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Design and Development of Wireless Sensor Network Based Autonomous Vehicle

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Abstract
An autonomous vehicle is a system capable of sensing its environment and navigates without the need of human action. Advanced management systems interpret sensory information to spot applicable navigation ways, in addition as obstacles and relevant accumulation. Potential benefits include reduced costs, increased safety, mobility and customer satisfaction. Reduction in crime and traffic collisions. There will be an increase in fuel efficiency of vehicle and reduced parking space requirements. This system utilizes an automotive localization system using Global Positioning System (GPS) and Compass.GPS based National Marine Electronics Association (NMEA) data is used for course navigation, distance and location. Using one web camera, sharp IR sensor, GPS receiver, digital compass and fiducially markers, the autonomous vehicle will be able to follow user specified directions as well as focus on components of the road to navigate independently.

Keywords– Autonomous vehicle, GPS, IR sensor, Proximity sensor, GPS receiver

1. Introduction

Autonomous vehicle technology is machinery installed on a motor vehicle that provides the automobile with the capability to drive without any control by a human operator . Mechanical, electronic and body engineering improvements have progressed to disc brakes, air bags and self-parking systems. Autonomous vehicle technology now consists of event data recording, lane departure warnings, pre-emptive braking and other driver engineering enhancements that are assistive manageable, and fully independent .With the addition of vehicles that have the capabilities to assess their environment, communicate with other vehicles, and interact with cloud data bases Georgia's roads and highways could see a reduction in fatal automobile accidents. Additionally, the capabilities mentioned in limited self-driving automation and full self-driving automation requires wireless connectivity between vehicles. This network connectivity deserves a lot of policy attention because it is likely to be the source of privacy, cyber security, and radio frequency concerns. Lane keeping cameras, LIDAR, infrared cameras . Visible light cameras, GPS navigation, and wheel-mounted sensors send information to and from a vehicle while moving, that information could be taken advantage of if not controlled properly. The applications of the system contains shuttle service in factory for material handling, Mobility for handicapped or aged people, Gated community autonomous mobility service, trash collection from homes.

2. Methodology

The vehicle will have to take logic decisions for the real life based on its map of the zone and the obstacles it detects while following the fastest of the possible paths that will lead it to its desired destination. Once it has decided which path is the best, it will send commands to the actuators that will perform the task of the driving wheel, the throttle and the brake. It is important to remember that, since most of these vehicles are going to be electrical, they won't need gears to drive. The major components that are required for this system are DC motors, caster, microcontroller, ultrasonic sensors, IR and Proximity sensors, RGB sensor, Camera, GPS and GSM module, Motor driver. The construction of this model starts with framing of the chassis, it is framed with the help of 1.5 cm square hollow metal rods and on the top of the chassis cardboard sheet is placed to get rigidity for the components to be attached.

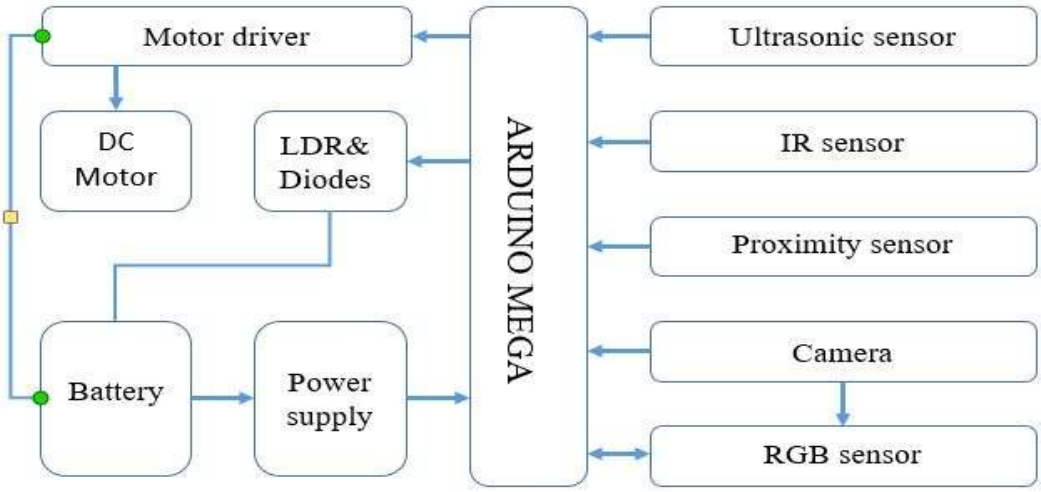

Fig.1. Block diagram

The autonomous cars need to follow usually works in this way: first, it creates an internal map of its environment and locates itself within it as precisely as possible, then it searches obstacles that would need to be avoided and, lastly, it plans the path it will need to follow. These processes are constantly done, many times per second.

