International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 12 | Dec 2020 www.irjet.net p-ISSN: 2395-0072

INDOOR NAVIGATION ASSISTANCE SYSTEM FOR VISUALLY IMPAIRED PERSONS: A SURVEY

Akshay Sawant#1, Abhijeet Patil#2, Yash Shiwalkar#3, Dr. Sunil Chavan*4

#Student of Computer Engineering, Smt Indira Gandhi College of Engineering, Navi Mumbai, Maharashtra, India
**Principal of Smt. Indira Gandhi College of Engineering, Navi Mumbai, Maharashtra, India*

---***---

Abstract: *Although various solutions are suggested for indoor navigation systems, most methods require the support of external physical hardware infrastructure. Due to the increase in complexity and price of set-up of supporting hardware requirements, scalability will always be a problem with such systems. In this paper we analyze the different techniques for indoor navigation system to help visually impaired persons. Study the existing technology and various mapping methods comparing them for building an application.*

***Key Words*: Indoor Positioning, Indoor Navigation. Sensors, Android, Voice assistance, mapping.**

1. INTRODUCTION

We use an efficient thanks to estimate the stride length and use step sensor to count steps in distance measurement module. For orientation detection module, so as to induce optimal results of orientation, we then introduce Kalman filter to de-noise the information collected from different sensors. In the last module, we combine the information data from the previous modules and calculate the present location

There are lots of apps available for Navigation for outdoor environment, but in indoor navigation there are not much apps develop yet, one of the most important limitations for people with visual defects is that unable for navigation and orientation in unfamiliar buildings. So overcomes that problem we introduce A Low-cost indoor navigation system, which is based on Computer Vision and mobile's in-built Sensors. Sensors like Accelerometer, Magnetometer, Gyroscope are use for accurate positioning. Instead of using RFID, WIFi, Ultrasonic, Bluetooth-Beacon based Indoor navigation we creating an android application and for their working we use Android Phone's inbuilt sensors. Our focus on to the users which are facing issues in routing in indoors with minimum cost.

2. LITERATURE SURVEY:

Indoor Navigation means the flexible guidance of individuals in confusing, unknown buildings and building complexes. The user gets his own location through indoor navigation system displayed on a map on his own smart device. After selecting a destination or point of interests, a route to chosen destination is displayed on the map. The user's position in and around the building is permanently updated by indoor positioning, so that device always shows the current location on the route. Because the location is calculated on the user's device, this is often called client-side positioning. The so-called inertial sensors built into the Device as standard, as an example the gyroscope (rotation sensor), are also used for navigation. The result is a turn-by-turn indoor navigation.

[1] In this paper, low cost sensors like accelerometer and barometer used for position estimation. Accelerometer is Micro Electro Mechanical System (MEMS) and it is used to estimate the translational acceleration by which a body moves from one point to another. Barometer is directly associated with elevation so it's used as altimeter (measures in altitude). Barometer is used for height information. Barometer computes the atmosphere pressure. Atmosphere pressure and altitude are inversely related, if one increases the other decreases and vice versa. Indoor navigation databases are simple to maintain if any change is required. Moreover, everyone has smart device includes various sensors like accelerometer, barometer, Bluetooth, Zigbee and gyro sensor. Additionally, as smart devices already suffered from memory issues so there should be a technique where the computations takes place remotely. On other hand, a database stored and execute queries on a sensible device acquires more memory space and consume more battery power. Therefore, i-Location is proposed to beat memory issues where most of the computation and database maintained on server that minimizes the memory problems with smart devices

[2] Interests in such a positioning technology increase because many commercial mobile phones are equipped with these motion sensors thus are able to provide key information like: position, orientation and velocity of a moving object/user through direct measurements, also in indoor environment. The position estimation process is crucial in indoor application and the error can vary a lot depending on how the localization problem is faced. To further limit the positioning error in the previous system, we propose an improved combined approach, for reducing the positioning error during motion and location fixes.

