GPS Navigating Autonomous Vehicle
Functional Requirements List and Performance Specifications
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Our world is becoming automated. Autonomous navigation is a necessity for any device that needs to operate without human interaction. GPS is a fantastic way to drive a vehicle, but alone is not accurate enough to be useful. An application of differential GPS will be needed to create a working feasible design. We will shoot to create a working system of differential GPS to be used on campus and have a system in place to control our vehicle remotely. The components of the systems will be outlined and described.

Differential GPS

A differential GPS system involves two key parts: the base station and the remote station. These GPS devices are from Novatel. They are to be setup in RT-20 mode for differential communication. The exact location (latitude, longitude, and altitude) are programmed into the base station. At that point it will send out live correction data over RS232 at 9600 baud. Internally it is sending data at three speeds. The shortest is every two seconds. Beyond that, it is used for worst cast scenarios to assist with differential communication. This can happen when there is a satellite communication breakdown or a breakdown in communication between the base station and the remote station. The autonomous vehicle will have internal programming to help assist with these worst case situations.

RF Communication

The communication between the base station and the remote station will be over 900 MHz radio frequency communications. This will be done using a pair of Lawn-II 9600 Baud RF transceivers. The basic low power antennas have an approximate range of 30 meters. Further research and development of antennas will be necessary for an acceptable range. In order to achieve the best possible performance, the range should eventually be the effective range of the GPS correction data. This range will be determined once the finalized base station is deployed and its working range is tested. This approximate range should be around two miles.

802.11 Communication

For initial development, the campus 802.11 wireless network will be used for communication between the vehicle and human remote control station. This should not be used for live driving, but for reading back location data and sending new coordinates. The on campus network is not stable enough for consistent communication. With local business sponsorship and campus group assistance, an outdoor long range 802.11 access point will be used. Live data logging and testing will be necessary to determine ideal operation locations. Since 2.4 GHz for 802.11 is the resonance frequency of water, range could be limited.

Embedded System

Windows CE 6.0 will be deployed on the x86 E-Box system for the vehicle. It will serve as a local server to manage data traffic and communication. The reason this is being setup as a server is that if communication was lost between the vehicle and the 'remote server', the vehicle would have no control. With a local server operation, quick external commands will provide the movement commands. In this scenario, if a loss of communication occurs, the vehicle would cease navigation. This embedded operating system supports Microsoft .Net 3.0. All applications will be built in C#. There are five commands the vehicle understands: forward, backwards, left, right, stop. These will be sent via wired RS-232 communication from the E-Box. The onboard GPS will be communicating live with the base station and sends local GPS data to the E-Box. This data is expected every two seconds. In a worst case scenario that the GPS does not send data or sends null data, the vehicle shall halt. The E-Box will then wait for either a valid position fix or a manual remote command telling it what to do.

Remote Control System

Sending data to the device can be done through one of two ways: either a desktop application or a web application. Both methods will operate in the same manner except for locations of use. Based on the scope of the 802.11 connection, communication is limited to the internal network. A user of this device will need to be on the local network or a server serving a web site needs to be on the LAN. ASP.Net web applications will send to and receive data from the remote device based on the commands given from the web interface. This web interface is limited only to the scope of the internet.

Additional Information

The subsystems described here are most likely going to be the final ones. As per both advisors recommendations, we need to find the exact numbers of assumed data. We need to determine appropriate ranges, values, speed, and exact accuracy of the differential GPS.

Sources

Andrew D. Canopy from RLS