Solar Powered Autonomous Vehicle with Smart Headlights

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Abstract:The autonomous car is the vehicle that is capable of sensing its environment and can navigate without any human input. In this vehicle we use GPS for navigation and the ultrasonic sensor to avoid collisions. Since it is autonomous, the threat of stealing the vehicle will be more. In order to keep it secure, the GSM and GPS modules are provided with key. If anyone tries to unlock the vehicle apart from the normal procedure, by using the GSM module the message will be sent to the owner of the vehicle. GPS is used to locate the exact latitude and the longitude position of the vehicle. If the owner replies back to the GSM module that the vehicle is in theft, the engine gets locked automatically. The Ultrasonic Sensor is used to detect the obstacles and also for the determination of the distance with high accuracy. So, the vehicle will be able to sense the fore coming vehicle or the obstacle and will get alert. In order to focus the headlights of the car in the direction of the turn, i.e. in the direction of wheels, the servo motors are used. The Servo Motors allows the control of the angle, velocity and the acceleration. The Servo Motors takes the angle of the wheel during the change of direction. By making use of that angle, the headlights will rotate along the direction of wheels. The solar panels are used to absorb the radiations that are emitted by the sun. These absorbed radiations are converted into Electrical Energy which is used to charge the batteries. An Arduino Port is used to interconnect all these equipment's to work according to their applications in an effective manner. The directions of the vehicle in which it is moving and the detection of the obstacle will be displayed on the LCD. Finally, when the predefined path is reached, the alarm starts ringing to confirm that the destination has been reached.

Index Terms— **GPS Navigation System, GSM Module, Ultrasonic Sensor, ServoMotors, SolarPanels, Arduino port, LCD, Alarm.**

1. INTRODUCTION

The Solar Powered Autonomous Vehicle is the self-driving vehicle that is capable of sensing and navigating its environment without human intervention. The Cyber Security is to avoid the thefts of the vehicles and help in securing the data in the vehicles. The accidents can be avoided by using the ultrasonic sensors and the smart headlights. In the current generation, the usage of vehicles is increasing exponentially. So, transport plays a major role in the day to day life. The major problem to be solved is the occurrence of accidents that happens every day. There is an urgent need to invent a technology that can make driving safe. Even a small problem done by one person may show impact on many people lives and surroundings.

Fuels like petrol and diesel are mostly used sources to run the vehicles, which in turn increases the pollution and decrement of the fuel for the future generations. The harmful gases released from vehicles may cause many environmental and health problems. Renewable energies like solar energy and wind energy are not being widely used in the vehicles. To reduce the pollution and usage of the fuels should be avoided. In the present world, the rate of crime is increasing rapidly which is a kind of evident from the actual facts that thefts became the matter of routine. The user expects of keeping the data secure & confidential and also protecting the vehicle from theft which became a major challenge to the manufacturer.

Route may become a major challenge for the people who are more indulged in travelling. To the people who visit the new places may arise a question in their minds that in which way or direction they should choose in order to reach the destination correctly. So, certain measures are to be taken in order to overcome this problem.

2. COMPONENTS AND SPECIFICATION

The System Prototype consists of many structural units that are assembled together to form a complete circuit and the circuit will be controlled by using a Arduino that is programmed by Arduino IDE Software which uses Embedded C Language. The System consists of the following hardware components.

A.ARDUINO

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Arduino Mega is a microcontroller board based on the ATmega2560(datasheet). It has 54 digital input/output pins (of which 6 can be used as PWM outputs), 16 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Arduino boards consist of an Atmel 8-bit AVRmicrocontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560) with varying amounts of flash memory, pins, and features. The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012. The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.
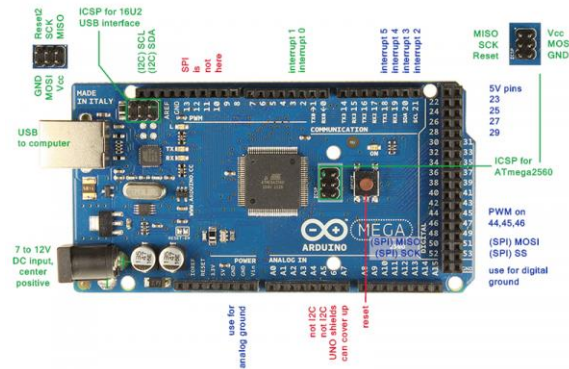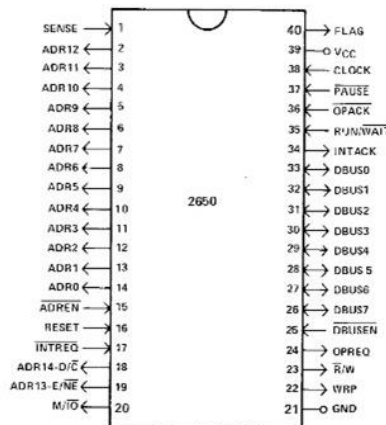
Fig 1.Arduino Mega

