Navigation Of Autonomous Ground Vehicle Using Gps System

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Abstract

The design and the development of an autonomous ground vehicle capable of navigating and reaching a destination, by taking guidance of a GPS RECEIVER is discussed. The system proposed can identify its present positional information from the satellite through the GPS modem and manoeuvre through the predefined way points to reach the given destination. Target location is fed as input in GPS co-ordinates. The GPS receiver identifies the vehicle position with respect to the global map available with latitudes and longitude and determines a path that the vehicle has to move and track. However, because of the dynamic environment in real driving, the GPS alone is not enough to maneuver the vehicle to move to its destination. The waypoints that will help the Autonomous Guide Vehicle (AGV) to reach every set of other destinations will be pre-set by the user. Once the destination to be reached is given by the user, the system should decide its waypoints from the present position, and navigate accordingly. The whole task of parsing the position and identifying the corresponding waypoints are done in microcontroller. The GPS can give only the positional information. Using all these information's, the microcontroller will take decisions and give commands to the motor driver module which in turn drives the motors to make the Autonomous Guide Vehicle (AGV) reach its destination.

Key Words: Waypoints, Gps receiver, AGV, parsing ,manoeuvre.

1.Introduction

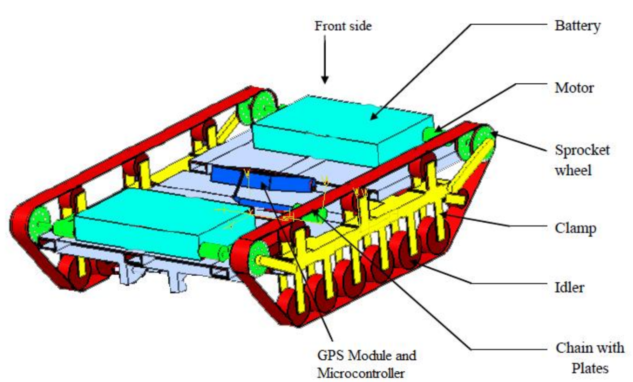

Figure. 1 AGV

Basically, guiding an intelligent vehicle from one location to another requires three modules namely global perception, local perception and vehicle control. The global perception system identifies the vehicle position with respect to an available global map which is usually represented in terms of latitudes and longitudes. It also determines a path which the vehicle has to track. However, because of the dynamic environment in real driving, the global perception system alone is not enough to maneuver the vehicle to move to its destination. In order to identify the pose and orientation of the Autonomous Guide Vehicle (AGV), an electromagnetic compass is deployed in addition, which gives the angle of deviation of the axis of Autonomous Guide Vehicle (AGV) from the primary N-S directions. Therefore, the intelligent vehicle also uses information from the local perception to avoid any static and dynamic obstacles that block the vehicle path and also to follow traffic rules. Finally, the vehicle control system integrates information from the global and local perception systems and then determines an appropriate action for the vehicle.

Global perception system involves vehicle localization and path planning. It allows the vehicle to know its position and direction with respect to the real world. It gives a series of position coordinates to the vehicle in order to reach its destination.

Besides the military, advances in manufacturing and automation have also increased demand for unmanned vehicles in factories, warehouses, and hazardous environments. One of the ways to provide automatic control to these vehicles is machine vision. However, vision-based tracking control can be slow and or expensive due to substantial demand for memory, data processing speed, and vision interpretation.

In GPS based system, satellites will send the signals at regular intervals of time. These signals would be picked up by the GPS module. Using these signals the delay of signal could be calculated. This delay is proportional to the distance of the module from the satellite.In this project a positioning system is proposed, which employs a GPS receiver and a map-matching algorithm. The algorithm correlates the received power from different GPS satellite vehicles (SVs) leading to specific signature, to a stored map with periodic time varying estimates of SVs received powers.

2. OVERVIEW

Figure 1. shows the Autonomous ground vehicle. Figure2. shows the AGV consisting of motors, GPS receiver & microcontroller. Ultrasonic sensors & GPS receiver provide the input to the microcontroller. Microcontroller combines the input and takes decision based on sensor input to control the motor. This is send to PC for tracking.

