Autonomous Vehicle Implementation using Arduino Board

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Abstract— The project is designed to build an obstacle avoidance robotic vehicle using ultrasonic sensors for its movement. An Arduino ATmega328p is used to achieve the desired operation. A robot is a machine that can perform task automatically or with guidance. Robotics is generally a combination of computational intelligence and physical machines (motors). Computational intelligence involves the programmed instructions. The project proposes robotic vehicle that has an intelligence built in it such that it guides itself whenever an obstacle comes ahead of it. Further the robot uses the GPS navigation to reach the destination once the user has entered the source and destination place. This robotic vehicle is built, using an Arduino ATmega328p. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the Arduino. The robot can be also be made fully automatic that is the robot will sense the obstacle and change its path on its own without any manual help. The vehicle will be programmed in such a way that it will sense any obstacle in its path and change its path accordingly. Further, the driver can enter the source and destination places and the vehicle would find the path and drive upto the destination on its own using the GPS technology.

Key words: GPS technology, Arduino Board, Ultrasonic Sensor, AVL

I. INTRODUCTION

Autonomous vehicles are a recently developed subset of robotics and can come in three general forms; air, ground and submarine. In ref. [1] SAFETY regulations in the automotive industry have increasingly become stringent along with the growing customer demands for comfort functionality. For this reason, the development of intelligent vehicle technology has been accelerated. The ultimate goal of intelligent vehicle technology is the realization of an autonomous car that can drive itself without collisions by perceiving the surrounding environment. In ref[2] Todays first-generation driver assistance systems tend to have embedded processors dedicated to a single sensor for achieving a single tasks like obstacle detection and braking. The GPS controlled autonomous vehicle is presented which employs a GPS Receiver Module to capture the GPS signal and determine the current location of the vehicle. The system is controlled using an Arduino ATmega328P microcontroller which interfaces to a LCD, ultrasonic sensors and DC motors. The ultrasonic sensor detects the presence of obstacle in the path using its ultrasonic waves. The microcontroller drives the DC motors to move the vehicle to a manually entered destination coordinates. Obstacle detection and avoidance are achieved by incorporating a ultrasonic sensor to measure the distance between the vehicle and the obstacle, and avoidance is implemented by the microcontroller. The designed GPS autonomous vehicle is able to navigate itself independently from one location to a second, user-prescribed location, using GPS-location data. The performance of the vehicle is enhanced with a capability to detect and avoid unexpected obstructions placed in its path. To navigate a vehicle autonomously, the control system must have the ability to determine its present location and direction of travel. Location can be determined either from an outside source with technology such as the Global Positioning System (GPS), GPS offers the benefit of retrieving location information that has no bearing upon previous results.

In ref [5] An e cient vehicle tracking system is implemented for monitoring the movement of any equipped vehicle from any location at any time. With the help of Global Position-ing System(GPS), Global System for Mobile communication (GSM) modem and microcontroller are embedded with the aim of enabling users to locate their vehicles with ease and in a convenient manner.This system provides the facility to the user to track their vehicle remotely through the mobile network.

In ref[6] Automatic Vehicle Location (AVL) is a system that provides vehicle tracking service which is used by eet operator to follow the movements of their vehicles. This system is mainly based on GPS where GPS receiver communicate with satellite to get the location information along with vital data.

Now a days Vehicle tracking system have been available in the market but they are application specie, region specie as well as too much costly.

In ref [7] Arduino is designed as an open-source electronics prototyping platform providing schematics and exible development kits for enthusiastic users who intend to produce interactive objects or environments. Arduino can be used to sense surroundings by utilising various transducers to read and interpret inputs in order to make responses for example the controlling of motors or transferring of data.

In ref [8] intelligent spaces are environments that can continuously monitor what's happening in them, communicate with their inhabitants and neighborhoods, make related decisions, and act on these decisions. Embedding such intelligence in an automobile would be a natural next step for intelligent vehicles. Current in-vehicle applications of GPS and sensor networks have already led the way. Future cars will behave more like intelligent agents travelling in intelligent spaces. Researchers working on such technologies aim for roads with zero fatalities. This concept in future can be ex-tended in such a way that if a destination is fed to the robot, the robot can map the whole terrain and can reach its destination by deciding a suitable path avoiding obstacles.

