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Self-Driving and Driver Relaxing Vehicle

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***Abstract*—In the modern era, the vehicles are focused to be automated to give human driver relaxed driving. In the field of automobile various aspects have been considered which makes a vehicle automated. Google, the biggest network has started working on the self-driving cars since 2010 and still developing new changes to give a whole new level to the automated vehicles. In this paper we have focused on two applications of an automated car, one in which two vehicles have same destination and one knows the route, where other don't. The following vehicle will follow the target (i.e. Front) vehicle automatically. The other application is automated driving during the heavy traffic jam, hence relaxing driver from continuously pushing brake, accelerator or clutch. The idea described in this paper has been taken from the Google car, defining the one aspect here under consideration is making the destination dynamic. This can be done by a vehicle automatically following the destination of another vehicle. Since taking intelligent decisions in the traffic is also an issue for the automated vehicle so this aspect has been also under consideration in this paper.**

***Index Terms*—Automated driving during rush hours, dynamic destination, self-driving**

I. Introduction

Automated vehicles are technological development in the field of automobiles. Although the automated vehicles are for ease of humankind yet they are the most expensive vehicles. In the paper considering the different features and the cost, on a small scale a three wheel Vehicular Robotic prototype has been designed that will automatically reach the destination of another vehicle to which it is supposed to follow.

We have focused on two applications of an Automated Vehicles here and designed a prototype vehicle for that. The one major issue is during heavy traffic a driver has to continuously push brake, accelerator and clutch to move to destination slowly. We have proposed a solution to relax the driver in that situation by making vehicle smart enough to make decisions automatically and move by maintaining a specified distance from vehicles and obstacles around.

The second issue is when two vehicles have the same destination but one of the drivers doesn't know its route. The driver can make his vehicle follow the front vehicle if they are known and share their location to reach the same destination.

A three-wheeled Mobile Robot is used for research is given. The Mobile Robot consists of multiple sensors, which helps it to communicate with Google Maps API (Application Program Interface) and makes it determine obstacles in order to follow the route and move smoothly. The Mobile Robot connects directly to Google Maps API using GPRS Module, gets route and moves in that direction. While the ultrasonic sensors, which have been used for prototype design, helps to avoid obstacles on run time.

The traffic situation in Pakistan leads to design this project prototype, which aims at relaxing driver and creating an automated vehicle whose destination is dynamic unlike Google car, whose destination is static and fixed. This research has been a need for Pakistan if implemented in real time.

The remaining paper is organized as the Section II shows the related work done in this field. Later we have discussed our methodology to implement this idea and solve the issue in Section III. Then we have shown performance analysis of our Mobile Robot in Section IV and finally, we have concluded the paper in Section V.

II. Literature

After the development of the autopilot airplanes [1], self-driven sailboats and ships; the deceptively modest dream that has rarely ventured beyond the pages of science fiction since

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our grandparent's youth is the self-driving car [2]. By the passage of time, much work has been carried out in the area to make cars self-driven [3], [4] but due to technological advancement in the roads and the increasing population has made difficult for this dream to becoming true.

In the pre-computer days of the 1930s, the driverless cars were only the science fiction things. But the development of the digital computer made possible to dream of self-driven vehicles outside the fiction. By the 1960s the self-driven cars have been dreamed to navigate on ordinary streets on their own. German pioneer Ernst Dickmanns, in the 1980s, got a Mercedes van to drive hundreds of miles autonomously on highways, a tremendous feat especially with the computing power of the time [2]. In the mid-2000s, the Defense Advanced Research Projects Agency (DARPA) sorted out the Grand Challenges where groups assembled to contend with self-driving vehicles. In 2009, Google began the self-driving car venture, including colleagues who had effectively devoted years to the innovation. By 2012 the Google car hits the road for testing. By the passing years, the car is developed and equipped with multiple sensors, radars, lasers, Global Positioning System (GPS), it uses heavily detailed maps, and many other things to safely drive and navigate itself with no human interaction. The car can not only drive itself but it can be parked on its own, it can go on freeways, Cameras are used to find and detect objects that are then processed by the computer within the car [5]. In May 2014, Google presented a new concept for their driverless car that had neither a steering wheel nor pedals and unveiled a fully functioning prototype in December of that year that they planned to test in 2015[6]. In summer 2015, Google launched and tested some different features where each prototypes speed is capped at a neighborhood-friendly 25mph, and during this phase safety drivers aboard with a removable steering wheel, accelerator pedal, and brake pedal that allow them to take over driving if needed [7]. After many successful roads testing of Google car has made to believe in some years roads will be safely occupied with self-driven cars.

