpful but might take longer to develop, so the priority was **Should** and it should be developed at the **Final** stage.

Here was our development process of BDD:

1. Requirements specification Review the backlogs and pick one from them to work on based on the priority and the estimated development time. Please can find the details of the backlogs in section 2.4.1, Development Process - Backlogs.

2. Design Review the how was the data storage, data flow and the user interface design, then design how should this requirement be fulfilled. Such as displaying the item list in the item list view, we would need to implement two view components, an item list cell view and an item list table view. The item's properties data, including items id, name and photo, would be stored in the table view's state and the list cell would receive the props from the table view and render the item's properties.

3. Development Put the design into actual codes.

4. Integration Integrate the new view component with previously developed view components. Such as connecting the item list view with the item details view, where users could see its' location with a map.

5. QA reviews Conduct the quality assurance of the functionalities of latest and previously developed components. Please find more details in the chapter 5, Quality Assurance.

6. Usability tests After several developments, we would bundle them as a new version of our mobile application. Then do the usability tests to test if any of the components, user interface or user experience could be improved. Please find more details in the chapter 3, Formative Evaluation.

7. Maintance After the usability tests, we did some improvement based on the usability testing results.

This was a cycle process, after step 7 we went back to step 1 and kept going.

2.4 Development Process

2.4.1 Backlogs

Based on the user stories we made in the proposal, not only did we added more but also wrote sub-user stories and acceptance criteria for each of them. We had a list contain backlogs stored in Google SpreadSheet, which contained these columns:

Column	Description
User Story ID	The user story ID or sub-user story ID, a user story ID should be 1, 2, 3...n, and sub-user story should be 1-1, 1-2, 1-3, ... 1-m where 1 is the parent user story.
User Story	A brief description of the user story, starting with "As a user I want to ..." to describe what is the users' needs. Then followed by "so that ..." to explain why users need it.
Backlog ID	An ID number for the backlog, a sub-user story may contain more than one backlog to satisfy the sub-user story. If a sub-user story ID is 3-5, then the task ID will be 3-5-1, 3-5-2, 3-5-3, ... 3-5-p .
Acceptance Criteria	A description of the backlog which describe how the mobile application or the tracker would satisfy the user stories
Priority	The priority of this backlog, should be Muse , Should or Could .
Dev Days	The estimated developing times in days, 8 hours counted as one day
Phase	In which phase should the backlog be finished, in our case was MVP or Final .
Process	The current developing process, which should be ToDo , In Progress , Deprecated or Done .

Table 3: Backlogs Columns

For example, the user story 3 **Track Item: User uses App to see the tracking list and track Item.** has 7 sub-user stories, which shows in the table 4:

User Story ID	User Story
3-1	As a user I want to view the tracking item list, so that I can view my item and look up more detail if I want.
3-2	As a user I want to activate or deactivate tracker, so that I can save my mobile and the tracker's batteries.
3-3	As a user I want to see the location history in a map format of the item, so that I can track/look for it if it's lost.
3-4	As a user I want to navigate me to my item, so that find it quicker.
3-5	As a user I want to edit my item detail, so that I can change the tracking item.
3-6	As a user I want to delete the item, so that I can stop tracking the item for good.

Table 4: Backlog Example: User Story 3

Take sub-user story 3-1 as an example. In order to satisfy this user story, we had 4 backlogs and acceptance criteria to meet the requirements. and each of them had their own priority, estimated development days, phase and process. So this backlog will look like figure 6:

User Story ID	User Story	Backlogs					
		Backlog ID	Acceptance Criteria	Priority	Dev Days	Phase	Process
3-1	As a user I want to view the tracking item list, so that I can view my item and look up more detail if I want.	3-1-1	Item list user interface should be simple, clear and easy to navigate.	Must ▾	2	MVP ▾	Done ▾
		3-1-2	App should get item data from mobile database	Must ▾	1	MVP ▾	Done ▾
		3-1-3	App should fetch latest locations of all the tracking items when User visit item list page.	Should ▾	1	MVP ▾	Todo ▾
		3-1-4	App should display if any of Items is lost clearly.	Must ▾	2	MVP ▾	In Progress ▾

Figure 6: Backlog Example: Sub-user story 3-1

The full backlogs can be found in the appendix A.1 and it was used to create our kanban showed in figure 5, which kept the developing process recorded easily to follow.

2.4.2 Progress Tracking

To record our progress, we kept using the same progress tracking form as the last term, and this term we did some improvement:

- Lock every week: To prevent any team member modify the resource hours dishonestly, a range of the form was locked every week. Only records within recent two weeks were allowed to be added.
- Status documented in more detail: To increase the traceability and convincing evidence, each resource hours commitment was asked to provide a more detailed description. Instead of *reporting writing*, it was improved to be *Final report: Formative Evaluation - mobile application test*

Please find the full progress tracking form in appendix A.4.

Until March 16, the total working time during these two terms is **581.9 hours**. All these hours contribution includes all lab sessions, supervisor meetings, daily sprint and self-independent working time. 58.7% was contributed by Hussein and Jheng-Hao as shown in the figure 7. The top contributor is Jheng-Hao with 222.95 hours contributed, while the last is Chin with 26.5 hours recorded. The line chart displays that commitment became dramatically different since the second term. Most of the team members stopped to work in the second term, excluding Hussein and Jheng-Hao who still kept working continually.

