International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

Indoor Navigation using Path Loss Model and Trilateration

Kokila B[1], C K Vanamala[2]

[1]*Student, MTech-Computer Network and Engineering, Department of IS&E, National Institute of Technology, Mysore, Karnataka, India*
[2]*Associate Professor, Department of IS&E, National Institute of Technology, Mysore, Karnataka, India*

ABSTRACT: *Location determination is the most prominent method to find location of the client. GPS is used to find location of outdoor but not suitable for indoor navigation. In this paper, Wi-Fi Positioning System is used to address indoor positioning of the devices.*

Key Words: Wi-Fi, RSSI, Trilateration, Access Point, Path-loss model.

1. INTRODUCTION

To find the indoor-positioning system researches are carried out and IEEE 802.11 WLAN (Wi-Fi) can be used to find Indoor positioning. Wi-Fi and Trilateration method is used to find the position of the client. And the database, "Indoor-positioning database" is used to collect the received signal strength indicator (**RSSI**) which help to find the distance from the Access point to the client.

2. RELATED WORK

In most of the paper they have used frequency division multiple access [1][2] and RSSI for finding distance [3][7][8][10]. We are using RSSI parameter to find distance using path-loss model and trilateration method to find the location of the client.

3. METHODOLOGY

Wi-Fi is the best solution for indoor navigation. The access point reads the RSSI value of the client which helps to find the location of the client. The exact location of the client can be find using Trilateration method.

Place the four Access points 10m apart in square format. Access point detect the clients by scanning the channel. Where detected client RSSI is feed into database. If client is detected from more than 2 or 3 AP's, then those values are passed into trilateration to find the exact location of the client.

3.1 Path-loss Model to find the distance

Path- loss model describe signal attenuation between the sending and receiving devices as a function of distance propagation and other parameters.

If there are no obstacles then Path-Loss of receiving signal is as follow,

$$PL_{rs}(d)=PL_{rs}(d_1)+10_n\log(d/d_1)+\alpha$$

Where, $PL_{rs}(d)$ is the path-loss of received signal from the measuring distance ; $PL_{rs}(d_1)$ is the path-loss of received signal from the reference distance say d_1, n indicated the path loss index and it indicate the speed of the path loss, which is increased along with increasing distance ; α is in dB, it is a cover factor.

"RSSI" is given by,

$$RSSI = P_{tp} - PL_{rs}(d)$$

where "P_{tp}" is the signal transmission power.

"B" indicated the signal strength which is received from reference nodes at the distance d_1.

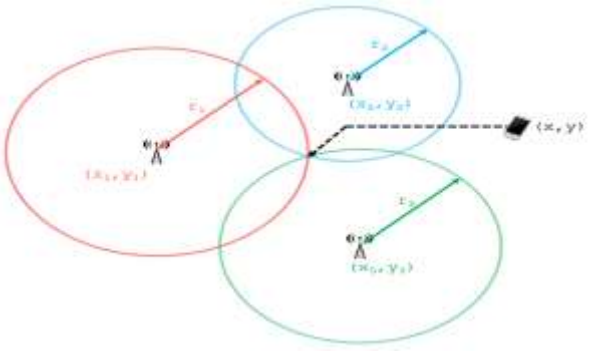
$$B = P_{tp} - PL_{rs}(d_1)$$

And "d" distance is given by,

$$d = 10^{(B\text{-}RSSI)/10n}$$

3.2 Trilateration

Triangulation is a method helps to find the location of the cell-phone using RSSI value radiated by the access point. Here, accurate results are obtained when we get readings from three different access points for the same cell phone.



In the above diagram each circle represents the distance to cell phone from the access point. The intersection of the three circle gives the position of the cell phone.