[3] The fingerprinting approach determines a user's position by matching RSSI measurements with a fingerprint database in a deterministic or stochastic way. The k-nearest neighbors (KNN) method employs a deterministic approach to estimate a location [19,20], which is centroid of the k closest neighbors, in terms of the Euclidean distance between the online RSSI measurements and the RSSI measurements in the database

[4] Physical location is expressed in the form of coordinates, which identify a point on a 2-D/3-D map. The widely used coordinate systems are degree/minutes/seconds (DMS), degree decimal minutes, and universal transverse mercator (UTM) system. Symbolic location expresses a location during a natural-language way, like within the office, within the third-floor bedroom, etc. Absolute location uses a shared grid for all located objects. A relative location depends on its own reference frame. Relative location information is typically supported the proximity to known reference points or base stations.

[5] Wilkes, and Kawamura developed a localization system using the heading information of a magnetic sensor. Their system collected data information and compared to experimental headings to what they actually should have been. At each location, they used the heading error from the current data as well as that from nine previous data points to creates a distinctive signature that was then stored. Haverinen and Kemppainen used a very similar approach – equipping a robot with a single magnetic sensor measured in all three planes.

3. OBSERVATIONS:

3.1 EXISTING SYSTEM:

3.1.1 Wi-Fi-based positioning system (WPS)

Wi-Fi positioning system (WPS) is used where the GPS is insufficient. The localization technique used for navigation with wireless accessible points is determining and measuring the intensity of the received signal (*received signal strength* RSS) and also method of "fingerprinting". To increase the accuracy of fingerprinting methods, statistical post-processing techniques (like Gaussian process theory) are often applied, for the transformation of discrete set of "fingerprints" to a continuous distribution of RSSI of each access point over complete location. Typical parameters useful to geo-locate the Wi-Fi hotspot or wireless access point which includes the SSID and the MAC address of the access point. The accuracy depends on the amount of positions that are entered into the database. The possible signal fluctuations which will occur can increase errors and inaccuracies in the path of the user.

3.1.2 Bluetooth (Beacons) System

Bluetooth was concerned about proximity, not about exact location. Bluetooth wasn't intended to give a pinned location like GPS, however is called as a geo-fence solution which makes it an indoor proximity solution, not an indoor navigation solution. Micro mapping and indoor mapping has been linked to Bluetooth and Bluetooth BLE based Beacon introduced by Apple Inc.. Large-scale indoor navigation system supported i-Beacons has been implemented and applied in practice Bluetooth speaker position and main home networks are often used for broad references.

3.1.3 Choke point concepts

Simple concept of position indexing and presence reporting for tagged objects, uses known sensor identification only. This is usually the case with passive radio-frequency identification (RFID) / NFC systems, which don't report the signal strengths and various distances of single tags or of bulk of tags and don't renew any before known location coordinates of the sensor or current location of any tags. Operability of such approaches requires some narrow passage to stop from passing by out of range.

3.1.4 Positioning based on visual markers

A visual positioning system can determine the position of a camera-enabled mobile device by decoding position coordinates from visual markers. In such a system, markers are placed at specific locations in entire venue, each marker encoding that location's coordinates: latitude, longitude and height off the floor. Measuring the visual angle from the device to the marker enables the device to estimate its own location coordinates in regards to the marker. Coordinates include latitude, longitude, level and altitude off the floors of buildings

3.2 SYSTEM ARCHITECTURE:

These three layers are shown

3.2.1 View: The task of this layer is showing the related information to the user. The information has two main parts. The first one is map information, which includes the indoor map, the point of the user on the map and the path the user walked. The second part is digital information, which includes the total number of steps, the coordinates of the user and the distance the user walked.

3.2.2 Controller: This layer is used for accepting input and converts it to commands for the model or view-. In our application, it is used to monitor the sensors and for the communication between activities.

3.2.3 Model: We implement all logical parts in this layer, which includes stride length detection, heading (orientation) detection, Kalman filter and dead reckoning algorithm.

