MINIMUM COST IMPLEMENTATION OF AUTONOMOUS VEHICLE

Prajkta Ravindra Jape[1], Arti.R.Wadhekar[2]

[1] M.E. Student, Electronics and Telecommunication Department, Deogiri Institute of Engineering and Management Science, Maharashtra, India

[2]Guide, Electronics and Telecommunication Department, Deogiri Institute of Engineering and Management Science, Maharashtra, India

Abstract

In order to increase driving comfort, transportation efficiency, vehicles are made artificially intelligent. Autonomous vehicles or driverless vehicles or making the vehicle drive on its own like humans do is the aim of automobile industry these days. An autonomous vehicle is a vehicle that drives its self without any human or robotic operators help and has the potential to notice the obstacles in its path and navigate through it. For vehicle to drive itself, it should have human perception of driving. This understanding of path to traverse and overcome obstacles in its way is done with the help of computer, microcontroller and sensors. In this paper, ARM-7 MCU is the main part that makes system driverless. This paper attempts to illustrate an effort towards low cost atomizing of vehicle. Developed project vehicle can be used as load carrier in industrial areas where path of location to destination is simple with minimum amount of obstacles.

***Key Words**: Arm, Mcu,Gps.*

--***--

1. INTRODUCTION

The idea of making vehicle autonomous was striking man since long time. It is not at once the vehicle was made driverless. The history of making vehicle driverless can be briefed into four levels. Firstly "Function-specific automation" was done which can be best explained with example of electronic control stability which applies braking to keep the vehicle planted. Here the vehicle automatically aids the driver by taking control over one or more specific function. Dynamic break support is also an example of function specific automation. Second level is "combined function automation" in which control functions are taken over by the car and used in combination to free the driver from controlling. Adaptive Cruise control when used with lane keeping can be an example of combined function automation. At level three, vehicle is limitedly atomized. It can be completely atomized under certain traffic or environmental conditions. Vehicle continuously monitors changes in those conditions that would require the driver's control and driver can take control of driving at any time. In level four fully atomized driving is provided in which the vehicle is completely controlling itself and monitoring road conditions continuously from the start of journey to destination. Here the driver just has to enter map to destination and he is not expected to control the vehicle any time during journey.

The model that inspired project proposed in this paper is Google's driverless car which is mainly based on Artificial Intelligence system and GPS guidance system [1]. For developing an autonomous car the integration of technologies from automotive industry and the mobile robot industry is required. The mechanical and electrical platform for the autonomous car can be achieved from the automotive industry. Numerous autonomous driving algorithms have been researched in the robot industry, and they can be applied to the autonomous car. 2005 DARPA Grand Challenge and the DARPA Urban Challenge of 2007 are two excellent driverless cars of the recent events [2]. Autonomous vehicles are being used on the battlefield today because they can travel in areas where soldiers cannot reach safely. The US Air Force's Predator and Global Hawk are unmanned Aerial Vehicles (UAV) that are example of application of autonomous vehicles in military [3].

2. SYSTEM DEVELOPMENT

2.1 Electrical and Mechanical Components

The designed project consists of chair mounted on chassis of wheels. Project vehicle is a four wheeler with single person sitting capability. Electrical subsystem consists of two lead-acid electrolyte batteries of 12V and 34 A/Hr each are connected in series, four 'double pole double throw' relays of 40 Amperes each; having coil input 12 V & 1Ampere, 6 mm^2 multithreaded cable for dc power transmission are used. Two permanent magnet DC series motors are placed on left and right side and having specification of 24 Volt and 9 Ampere (on no load condition) are used to drive the vehicle. The vehicle dimensions are 0.7m*0.6m*1.21m and it weighs about 140 kg along with battery weight.

2.2 Electronic Components

Fig.1 is the block diagram of autonomous vehicular system. Two parts constitute the system as shown in Fig.1. First part called as master unit because it directs the vehicle by map. It consists of personal computer and Zigbee module (XBee-PRO S2B).Other part called as slave unit consist of a 32-bit MCU-ARM7-LPC2148 Development Kit, Zigbee module (XBee-PRO S2B), three Vivotech HC-sr04 ultra sonic distance measuring sensor (2cm-450cm), 2*16 Character

LCD display with back Light ,L293D relay driver IC. Slave unit traverse the path given by master unit.

