

ABSTRACT

In this research, we proposed A 3D modified trilateration with least square method algorithm using Wi-Fi RTT measurements. When there are sufficient access points present, this technique can reduce the square of the error and locate the best functional match of the data. But this localization algorithm required four access points (APs) to be non-coplanar. Although, this localization algorithm cannot be used in coplanar access points scenario. This paper focused on the coplanar problem of trilateration with least square method in three-dimensional (3D) space. A Modified 3D modified trilateration with least square method algorithm is used to determine the user's 3D position in the case of coplanar access points scenario. The proposed algorithm consists of two stages. In the first stage, the conventional trilateration with least square method equation was modified to obtain the 2D space (X-axis and Y-axis) of the user position. Then, in the second stage, the Pythagoras equation from 4 access points was used to obtain the 3D space (Z-axis) of the user position based on (X-axis and Y-axis) of the user position from the first stage. The simulations used public dataset to illustrate the positioning error of the proposed algorithm. Moreover, we compared the RMSE of the trilateration in geometry and our proposed modified trilateration algorithm with the least square method algorithm in order to evaluate the performance in coplanar APs scenario.

The simulation shown, the lowest RMSE of our proposed modified trilateration with least square method algorithm with 1.891 m are in scenario 7-12. And the highest RMSE of our proposed modified trilateration with least square method algorithm with 2.6784 m are in scenario 19-24. Meanwhile, the lowest RMSE of the trilateration in geometry algorithm with 1.9124 m are in scenario 6, 14, 23. And, the highest RMSE of the trilateration in geometry algorithm with 4.4764 m are in scenario 5, 8, 21. The simulation indicated that for our proposed modified trilateration with least square method algorithm, the higher the distance measurement error in the first order of AP, the higher the positioning accuracy and vice versa. And, for the trilateration in geometry algorithm, the higher the distance measurement error in the fourth order of AP, the higher the positioning accuracy and vice versa. Hence, if the order of APs was arranged correctly, especially the first and fourth order of AP based on algorithm used, then the performance might be improved even with the same range measurement

available that being used for positioning calculation. Therefore, the coplanar access points problem has been solved.

Keywords: Indoor Positioning System; Trilateration; Coplanar; Least Square.