The authors in [8], [9], [10] have developed unmanned vehicle prototypes in which they have worked on the obstacle avoidance and path planning [11].

In this paper, we have designed two applications of an autonomous vehicle, which can help the driver to relax for the certain duration of time. This paper presents a concept in which the modified concept of Google car is focused, the Google car has to reach the static destination automatically; in our prototype, we have made the destination dynamic. Here our destination is also a vehicle which is moving on a certain route. Our prototype will follow that vehicle. Another application that we have implemented here was to tackle heavy traffic congestion and allow the vehicle to move automatically during that traffic congestion.

III. Implementation Methodologies

Our prototype model shows some work on both the application that we have discussed in this paper. Fig.1 shows the block diagram of prototype Mobile Robot (Vehicle).

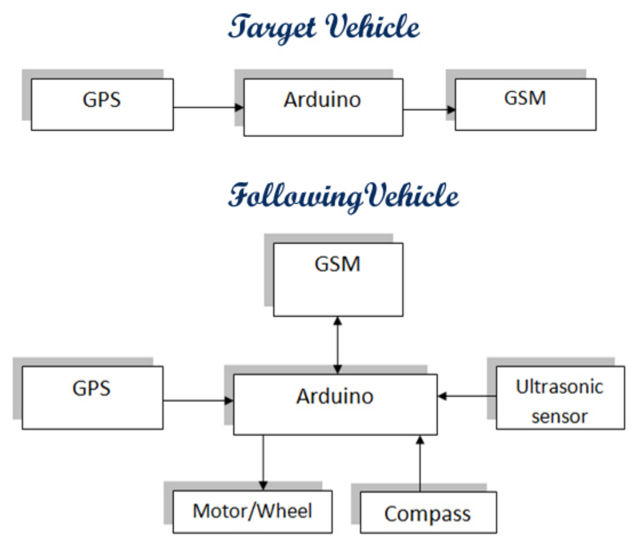

Fig. 1. Block Diagrams

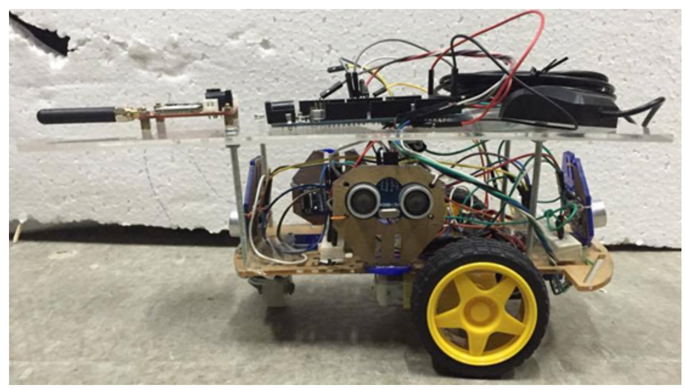

Fig. 2. Designed Robotic Vehicle

Our main focus was on Following Vehicle, which detects and avoids obstacles, coordinate with Google Maps API, get route and follow the route. For another application, it checks vehicles around and automatically moves slowly behind the traffic until it gets out of traffic jam situation. The function of the Target vehicle is just to provide the coordinates to Following Vehicle, which are also not static as the Target vehicle is moving towards its destination.

Fig.2 shows one application in which it follows another vehicle.

Fig.3 shows another application in which vehicle automatically follow the front vehicle and maintains specified distance from vehicles around. The vehicle automatically moves and hence relaxes the Driver.

