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High-Precision Vehicle Navigation in Urban Environments Using an MEM's IMU and Single-Frequency GPS Receiver

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Abstract

The paper represents a navigation system which helps the pedestrian to locate his current position, when the well known technology like GPS used in navigational systems fail. and send the details through WiFi with which the details will be sent to an android phone.

Keywords: Micro controller, wifi, GPS, Digital compass, pedometer.

1. Introduction

GPS is a navigation system that provides instantaneous sub-meters accuracy position information for users worldwide. It is based on the multilateration principle where the user on the surface of the earth determines position using range information from multiple satellites. Because of its superior performance and capabilities, GPS is slated to be the primary means of navigation for all sectors. However, GPS is susceptible to electronic interference and jamming. A deliberate or unintentional low-power radio transmission in certain frequency bands can render GPS unusable in a large geographical area.

Dead reckoning is a form navigation whereby the current position of pedestrian is deduced by knowing speed and direction of travel since the last known position. The primary advantage of dead reckoning is that it relies on sensors contained within and, therefore, provides a navigation system that requires no interaction with the world outside. A self contained navigator such as this is desirable especially as a backup navigation system.

The controlling device of the whole system is a Microcontroller. The microcontroller continuously reads data from GPS (Global Positioning System) receiver and displays this information on LCD display unit. When the system is not able to read the data from GPS receiver, it automatically switches to the backup navigational system from the last stored GPS location. This back up navigational system has a Digital compass and Pedometer button which helps in locating the movement direction. Also the heading direction is shown through a LCD display

2. LITERATURE SURVEY

Technologies and resources

1) Integration of MEMS INS with GPS Using Kalman Filter

In the last few years, several researchers have investigated the MEMS INS/GPS integration using the Kalman filter. Salychev et al (2000) and Nayak (2000) applied a loosely coupled integration strategy to integrate the MotionPakTM MEMS IMU with pseudorange differential GPS (DGPS). Brown and Lu (2004) and Jaffe et al. (2004) developed Kalman filter-based MEMS INS/SPP GPS integrated navigation systems using tightly coupled integration strategy. Shin (2005) applied the unscented Kalman filter and extended Kalman filter for low-cost MEMS INS/DGPS integration. The above researches focused on evaluating the system performance under benign operational conditions such as open-sky environments and assessing the INS prediction accuracy during simulated GPS outages. The test results have demonstrated that the navigation performance degrades rapidly following loss of the GPS aiding data due to the large INS bias variation and noise. 5 Currently, Hide and Moore (2005) and

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Godha (2006) investigated the performance of the MEMS INS/DGPS integrated vehicular navigation systems in real life suburban/urban environments. Hide and Moore (2005) demonstrated that the horizontal position error within around 20 m using the tightly coupled integration of Crossbow AHRS400 MEMS IMU and DGPS is attainable when the system was tested in the city of Nottingham, UK where the surrounding buildings are generally only 3 to 4 stories tall. Godha (2006) demonstrated the similar performance obtained in downtown Calgary, Canada using the tightly coupled integration of Crista MEMS IMU and DGPS and 27-state INS filter with height and velocity constraints. However, the use of DGPS and tightly coupled integration scheme suggested by these two researches will increase the cost of system implementation and operation in real applications since it requires base stations, additional communication links and more powerful processors.

2) Optimization of INS and GPS Data Fusion

Another challenge to MEMS INS/GPS integration is to perform optimal and adaptive data fusion especially in signal-degraded environments so that the corrupted GPS data will not deteriorate the integration performance to a large extent. Several adaptive methods to optimize INS/GPS data fusion have been proposed in literatures. Karatsinides (1994) identified and rejected the unreasonable GPS data by formulating the measurement noise statistics dynamically based on the residuals between INS and GPS. Mohamed and Schwarz (1999) and Hide et al. (2003) applied adaptive Kalman filtering techniques for INS/GPS integration in benign environments. Swanson (1998), Sasiadek et al. (2000) and Loebis et al. (2003) used fuzzy-rule-based adaptation scheme to tune the data fusion gain (Kalman gain) based on the residuals between INS and GPS. Rahbari et al. (2005) developed an expert system to adaptively tune the measurement noise covariance of the Kalman filter for an INS/DGPS integration system according to the manoeuvring condition of the aircraft. These adaptive data fusion algorithms, however, are not designed for and tested by land vehicle navigation in signal-degraded environments. Currently, Salycheva (2004) applied innovation-based adaptive filtering techniques to integrate a tactical-grade IMU with high sensitivity GPS (HSGPS) for vehicular navigation in urban areas. The work on adaptive fusion of low-cost MEMS INS and GPS or HSGPS data in signal-degraded environments still needs to explore.