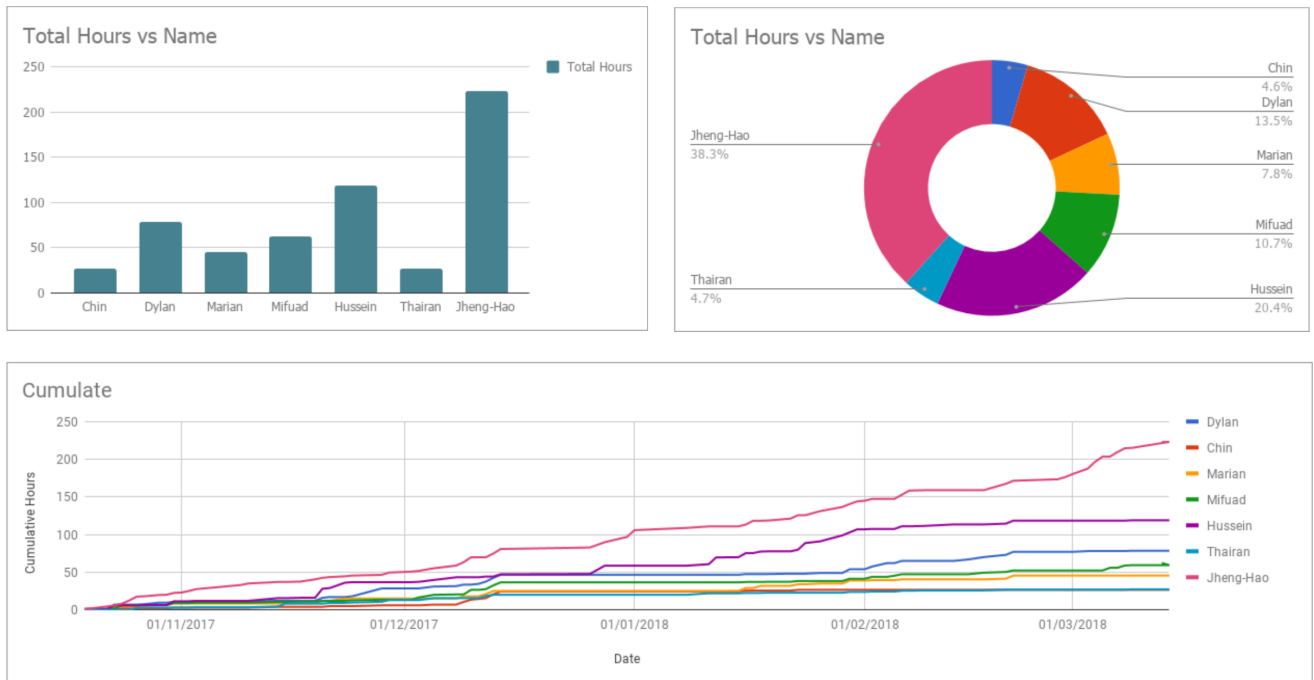


Figure 7: Progress Tracking Diagram (until March 16th)

2.4.3 Evaluation

Scrum This methodology is suitable for a team where they tend to work together in a fixed time day-to-day. Even though we had scheduled the daily sprint time, not everyone would attend since it was not compulsory and registered. Only few sprint sessions at the beginning went well. In terms of the time management, not every one of us would able to contribute fixed time every one or two days, so we could not have a daily sprint or even weekly sprint. Unless we have could work full time for this project and everyone is willing to meet at a place and work together, or it would be better not to implement Scrum in our team.

Kanban Regards of project management, Kanban went well, but it would be better if we could have a workspace where we could combine our backlogs and kanban. We found that there was two web application could provide this kind of services: Clubhouse and Jira They are the web applications where we can add user stories which link to kanbans at the same time. It would be nice to use this kind of tools to save time if the team has enough budget.

Backlogs The backlogs were the most important things we could improve on. We only listed the basic cases while the extreme use stories were not in our backlogs. For example, "**As a user I want my tracker to keep working in the snowing seasons**" could be in our user story as our product should still be functional in the winter season.

Progress Tracking In terms of progressing tracking form, it should added one column which links to the contributions, either ther github commit or documentation. It was not be nice to record n hours working without any evidence but it did happen. Also, it was not really feasible to use working hours to represent the contributions. With the same task, people spend less time to finish the same job should be rewarded higher compared to who spend longer period to do so. But we were not able to do this since everyone worked on different tasks. It would be fairer if

each task could be evaluated by the importance, whoever completes the higher importance means contributing more. We should have a contribution list which records everyone's participation. Then with the list, we could write the peer access form in a more objective point of view.

3 Formative Evaluation

3.1 iOS App Evaluation

3.1.1 Objectives and Questions

We wrote quantitative tasks to test the usability of our mobile application[3]. The purpose of the tests was to test if the participants can actually finish the task with the application, and we could learn from the process to observe how users used our application and improve it if any issue or confusion was raised.

