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INDOOR POSITIONING USING MAGNETIC VARIATIONS

N. Subbulakshmi, Suhirtha M. A. and Karthick Nanmaran
Department of Computer Science & Engineering, SRM University, Chennai, India
E-Mail: nsubbulakshmi95@gmail.com

ABSTRACT

Indoor Positioning System (IPS) is one of the emerging technologies, such that locating the user's position in indoor environment using GPS has many obstacles by the indoor objects such as walls, pillars, glass doors etc. To overcome these obstacles indoor positioning system is used. This paper is about positioning the smart phone user inside the building in real time using smart phone sensors. The smart phone sensors used for the experiment were Magnetometer and pedometer, using these sensors the smart phone user can track his/her position inside the building. This can be achieved by calculating the magnetic field strength from the pillar that present inside the building The variation in the magnetic field is noted and it varies from each pillar in the building and this variation in the magnetic field helps the user to know his/her position inside the building as they walk through in the building.

Keywords: smartphone sensors magnetometer, indoor, magnetic field strength.

INTRODUCTION

Indoor positioning system is used to locate the person or objects inside the building. In recent days the trend in addressing indoor positioning is to make use of existing technologies [1]. As GPS and GNSS cannot support as well in indoor environment and so Indoor Positioning System (IPS) is been used [2]. Using IPS it is quite easy to show some accuracy of the signal variation in indoor environment. Various methods are used for positioning in indoor environment such as Wifi, Bluetooth, inertial sensors, etc [4].

The research work found in this paper was about positioning the smart phone user in the indoor environment using the smart phone sensors [3]. The sensors used were Magnetometer and Step Counter sensors .This paper allows the user to know his/ her position inside the building while walking through the building carrying the Android smart phone. This is an Application development project where the smart phone user using this App installed in the Android smart phone can track himself in indoor environment.

IMPLEMENTATION

This can be achieved through developing an Android application, such that the smart phone should have these inertial sensors inbuilt and using this application in the user smart phone it is used to locate the user where he is walking inside the building with respect to the magnetic variation in the building. The smart phone which can access these sensors are used for the experiment.

METHODOLOGY

The Methodology used were based on the Magnetometer values such as the magnetic field strength of each pillar inside the building is noted and this is used to find the magnetic variation in each floor such that the position of the user is been defined using the magnetic variation in each floor ,the magnetic field strength will show variation between higher values to the lower values such that when the user walks near the pillar it gives higher value and when he/she is far away from the pillar the value will be lesser. A fifteen stories building is been used for this experiment the floor map of each floor in the building is been mapped using magnetic mapping ,where each floor has pillar with average magnetic field strength and by finding the threshold frequency of each pillar in the floor positioning is been made. The smart phone user use the magnetic compass, magnetometer and the step counter sensor.

Magnetic compass

Magnetic Compass is used to find the direction of the user and the device, such that the user walking through the building with smart phone having this compass will direct the user in each floor in the building. The magnetic compass in the device will always faces in the North pole direction and the user starting position of the user in each floor can be defined by the user itself. To get heading direction heading = my bearing +(my bearing-heading).

To convert degree of true north (-180 to 180) into normal degree (0-360) = math.round(-heading/360-180)
To get direction current degree >=90 and <=145

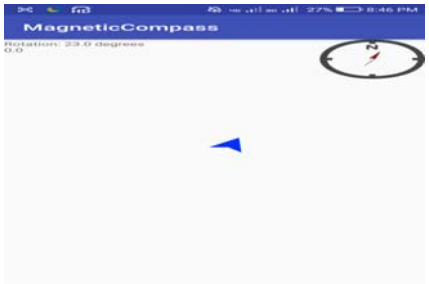

Figure-1. Magnetic compass.

Magnetometer

A Magnetometer is an instrument used to measure the strength and direction of the magnetic field. It measure the component of the magnetic field from the pillars in one particular direction.[7]. This is used to get the magnetic field strength value from the pillars that are

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present inside the building , each floor inside the building is been mapped and the pillars in each floor will have different magnetic field strength. To calculate the magnetic values do as follows:

magnetic values = $\sqrt{x^2 + y^2 + z^2}$

Step counter sensor

Step Counter sensor is used to find how many steps does the user takes every time, the new position of the user can be defined from the previous position. This sensor will allow the device to count the number of steps taken by the user everytime and the floormap of each floor is been mapped and using this step counter the user can estimate the new position from the previous position such that the distance between the previous position to the new position is been determined.

Distance = previous position +current position

Count=dynamic count-initial count

Experiment and results

With the step count estimation and the magnetic field strength values position of the user who walks through the building is been estimated. The user who carries the smart phone with this application will direct themselves inside the building such that he/she can estimate his/her position where they are moving. The floor layout of each floor in the building is been mapped and whenever the user is in that floor that floor layout will open and the starting position of the user can be fixed by the user by choosing the landmark in that floor and when the user starts to walk in the path way the magnetic field strength values which is been mapped will give the estimated Positioning such that when the user is nearby the pillar it will give maximum strength. The heading direction of the user is directed by the magnetic compass such that the user can also know that he/she moving in which direction.