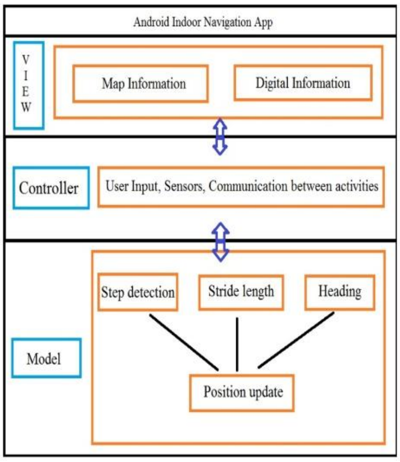

Fig 1: System Architecture

3.3 FUNCTIONAL ANALYSIS

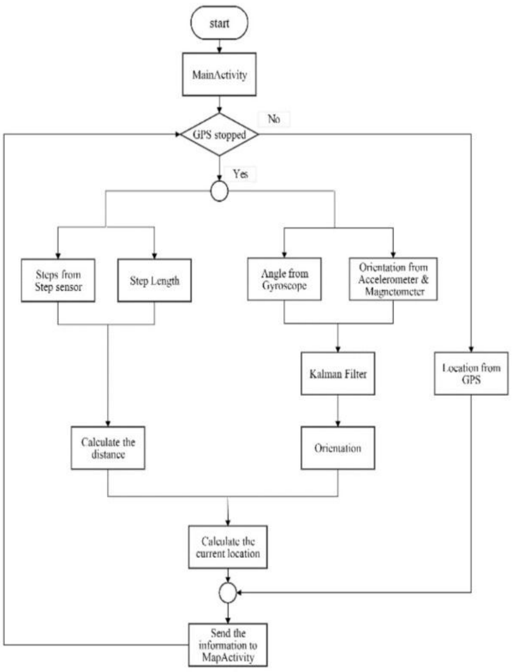

Fig 2: Functional Analysis Flowchart

In a navigation system, the information, abstract data reported by the IMU is fed into a processor which calculates attitude, velocity and position. A typical implementation mentioned to as a Strap down Inertial System integrates angular rate from the gyroscope to calculate angular position. This is fused with the gravity vector measured by the accelerometers during Kalman filter to estimate attitude. The attitude estimate is employed to transform acceleration measurements into an inertial frame of references (hence the term inertial navigation) where they're integrated once to urge linear velocity, and twice to get linear position

3.3.1 Gyroscope

3.3.1.1 Angular velocity sensing

Sense the quantity of angular velocity produced utilied in counting the quantity of motion itself

3.3.1.2 Angle sensing

Senses angular velocity produced by the sensor's own movement. Angles are detected using integration operations by a CPU.

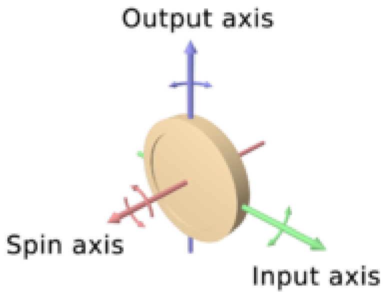

Fig 3: Gyroscope

3.3.1.3 Control Mechanism

Senses vibration produced by external factors, and transmits vibration data as electrical signals to a CPU. Used within correcting the orientation or balance of an object.

3.3.2 Accelerometer:

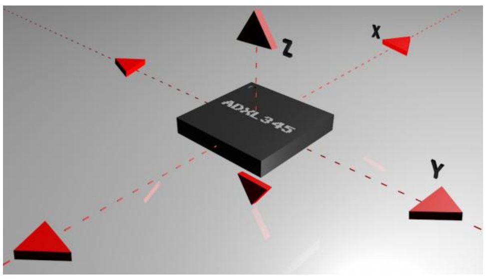

Fig 4 : Accelerometer

An inertial navigation system is a navigation aid that uses a computer and motion sensors (accelerometers) to continuously calculate via dead reckoning the position, orientation, and velocity (direction and speed of movement) of a moving object without the necessity for external references. Other terms wants to ask inertial navigation systems or closely related devices include inertial guidance system, inertial reference platform, and lots of other variations.

3.3.2 Step Sensor:

The step counter sensor would urge the entire number of steps taken by the user since the last reboot (power on) of the phone. When the phone is restarted, the worth of the step counter sensor is reset to zero. In the *onSensorChanged()* method, the number of steps is given by *event.value[0]*; although it's a float value, the fractional part is always zero. The event timestamp determines the time at which the last step was taken

3.3.3 Barometer:

The barometer assists the GPS chip inside the device to getting a faster lock by instantly delivering altitude data. Additionally, the barometer can be utilized to provide 'floors climbed' data to a phones 'health' app. With the advent of more accurate indoor navigation, the barometer can assist in determine what floor

3.3.4 Magnetometer:

The digital compass that's usually supported a sensor called the magnetometer and provides mobile phones with a simple orientation in reference to the Earth's magnetic flux. As a result, your phone always knows which way is North so it can auto rotate your digital maps looking on your physical orientation.