Task ID	User Goal	Task	Scenario	Developing Status	Can be tested		
					v0.10	v0.11	v0.12
1	Log item in the app	Add my bag as a new item and pair a tracker in the mobile app	You are planning to find a solution to prevent losing your bag in public again, so you buy a iLost tracker online now and download the free mobile app in your phone. Go to the app to add your bag in the tracking list.	Done	Y	Y	Y
2	Check items status	See if all my bag item is safe.	You are have successfully log your item and pair the tracker with the mobile app. Go to the app to check if your bag is safe.	Done	Y	Y	Y
3	Check item position	See my bag's current position	You just come back from a chill night in a bar, you realise that you forget your bag at somewhere until arriving home. Check where is your bag now.	Done	Y	Y	Y
4	Check item position records	See my bag's 10 minutes before's position	You have checked your bag's current position and feel weird why is it in a place you have never been before, so you decided to see how it end up there. Check your beg's location ten minutes ago.	Done	Y	Y	Y
5	Trigger native maps app navigation with current position	Navigate me to the my bag's current position in a public transportation way.	You are really worry about where is your bag , because it seems like someone has taken it to somewhere, and inside your bag are all your important belongings. Go find your bag with the app's navigation feature.	Done	Y	Y	Y
6	Trigger native maps app navigation with history position record	Navigate me to the my bag's 10 minutes before's position on foot.	There is something misling from your bag, it might be left outsied of the bag, Go and find your bag's previous location 35 minutes ago .	Done	Y	Y	Y
7	Edit item name or photo.	Attach the tracker to other item.	You just bought a new bag and you would like to attach the original tracker to it. Go to one of the tracker view to edit the item's name and photo.	Done	Y	Y	Y
8	Receive notification	Receive notification once my bag is lost.	You receive an notification since the app detecting your item is too far away from you. Check the notification and find where is you lost item.	Done	N	N	Y
9	Setup password	Setup password for the app	Now you know how iLost can help you find your lost precious, but the app need to be kept in private otherwise other people can the app to track you! So you decide to prevent someone else to use the app by setup a password in the app.	Done	N	N	Y

Figure 8: Usability test task list

Column	Description
Task ID	Identify number of the task
User Goal	What is the objective we need users to perform.
Task	The process in terms of completing the goal
Scenario	A setup scenario for engaging testers to use the application in a real-life case.
Developing Status	Current latest developing status of the functionality of this task, it should be To do , In Progress and Done .
Can be tested	Whether the functionality of the application is ready to be tested in each version.

Table 5: Usability test task list columns

Figure 8 demonstrates our tasks and goals. The table 5 shows what the columns stand for.

3.1.2 Participants, Location and Setup

According to Jakob Nielsen, testing 5 users in a usability study could find almost as many usability problems as testing more participants[2]. So application was tested with 5 participants

for each version. The study was taken place in the library of the Goldsmiths, University of London, and the participants were the students who used to bring a bag to the campus daily. Totally we have conducted three versions of the application.

3.1.3 Methodology and Measures

Firstly, we explained what was our project about and asked participants to sign up the consent form which can be found in appendices B.1. During the test, the participants were provided an iPhone with the application built-in to test. An observer would guide them through the tasks and the scenarios, then took notes of how the participants reacted to the application. For each task, the observer would record it was successfully completed or failed. The records would help us to build the success rates diagram which helped us to understand which usability needed to be improved[4].

3.1.4 Evaluation

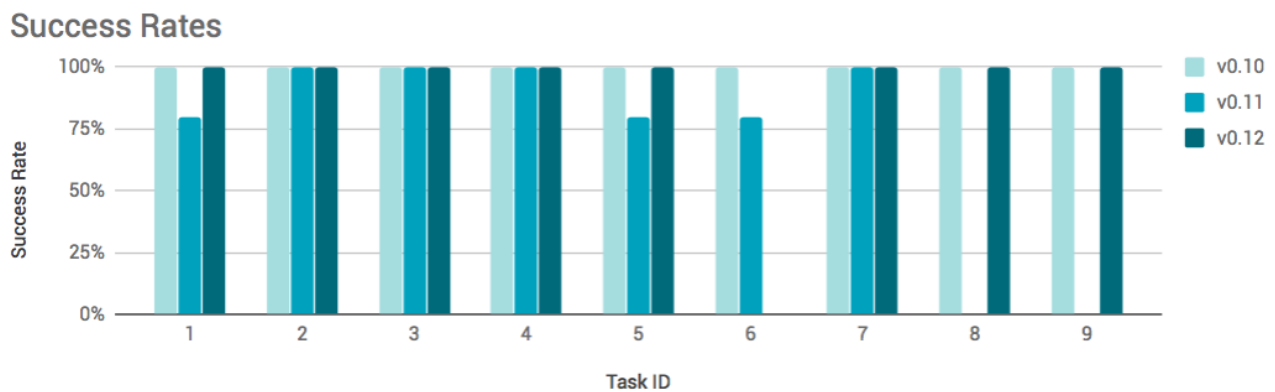


Figure 9: iOS App Success Rates Diagram

v0.10 The tested subject was the application prototype built in **Adobe XD**, which was one of the best design tools to test the prototype. Thanks to the well-designed user interfaces, the goals were easy to achieved and all the tasks were all succeeded. The result could only prove that the user interfaces guided the users to the right view, but it could not actually reflect on the usability of the real application. After all, Adobe XD could only let users walk through each view by clicking, while an actual iOS application should support swipe or other gestures. It was more like a paper prototype usability test.

v0.11 We benefited most from this test since this test was the native mobile application we where the participants can actually use it like other application. This version was built in React Native and tested in Expo which a tool and service which we used to build the mobile native application with React Native. During this test, we received several comments towards the **add item view**. For example, the camera icon in that view was originally used as a button. But some of the users could not really regard it as a button but a decoration since it was colourful. Also, the placeholder of the item name field was **Item Name** instead of a prompt message which confused some of the participants as well. So after this test, we resolved the issues and the difference shows in figure 10. The task 8 and 9 were not developed completely at the moment so there was not any record.