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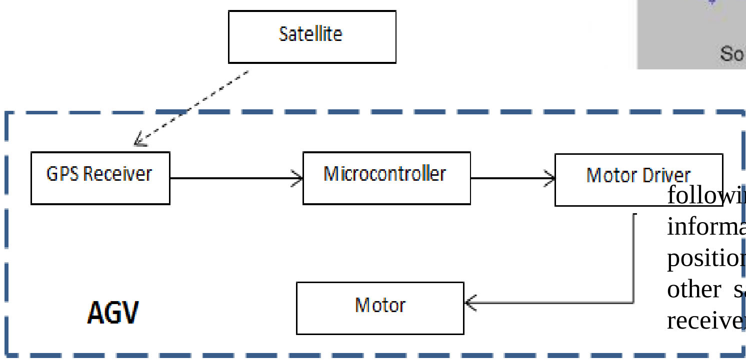

Figure2. Functional Block Diagram of AGV

3. WORKING PRINCIPLE

GPS is a worldwide navigation system from a constellation of 24 satellites and the associated ground stations. GPS calculates its position by using the triangulation method

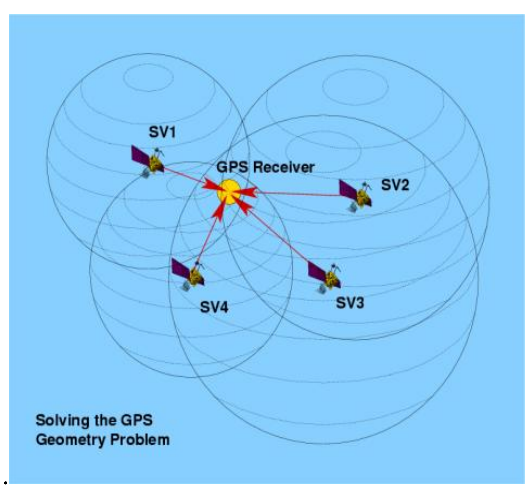

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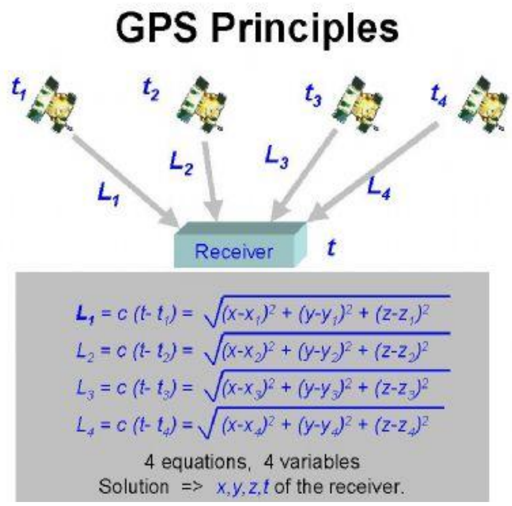
Figure.3.Working Principle of GPS



Each satellite is sending out signals with the following content: Satellite is X, Its position is Y and this information was sent at time Z. In addition to its own position, each satellite sends data about the position of other satellites. These orbit data are stored by the GPS receiver for later calculations.

For the determination of its position on earth, the GPS receiver compares the time when the signal was sent by the satellite with the time the signal was received. From this time difference the distance between receiver and satellite can be calculated. If data from other satellites are taken into account, the present position can be calculated by triangulation method. This means that at least three satellites are required to determine the position of the GPS receiver on the earth surface. By means of four or more satellites, an absolute position in a three dimensional space can be determined. More the reference points, smaller the triangle they will form and higher the accuracy. A 3D-position fix also gives the height above the earth surface as a result.

GPS devices may also have additional capabilities such as:

Containing maps, this may be displayed in human readable format via text or in a l format.

- Providing suggested directions to a human in charge of a vehicle or vessel via text or speech.
- Providing directions directly to an autonomous vehicle such as a robotic probe.
- Providing information on traffic conditions (either via historical or real time data) and suggesting alternative directions.

- Providing information on nearby amenities such as restaurants, fueling stations.

Applications

i. Automotive and Marine Navigation
ii. Automotive Navigator Tracking
iii. Emergency Locator
iv. Geographic Surveying
v. Personal Positioning
vi. Sporting and Recreation
vii. Embedded applications
viii. Mapping devices application

4. GPS RECEIVER MODULE

Figure 4. GPS Receiver Module

Features

- High sensitivity -159dBm
- Searching up to 32 Channel of satellites
- Fast Position Fix with LED indication of status
- Low power consumption
- RTCM- in ready
- Built-inWAAS/EGNOS/MSAS Demodulator
- Supports NMEA0183 V 3.01 data protocol

Specification

- Operating Voltage =10-40 V (12V Typical) V DC
- Operating Current=150 mA
- Sensitivity =159 dBm
- Channels =32 channels all in view searching
- Protocol output baud rate= 4800 bps no handshaking(8-N-1)
- Output Voltage level= RS232 signals (+12/-12V)
- Frequency =1,1575.42 Mhz
- C/A Code= 1.023 Mhz chip rate
- Accuracy in Position =3 Meters

NMEA Protocol

The NMEA 0183 Interface Standard defines electrical signal requirements, data transmission protocol and time, and specific sentence formats for a 4800-baud serial data bus. Each bus may have only one talker but many listeners. This standard is intended to support one-way serial data transmission from a single talker to one or more listeners. This data is in printable ASCII form and may include information such as position, speed, depth, frequency allocation, etc.

