ADVANCED WAYPOINTS ANALYTICS FOR AUTOMATED DRONES

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Abstract - *Currently drones are manually operated. Automating drones to calculate its own waypoints and shortest path is required for building smart drones. We have developed an algorithm which takes coordinates of grid as input, plots waypoints, finds shortest path and helps drones to take this path. It also has various machine learning algorithms for various applications.*

Key Words: **Waypoint, Shortest Path, Machine learning, Drones, Automation**

1. INTRODUCTION

A drone is a semi-autonomous aircraft that can be controlled and operated remotely by using a computer along with a radio-link. Commercially-available drones are increasingly been used in a variety of applications such as monitoring and surveillance, search and rescue operations, media coverage of public events, and aerial package delivery. However, with the growing popularity and use of drones for consumer applications, the number of incidents involving drones is also increasing dramatically. Ensuring a hazard-free, safe flight is also equally important for indoor applications. Autonomous drones has various applications such as disaster management, finding fire in forests, finding signal strength around a tower in telecom industry.

2. PLOTTING WAYPOINTS

Our model takes coordinates of grid as input. It plots a polygon with coordinates of grid as end points. It then takes centroid of polygon as initial point. Recursion is used to add all neighboring points which are inside polygon as waypoints.

Function plotWP:

Input: Initial Point, Distance between two waypoints

Output: List of waypoints in a grid

Algorithm:

1>For given point, check if all four neighbours at distance d are inside grid.

2> If yes, add this point to list and check for all for all four neighbouring points recursively.

3> If no, return.

Fig-1: Algorithm to plot way points

After plotting waypoints, our model uses Google API to get the altitude. Now all waypoints will have all three coordinates. Waypoints along with grid border are plotted on Google maps for better analysis.

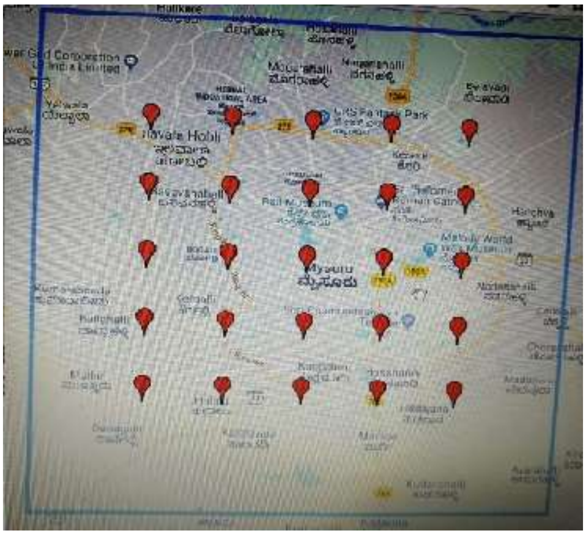

Fig-2: Waypoints plotted on map

In the above figure, blue polygon represents a grid. All red markers indicate the waypoints plotted by our model.

3. FINDING SHORTEST PATH

Once waypoints are plotted, shortest path covering all waypoints is found. We have used two Travelling Salesman Problem algorithms. One algorithm uses concepts of dynamic programming to find most optimal path. Another algorithm uses minimum spanning tree algorithm. Depending upon the processing capacity of drones, suitable algorithm is selected. DP algorithm gives most optimal path but time complexity is more. MST algorithm finds good path but time complexity is less. Here, Euclidean distance is used between waypoints. The following is the algorithm:

If size of S is 2, then S must be {1, i},
C(S, i) = dist(1, i)
Else if size of S is greater than 2.
C(S, i) = min { C(S-{i}, j) + dis(j, i)} where j belongs to S, j != i and j != 1.

After finding shortest path, the coordinates of shortest path is output to KML file which can be used by drones. Also this shortest path is plotted on Google map for better analysis.

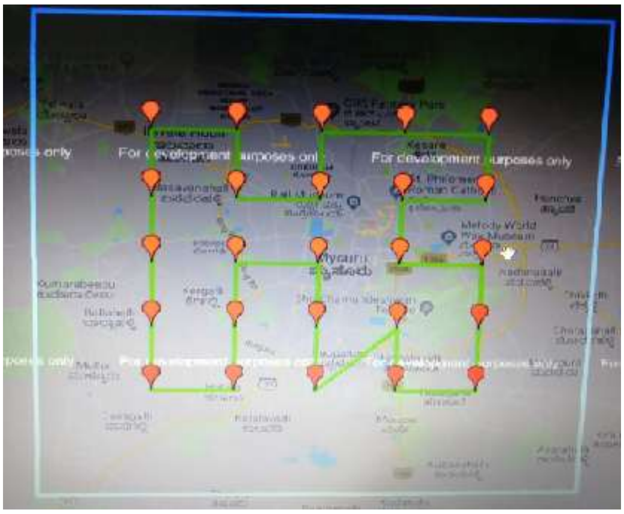

Fig-3: Shortest path plotted on map

In the above figure, blue polygon is the grid. Red markers indicate the waypoints plotted by our model. Green path connecting all waypoints is the shortest path calculated by our algorithm

4. GENRALISED ML ALGORITHMS

To make drones smart, we have included many machine learning algorithms in our model. The catch here is that efficiency of model varies with dataset. Since dataset varies according to applications of drone, a pre defined algorithm cannot be chosen. Depending upon the number of dependent variables, decision of using regression model or classification model is done. Simple linear regression, multiple linear regression, polynomial regression, decision tree and random forest are some of regression models used. All models will be applied and the one with least mean error will be chosen. This will predict the most accurate values. Prediction of signal strength around a base station in telecom industry is one of its application. Logistic regression, KNN classification, Naïve-Bayes model, support vector machine, kernel SVM, Decision tree and Random forest are the models used. Here, grid search is used to get the best parameters. After getting best parameters, 10-folds cross validation is used to pick out the most accurate model and that model is used. Diagnosis of problems in a tower is one of the application of classification models in telecom industry. This is coded in such a way that even if there is a need to add some more models, very less modification needs to be done.

5. CONCLUSION

Drones have many real life applications. They are used in disaster relief, archeology, law enforcement and crimes, aerial surveillance and also in military. Since current drones are controlled drones, they need input from user each second. Automation of drones removes that requirement. User needs to just give the coordinates of grid. The rest will be taken care by the drone itself. It will take care of plotting waypoints at specified distance, finding shortest path depending upon number of waypoints and performance capacity of the drone. It then gives the shortest path coordinates in a kml file to drone. Adding generalized machine learning models gives drone the ability to predict or classify based on given dataset. This improves the applications of drones. They can be used to predict signal strength, to diagnose problems in signal towers, find natural disasters. These algorithms makes drones more powerful.

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