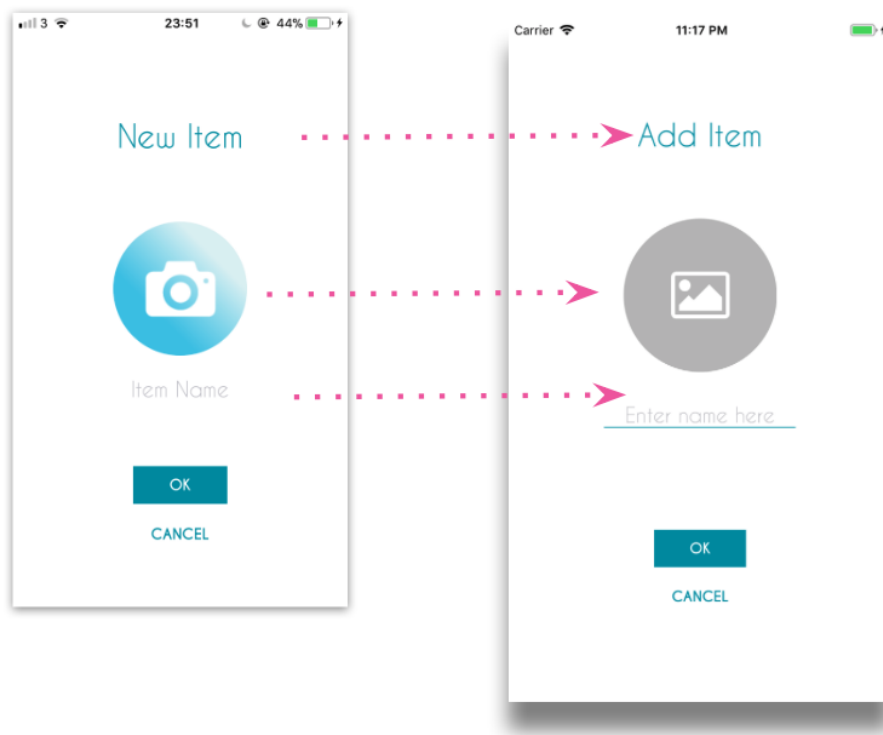


Figure 10: Improvement of the add item view

v0.12 After the previous test, we not only improved some of the user interfaces but also removed some of the features. It is worth notice that there is no record of task 6, which is **navigating to previous locations of the item's location history**. The reason we removed this task was that this goal was not really helpful. The participants commented that it was not beneficial to navigate to the previous locations, they cared about the current location of the item more. So thanks to the feedback, we removed the task 6 and eliminated the functionality of navigating through history locations which made the application more simple.

3.2 Tracker Evaluation

total 700 words

3.2.1 Objectives and Questions

100 words

3.2.2 Location, Setup and Participants

100 words

3.2.3 Methodology and Measures

100 words

3.2.4 Tracker v0.10 Evaluation

150 max words

3.2.5 Tracker v0.11 Evaluation

150 max words

3.3 Conclusion

Even though the tasks could be completed, but in terms of the user experience, we still had space to improved.

4 Design and Implementation

5 Quality Assurance

5.1 Process

We conducted two types of quality assurance to ensure our mobile application working as we expected, including black-box testing and white-box testing. While the white-box testing focused on the functionalities, such as how an item list view should react when an add new item button was clicked, the black-box testing covered how a view component or a function should be rendered or implemented, such as a button should render a text on it based on what text state passed to it. Usually, the black-box tests were conducted after the white-box tests, since the functionalities could be functional only if the component worked properly.

Since the time limitation, only the iOS version was fully tested, but the test cases could be implemented in both version of the application.

5.2 Black-box Tests

5.2.1 Method and Environment

The black-box tests covered the functional testing testing of the use scenarios, they were developed by the acceptance criteria of the backlogs. Since our mobile application was not really complicated and complex, we did not implement any automated way to conduct the tests but manually merely. We chose **use case testing** as our approach to conduct the static tests, since it was the quickest way we could conduct the tests with existing resources.

The iOS application was written in React Native, it was imported and tested in the Expo[5] application on an iPhone 6. Expo is a mobile application where everyone can download others' React Native codes and run on their iPhone or iPad, rather than paying USD 3000/year to subscribe the Apple Developer Programme to use TestFlight[6], which is the official testing application owned by Apple Inc.

5.2.2 Test Cases

Our use cases table was adapted from the format wrote by a software consultant company IntexSoft [7].