NMEA 0183 is a simple, yet comprehensive ASCII protocol which defines both the communication interface and the data format. The NMEA 0183 protocol was originally established to allow marine navigation equipment to share information. Since it is a well established industry standard, NMEA 0183 has also gained popularity for use in applications other than marine electronics. The GPS receiver supports the latest release of NMEA 0183, Version 3.0 (July 1, 2000). The primary change in release 3.0 is the addition of the mode indicators in the GLL, RMC, and VTG messages. For those applications requiring output only from the GPS receiver, the standard NMEA 0183 sentences are a popular choice. Many standard application packages support the standard NMEA output messages. Each sentence begins with a six character identifier, the first character of which is always "$". The NMEA 0183 standard defines dozens of sentences, but only a fraction applies directly to GPS devices. The most useful sentences include:

- $GPAAM - Waypoint Arrival Alarm
- $GPBOD - Bearing, Origin to Destination
- $GPBWW - Bearing, Waypoint to Waypoint
- $GPGGA - Global Positioning System Fix Data
- $GPGLL - Geographic Position, Latitude/Longitude
- $GPGSA - GPS DOP and Active Satellites
- $GPGST - GPS Pseudo range Noise Statistics
- $GPGSV - GPS Satellites in View
- $GPHDG - Heading, Deviation & Variation
- $GPHDT - Heading, True
- $GPRMB - Recommended Minimum Navigation Information

- $GPRMC - Recommended Minimum Specific GPS/TRANSIT Data
- $GPRTE - Routes
- $GPVTG - Track Made Good and Ground Speed
- $GPWCV - Waypoint Closure Velocity
- $GPWNC - Distance, Waypoint to Waypoint
- $GPWPL - Waypoint Location
- $GPXTE - Cross-Track Error, Measured
- $GPXTR - Cross-Track Error, Dead Reckoning
- $GPZDA - UTC Date/Time and Local Time Zone Offset
- $GPZFO - UTC and Time from Origin Waypoint

5. RESULT AND CONCLUSION

Software For Monitoring Gps Data:
Trimble GPS Studio version1.00.1

Trimble's software is a powerful stand-alone software tool supporting any form of analysis to determine visibility for GPS, GLONASS, IGSO and geostationary satellites.

- Enables full GPS receiver status, setup, and management
- Provides full control over real-time differential sources
- For best accuracy allows logging of data for differential postprocessing
- Logs DeltaPhase data for optimal GPS code postprocessing accuracy
- Works seamlessly with Trimble GPS receivers and field computers
- Provides standard COM components

PROTOCOL FORMAT
NMEA 0183 V 3.01

The NMEA 0183 standard is a purely digital data transmission scheme, using '1's and '0's in a binary format, to communicate with a connected device. The standard NMEA output only messages are: GGA, GLL, GSA, GSV, RMC, VTC, and ZDA.

Example: $GPGLL, 4916.45, N, 12311.12, W, 225444,

4916.46,N Latitude 49 deg. 16.45 min. North

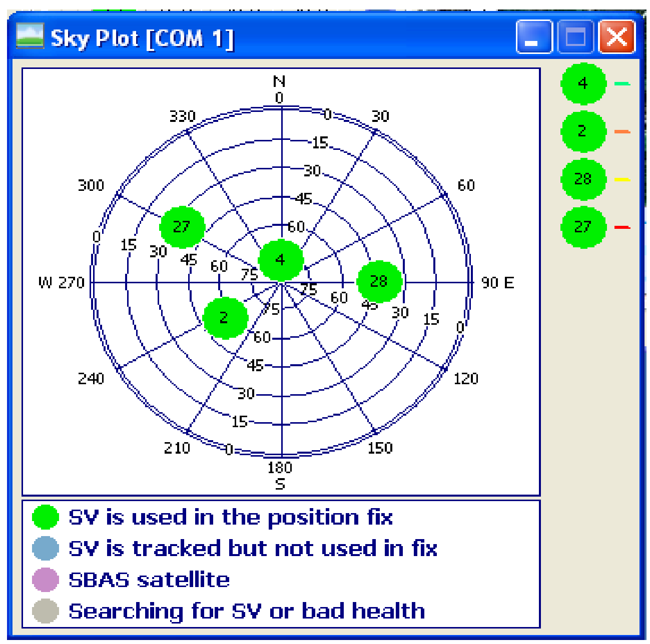
12311.12,W Longitude 123 deg. 11.12 min.west

225444 Fix taken at 22:54:44 UTC

A Data valid

Simulation results

The simulation result obtained from the GPS receiver is shown in the following figure.



