Remote object localization using Android devices

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Background

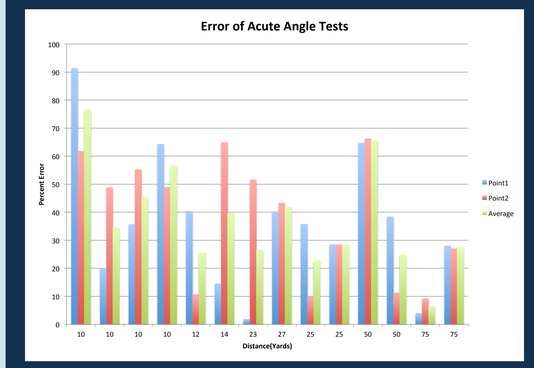
The capability to find the distance to a remote object as well as its location is one that has many practical applications. Android devices contain a wide range of sensors, including GPS and a digital compass. These can be utilized together to get the data necessary to calculate the object's location. Work has already been done on an image-based implementation of the localization issue. The purpose of this study was to test the feasibility of an angle based implementation in relation to the results obtained by the image-based method.

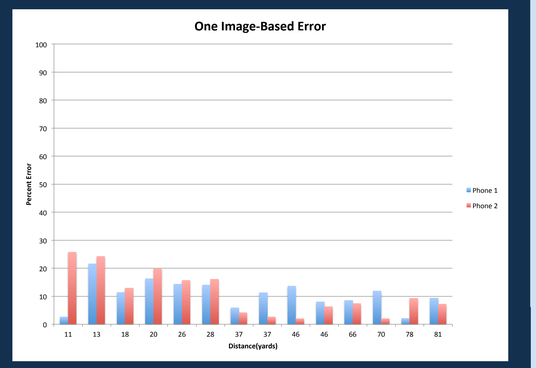
Implementation

The angle-based method for calculating a remote object's location requires two GPS locations as well as the bearing from those locations to the object. This data is obtained from the phone by requiring the user to point the phone toward the object and hitting a button so the phone can obtain the data. Then the user must move to another location and repeat the steps to get the second data set. A camera view is used to allow the user to more precisely point the phone to get a more accurate compass reading.

Method

Once the data is collected, the program changes the compass reading into Cartesian angles in order to properly use trigonometric equations. The equation m = tan(x), where x is the angle and m is the slope of the line that is created by the compass angle, is used to find the slope of both lines. Then these slopes are used with their corresponding GPS coordinates to get the equations of the lines. Finally, the intersection of the two lines is found, which is the location of the object.





Results

The results show that, although the angle-based method is much more accurate when the angle formed by the two lines at the object is acute rather than obtuse, the one image-based method is much more accurate overall. In angle-based, the average percent error for acute angles is 36 and 38 percent for points one and two compared to 68 and 154 percent for obtuse angles. In comparison, the image-based method has an average error of 10.96 percent.

Conclusion

Tests show that the one image-based method of object localization is much more accurate. It has the severe disadvantage of requiring the user to know the physical size of the object, which is not always possible. The angle-based method is not very precise, but in applications where pinpoint accuracy is not essential, it can provide a reasonable approximation of the object's location, given that the angle at the object is acute. Since each method has weaknesses in certain circumstances, the presence of both would be the most ideal for the greatest range of situations to best avoid their respective weaknesses.

Future Work

The next step in the development of the angle-based method is to add the functionality to share information between two phones to calculate the object's location. This will allow for a greater level of flexibility in its usage due to the ability for simultaneous data collection.

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