Fig 2. Pin diagram of Arduino Mega 2560

B.*GSM(GLOBALSYSTEMFORMOBILECOMMUNICATION)*

The GPS (Global Positioning System) is a "constellation" of approximately 30 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to pinpoint their geographic location. The location accuracy is anywhere from 100 to 10 meters for most equipment. Accuracy can be pinpointed to within one (1) meter with special military-approved equipment. GPS equipment is widely used in science and has now become sufficiently low-cost so that almost anyone can own a GPS receiver. A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone.

When a GSM Modem is connected to an Arduino, this allows the Arduino to use the GSM Modem to communicate over the mobile network. While these GSM Modems are most frequently used to provide mobile network connectivity, these are used for sending and receiving SMS and MMS messages.

Fig 3. GSM MODEM

C.SERVO MOTOR

A Servo Motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. Due to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc. Servos are controlled by sending an electrical pulse of variable width, or pulse width modulation (PWM), through the control wire. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90° in either direction for a total of 180° movement. The motor's neutral position is defined as the position where the servo has the same amount of potential rotation in the both the clockwise or counter-clockwise direction. The PWM sent to the motor determines position of the shaft, and based on the duration of the pulse sent via the control wire; the rotor will turn to the desired position.
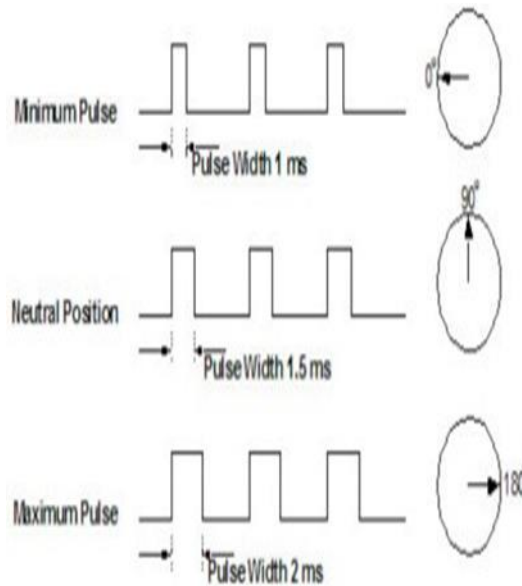

Fig 4. SERVO MOTOR CONTROLS

When these servos are commanded to move, they will move to the position and hold that position. If an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position. The maximum amount of force the servo can exert is called the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position.

D.ULTRASONIC SENSOR:

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances.

Fig5.Ultrasonic Sensor

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

E.BATTERY

Specifications:Voltage :12V, Current :1.3AH/20Hr,Cycle use :14.4 – 15.0V,Standby use :13.5 – 13.8V,Initial current: less than 0.39A.Batteriesconvert chemical energy directly to electrical energy. A battery consists of some number of cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing anions and cations. One half-cell includes electrolyte and the negative electrode, the electrode to which anions (negatively charged ions) migrate; the other half-cell includes electrolyte and the positive electrode to which cations (positively charged ions) migrate. Redox reactions power the battery. Cations are reduced (electrons are added) at the cathode during charging, while anions are oxidized (electrons are removed) at the anode during charging. During discharge, the process is reversed. The electrodes do not touch each other, but are electrically connected by the electrolyte. Some cells use different electrolytes for each half-cell. A separator allows ions to flow between half-cells, but prevents mixing of the electrolytes.

F. SWITCH

Switch is a device used to turn on and off the electrical devices. The switch consists of a conductor and an insulator. When the switch is turned on, it acts as conductor and when it is turned off, it acts as an insulator.

The switch we used has three modes. In first mode, the switch will act as a conductor that disables the solar panel and enables the battery,which states that vehicle is in driving mode. In the second mode, the switch will act as an insulator to stop the vehicle by disabling both solar panel and battery. The third mode is the charging mode, which will charge the solar panel and store the power in the battery by disabling it.