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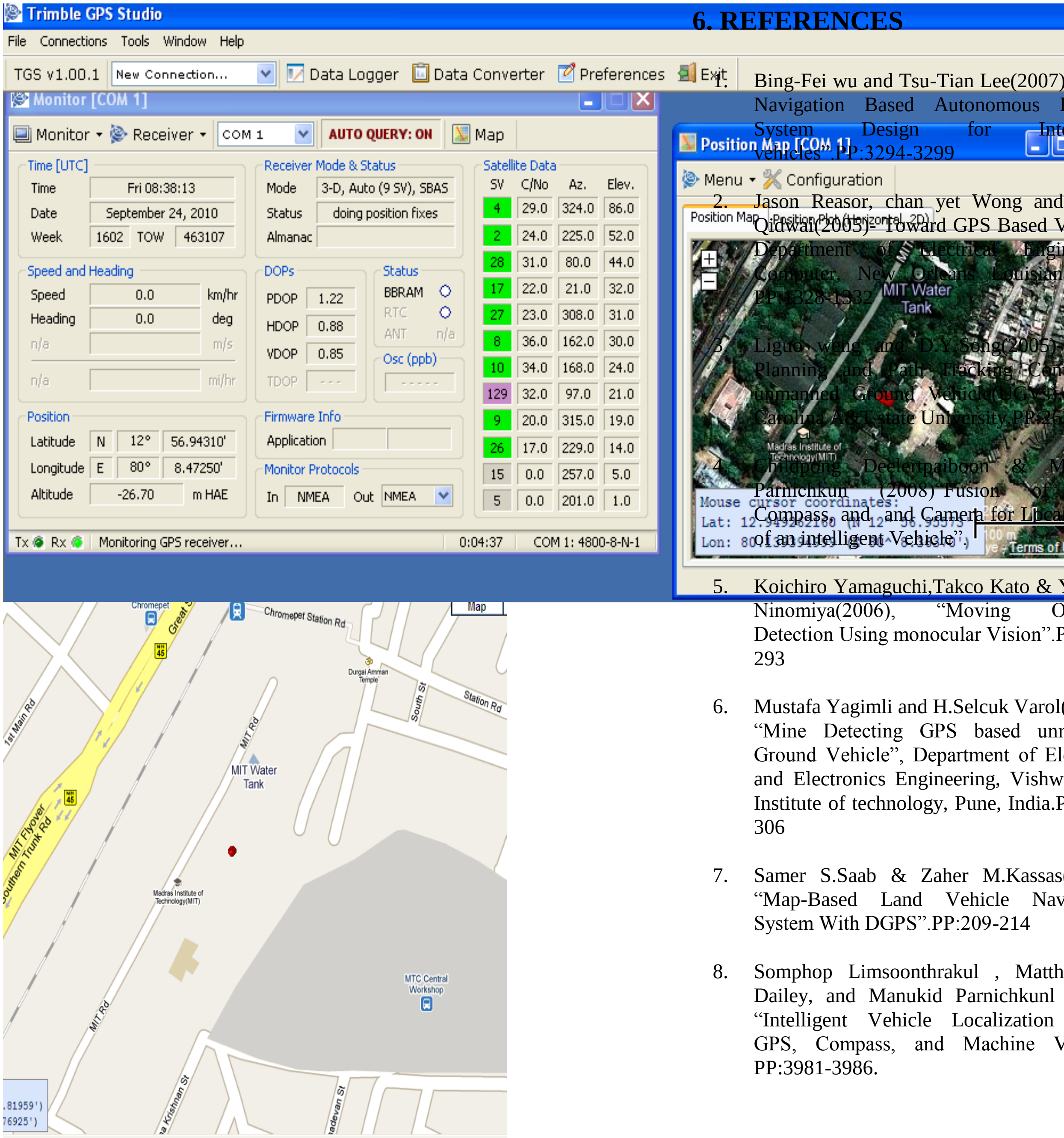

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