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3D Point Cloud Generation Using IMU for Indoor Positioning

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Abstract:

3D point clouds are graphs that show moving discrete objects in a 3 dimensional space as moving points. Such graphs are used in applications like defence and high security applications to keep track of moving objects or people. Earlier approaches of such applications were based on technologies like RFID which are limited in many aspects and practically useless in most applications. In this project a IMU along with wireless communication will be used for the same. An Inertial Measurement Unit (IMU) is a electronic device that includes up to 10 different measurements from various transducers to estimate the motion of an object in a 3D space. These measurements are then processed by a on-board processor that uses algorithms like EKF (extended kalmanfilters) to generate data that correspond to the motion of the object in 3D space. But without using a 3D plotting system the information from an IMU is practically useless for such applications. Hence in this project the raw data from an IMU is taken using a embedded system using SPI communication and the same is transmitted using a wireless link to a computer running a 3D plotting application to generate a point cloud of the moving object. Such point clouds are can be used for defence applications to keep track for soldiers in indoor warfare / outdoor ware fare. The same can also be used for high security prisons and even for many civil applications like keeping track for workers in underground mines etc.

1. Introduction

Our research is dedicated to the new innovation in tracking system. In our research we are introducing a new tracking system based on the electronic device called as Inertial Measurement Unit (IMU). IMU takes the 10 different measurements of the object under observation and then process it to the microcontroller. Microcontroller then further manipulates the measurements taken by the IMU. The main aim of this proposed system is to track the person or object inside the building where the GPS positioning system doesn't work effectively. We find the position of the moving indoor object with the help of Inertial Measurement Unit (IMU) which consists of several sensors inside it as given in the Figure 1 below. Indoor Positioning of the object using IMU has much advantage over RFID based indoor positioning system.

2. Existing System

- RFID based indoor positioning system.
- GPS based 2D outdoor positioning system.

3. Drawbacks of the Existing System

RFID based indoor positioning system comes with certain limitations and boundaries. Limitations like it doesn't have versatile uses like IMU based indoor positioning system. IMU based indoor positioning system can't only be used for defense purposes but also can be used to find the locations of the object in deep mining and can be used very effectively for high security prisons.

Global Positioning System (GPS) were originally designed and utilized by the military for a variety of purposes like to provide locations and current velocities of objects or individuals around the world. Since satellite transmission power is low, so certain geographical conditions may cause problems with GPS receiver's ability to record location information. "Weather" can be a big factor in degrading the signal strength of the satellite. Signal strength can also be degraded by moisture such as rainfall, fog, or snowfall. Because of these factors, it is hard to ensure complete GPS coverage at all times.

4. Proposed System:

In our prototype we have proposed solutions of all the drawbacks of the existing system like attenuation caused by certain geographical conditions in the GPS system and also the limitations of RFID based indoor positioning system have been enhanced. The proposed system operates with the help of IMU unit which contains several sensors and further IMU is connected to the microcontroller to process the raw data in the form of 10 different measurements taken by the sensors. RF transceiver then processes the signals and sends it to the monitoring room. Further the signals are received by another RF transceiver of the PC module and the output can be displayed on the computer screen by using Lab View software.

5. Working Principle

An Inertial Measurement Unit (IMU) is an electronic device that includes up to 10 different measurements from the various transducers to estimate the motion of an object in 3D space. 10 different measurements from various transducers to estimate. These measurements are then processed by an on-board processor that uses algorithms like EKF (extended Kalman filters) to generate data that correspond to the motion of the object in 3D space. But without using a 3D plotting system, the information from an IMU is practically useless for such applications. The raw data from an IMU is taken by an embedded system using SPI communication and the same is transmitted by antenna using a wireless link to a computer running a 3D plotting application to generate a point cloud of the moving object. To function and process the project we use few software. They are Orcad for schematic design, MPLAB for controller programming, Eagle for PCB design, Labview for 3D point cloud generation. Labview software helps in getting the final result on the computer screen.

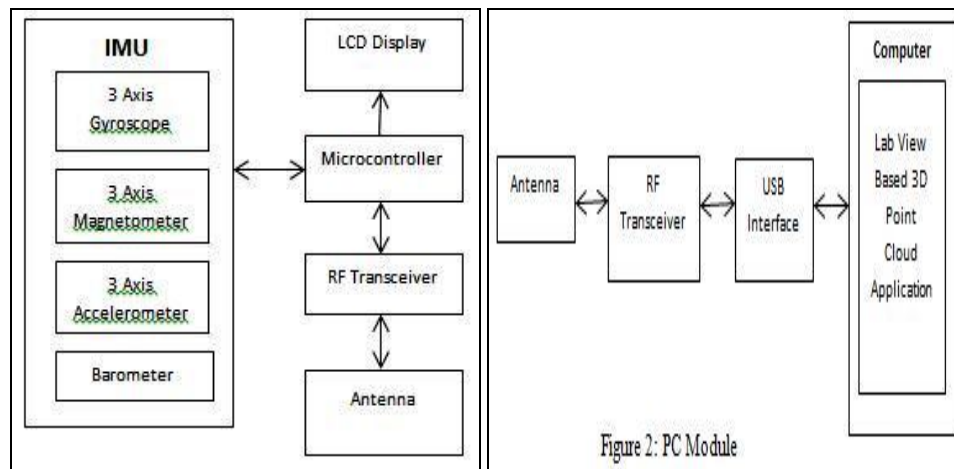


Figure 1: IMU Module & Figure 2

3D point clouds are graphs that show moving discrete objects in a 3 dimensional space as moving points

6. Drawback of Proposed System

A major disadvantage of using IMU for navigation is that they typically suffer from accumulated errors. Other than the accumulated errors, IMUs are normally only one component of a navigation system. Other systems are used to correct the inaccuracies that IMUs inevitably suffer, like gravity sensors (for local vertical), external speed sensors (to compensate for velocity drift), barometric system for altitude correction, and a magnetic compass.

7. Conclusion

The proposed system is a new discovered technique in the field of indoor positioning and having useful advantages over existing systems. Use of IMU makes the system very useful. This technique turns out very vital in high security area like prison, mining, military base in underground etc. The adaptation of IMU based indoor positioning system can bring a huge change in tracking. It makes the tracking simple and help us in finding the new innovative application for positioning the object. Thus we can conclude that this system is practical and very useful. And it's also can be proved a milestone for high security and safety.

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