3.3.5 Augmented Reality

The highly accurate sensors detailed above, when combined with the powerful CPU and GPU's of recent smart phones, allow very realist and responsive Augment reality applications to be created. When the sensors are merged with a smartphone's camera they facilitate Augmented Reality applications.

3.4 INPUT-PROCESS-OUTPUT

3.4.1 INPUT:

1. Voice Commands

2. Mobile's inbuilt Sensors:

Accelerometer, Gyroscope, Magnetometer, GPS, Vision (Camera)**,** Map/ Blue-print of Place/ building

3.4.2 PROCESS:

Owner should upload the Blue-Print of Building/Place. Then owner ought to process on uploaded blue print. Selection of points of interest, path point is must for efficient navigation of user. Then User can download the blue-print through cloud database if it available on cloud. Give the command for destination through voice. App show the path to the destination Voice Assistance Navigate the user using Augmented Reality.

3.4.3 OUTPUT:

3.4.3.1 Voice Assistance

Assistance will gives the directions to the user through voice Assistance.

3.4.3.2 Location of Person:

The system maintain the position of user and update the user's current location which can show in navigation output of users screen

3.4.3.3 Road map and Destination Path:

Calculating the current location and destination location system show the shortest path to reach the destination.

3.5 ALGORITHM:

3.5.1 Step Detection:

To collect the step counts information, we directly use the step sensor to detect steps. This sensor is supported by Android. One of the most accurate pedometers available in a smartphone right now. We will get the steps data from step sensor easily and directly without using other sensor. The information we get from step sensor is the total steps, beginning when the smartphone boots. So, the number we would require is the amount of steps at the present point minus the amount of steps at the last point.

Stride Length Since the stride length will change while walking associated with the speed, we use acceleration to determine the stride length. In our work, we refer to, which shows that "As period of 1 step becomes shorter, a stride becomes larger, and the vertical impact becomes bigger as the walking speed increases". The equation represents the relation between measured acceleration and stride.

$$\text{stride(m)} = 0.98 * \sqrt[3]{\frac{\sum_{k=1}^{N} |A_k|}{N}}$$

3.5.2 Distance Calculation:

After collecting the steps and step length, we can easily calculate the distance that the pedestrian has walked during a period of time by following equation:

Distance = steps × stride length

3.5.3 Kalman Filter:

As stated above, we use Kalman filter to de-noise data and obtain the ultimate accurate orientation. The Kalman filter are often called an optimal recursive processing algorithm. It is a 30 way to estimate the optimal system state by using observation value and therefore the previous system state.

It's one among most widely used filtering methods. Kalman filter has five main equations.

This first equation is used to predict the present estimated state.

X(t|t-1) = A X(t-1|t-1) + B U(t)

The second equation is to estimate the covariance.

P(t|t-1) = A P(t-1|t-1) A' + Qk

third equation is to combine the estimate state and observed state.at time k.

X(t|t) = X(t|t-1) + Kg(t) (Z(t) - H X(t|t-1))

The last equation is to update the covariance of X(t|t) to make sure the system can still to work:

P(t|t) = (I-Kg(t) H) P(t|t-1)

4. CONCLUSION:

We analyze indoor navigation system and various technologies for Indoor navigation on android platform to makes people's lives more convenient. Our goal is to adopt a highly efficient indoor navigation system with high accuracy. For giving the good experience with minimum cost we are adopting the Sensor Fusion technology of inertial sensor of Android phone.

REFERENCES:

[1]https://www.researchgate.net/publication/334049305_Indoor_Positioning_and_Tracking_using_Sensors_of_a_Smart_Device/link/5d143cc1a6fdcc2462a91ec2/download
[2]https://www.researchgate.net/publication/334049305_Indoor_Positioning_and_Tracking_using_Sensors_of_a_Smart_Device

[3] https://doi.org/10.3390/s121217208

[4] http://www.pitt.edu/~dtipper/2011/Survey1.pdf

[5]https://www.media.mit.edu/speech/papers/2011/positioning.systems.pdf