3. IMPLEMENTATION:

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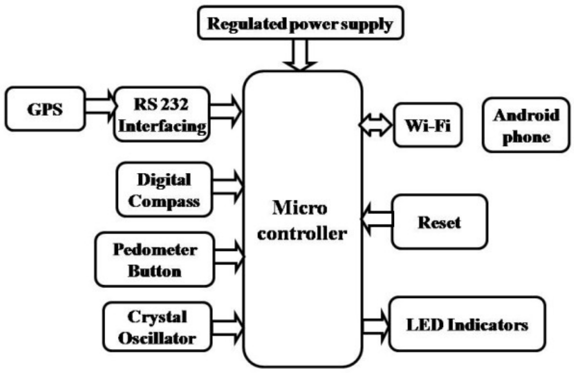


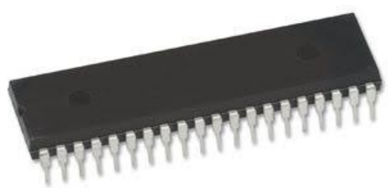
From the above figure, we can see that the device which is able to perform the task is a **micro controller**. There are different modules such as GPS, Digital compass, Pedometer. The location is sent to android phone through Wi-Fi. To perform this task, **Micro controller** is programmed using embedded 'c language'.

Wi-Fi (Short for **Wi**reless **Fi**delity) is a wireless technology that uses radio frequency to transmit data through the air.

4. RELATED WORK:

This system consists of 16f452 micro controller which is the main controlling part of the system. The module will receive the readings from the GPS and it can shows in mobile by using WiFi. The brief introduction of different modules used in this project is discussed below:

Micro controller (18f452):



The micro controller is the heart of the project and it takes location from the GPS, if fails of GPS by using Pedometer and digital compass shows the location of the person and send the location to the android mobile through the wifi module

GPS module

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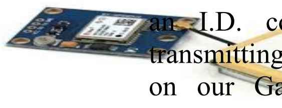


of information a pseudorandom code, ephemeris data and almanac data. The pseudorandom code is simply an I.D. code that identifies which satellite is transmitting information. We can view this number on our Garmin GPS unit's satellite page, as it identifies which satellites it's receiving.

Ephemeris data tells the GPS receiver where each GPS satellite should be at any time throughout the day. Each satellite transmits ephemeris data showing the orbital information for that satellite and for every other satellite in the system. Almanac data, which is constantly transmitted by each satellite, contains important information about the status of the satellite (healthy or unhealthy), current date and time. This part of the signal is essential for determining a position.

Description

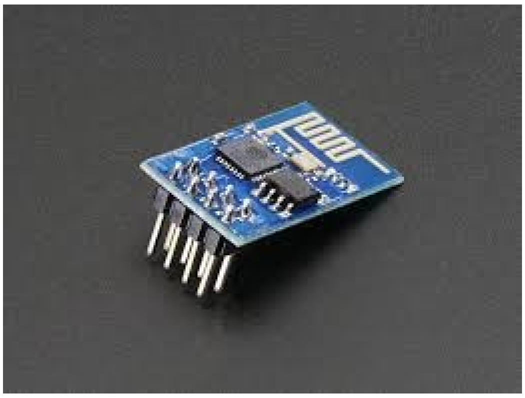
GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map. GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more.

The GPS satellite system:

The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are traveling at speeds of roughly 7,000 miles an hour.GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path. Here are some other interesting facts about the GPS satellites (also called NAVSTAR, the official U.S. Department of Defense name for GPS):

GPS satellites transmit two low power radio signals, designated L1 and L2. Civilian GPS uses the L1 frequency of 1575.42 MHz in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains.A GPS signal contains three different bits

WIFI MODULE:



Wi-Fi or WLAN as it is commonly known is fast becoming the preferred mode of connecting to the internet. Many people are not aware of the descriptions and explanations related to it. Wi-Fi gets its name from a certification called Wireless Fidelity given to networks operating under 802.11 standards. Wi-Fi allows computers, PDAs and other devices to connect to a broadband connection in a wireless mode. The 802.11 standard defines the wireless communication operating via electromagnetic waves. While reading the descriptions and explanations related to Wi-Fi, one should remember there are different modes for wireless networks like Infrastructure mode and Ad-Hoc mode that can be used for different criteria.

Pedometer(button):

This is pretty much how a pedometer works. Photo: Pedometers can measure your steps because

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your body swings from side to side as you walk. Each swing counts as one step. Multiplying the number of "swings" by the average length of your steps tells you how far you've gone. Modern pedometers work in a very similar way but are partly electronic. Open one up and you'll find a metal pendulum (a hammer with a weight on one end) wired into an electronic counting circuit by a thin spring. Normally the circuit is open and no electric current flows through it. As you take a step, the hammer swings across and touches a metal contact in the center, completing the circuit and allowing current to flow. The flow of current energizes the circuit and adds one to your step count. As you complete the step, the hammer swings back again (helped by the spring) and the circuit is broken, effectively resetting the pedometer ready for the next step. Counting steps with a pedometer sounds super-scientific, but you need to remember that it's only an approximate measurement. Not all your steps will be correctly counted and some false movements (jolts in the road as you ride in a car, for example) might be counted as steps too. Don't take the count too seriously; assume that it's in error by least 10 percent (the best electronic pedometers claim 5 percent accuracy).

