WIFI-BASED TECHNIQUE FOR INDOOR POSITIONING

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GPS and GLONASS are widely used in all areas of human activity. However, they have a drawback – the inability of positioning inside buildings.

Problem of finding placement in unknown building is one of the possible problems, which can be solved by indoor positioning. This problem is very actual for large shopping centers and airports. If the visitor needs to find a specific room in the building, frequently he has to be guided by a wall map. If the wall card is not present, than human-guide only can help. Electronic program-guide can help to solve this problem with displaying the current location and the shortest path.

This paper proposes a method of positioning an object based on WiFi within the university. The main advantage of the proposed method is working on the basis of an existing WiFi-network.

Figure 1 shows a situation when a device (Z) receives signals from the three access points: W1, W2 and W3. The device has coordinates (X0, Y0), the access point, respectively: (X1, Y1), (X2, Y2) and (X3, Y3). Distances from Z to each access point, respectively: L1, L2 and L3. A weighted centroid algorithm [1] can solve the problem geometrically. However, the positioning accuracy is not good enough when using this solution.

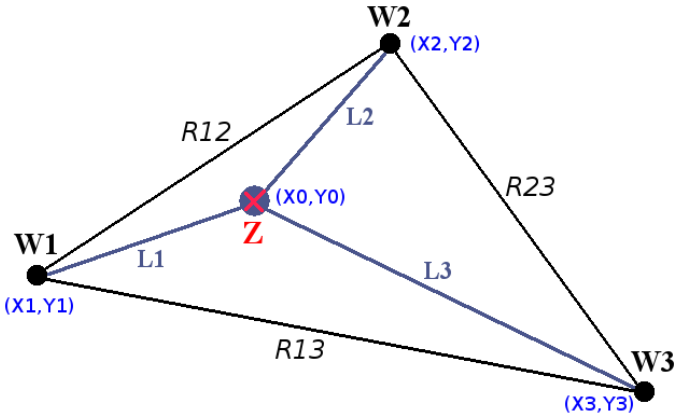

Fig.1. Positioning by three access points

The main provisions of local positioning method are divided into two stages. Preliminary stage is a training phase. After all, you must have a reference set of points with known coordinates for the calculation. It is necessary to obtain reference coordinates for each room. The important thing is that all the rooms were made in the same coordinate system.

It is necessary to obtain reference values of signals WiFi-points for each room during the preparation of the reference coordinates. Also, it must not be forgotten to drop unstable and low-level signals.

Further, it remains only to save information about the room in the database. This info must contain information about five most powerful signals for this concrete room. The number of stored access points may vary depending on the type of room. For example, a classroom can have a lot of visible access points. In this case, the filter must be strict. Gym usually have few access points. So you need to keep all the points in database for accurate positioning.

The main phase of the positioning process is described below.

1) The device eliminates the signal levels to identify the reference points.

2) Points with a low signal level is discarded. Next is verify how many access points have sufficient signal strength. This step is performed 3-5 times in a short time. The results, which are quite different from the others discarded as well. The remaining coordinates are averaged.

3) Coordinates are sent to the server according to the schedule of classes. The data is sent every 15 minutes during class. During the breaks – every 2-3 minutes. Dynamic time intervals are also supported by the system.

4) The server processes the data and determines the position of the object, with single room accuracy. Statistics are kept on the server for later use.

The weak point of the method is necessity to retrain the system in case of equipment reconfiguration. For example, a change in the type or location of access points, adding new points with a high level signal, and the like. Thus, correction information is required after each reconfiguration. In some cases this may be equivalent to the initial training of system. Solution to this problem was proposed in [2]. Author recommends to use system users for its training. Another solution is a so-called dynamic reference. In that case, the stationary device is added to each room. Further, the device sends to the server level of visible points of this particular room in real time.

The experiment was conducted at the Department of "Information Technology" at Pavel Sukhoi State Technical University of Gomel. Five access points have been installed. From 8.00 to 12.00 were carried out 33 measurements. Each measurement was sent to the web server. The resulting graph of time-position dependency can be seen in Figure 2.

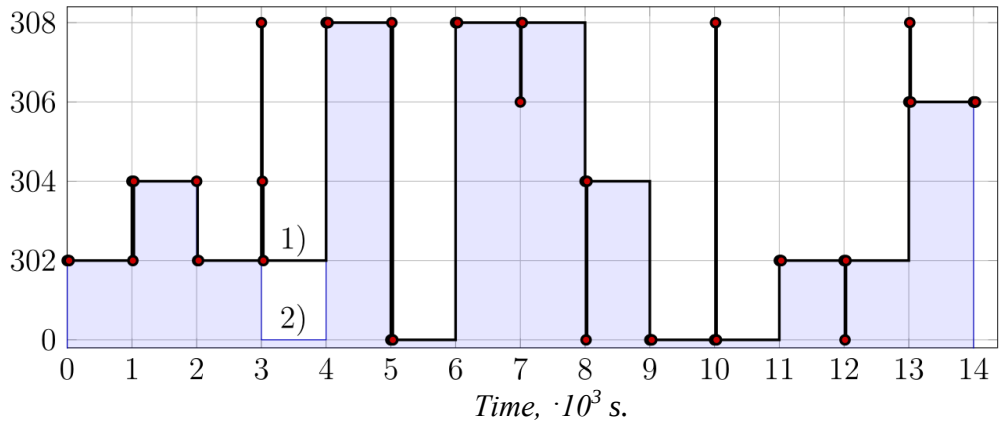

Fig.2. Time-position dependency: 1) Calculated position; 2) Actual Position

Y-axis in Figure 2 is the room in which is currently located positioned device. Code 0 corresponds to the corridor and other rooms, which are unknown. As can be seen, several consecutive measurements can significantly improve picture. At the beginning of the experiment, all three measurements coincide. Measurements on seconds 1000, 1015 and 1030 have the meanings respectively: 304, 302, 304. However, since the two measurements are the same, then the room is accepted value 304.

In this paper we propose a method of indoor positioning based on existing WiFi-network. Applying of this technique allows you to quickly obtain information on the status of a student or a teacher in high school (using the server software that collects statistics), as well as to automated accounting attendance for module-rating system.

References

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