Informatics Project Proposal:
Hunted... with GPS

Kun Zhang

s1646851

s1646851@sms.ed.ac.uk

Abstract:

Young people from Scouts and/or Duke of Edinburgh (DoE) award scheme routinely uses paper maps from Ordnance Survey to plan and execute remote multi-day expeditions across Scotland and elsewhere in the UK. This project aims to build an open source online planning and training system and design a hunted style game to help young people to learn navigation skills and have fun.

I. Motivation

Every year, thousands of young people take part in an expedition as part of their Duke of Edinburgh's (DoE) Award and/or Scouts activities. They push themselves to leave their comfort zone, enjoy the great outdoors and get a try of an expedition. This remote multi-day expedition allows young people to use paper maps from Ordnance Survey and compass to plan and execute. These activities can achieve many goals, such as having fun, making friends, pushing themselves out of their comfort zone, raising money for charity. However, the most important purposes which we focus on is to learn, train and practice navigation skills.

The development of online navigation applications based on GPS tracking system makes our life unprecedentedly convenient. For example, when people travel to an unfamiliar city, it is easy to use those applications to find destinations where we intend to go. however, the overuse of these automatic wayfinding applications may erode people's navigation skills (McKinlay, 2016). Therefore, training navigation skills becomes a very meaningful activity. Although training and practicing navigation skills with paper maps and compasses is an essential component of these activities, it is

traditionally recognized as a fairly boring activity. Hence, it is important to exploit tracking and communications technologies to make it more interactive and fun for the young people involved. An example is a hunted style game done in small teams with radio communications. There are some online tools helping plan purposes but nothing that really works that well and very little of them is integrated with logged GPS tracking. This project aims to research and develop a series of integrated online and mobile based tools and designs a hunted style game to help plan and learn how to use both the online and the paper-based systems effectively. To achieve this, we need to build several linked components, many of which already exist in some forms or another but many of them are in locked/closed environments and are not customizable.

II. An initial approach

As we discussed before, we are going to design a hunted style game. This game consists of three kinds of teams. Figure 1 gives an overview of them.

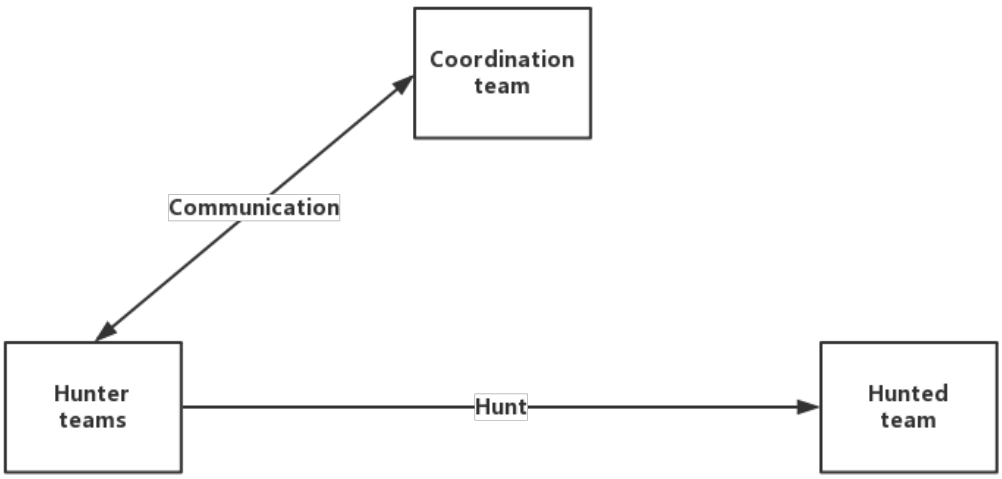

Figure 1: *An overview relationship between teams.*

First, there is a hunted team carrying a GPS tracker, paper maps and compasses with transmission functions. Hunted team will play a role of being hunted. The mission of this team is to decide the way on their own. Then, there are multiple hunter groups also with GPS trackers, paper maps, compasses and communications devices (e.g. radio) and a coordination team with an on-line map and access to the GPS signal who

can then direct and communicate with the hunters. The mission of the hunter teams is to discuss the hunting plan and camping site along with coordination team and other hunter teams until they catch the hunted team. They will use their paper maps and compasses to execute the discussed plan to achieve the purpose of training. Moreover, the coordination team can see the locations of both hunted team and hunter teams through an on-line map which is shown on figure 2. This team can make an overall hunting plan to manage hunter teams and communicate with them.