G. LIQUID CRISTAL DISPLAY:

The LCD is a flat-panel display that uses light-modulating properties of liquid crystals. In this vehicle, it is used to indicates the direction. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segmentdisplays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

H.GPS (Global Positioning System):

GPS, is   a global   navigation   satellite   system that   provides geo   location and time information total GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Obstacles such as mountains and buildings block the relatively weak GPS signals. The GPS provides critical positioning capabilities to military, civil, and commercial users around the world. When the vehicle is under theft, the Arduino send a pulse to activate the GPS Receiver. Therefore, the GPS receiver sends the Latitude and Longitude position to the GSM Module.

I.POTENTIOMETER:

A Potentiometer is a three-terminal resister with a sliding or rotating contact that forms an adjustable voltage divider. If any two terminals are used, one end and the wiper, it acts as a variable resistor or a rheostat. The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name. Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load. In this vehicle, the potentiometer acts as a steering which is connected to the servo motor.

J. WHEEL MOTORS:

These motors are responsible for the movement of the wheels. In this vehicle, four motors are used which are connected to the motor driver and receives the power supply from the Arduino.

H. SOLAR PANEL:

Solar panel absorbs sunlight as a source of energy to generate electricity. By using the solar energy and the wind energy to run the vehicles, the rate of consumption of fuel may be reduced. Instead of using the non-renewable resources like petrol and diesel, renewable sources like solar energy are adopted. The Solar cells present in the solar panels are used to absorb the radiations that are emitted by the sun. These absorbed radiations are converted into Electrical Energy which is used to charge the batteries. As, the solar energy consumption does not release the harmful gases, this is eco-friendly and reduces the pollution. This will be more eco-friendly and the renewable energies are also more effectively used.
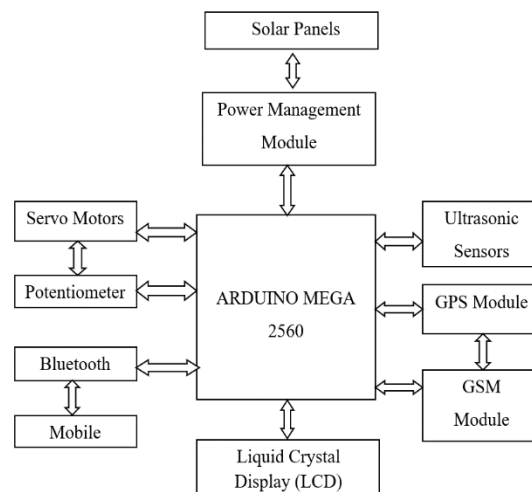
3. PROPOSED METHOD

Fig . Block Connection-Proposed Method

  The objective of this project is to build an autonomous vehicle inbuilt with cyber security. The renewable resource, solar energy, is effectively used as a fuel in this vehicle to reduce the pollution and save the non-renewable resources. GSM module is automated in the vehicle to send a message alert to the proposed user in case of any theft. In this way, effactually cyber security is introduced in this vehicle. In the current generation, the usage of vehicles is increasing exponentially. So, transport plays a major role in the day to day life. The major problem to be solved is the occurrence of accidents that happens every day. In this vehicle we use the ultrasonic sensors to detect the obstacles and sense the environment and a camera to capture the images of the surroundings of the vehicle. The headlights should also be used to avoid accidents. As the headlights focus on the forward direction, in some cases there will be a chance that the person

may not be able to see what is ahead when the vehicle turns around. So, for this issue we introduce a solution of rotating the headlights along with the wheel direction.

4. .RESULTS

'Solar Powered Autonomous Vehicle with Smart Headlights' is developed to avoid accidents that occur in the day-to-day life. Ultrasonic sensors are used to detect the obstacles which plays major role in avoiding accidents. Our vehicle is designed for vehicle safety and data security. The vehicle is included with the solar panels which controls the pollution and saves the non-renewable resources like petrol, diesel, etc. The Smart headlights are provided for safe driving during night time.

5. CONCLUSION AND FUTURE SCOPE

By using the Autonomous Vehicle, the rate of accidents that occur in our day-to-day life will be avoided. The increasing pollution can be reduced by making use of the renewable energy like Solar Power that makes it eco-friendly and thefts can be controlled with the Cyber Security. As the headlights focus on the forward direction, in some cases there will be a chance that the person may not be able to see what is ahead when the vehicle turns around. So, for this issue we introduce a solution of rotating the headlights along with the wheel direction.

This vehicle can be further developed by installing route maps to direct towards the destination. The user data inside the vehicle can be secured by storing in clouds if any theft indications occurs. For more accurate latitude and longitude positions LIDAR (Light Detection and Ranging).

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