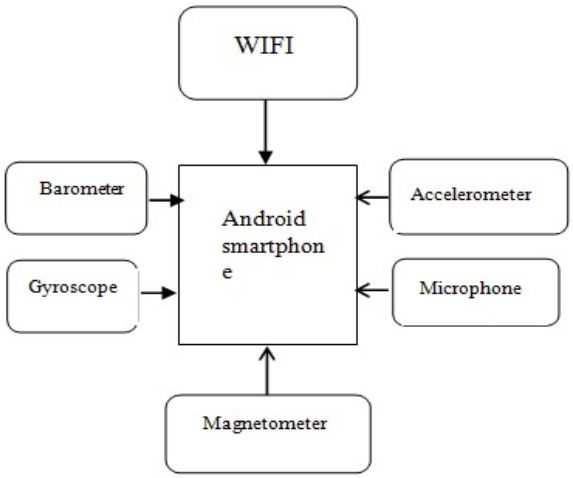
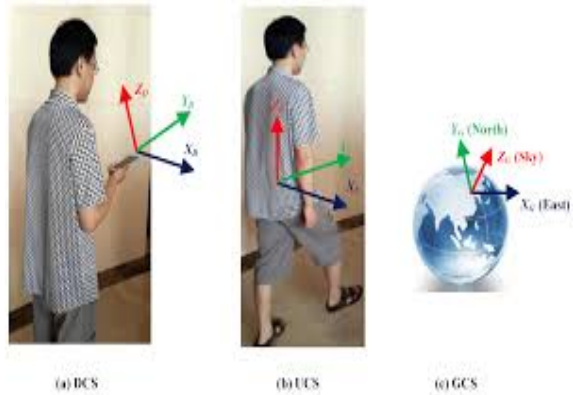
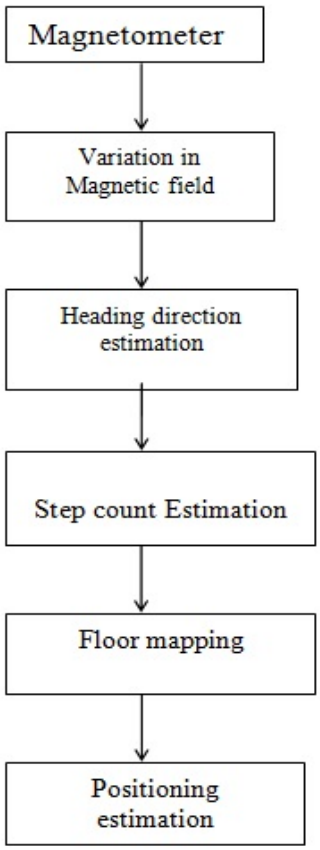


Figure-2. Sensors available in the smart phone.



Architecture



Result obtained

The result obtained is plotted in the graph such that magnetic field strength values with respect to the distance travelled by the smart phone user in each floor inside the building is been estimated and the screenshots image of the application is also added such that the positioning of the user in the floor with respect to the magnetic field variation is calculated.

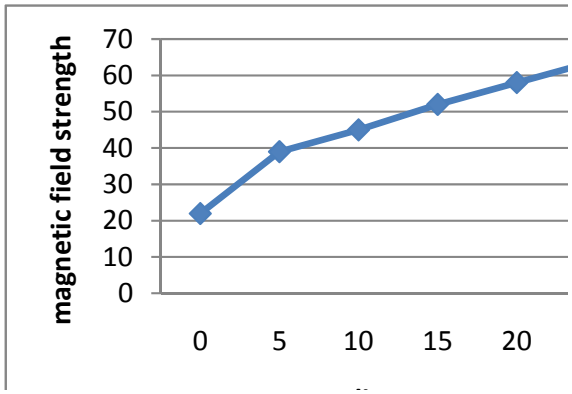
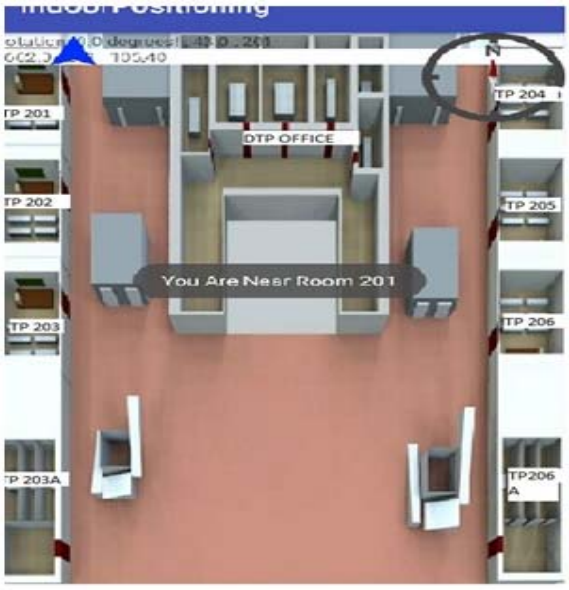


Figure-3. Magnetic field strength variation with distance.



CONCLUSIONS

The main objective of this research paper is to examine the level of accuracy that can be achieved in the indoor positioning using the Magnetometer sensor. Possible results are obtained in the research stage. The result obtained will show the estimated Positioning in real time The application developed was implemented in Android phone .It holds the database with fingerprint database for map structure takes the sample from the Magnetometer and step count sensor calculate and merge the coordinates, does the map matching and display the result on the phone screen and the estimated positioning of a smart phone user can be determined by the variation in the magnetic field.

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