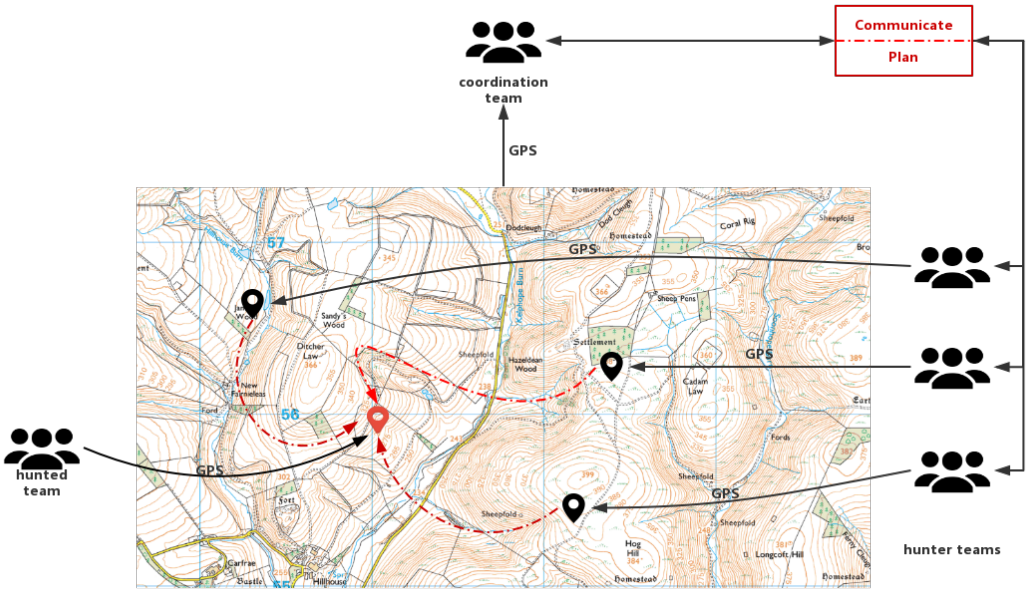

Figure 2: *An example of hunted game. In this example there are three hunter teams with a coordination team and a hunted team. In this map which can be seen by the coordination team, three black markers represent three hunter teams, and the red marker represents the hunted team. The red dotted line represents the proposed hunting plan.*

In order to achieve this game, we need to build a web server for planning and managing, and a mobile application for training and executing.

For the web server, what we need is that it can visualize the locations of hunted and hunter teams on an on-line map. For planning and managing, we need a marking waypoints tool which can mark multiple locations on the online map and display their location information, such as latitude, so that young people can view locations and then translate. Moreover, from a planning or management perspective, all routes need to be risk assessed. Some of these are hard rules dictated by the organizations who

run them, such as, maximum altitude allowed, maximum distance from a road or habitation. We want to be able to overlay maps with color coded regions as defined by these sorts of rules. The rules can be pre-defined and allowing the data to be calculated in advance then produce an overlay. In addition, we want to provide a safety measure for remote supervision. This system structure is presented in figure 3.

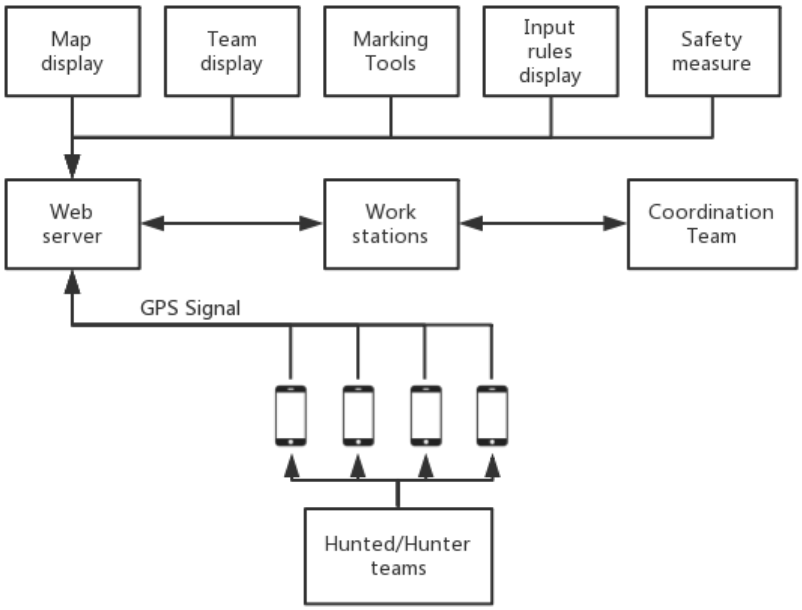

Figure 3: *There are five functions integrated on the web server which can collect location information and allow members of coordination team to use it through the work stations.*

The first function of web service is map display. As we know, both Scouts and DoE Award activities use the same paper maps which are provided by Ordnance Survey (OS). Moreover, OS map provides on-line map APIs, so that we can use them directly.

The second function is team display. We plan to design a real-time team location which sent from mobile devices display system.

The third function is marking tools for planning and management. This function should allow coordination team members to set markers on the on-line map.

Input rules display function should allow coordination team members enter the limiting conditions, such as maximum altitude allowed and maximum distance from a

road or habitation that described by organizers. Then the system should generate deploy the corresponding overlay which colored by limiting conditions onto the on-line maps. This overlay should be a not-allowed area of activities.

Considering safety measure function such as one team get lost and out of the allowed range, the system should report a danger signal for coordination team.

For mobile application base on iOS device, it should send location information to the web server in real time via the GPS function of the device. The program flow is presented in figure 4.