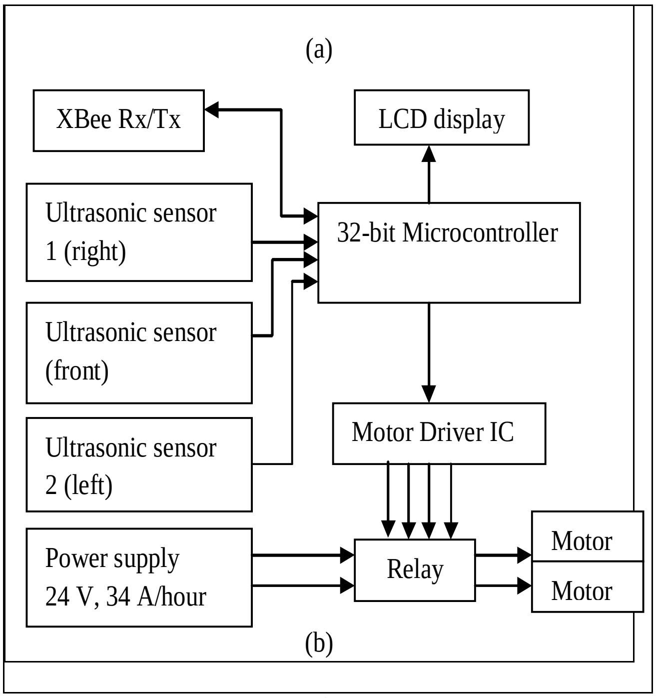

Fig-1: Block diagram of autonomous system. (a) Autonomous vehicle- slave unit (b) Personal computer - Master unit

3. SYSTEM OPERATION

3.1 Starting the autonomous vehicle

To start the vehicle user need to enter correct password in a window that flashes on the screen. The program of this login window form is coded in Matlab7.6.0 software. In Fig-2 login form window is shown that will appear to enter password for starting up the car. Password acts like a key to vehicle. If correct key is put in then only the vehicle starts.