5.3 White-Box Tests

5.3.1 Coverage

5.3.2 Process

5.3.3 Test Cases

5.3.4 Test records

5.4 Evaluations

Both types of tests helped us to maintain the quality of our software before actually conducting the usability tests with the participants, and here are some points could be improved in terms of our black-box tests:

- **Add extreme cases:** The test cases aimed to test the normal use cases since we did not have much time to test the extreme cases. But in real life, the boundary value analysis is relatively important in terms of the software testing as well apart from the normal use cases.
- **Automated the tests:** During the black-box tests we conducted the tests manually, but in fact, we could automate the process and save us a lot of time. In fact, Jest, the tool we used to automated unit testing, supports the automated application testing, it is worthy to do more research on it.
- **More tests related to the tracker:** Since the limited time, we did not have much time left to do the tests for the physical tracker. It is important to test any part of our product, especially the integration between the tracker and the mobile application should be well tested.

6 Summative Evaluation

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Appendices

A Development Records

A.1 Backlogs

User Story ID	User Story	Backlogs					
		Backlog ID	Acceptance Criteria	Priority	Dev Days	Phase	Process
1	Log Tracker: User logs the Tracker into App			Total Dev Days	11	Completion Rates	61.54%
1-1	As a user I want to have a nice item logging user interface, so that I can easily log items in App.	1-1-1	Log item user interface should be simple, clear and easy to navigate.	Must	2	MVP	Done
1-2	As a user I want to add a picture of the item as a reminder of what it looks like.	1-2-1	User can take a picture of their item within App.	Must	2	MVP	Todo
		1-2-2	User can decide to use the taken picture or retake the picture.	Must	1	MVP	Todo
		1-2-3	User can decide to retake the picture if the photo is not good enough.	Must	0.5	MVP	Done
		1-2-4	App can store the picture in the mobile.	Must	0.5	MVP	Done
		1-2-5	User can choose to skip adding a picture.	Must	0.5	Final	Done
1-3	As a user I want to name my item, so that I'll know what the item is if I don't want to take a picture of it.	1-3-1	User can add the item's name.	Should	0.5	MVP	Done
		1-3-2	App can store the item's name.	Must	0.5	MVP	Done
1-4	As a user I want the app to tell me if my inputs are correct automatically, so that I don't need to revise them.	1-4-1	App should validate the item inputs.	Should	0.5	Final	Done
1-5	As a user I want to know app can actually detect the tracker, so that I will feel safer that it actually works.	1-5-1	App should send a request to register Tracker.	Must	1	MVP	Todo
		1-5-2	Tracker should receive request and register App.	Must	1	MVP	Todo
		1-5-3	App should be able to store Tracker data.	Must	0.5	MVP	Done
		1-5-4	App should activate Tracker and make it send the location to App.	Must	0.5	MVP	Todo
2	Monitor Tracker: App listens to the signal of Tracker			Total Dev Days	22	Completion Rates	0.00%
2-1	As a user I want the app to track the item's location all the time, so that I have a record of its location once it's lost.	2-1-1	App listens for signal at regular intervals.	Must	3	MVP	Todo
		2-1-2	Tracker send position data to App at regular intervals.	Must	3	MVP	Todo
		2-1-3	App saves the history of the position of Tracker at regular intervals.	Must	1	MVP	Todo
		2-1-4	App should be able to upload the history of the Tracker's position to server at regular intervals.	Must	1	MVP	Todo
2-2	As a user I want the tracker to send the accurate location data to app, so that I can find it easily if it's correct..	2-2-1	Tracker uses bluetooth mode while close to User.	Must	7	Final	Todo
		2-2-2	Tracker uses cellular mode while is far from User.	Must	7	Final	Todo
3	Track Item: User uses App to see the tracking list and track Item.			Total Dev Days	29.5	Completion Rates	50.00%
3-1	As a user I want to view the tracking item list, so that I can view my item and look up more detail if I want.	3-1-1	Item list user interface should be simple, clear and easy to navigate.	Must	2	MVP	Done
		3-1-2	App should get item data from mobile database	Must	1	MVP	Done
		3-1-3	App should fetch latest locations of all the tracking items when User visit item list page.	Should	1	MVP	Todo
		3-1-4	App should display if any of Items is lost clearly.	Must	2	MVP	In Progress
3-2	As a user I want to activate or deactivate Tracker, so that I can save my mobile and the tracker's batteries.	3-2-1	User should be able to activate/deactivate Tracker to stop tracking.	Should	2	Final	Todo
3-3	As a user I want to see the location history in a map format of the item, so that I can track/look for it if it's lost.	3-3-1	Item history user interface should be simple, clear and easy to navigate.	Must	2	MVP	Done
		3-3-2	User should be able to navigate to from item list to the item history.	Must	0.5	MVP	Deprecated
		3-3-3	App should display the Item and User's location in a map format.	Should	4	Final	Done
		3-3-4	User should be able to see Item's location on the map in at different time.	Should	2	Final	Done
3-4	As a user I want to navigate me to my item, so that find it quicker.	3-4-1	App should link to Apple Map to navigate User to Item's last location.	Should	3	Final	Done
		3-4-2	App should link to Google Map App to navigate User to Item's last location.	Should	1	Final	Todo
		3-4-3	App could point in direction of item using a compass and distance in meters for close range situations in which the item isn't clearly visible.	Could	2	Final	Todo
3-5	As a user I want to edit my item detail, so that I can change the tracking item.	3-5-1	User can rename item.	Should	1	Final	Done
		3-5-2	User can retake the photo of the item.	Should	1	Final	Done
3-6	As a user I want to delete the item, so that I can stop tracking the item for good.	3-6-1	User can delete the item.	Should	1	Final	Todo
		3-6-2	App should delete all the data related to the item.	Should	2	Final	Todo
		3-6-3	App should deactivate the Tracker.	Should	2	Final	Todo