In ref[9] Eliminate the driver, and society will have safer, more efficient highways and fewer accidents. Take away the steering wheel, and automobile manufacturers will design vehicles to accommodate only the rider. Remove the brake and accelerator, and billions of dollars will be saved annually in fuel costs. Driverless technology is paving the way for society's future transportation system. Though it may seem impossible right now, technology never fails to amaze

us. When considering companies are pouring billions of dollars into research and design, while petitioning governments for approval, it is only a matter of time when we discover driverless technology has conveniently arrived at our doorstep, ready to take us to any destination we choose.

II. PROPOSED METHODOLOGY

The system setup will first enable the ultrasonic sensors to sense the presence of the obstacle and set the source and destination coordinates and send the data to the controller.

The system that is the car will move in the direction of the entered destination, depending on the value/data send by the sensors the system will examine the presence of obstacle.

1) If obstacle is detected the car changes the path and continues moving forward in the direction of the entered destination.
2) If there is no obstacle than the car continues to move in the same direction until it reaches the destination.

Accordingly the movement of the motors is controlled by the motor driver. When the destination is reached the coordinates which are stored are checked by the controller if the coordinate's match the car has reaches its destination successfully.

III. SYSTEM ARCHITECTURE

The system mainly consists of an Arduino, ultrasonic sensors, GPS module and LCD display.

A. Arduino

Arduino is a microcontroller board based on the AT-mega328P (datasheet).It consists of 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

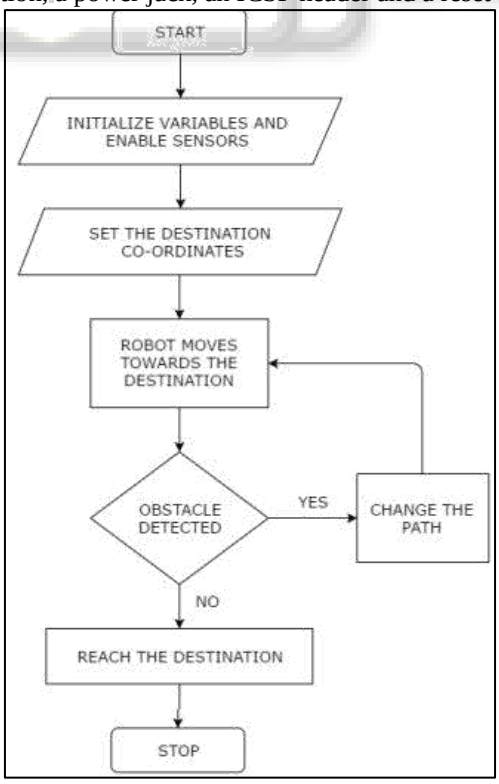

Fig. 1: Flowchart

Fig. 2: ATmega328P[12]

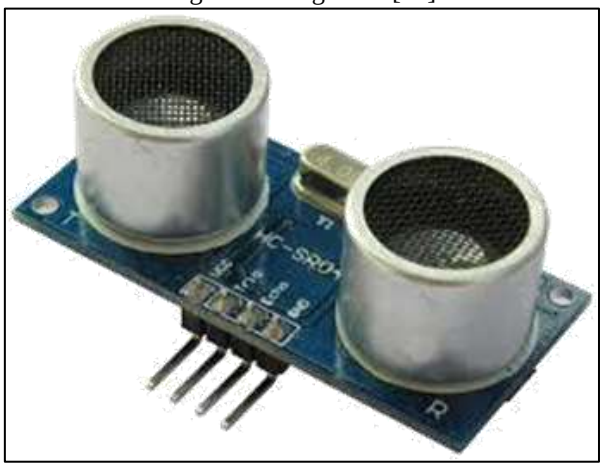

Fig. 3: Ultrasonic Sensor [13]

The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

B. Ultrasonic Sensors

Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target. Ultrasonic sensors emit a sound pulse that reflects off of objects entering the wave field. Depending on the input signal received, the microcontroller changes the path of the robot by actuating the motors interfaced with the controller.