GPS and GSM Module

The board uses the 2G GSM networks. Since the GPS can have an error as big as some meters, the information of the position must be refined by fusing it with the information of the inertial sensor and the camera. This way, the knowledge of the positioning will be much more exact. To remove uncertainty from the GPS signal, a map is constantly updated internally to have already a previous map from the same location, with the current and predicted location of the obstacles near it. This map is updated with the vehicle's movement. These sends signal to microcontroller for further controlling of the vehicle to move in different directions.GPS is responsible for the location monitoring through messages that will be sent by GSM .Camera is the additional feature for this project for monitoring and taking pictures of the surroundings. The power supply module ensures the power to the components. When all the connections are made and the power is in on position then the whole sensors start working and the vehicle starts moving.

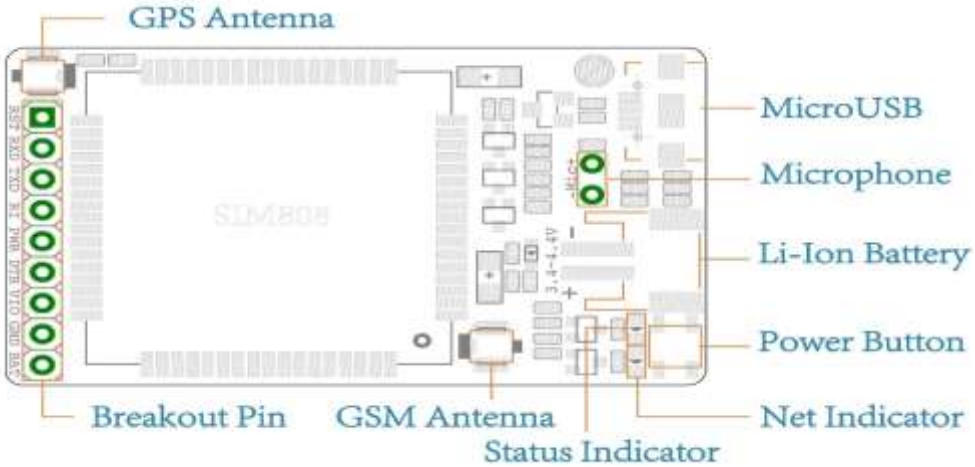

Fig 2. GPS and GSM PCB connections

RGB sensor

The TCS3200 has an array of photo detectors, which will contain the individual colors. The filters of every color are distributed equally throughout the array to eliminate location bias among the colors. Internal to the device is associate generator that produces a square-wave output whose frequency is proportional to the intensity of the chosen color.

Fig 4.RGB sensor

Ultrasonic sensor

The ultrasound sensors selected were the LV-MaxSonarEZ0, since it could detect obstacles since the centimeter 0 (usually, these sensors start detecting after some centimeters), however, until the 15cm it will always say 15cm. Another good thing about this model is that it is very small, so it's easy to put it anywhere and it returns an analog signal with the distance, which makes things easier.

Fig 5. Ultrasonic sensor

Arduino Mega 2560

It comes with more memory space and I/O pins as compared to other boards available in the market.There are 54 digital I/O pins and 16 Analog pins incorporated on the board that make this device unique and stand out from others. Out of 54 digital I/O, 15 are used for PWM (pulse width modulation).A crystal oscillator of 16MHz frequency is added on the board. This board comes with USB cable port that is used to connect and transfer code from computer to the board. DC power jack is coupled with the board that is used to power the board. ICSP header is a remarkable addition to Arduino Mega which is used for programming the Arduino and uploading the code from the computer. It contains two voltage regulator i.e. 5V and 3.3V which provides the flexibility to regulate the voltage as per requirements as compared to Arduino Pro Mini which comes with only one voltage regulator. It can be used either way i.e. for creating stand-alone projects or in combination with other Arduino boards. Most complex projects can be created using this board. All Analog pins can be used as digital I/O pins.

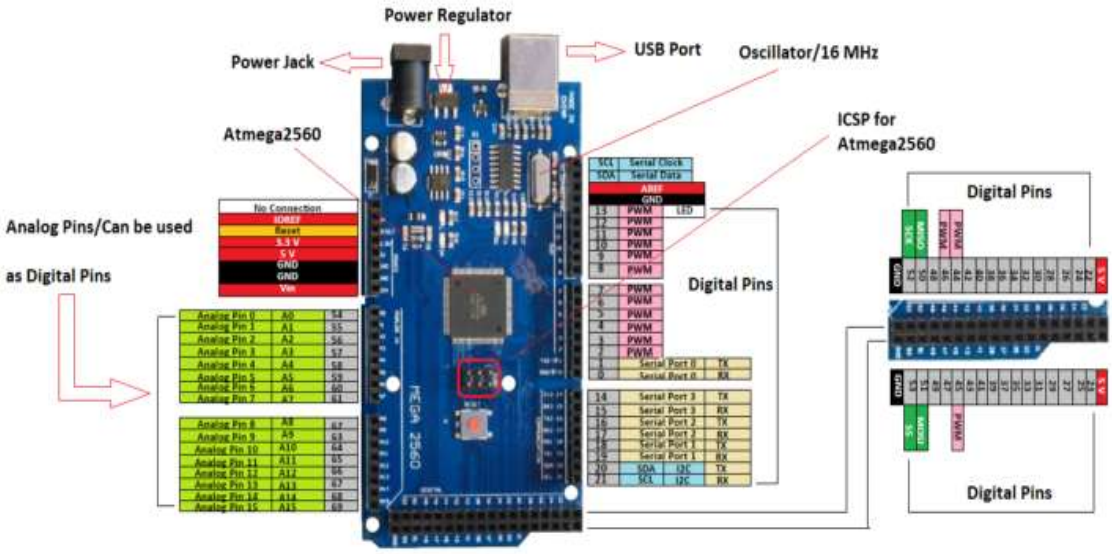

Fig 3. Arduino Mega 2560 pin description

Camera (OV7670)