User Story ID	User Story	Backlogs					
		Backlog ID	Acceptance Criteria	Priority	Dev Days	Phase	Process
4	Notification: User should receive notification if the item is lost			Total Dev Days	4	Completion Rates	0.00%
4-1	As a user I want to get notification if the item is far from me, so that I can retrieve before it's taken by someone else.	4-1-1	App should activate the OS notification function while it detects Item is too far.	Must	3	MVP	Todo
		4-1-2	Notification should be able to link to App.	Should	1	Final	Todo
5	Onboarding: User registers/logins a password for logging the app			Total Dev Days	14.5	Completion Rates	88.89%
5-1	As a user I want to set password for the app, so that others can't see where's my item.	5-1-1	Password register user interface should be simple, clear and easy to navigate.	Must	2	MVP	Done
		5-1-2	User can register 4-digit password in App	Should	3	Final	Done
		5-1-3	User can use Touch-ID as login method.	Should	1	Final	Done
5-2	As a user I want to reset my password, so that I can prevent if someone has seen my password.	5-2-1	Setting page user interface should be simple, clear and easy to navigate.	Must	1	MVP	Done
		5-2-2	User should be able to reset the password in Setting page.	Should	3	Final	Done
5-3	As a user I want to turn off password, so that I can login quicker.	5-3-1	User can turn off password protecting feature in Setting page.	Should	1	Final	Todo
5-4	As a user I want to access the app, so that I can use it.	5-5-1	User can use 4-digit or Touch-ID as input to login.	Should	2	Final	Done
		5-5-2	App prevents User from accessing App if the login authentication fail.	Should	0.5	Final	Done
		5-5-3	App redirect to item list if the login authentication succeed.	Should	1	Final	Done
6	Physical Tracker			Total Dev Days	13	Completion Rates	0.00%
6.1	As a user I want to make sure that the actual hardware is working as expected	6-1-1	User should be able to switch on and off the tracker	Must	1	Final	Todo
		6-1-2	The tracker must always work when is switch on	Must	1	Final	Todo
		6-1-3	The tracker should locate itself and send the location in the Amazon Cloud Server	Must	1	Final	Todo
6.2	As a user I want that the battery to last enough long	6-2-1	The battery should to last for at least one day	Should	1	Final	Todo
		6-2-2	User should be able to charge the battery	Should	2	Final	Todo
		6-2-3	Users should be able to change the battery if it broke	Should	2	Final	Todo
6.3	As a user I want that my tracker does not brake if I drop it.	6-3-1	The case should be enough resisten to not brake on first drop	Should	2	Final	Todo
		6-3-2	The case architecture should be made with harmless in mind	Should	3	Final	Todo
7	Data Security			Total Dev Days	3	Completion Rates	0.00%
7.1	As a user I want that sensitive data is kept restricted to authorized to access it.	7-1-1	Specify which data produced by the system is to be considered sensitive	Should	3	Final	Todo

A.2 Architecture Decision Records

A.2.1 Mobile Development

Column	Description
Title	Which mobile OS to work on the mobile application
Context
Decision	...
Status	...
Consequences	...

Table 6: ADR Mobile Application Development

A.2.2 iOS Development

Column	Description
Title	Which language to used for developing iOS mobile application
Context
Decision	...
Status	...
Consequences	...

Table 7: ADR iOS Application Development

A.2.3 Android Application Development

Column	Description
Title	...
Context
Decision	...
Status	...
Consequences	...

Table 8: ADR Android Application Development

A.2.4 Tracker Development

Column	Description
Title	...
Context
Decision	...
Status	...
Consequences	...

Table 9: ADR Tracker Development

A.2.5 Build a customised server

Column	Description
Title	...
Context
Decision	...
Status	...
Consequences	...

Table 10: ADR Customised Server

A.2.6 Transfer iOS Development from Swift to React Native

Column	Description
Title	...
Context
Decision	...
Status	...
Consequences	...