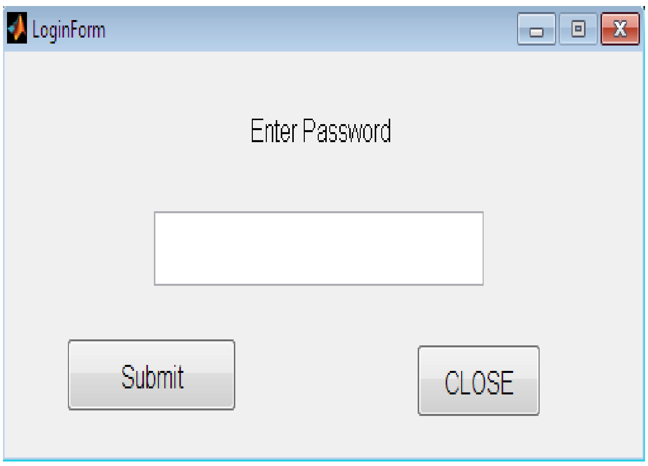

Fig-2:Login form window

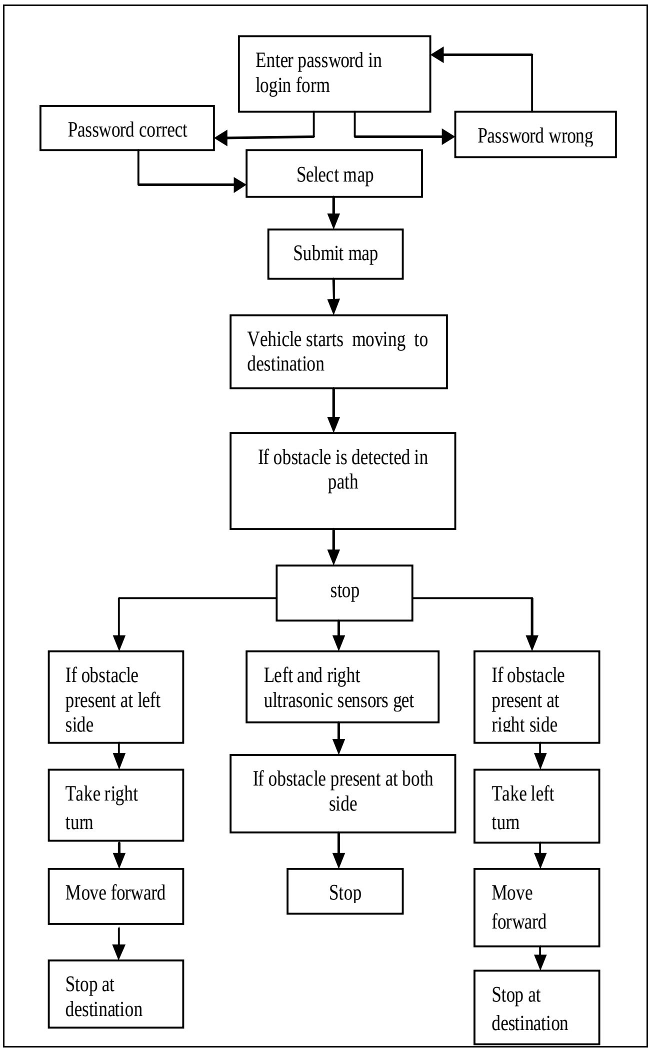

Fig-3: System flow of autonomous vehicular system

3.2 Commutation to the Destination

After entering correct password user has to select map to destination.Fig-3 shows how the vehicle starts and attains destination. For the purpose of demonstration of project, four maps showing paths are stored in the personal computer that acts as a data server. As soon as user selects one of the maps the vehicle starts moving according to the path. Fig-4 gives an idea about map stored on personal computer. Here this map is considered just for demonstrating that vehicle can take left and right turns as shown in map. But when the vehicle is to be made customized, the map of that exacting area where user has to travel recurrently can be saved in the database of autonomous vehicular system. In the designed autonomous vehicular system of this project as the vehicle gets the information of map to destination it starts moving according to it. Considering the map, processor sends the signal to motor driver IC to operate the motors and depending upon distance we have programmed for how long motor should operate. Thus on selecting a specific map vehicle starts moving automatically. The vehicle covers 2 Feet distance in 1Second. The distance vehicle should travel from location to destination is considered approximately seeing the map selected. If we consider map in Fig-4 then vehicle will move 20Feet straight, then take left turn for which only right side motor will run for 1Second, then again vehicle will move straight for 20 Feet, take right turn for which left motor will run for 1Second, again vehicle moves 10 Feet straight, takes left turn, moves 20 Feet straight, takes right turn, moves 20 Feet straight, takes left turn and moves 5Feet straight and stops. All these calculation of distances are just made approximately by looking at the map. In the past years, some researchers have presented GPS applications for vehicle control design. In [4] the researchers were successful to use GPS receiver and digital compass to find exact angle of direction to destination. Path to the destination was preprogrammed. The servo motor was used to control steering wheel angle. The deviation in angle calculated by compass would lead to lowering of car speed. Servo deviation and motor speed were controlled by Arduino. Reflective photo interrupter has been used for sensing motion of the wheels, GPS and magnetic compass for guiding direction to vehicle has be illustrated in[5].

