

Boston University
Electrical and Computer Engineering
EC 463 Senior Design Project

First Prototype Testing Plan
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Aerial 5G Network Modeling



Team 17

Team Members

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1.0 Project Details:

1.1 Our end goal is the creation of software that uses a machine learning model to predict 5G connection speeds at different altitudes and various conditions. We will be using the DJI Flame Wheel Drone for reaching specific altitudes, and a 5G connected phone for data collection and running network speed tests. The 5G phone will be attached to the drone for the collection process, and at altitude, the phone will complete the speed tests and record the data as a .csv file. With the received data, a python script will be used to visualize the data, and a machine learning model for predictions. We will be showing you our current progress and demonstrating our functional components.

2.0 Prototype Required Materials

2.1 Hardware:

- Phone with cellular connection
- DJI Flame Wheel Drone
 - F450 Frame Kit
 - 2312E 800KV Motors
 - 30A ESC Brushless Speed Controllers
 - 10 inch FPV 1045 Propeller
 - 2x 3000mAh LiPo battery
 - Flysky FS-i6X Transmitter



Figure 1: DJI Flame Wheel Drone

2.2 Software:

- Data collection
 - Ookla Speedtest application
 - Ookla SDK for testing automation
- Data display and management
 - Python3
 - Pandas
 - Plotly
 - Numpy
 - Scipy

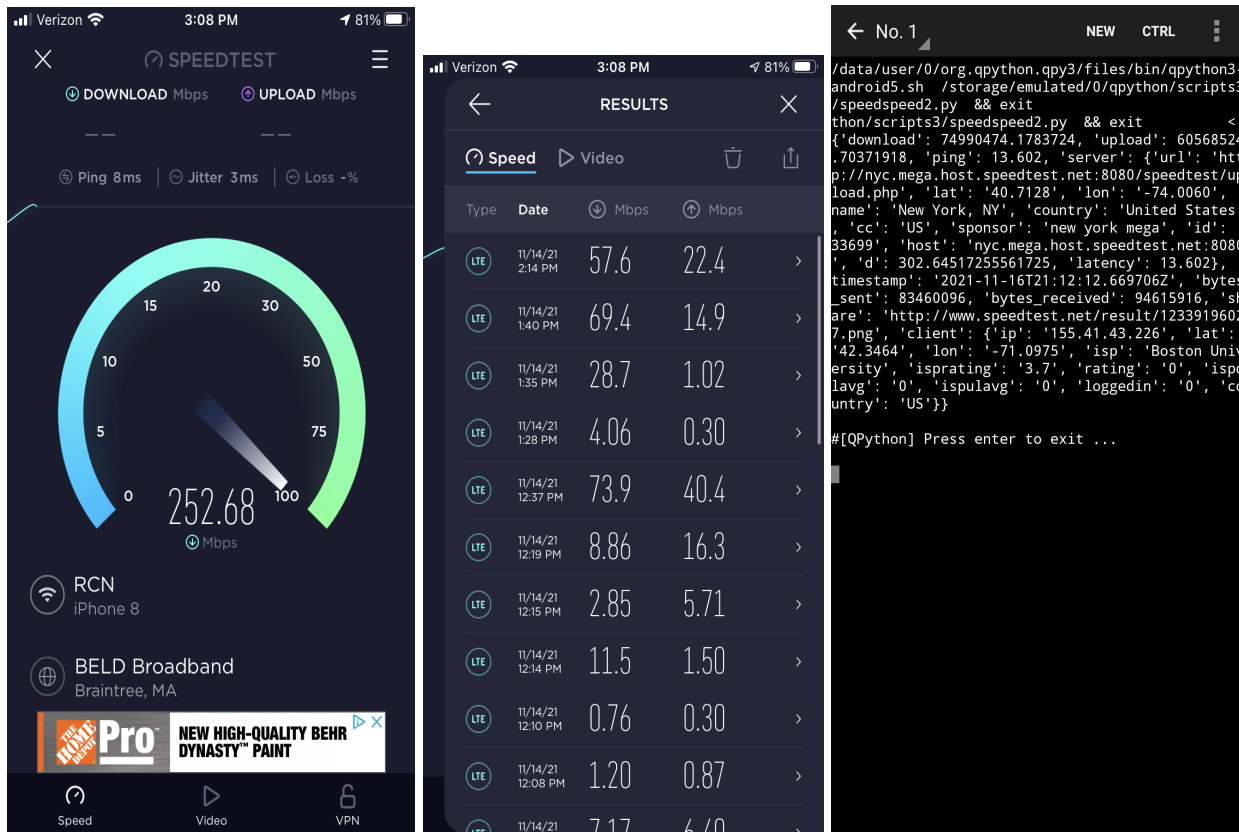


Figure 2: Ookla Speedtest Application

3.0 First Prototype Testing Outline

We will take you through the two sections to our demonstration, the data collection and the data visualization portions.

3.1 *Data collection* is first and is where we will run the Ookla speedtest to collect data to be used in the second step. We do not yet have our 5G device from our client yet so our personal phones will take its place in this demonstration. We will then send the data as a .csv file for use in our data visualization.