Table 11: ADR Transfer iOS Development from Swift to React Native

A.3 Tasks Divided

A.4 Progress Tracking Form

WBS Code	Date	Status	Resource Name (Hours)						
			Chin	Dylan	Marian	Mifud	Hussein	Thairan	Jheng-Hao
1-1	19/10/2017	Brainstormed and decided the subject topic.	1	1	1	1	1		1
1-2	22/10/2017	Planned and scheduled tasks and redesigned progress tracking form							3.5
1-3	23/10/2017	Built online survey - refined and ready to deploy		3	0.5		4		
1-3	23/10/2017	Deployed online survey, collecting data		3	3	1	1		
1-2	23/10/2017	Read references and drafted first persona							1.5
1-2	24/10/2017	Drafted the second and third of personas							0.5
4-2	24/10/2017	Lab session	1			1			1
2-1	24/10/2017	Drafted the user scenarios							0.75
2-2	24/10/2017	Competing Products (Market Research)				3			
2-1	25/10/2017	Improved the user scenarios and drew the use case diagram.							1.5
2-1	25/10/2017	Drew the diagrams.							2.75
2-4	26/10/2017	Regulation and Standards							2
2-3	26/10/2017	Academic Research							1.5
2-10	26/10/2017	Integrate all the reports together							1.5
1-2	26/10/2017	Stakeholders Report						2.5	
4-3	27/10/2017	Meeting with supervisor		0.5	0.5	0.5	0.5	0.5	0.5
4-4	29/10/2017	Recorded meeting notes							0.25
2-7	29/10/2017	Emailed Pete to ask for a meetup							0.5
2-7	29/10/2017	Research on Hardware to use for the sensors		2	1				
2-7	29/10/2017	RFID and NFC research							1
2-7	30/10/2017	Schedule a meeting with Pete							0.25
4-2	31/10/2017	Lab session	1	1	1	1	1		1
2-7	31/10/2017	Meeting with Pete			1	1			1
2-7	31/10/2017	Estimote research					3		
2-10	31/10/2017	Product name survey					1		
4-1	31/10/2017	Divided and assigned the tasks			0.5	0.5			0.5
4-1	01/11/2017	Tracking tasks progress.							0.5
4-1	02/11/2017	Tracking tasks progress.							0.5
2-10	02/11/2017	Integrate all the reports together							0.5
2-5	02/11/2017	Search and select project management tool							1
4-3	03/11/2017	Meeting with supervisor		0.5		0.5	0.5	0.5	0.5
2-7	03/11/2017	Physical lab induction							2
2-6	09/11/2017	Conceptual Prototype Interviews							4
2-6	09/11/2017	Conceptual Prototype Report							1
4-1	09/11/2017	Set up Github Repository							0.5
4-1	10/11/2017	Move reports to Github Repository							2
4-2	14/11/2017	Lab session	1	1		1	1	1	1
2-7	14/11/2017	Prepare Arduino tutorial kits					2.5		
4-1	14/11/2017	Updated repository and readme							1
2-5	15/11/2017	Planning the project (Sub tasks, Major tasks and Milestones)						3.75	
4-3	17/11/2017	Meeting with supervisor			0.5	0.5	0.5		0.5
2-5	19/11/2017	Drew gantt chart and improved the project plan							3
2-7	20/11/2017	Required Training Project 0 and 1.		2	2.5	1			
2-9	20/11/2017	Project Prototype		2			12		
2-5	20/11/2017	Project Sequence Diagram							2
4-2	21/11/2017	Lab session	1	1	0.5		1	1	1
2-9	23/11/2017	Project Prototype Report			3		7		
2-1	23/11/2017	Technical Architecture Research							1
4-3	24/11/2017	Meeting with supervisor		0.5			0.3		0.5
4-2	28/11/2017	Lab session	1	1		1		1	1
2-10	28/11/2017	User Need Overview & Concept Introduction Draft		9.5					
2-7	29/11/2017	Arduino GPS						2.25	
2-1	29/11/2017	Architecture Diagrams							3
4-3	24/11/2017	Meeting with supervisor		0.5		0.5	0.5	0.5	0.5
4-1	02/12/2017	Updated github work flow & convention							1.25
2-7	03/12/2017	Arduino - RFID				3			
2-10	03/12/2017	Prepare presentation					0.4		1
4-2	05/12/2017	Lab session	1	1		1	1	1	1
-	05/12/2017	Resource request meeting		1.5		1.5	1.5	1.5	
2-10	05/12/2017	Final Proposal				1			2.5
4-3	08/12/2017	Meeting with supervisor		0.5		0.5	0.5		0.5
2-1	08/12/2017	Update use cases					3		3