Whenever the robot is going on the desired path the ultrasonic sensor head, when obstacle is present the waves are reflected and accordingly the action is taken by the con-troller. The output signal can be analog or digital. The ultrasonic sensors play a very important role in the project.

C. GPS Module

GPS or Global Positioning System is a network of orbiting satellites that send precise details of their position in space back to earth. The signals are obtained by

Fig. 4: GPS Module [14]

GPS receivers, such as navigation devices and are used to calculate the exact position, speed and time at the vehicles location. Every single location in the entire globe can be specified in terms of geographical coordinates.

The geographical coordinate is a system which specifies any given location on the earth surface as latitude and longitude. There are devices which can read the geographical coordinates of a place with the help of the signals received from a number of satellites orbiting the earth. An efficient vehicle tracking system is implemented for monitoring the movement of any equipped vehicle from any location at any time.

IV. ADVANTAGES & DISADVANTAGES

A. Advantages

1) The owner can track the current position of the car.
2) Due to autonomous cars the traffic and fuel efficiency will greatly improve.
3) It can be used as a movable Surveillance System.
4) It does not require Man Power.
5) It can be used for critical application like flood, bomb disposal, Fire etc.

B. Disadvantages

1) It is use for short distance only.
2) It is not in human control.
3) It is not recommended to keep the range very long because this would cause the robot to keep moving forward and backward as it senses obstacle, even far away from it.

V. RESULTS

The car will work in the following manner:

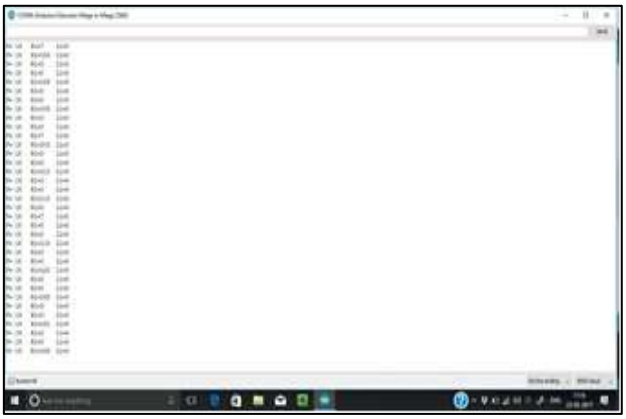

Fig. 5: Sensor Readings

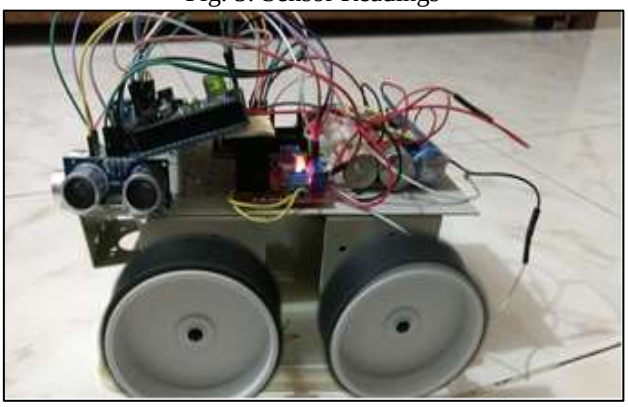

Fig. 6: Working Model

The sensors will continuously radiate the ultrasonic waves in all the directions to check the presence of obstacle.

If the obstacle is present it will decrease the speed of the car and check for the change in the path according to the values that are sent by the other sensors to the microcontroller.

If no obstacle is detected the vehicle will move in the same direction until the gps module sends signal to change the path.

VI. CONCLUSION

From the proposed system the autonomous car can be developed using arduino and the application of GPS technology can be achieved. The coordinates of the destination helps the car to reach the destination using GPS navigation. This project can be implemented in order to build up smart cities with the use of GSM along with GPS navigation and arduino. This system can be further improvised to develop smart cars using IOT and logging the data on the server about the routes which contains least amount of traffic to reach the required destination.

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