3.2 *Data visualization* is where our python script will take this data and create a visual representation of the data including testing locations and speed. You will be able to see the newly collected data as well as previous tests displayed. These will be shown with various colors representing the speed of tests at each location. Different maps show upload speeds, download speeds and latency. In the future we will use a similar method to display our predictive model's results based on 5G data.

```

import pandas
import plotly.express as px
data = pandas.read_csv("SpeedTestExport_20211116 (1).csv")

fig = px.scatter_mapbox(data, lat = "lat", lon = "lon", hover_name = "Date", hover_data = ["Download", "DownloadBytes", "Upload", "UploadBytes", "Latency", "ServerName", "ConnType", "ConnDetails"],
fig.update_layout(mapbox_style = "open-street-map")
fig.update_layout(margin = {"r":0,"t":0,"l":0,"b":0})
fig.show()

```

Figure 3. Code for mapping

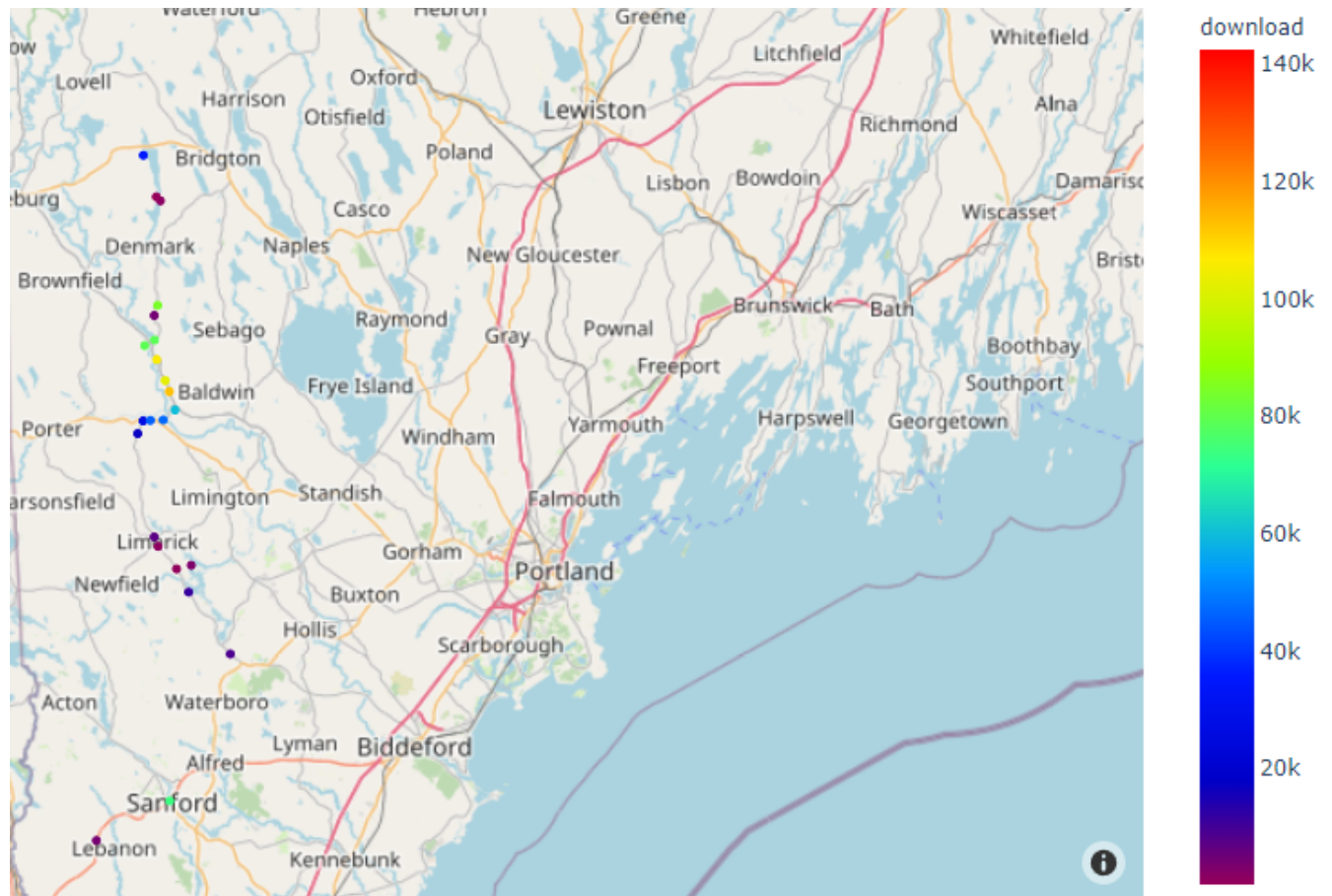


Figure 4. Example of mapping and scale

4.0 Pre-testing Procedure

Drone:

- I. Attach phone with 5G connection to the drone
- II. Open Ookla Speedtest App
- III. Turn on charged drone

5.0 Testing Procedure

5.1 Data collection:

- I. Fly drone to desired altitude and location
- II. Run Ookla Speedtest python script to automatically record to database
- III. Download data as .csv file

5.2 Data visualization:

- I. Input .csv file for use in python script
- II. Display mapped data

6.0 Measurable Criteria

6.1 Criteria for successful running and displaying:

Data is collected from Ookla speed test on phone

- Collection is repeatable and consistent

Data is exported to a .csv file

- File can be sent to team for use
- Data is properly formatted and labeled for python script

.csv file is opened and displayed for visual clarity of the user

- Map is scalable as amount of data increases
- There are multiple maps corresponding to different aspects of connection speed