The following are the steps to calculate these (x,y) coordinates:

The equations for the circles are as follows:

$$(x-x_1)^2 + (y-y_1)^2 = r_1^2$$
$$(x-x_2)^2 + (y-y_2)^2 = r_2^2$$
$$(x-x_3)^2 + (y-y_3)^2 = r_3^2$$

Expand the equations:

$$x^2-2x_1x+x_1^2+y^2-2y_1y+y_1^2=r_1^2$$
$$x^2-2x_2x+x_2^2+y^2-2y_2y+y_2^2=r_2^2$$
$$x^2-2x_3x+x_3^2+y^2-2y_3y+y_3^2=r_3^2$$

Now subtract the above second equation from the first and third equation from the second

$$(-2x_1+2x_2)\,x+(-2y_1+2y_2)\,y=r_1^2-r_2^2-x_1^2+x_2^2-y_1^2+y_2^2$$

$$(-2x_2+2x_3)\,x+(-2y_2+2y_3)\,y=r_2^2-r_3^2-x_2^2+x_3^2-y_2^2+y_3^2$$

Rewrite these two equations using P, Q, R, S, T, U values.

$Px+Qy=R$

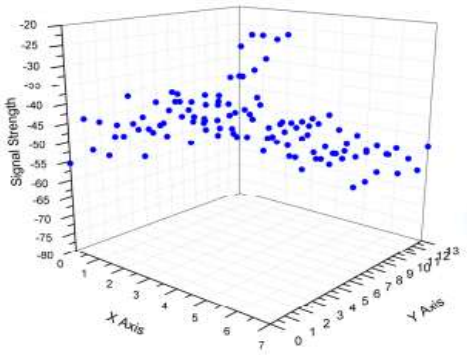
$Sx+Ty=U$

x and y value are as follow

$$x=\frac{RT-UQ}{TP-QS}$$

$$y=\frac{RS-PU}{QS-PT}$$

4. RESULT



In the above graph it shows the results of the client position based on the RSSI value using trilateration method.

5. CONCLUSION AND FUTURE WORK

In this paper we discussed about the detection of the client position in indoor-navigation using trilateration method and for distance calculation we used path-loss model. For further work we can consider the obstacles like building and walls to find the distance using path-loss model and can also use some other parameter to calculate the distance.

REFERENCES

[1]. Yuan Zhuang, Bruce Wright, et al., "Fast WiFi Access Point Localization and Autonomous Crowdsourcing", IEEE, UPINLBS-2014.

[2]. Zongpeng Pan, et al., "GLONASS Precise Point Positioning Considering the Influence of Code Inter-Frequency Biases", CPGPS 2017 Forum on Cooperative Positioning and Service-2017.

[3]. Bang Wu, Zixiang Ma, Stefan Poslad, Wei Zhang, "An Efficient Wireless Access Point Selection Algorithm for Location Determination Based on RSSI Interval Overlap Degree Determination" WTS 2018 1570425518-2018.

[4]. Yui Tanaka and Masaya Ohta, "A Two-Stage Method for Indoor WiFi Positioning Based on Bayesian Estimation",2018 IEEE 7th Global Conference on Consumer Electronics-2018.

[5].Dhanny Kurniawan Haryanto et al., "The Comparison Between Geo-magnetism and WiFi for Indoor Positioning System for Public Places",2018 International Conference on Robotics, Biomimetics, and Intelligent Computational Systems (Robionetics) Bandung, Indonesia, August 08-10, 2018

[6]. Konstantinos Poularakis, et al., "Joint Deployment and Pricing of Next-Generation WiFi Networks", IEEE TRANSACTIONS ON COMMUNICATIONS, VOL. 67, NO. 9, SEPTEMBER 2019.

[7]. JUSHANG SHEN et al., "On the Reliable Localization of WiFi Access Points", IEEE Access, Volume 7, pp. 90931-90941.2019

[8]. Wi-Fi Indoor Positioning System Based on RSSI Measurements from Wi-Fi Access Points – A Tri-lateration Approach

[9]. CSI-based Fingerprinting for Indoor Localization

[10] Indoor Fingerprint Positioning Based on Wi-Fi

[11]. Wi-Fi Fingerprint-Based Indoor Positioning: Recent Advances and Comparisons

[12]. Xufang Wang, et al., "A Novel Positioning System of Potential WiFi Hotspots for Software Defined WiFi Network Planning", 16th annual consumer communication and networking conference (CCNC).2019.