WBS Code	Date	Status	Resource Name (Hours)						
			Chin	Dylan	Marian	Mifud	Hussein	Thairan	Jheng-Hao
2-10	09/12/2017	Evaluation Plan - Proposal	3.5						
2-10	09/12/2017	Proposal structural research		2					
2-10	09/12/2017	Final Proposal							4.5
2-7	09/12/2017	Estimate research			3				
2-10	10/12/2017	Final Proposal	3						6.5
2-10	10/12/2017	Final Proposal				6			
2-10	11/12/2017	Proposal reviews	1	1					
2-10	12/12/2017	Final Proposal		2	2			2	
4-2	12/12/2017	Lab session	1	1	1	1	1	1	
2-10	13/12/2017	Final Proposal	5	5	4	5		1.5	5
2-10	14/12/2017	Final Proposal	4	4		4	3		6
4-1	26/12/2017	Project cleanup					0.4		2
3-7	28/12/2017	iLost logo					2		2
-	28/12/2017	Computer fair prep - posters					9		5
3-7	31/12/2017	(ongoing) iLost app user interfaces redesign							7
3-9	01/01/2018	(ongoing) iLost app front-end development							9
-	08/01/2018	Computer fair prep - posters retouching							3
-	11/01/2018	Computer fair (severe travel issues)					2	2	2
3-9	12/01/2018	(ongoing) iLost back-end development					9		
4-1	15/01/2018	Set up back-end repo and team			0.2		0.3		
4-2	16/01/2018	Lab session	1	1	1	0.5	0.5	0.5	1
4-1	16/01/2018	Refactor project tasks and retouch use cases.							1.5
3-7	16/01/2018	(ongoing) iLost back-end development			2.75		5		
3-7	17/01/2018	iLost iOS app user interfaces design							5
3-8	18/01/2018	iLost back-end Set up with Rapsberry and Nova			3		2		
4-3	19/01/2018	Meeting with supervisor				0.3	0.3	0.3	0.3
4-1	22/01/2018	Write the user stories, backlogs and acceptance criteria.		0.5					2.5
-	23/01/2018	3D printing induction							3
4-2	23/01/2018	Lab session	1		1	1	1		
-	23/01/2018	Meeting with tech support			1		1		
4-1	23/01/2018	Setup Sprint structure							1.5
3-8	24/01/2018	Short-range development (puck.js)					9		
4-3	26/01/2018	Meeting with supervisor		1	1		1		1
3-8	26/01/2018	iLost long range					1.2		
3-8	26/01/2018	iOS app develop - add a new Item view							4.5
3-8	29/01/2018	iOS app develop - item list view							5.5
3-8	29/01/2018	iLost long range					8		
4-2	30/01/2018	Lab session		1	1	1	1	1	1
3-8	30/01/2018	Android app development - Welcome screens		4					
	30/01/2018				3				
	30/01/2018					2			
3-8	30/01/2018	app endpoint fixed					3		
3-8	30/01/2018	iOS app develop - item list view							3
3-8	31/01/2018	iOS app develop - item list view							3.5
3-8	31/01/2018	fixed ilost-long range					4		
3-8	01/02/2018	iOS app develop - item detail view							0.75
4-3	02/02/2018	Meeting with supervisor		0.5	0.5	0.5	0.5	0.5	0.5
3-8	02/02/2018	iOS app develop - item detail view & discuss extending user stories							2
3-8	02/02/2018	Android app development - Main activity navigation drawer		3		2			
3-8	04/02/2018	Android app development - Login screen lockpattern		4.5					
3-8	05/02/2018	Android app development - Learning android studio				1.5			
3-8	06/02/2018	Android app development - item list		2		1			
3-8	06/02/2018	update API & back-end script					2.5		
4-2	06/02/2018	Lab session		1	1	1	1	1	1
3-8	06/02/2018	iOS app develop - Amazon S3 API intergrate							4.5
3-8	07/02/2018	iOS app develop - Amazon S3 API intergrate							1
4-3	09/02/2018	Meeting with supervisor					0.5	0.5	0.5
3-8	07/02/2018	iOS app develop - Amazon S3 API intergrate							4.5
5-5	13/02/2018	Final Report ch4 plan					2		
3-8	15/02/2018	Android app - item list		2					
3-8	17/02/2018	Android app - itemlist screen development & testing		3		2			
3-8	20/02/2018	iOS app develop - item detail view, load location							4.5

WBS Code	Date	Status	Resource Name (Hours)						
			Chin	Dylan	Marian	Mifuad	Hussein	Thairan	Jheng-Hao
3-8	20/02/2018	Android app - tracking activity, google maps api implementation		2		1			
3-8	20/02/2018	iOS app develop - map api, data parsing							3
4-2	20/02/2018	Lab session		1	1		1	1	1
3-8	21/02/2018	Android app		4		2			
3-8	21/02/2018	Tracker - Intergrate raspberry pi zero			4				
3-8	21/02/2018	Tracker - Intergrate raspberry pi zero					4		
3-8	21/02/2018	iOS app develop - UI storyboard							4
5-5	27/02/2018	Final Report ch3 plan							2
5-3	28/02/2018	Make presentation slides							3
3-10	01/03/2018	Usability Tests: research							4
5-5	03/03/2018	Final Report section 1 plan		1					
3-8	03/03/2018	iOS app develop - Migrated to React Native							7
3-8	04/03/2018	iOS app develop - Authenticate Views							9
3-8	05/03/2018	Make the tracker demo case							2
3-8	05/03/2018	iOS app develop - add item view, edit item view, data storage management							5
5-3	06/03/2018	presentation script pt. 5				1.5			
5-5	06/03/2018	Final report conclusions structure/plan				2			
3-10	07/03/2018	Usability Tests: make cosent form, structure test record table, conduct tests							5
5-5	07/03/2018	Final presentation: update slides - test & evaluation and production pages.							1
3-8	08/03/2018	iOS app develop - bugs fixed, details in commit message							2
3-10	08/03/2018	Usability Tests: conduct tests							1
5-5	08/03/2018	Final presentation: update slides - test & evaluation and production pages.							2.15
5-5	08/03/2018	report structure/writing				3			
4-3	09/03/2018	Meeting with supervisor		0.5		0.5	0.5	0.5	0.5
5-5	14/03/2018	Final report: Formative Evaluation - mobile application test							4
5-5	14/03/2018	Final report: Development Record - Technology selection, agile development							4
5-5	13/03/2018	report writing/reading other points				3			

B Formative Evaluation

B.1 consent Form

Usability Test Consent Form

Please read and sign this form.

In this usability test:

- You will be asked to perform certain tasks on a provided mobile phone.
- We will also conduct an interview with you regarding the tasks you performed.

Participation in this usability study is voluntary. All information will remain strictly confidential. The descriptions and findings may be used to help improve the iLost Project.

However, at no time will your name or any other identification be used. You can withdraw your consent to the experiment and stop participation at any time.

If you have any questions after today, please contact Jheng-Hao Lin at jlin015@gold.ac.uk

I have read and understood the information on this form and had all of my questions answered

Subject's Signature

Date

Thank you!

We appreciate your participation.

C Design and Implementation

D Quality Assurance