The OV7670/OV7171 may be a low voltage CMOS image device that gives the complete practicality of a single-chip VGA camera and image processor in an exceedingly little footprint package. The OV7670/OV7171 provides full-frame, sub-sampled or windowed 8-bit pictures in an exceedingly big selection of formats, controlled through the Serial Camera management Bus (SCCB) interface.

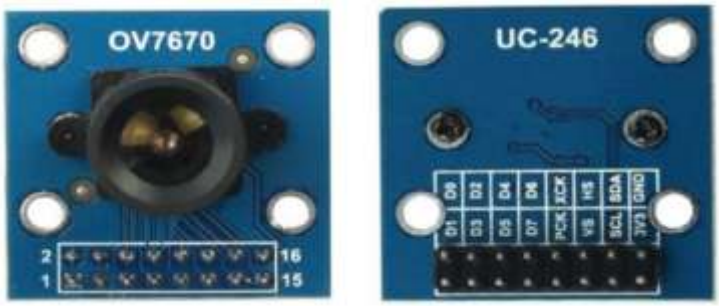

Fig 6. Camera OV7670

Then L-clamps are welded to metal for holding of the motors, caster is fixed in the front side of the chassis. Then the arrangement of all components is carried out in such a way that the four ultrasonic sensors are arranged four sides of the chassis. IR sensors arranged in the front and back of the chassis so these sensors are responsible for detecting the obstacles in the way of the vehicle.

Fig 7.IR Sensors

As when vehicle starts moving if some obstacle is detected in any one of the sides, the sensors are arranged in the four sides, moves vehicle in the other direction till the obstacle range is not detected. So that it can move in a straight motion until an obstacle is detected. If the obstacles are in both sides of the sensor range then the vehicle will stop and sends location to the person who is looking after the vehicle in case any vehicle comes in the back side then the vehicles moves front so that there will not be any collision between the vehicles. The signals are detected by the color sensor so that when there will be signal the vehicle will either stop or start according to signal that is given . Mostly the signals are green for the vehicle move and red for the stop so red and green color detection is enough for the signaling of the vehicle. Then addition to this color sensor camera is also used for the efficient detection of the signal as there may also be some other vehicles with signal color so as to overcome this, camera is installed for improving the safety.

Results and Discussions

The results that are obtained with the prototype model when initially testing the vehicle are not satisfactory as when the connections are made and the circuit is given with the power supply and left out for the movement, the vehicle just moved very straight and hit one of the corner of the room. This has happened due to the non-detective of the obstacle from the range of the ultrasonic sensor. IR and Proximity sensors are arranged in the front and back of the vehicle for quick response. When the vehicle is tested for the second time, vehicle moved in straight direction and it stooped when some obstacle came in the front of the vehicle. Again tested it for back and sideways then the sensors worked properly and sending perfect signal to the microcontroller based data acquiring system. When tested with the GPS location of the vehicle, where the coordinates of the vehicle is sent through GSM as a message to the mobile. When opened those location coordinates it showed the perfect location of the vehicle in goggle maps. Based on these tests it is observed that the working of the GPS has no issues with sending of the location coordinates of the vehicles. The signal detection is done by the camera and RGB sensor and sent the signal to the micro controller which has controlled the vehicle movement with the help of the motor driver module.

Conclusions

Building metallic vehicles has always a high environmental cost for the material extraction required and the high energetic cost required to give form to it. However, another very important cost is the energy supply for the vehicle. In the case of the autonomous vehicles of the present and the near future, since they are fully electric, the pollution is going to be greatly reduced. Even if producing the electricity required for them to move is polluting, it is always considered to be less polluting to do it in a single place, rather than extending it, which is what usual cars do. Autonomous cars point is that they drive better than humans. If they didn't, this technology would not make any sense to develop. And driving better not only means being safer, but also more smoothly and following the shortest paths. Also, when the smart cities arise, the roads, as other vehicles and signals, will communicate with the autonomous cars, which will help ending with traffic problems as they will tell them when any problem occurs in their path. Autonomous cars, and vehicles in general, will pollute less and, therefore, will be much more environment friendly. Autonomous vehicles are relatively new and exciting technology. Like any new advancement before them, there is an inherent risk involved, especially at the early stages. These vehicles enable the safety of people such that accidents will be reduced. These vehicles can also be for transports .Motion control can occur according to a user predetermined or vehicle generated path by sending a command to the vehicle tracker.

Conflict of Interest

The authors make sure that this text contents haven't any conflict of interest.

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