For a pedometer to work correctly, you need to fix it to your waist—and not put it in your pocket—because a pedometer needs to detect the side-to-side tilting motion of your body to register each step correctly. Most devices come with a belt clip, making it reasonably easy to attach them properly. Some pedometers have a screw you can turn to alter the tension of the swinging pendulum-hammer inside them so it will register your steps correctly. If you're running, you might need to adjust it slightly differently compared to walking, for example, because your steps will likely be a different length.

Digital compass:

No matter where you stand on Earth, you can hold a compass in your hand and it will point toward the North Pole. What an unbelievably neat and amazing thing! Imagine that you are in the middle of the ocean, and you are looking all around you in every direction and all you can see is water, and it is overcast so you cannot see the sun... How in the world would you know which way to go unless you had a compass to tell you which way is "up"? Long before GPS satellites and other high-tech navigational aids, the compass gave humans an easy and inexpensive way to orient themselves.

But what makes a compass work the way it does? And why is it useful for detecting small magnetic fields, as we saw in How Electromagnets Work? In this article, we will answer all of these questions, and we'll also see how to create a compass from scratch!

A compass is an extremely simple device. A magnetic compass (as opposed to a gyroscopic compass) consists of a small, lightweight magnet balanced on a nearly frictionless pivot point. The magnet is generally called a needle. One end of the needle is often marked "N," for north, or colored in some way to indicate that it points toward north. On the surface, that's all there is to a compass.

Earth's Magnetic Field

The reason why a compass works is more interesting. It turns out that you can think of the Earth as having a gigantic bar magnet buried inside. In order for the north end of the compass to point toward the North Pole, you have to assume that the buried bar magnet has its south end at the North Pole, as shown in the diagram at the right. If you think of the world this way, then you can see that the normal "opposites attract" rule of magnets would cause the north end of the compass needle to point toward the south end of the buried bar magnet. So the compass points toward the North Pole.

To be completely accurate, the bar magnet does not run exactly along the Earth's rotational axis. It is skewed slightly off center. This skew is called the declination, and most good maps indicate what the declination is in different areas (since it changes a little depending on where you are on the planet).

The magnetic field of the Earth is fairly weak on the surface. After all, the planet Earth is almost 8,000 miles in diameter, so the magnetic field has to travel a long way to affect your compass. That is why a compass needs to have a lightweight magnet and a frictionless bearing. Otherwise, there just isn't enough strength in the Earth's magnetic field to turn the needle.

Magnetism

An electronic compass works by magneto-inductive technology, reading differences in the Earth's magnetic field. An electronic compass needs to be able to take clear readings. If it is installed near a large mass of metal, say a car, it needs to be able to subtract that reading from the reading it gets from the

Earth's magnetic field in order to get a truly accurate reading.

Deviations

Magnetic north and true north differ by an approximate angle of 11.5 degrees, which is called the variation angle. Hard iron and soft iron can also affect the readout of the compass. Hard iron is the result of permanent magnets, or magnetized metals like steel, while soft iron distortion comes from the reaction between the Earth's magnetic field and soft metals near the compass. Many electronic compasses can store the compensation for hard iron distortion in their memory.

4. ACKNOWLEDGEMENT

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REFERENCES

[1] J. A. Farrell, Aided Navigation: GPS with High Rate Sensors. McGraw Hill, 2008.

[2] J. Codol and A. Monin, "Improved triple difference GPS carrier phase for RTK-GPS positioning," in Statistical Signal Processing Workshop (SSP), 2011 IEEE. IEEE, 2011, pp. 61–64.

[3] J.-M. Codol, M. Poncelet, A. Monin, and M. Devy, "Safety robotic lawnmower with precise and low-cost L1-only RTK-GPS positioning," in Proceedings of IROS Workshop on Perception and Navigation for Autonomous Vehicles in Human Environment, San Francisco, California, USA, 2011.

[4] W. Hedgecock, M. Maroti, J. Sallai, P. Volgyesi, and A. Ledeczi, "High-accuracy differential tracking of low-cost GPS receivers," in ACM MobiSys, 2013.

[5] H. Strasdat, J. Montiel, and A. J. Davison, "Real-time monocular SLAM: Why filter?" in Robotics and Automation (ICRA), 2010 IEEE International Conference on. IEEE, 2010, pp. 2657–2664.

[6] H.-P. Chiu, S. Williams, F. Dellaert, S. Samarasekera, and R. Kumar, "Robust vision-aided navigation using sliding-window factor graphs," in ICRA, 2013.

[7] V. Indelman, S. Williams, M. Kaess, and F. Dellaert, "Factor graph based incremental smoothing in inertial navigation systems," in IEEE Information Fusion (FUSION), 2012, pp. 2154–2161.

[8] S. Zhao, Y. Chen, H. Zhang, and J. A. Farrell, "Differential GPS aided inertial navigation: a contemplative realtime approach," in IFAC World Congress, 2014.

[9] T. Takasu and A. Yasuda, "Development of the low-cost RTK-GPS receiver with an open source program package rtklib," in International Symposium on GPS/GNSS, International Convention Center Jeju, Korea, 2009.

[10] X.-W. Chang and T. Zhou, "MILES: MATLAB package for solving mixed integer least squares problems," GPS Solutions, vol. 11, no. 4, pp. 289–294, 2007