

Monitoring Outdoor WIFI Coverage using Drones

1. Purpose

IT Services always aims at providing a good WIFI signal coverage within the university for staff and students. With more and more mobile users, how to detect the WIFI signal strength and maintain a stable WIFI connection is one of the key challenges. More WIFI access points were planned and installed last year to help with the situation. However, to maintain the service quality, we still need to monitor the WIFI signal coverage effectively. In such context, the UOB Drone Forum proposed an experiment of using drones to monitor outdoor WIFI coverage.

2. Experiment Overview

In the experiment, an outdoor WIFI heat map of the main university campus was created. A WIFI heat map shows the real-time coverage and quality of a wireless infrastructure overlaid on a map. It gives an approximate location of the access point and the places where the users can find the best average signal. It can be used for diagnosing signal problems, adjusting wireless access point setting or location for maximum speed, signal quality and best coverage.

Planning of the experiment

In order to fly the drone over the campus, we followed the flying drones safety rules by the UK Civil Aviation Authority (CAA) and the Drone Code by Drone Safe. We selected a weekend when the university is relatively quiet and with fewer students on site. When taking off and landing the drones, make sure there are no people nearby. Observing the drone at all times and stay below 120m. Before flying, we also informed the security about when and where that the drone fly experiment was carried out.

Experiment Implementation

To do the experiment, we have used the following hardware and software:

- A quad-rotor platform (DJI Phantom 4);
- Android mobile phone – (other alternative? GPS module, wireless network adaptor with raspberry PI);
- Java, PHP, JavaScript and Google Maps' API;
- GIT repositories to store code and track changes.

The implementation includes the following steps:

1. Development of an application that records WiFi signal strength information from all access points nearby. This information is sent to an online server where it can be processed and analysed:
 - a. First prototype application has been implemented as an android application utilising the cell phone built-in hardware to for recording the WiFi signal strength;
 - b. Future versions may be implemented using low cost hardware or microcontrollers, e.g. raspberry PI or Arduino);
2. Construction of a back-end web application to receive, process, and analyse the WiFi signal information recorded using the android app;
3. Design and implement the web application front-end, consisting of a heatmap visualisation overlaid on top of the satellite map of the campus;
4. Integration and testing of the final system;
5. Execution of WiFi mapping experiments utilising a quad-rotor platform on campus.

Experiment Results

As the results of the experiment, using drones to monitor outdoor WIFI coverage could help us:

- Identify weak signal areas;
- Place new WIFI access points in better positions;
- Direct students to strong-signal regions using the interactive map.

Figure 1 shows the outdoor WIFI signal coverage in the university main campus, the red areas represent the strong signal area, while the blue areas represent the weak signal area.

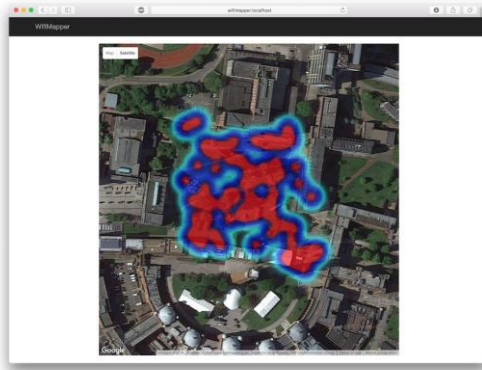


Figure 1 WIFI Heat Map

3. Findings

A SWOT analysis has been carried out to discuss the impact of using drones to monitor WIFI coverage in the university.

<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Precise path: drones can follow the defined path very precisely • Efficiency: drones can easily navigate the campus within a few minutes • Flexibility: it is easy to change when and where to detect the WIFI signal if necessary. 	<p style="text-align: center;">Weakness</p> <ul style="list-style-type: none"> • Need to comply with the safety rules of CAA and the drone code, which limits the time and place where drones can fly • The person who flies the drones will be best to be trained and certified.
<p style="text-align: center;">Opportunities</p> <p>Drones could be used in many other areas within the university:</p> <ul style="list-style-type: none"> • Academic research • Marketing • Estate management • Security • Aerial video shots in events 	<p style="text-align: center;">Threats</p> <ul style="list-style-type: none"> • Risk of accident if a drone falls • Public insurance for flying drones on the campus

Through the prototype of monitoring outdoor WIFI coverage using drones and the SWOT analysis, we find out:

- The experiment showed a proof of concept that could later be used to more precisely identify WIFI weak spots around campus, allowing the IT Team to provide better coverage in outdoor areas in the university.
- Furthermore, drones have lots of potential in many areas, including but not limited to using drones to do aerial shots to reduce cost in marketing, monitoring unreachable zones in estate management, low cost events footage, scanning campus premises for security and academic research. Using drones to monitor the outdoor WIFI coverage in the university is only one example.
- The experiment was the collaborative efforts of the UOB Drone Forum, we have been working as a virtual team on SharePoint and WhatsApp platform to exchange ideas and update the project progress. WhatsApp was used as a new approach to manage project agile and efficiently.