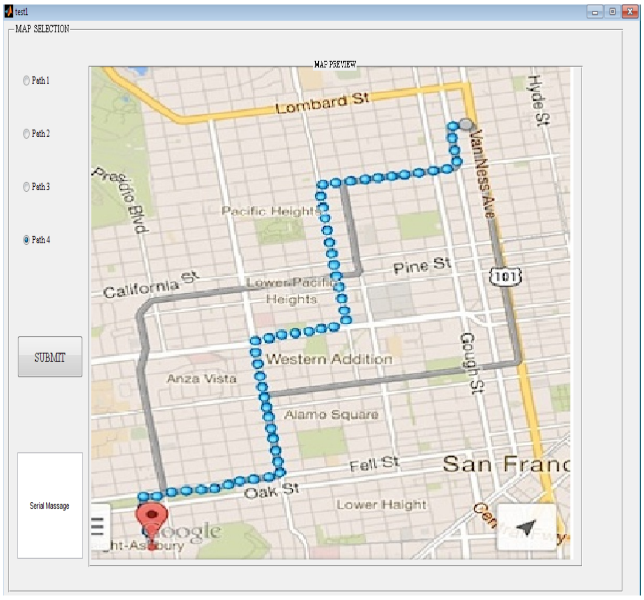

Fig-4: Destination map for autonomous vehicle

3.3 Obstacle Avoidance

For avoiding obstacles vehicle has ultrasonic sensors mounted on front, left and right side of the vehicle. The vehicle senses obstacle in front, left and right side by means of ultrasonic sensors. Vehicle has human like intelligence called artificial intelligence for traversing path because if it is jammed by the obstruction in front it will wait for the obstacle to move away in certain time but even then the obstacle doesn’t move and there is no clearance of path then side ultrasonic sensors check if there is any obstacle is there at left and right side. If no obstacle detected sideways then vehicle takes a turn to one of the side where there is no obstacle within limits of ultrasonic sensor. Thus overcoming the obstacle and coming over to original path, the vehicle resumes its journey to destination. On reaching the destination the vehicle stops. In referred paper [6] multi-sensor data fusion technology and obstacle avoidance algorithm based on fuzzy control, a design of intelligent mobile robot obstacle avoidance system based on S3C2410X (ARM9) RISC microprocessor is described.

3.4 Indication

Motion of the vehicle like forward, reverse, right and left, is displayed ‘forward’, ‘reverse’, ‘right’, ‘left’ respectively on the LCD. Work of indication is done by LCD. As destination is attended by vehicle, LCD displays ‘stop’.

4. RESULT

Table-1: Voltage and current readings of main components used in system

Sr. no.	Quantity of components	Components used in project	Practical readings	
			Output V	Output I
1.	3	Ultrasonic sensor	5.04V	15mA
2.	1	Microcontroller unit(LPC2148 Development board)	3.33V	145mA
3.	2	Zigbee module board	3.36V	60mA
4.	4	Relay	9.86 V	70mA
5.	2	Motors	-	48A (Torque = 240Kgcm)
6.	1	Battery	11.53 V	600mA
	2		12.26 V	4086.6mA

Total circuit power consumption is 32.4184 Watt. Designed autonomous vehicle speed is 2.19 Km/hr. It can run continuously for 14 hours and 30 Km if the batteries are fully charged. Vehicle can carry total weight of 300 Kg along with system weight. Ultrasonic sensors gives impulsive response of obstacles detected to Microcontroller.

5. CONCLUSION

Proposed system has the provision for moving in small peripheral areas where the traffic signals does not participate. The designed vehicle autonomously performs basic functions of driving according to map, obstacle avoidance and attaining the destination safely. It is very helpful in reducing the number of accidents. Sensor system is costly which can affect production of driverless vehicles. But mass production of such vehicle can reduce the adverse effect on production. Driverless system can be advantageous to the people with disabilities such as blindness, amputated legs, deafness etc, would no longer be dependable for travelling. The autonomous vehicle can be made customized by applying image processing system for obstacle detection and audio system for obstacle announcement. As this car is made to run on electric battery, air pollution caused by it would be zero. Self driving vehicle will help eliminating human errors like excess speeding and driving under the influence of alcohol, driverless vehicle will guarantee a very high percentage of safety to avoid accidents. Shortcoming of autonomous vehicular system is that if the vehicle is using internet which have less security then, from the hackers point of view in some cases the vehicle can be switched off or reach another destination if hackers changes the rout which is plotted in the system(in rare cases). Also in case of failure of main sensor the vehicle can create a chance of accident. As this kind of technology is not cheap, it will be impossible for an average common man to afford this car. In this project a small prototype vehicle model has been designed. To make actual road running big car we need to use advanced versions of electronics devices such as faster processor, higher sensitivity sensors, microphone and speakers, etc in this project. Various types of sensors can be implemented in the car to sense variety of objects and materials. Also by using image processing the traffic signals can be determined.

REFERENCES

[1]. http://www.mechanicalengineeringblog.com/tag/google-driverless-car/

[2]. http://archive.darpa.mil/grandchallenge

[3]. https://airandspace.si.edu/exhibitions/uav/

[4]. Wan Rahiman and Zafariq Zainal, “An Overview of Development GPS Navigation for Autonomous Car”. 2013 IEEE 8th Conference on Industrial Electronics and Applications (ICIEA).pp.1112-1118, 2013

[5]. Ray-Shine Run, Jui-Cheng Yen ,Cheng-Yu Tsai, “A Low Cost Implementation of GPS Guided Driverless Car” 5th IEEE Conference on Industrial Electronics and Applicationsis, pp. 1610-1614,2010.

[6]. Yi Jincong, Zhang Xiuping, Ning Zhengyuan, Huang Quanzhen, “Intelligent Robot Obstacle Avoidance System based on Fuzzy control ”. 1st International Conference on Information Science and Engineering (ICISE). pp. 3812-3815, 2009.