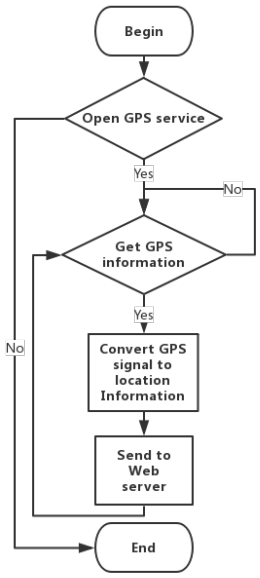

Figure 4: *The initial program execution process of iOS application.*

In terms of ethics, we will not log the identify of young people who use the application. Instead of that, we will ask them to register a code name to represent them on the map. The application will be also enhanced anonymity and confidentiality.

III. Background

There are already some tools for route planning that are web enabled. Both Ordnance Survey and DoE use the same route planning system. This provides a simple but reasonably effective tool for marking waypoints on the online versions of standard

maps that young people can view then translate. However, for a fully functional system, it is not enough. We want to expand the functionality either by developing a new system or extending the existing one (there is an API and open development environment). None of the mobile app (iOS) apps we use are exactly correct for the job. Many require expensive subscriptions. None of them plug into the Ordnance Survey maps system which defeats the learning objective. So, we decide to build this new open source project, so that it can be extended and reused.

IV. Methods

As part of this project we will implement a web server with functions described in the section II and graphical user interface. This system will be implemented in Python 3.6 (Python Core Team, 2018) and flask 0.12 toolkit which is described in detail by Grinberg (2018). Moreover, we will implement an iOS (Apple Inc.) application by swift 4 (Apple Inc.) with GPS API, and this application will be tested on Iphone 8 and Iphone X.

Map display: Leaflet 1.3.1 (Vladimir, 2018) is an open-source JavaScript library that can be used to display OS Maps API mapping. This will be the background map layer on our web page.

Team display: We are going to use marker function provided by Leaflet. And a specific variable which can collect location information sent by iOS devices. The position of team marker is determined by the corresponding location information, and the number of team markers is determined by the number of teams.

Marking tools: A function can monitor the mouse events and keyboard events from users. Also, it can set up and delete linked planning markers, and give comments on markers.

Input rules display: We are going to use circles and polygons functions which are provided by leaflet. We will create a rule module on the web page, which allows users to enter the rules from organizers. Furthermore, the circles or polygons drawn by the rules are entered by users. Then, this function can produce an overlay on the

background layer as the danger area.

Safety measure: We will implement a function which can monitor team markers. First, the function changes the color of team markers and reports a warning signal, if the corresponding team located inside the danger area which is provided by the Input rules display function. Second, it reports the lost signal, if the team display function cannot get the locations for half an hour.

iOS application: This application is based on iOS 11 and GPS usage privacy. The program flow is described in the previous section. In addition, we will create a loop that checks whether there is location information each half an hour, if not, it will send a lost message to the web server.

V. Evaluation

We will test our project in three stages: Initial stage, simulation stage, optimized stage.

Initial stage: First step is a self-test process. In this process we will use each function of our project and write a user manual and make sure the reusability of our test case. Second step is quality self-test project. In this respect, we will test the reliability of each function by ourselves and also make sure the reusability of our test case.

Simulation stage: We will use three iOS devices and go outside to do this simulation. One iOS device is used by the hunted group, three iOS devices are used by the hunter group. We make multiple simulation cases which are designed for test purpose and document them. We ensure the reliability of each test item, then find bugs through these cases and repair and verify.

Optimized stage: It is aimed to ensure traceability and monitor bugs. We predict product quality trends, such as forecast deviations, and achieve timely corrective design deviations. Then we can improve and adjust test case, correct design deviation and focus to ensure and improve project scalability maintainability.

VI. Outputs

An iOS application can send in GPS signals to a web service that can be logged anonymously and displayed as an overlay in the online OS maps system.

A web project can display the OS maps, display teams' locations as marker layers, display expedition area describe by the organizers, set up markers which can help coordination team make plans. In addition, a safety measure function can improve the level of security.

VII. Work plan and risk assessment

Milestone	Milestone Estimated Time of Completion
-Analyze the project and do literary review	-March 1st
-Define the problem and write research proposal	-April 19th
-Build iOS application and display OS maps	-June 10th
-Build each function	-July 15th
-Integrate functions	-July 15th
-Self-test project	-July 20th
-Design simulation cases	-July 20th
-Run simulations	-August 1st
-Gather results and adjust the program	-August 12th
-Complete dissertation paper	-August 26th

The risk assessment: In our project, the communication between iOS application and web server could be the riskiest part. For this part we plan to use HTTP (Fielding et al., 1999) network protocol because of the efficiency. However, HTTP is a 'short connection' which means it establishes the connection and closes the connection each time. Socket protocol (Leffler et al., 1983) can be maintained for a long time (several days or months) as long as the network continues, the program is not exited, and it can be programmed flexibly. So, we intend to use Socket protocol if the HTTP causes some unpredictable bugs after the simulations. We will have more than ten days adjustment period as planned for this and other unpredictable problems.

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