The Fig. 2 and 3 shows the hardware implementation. This whole project involves the two vehicles first defined as the Target Vehicle and second as Following vehicle. The Target vehicle fetches its existing location coordinates through GPS

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Fig. 3. Scenario how we tested it

and sends to Arduino then these coordinates in the form of the message has been sent to Following vehicle after every certain time of interval.

The Following vehicle whenever receives a message through GSM, the message is sent to Arduino. Arduino then decodes the message and fetches the coordinates of Target vehicle. Since Arduino already has its own coordinates (at Following Vehicle side). Through GPRS arduino then connects to the Google Maps and compares the existing location coordinates of Target vehicle received through the message with existing location coordinates of the Following vehicle; thus tries to find the smallest possible route to reach the Target vehicle. Arduino after all the processing gets the direction from Google API. This direction is then compared with Robot's current direction and after rotating vehicle in that direction, the vehicle starts moving forward. Thus vehicle will continue fetching the current location received from the Target vehicle after every certain time span and will continue move in that direction and this process continues until the vehicle reaches the destination vehicle's location.

The Following vehicle in the middle of following the Target vehicle will keep on looking for the obstacle that might come. To look for the obstacle, ultrasonic sensors have been used. Ultrasonic Sensors have been fixed all around the vehicle so that the vehicle detect the obstacle and get away from it. For instance if there is a wall or a pedestrian in front of the vehicle, the ultrasonic sensors at the front side of the vehicle will detect and the vehicle will turn to the safe side, another possible scenario might come in which there are three obstacles; in front, at the right side and at the left side of the vehicle, the ultrasonic sensors will again detect the obstacles and the vehicle will then moves backward even if there is an obstacle behind, it will stop for a moment and thus again looks for the obstacles from the beginning thus deciding the route on the basis of circumstances.

The complete flow chart of Following vehicle is shown in Fig.4.

IV. Results

The project has been tested at Mehran University of Engineering and Technology, Jamshoro and found working smoothly as shown in Figure 5, 6 and 7. The front vehicle is moving on its way to some destination, while the following vehicle (at back) is getting GPS location of the front vehicle and moving towards it by getting directions and instructions from Google Maps using Google Maps API. Blue line route

Fig. 5. Experimenting the self driving mechanism

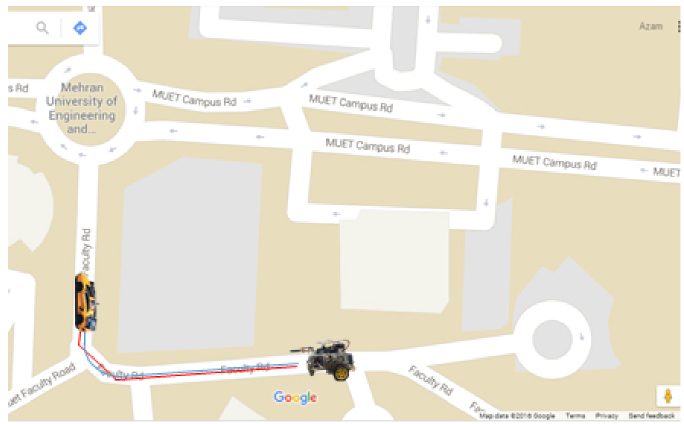

Fig. 6. Experiments during turns

shows the route taken by the Front vehicle while the Red colored line shows the route taken by the Following vehicle after getting instructions from Google Maps.

By testing the vehicle in real time, we have also observed that even if the target vehicle takes the wrong route, the following vehicle will follow the right route because it is connected to Google Maps. As it is a prototype and vehicle is very small, hence it is very slow but if the system is implemented in real vehicles then this could help in solving the discussed issues in real time.

V. Conclusion

This is an advanced step for autonomous driving vehicles. With the help of this algorithm, vehicles can be set to automatically navigate to the destination location by continuously receiving the direction from another vehicle moving ahead to the same destination.

The robotic vehicle routes itself with the guidance of another vehicle moving ahead to the same destination, therefore, deviations in time can occur. The goal of navigation process for a robotic vehicle is to move the robot to a known destination in an unknown environment. The navigation planning is one of the vital aspects of autonomous systems. When the robotic vehicle actually starts to move towards the planned

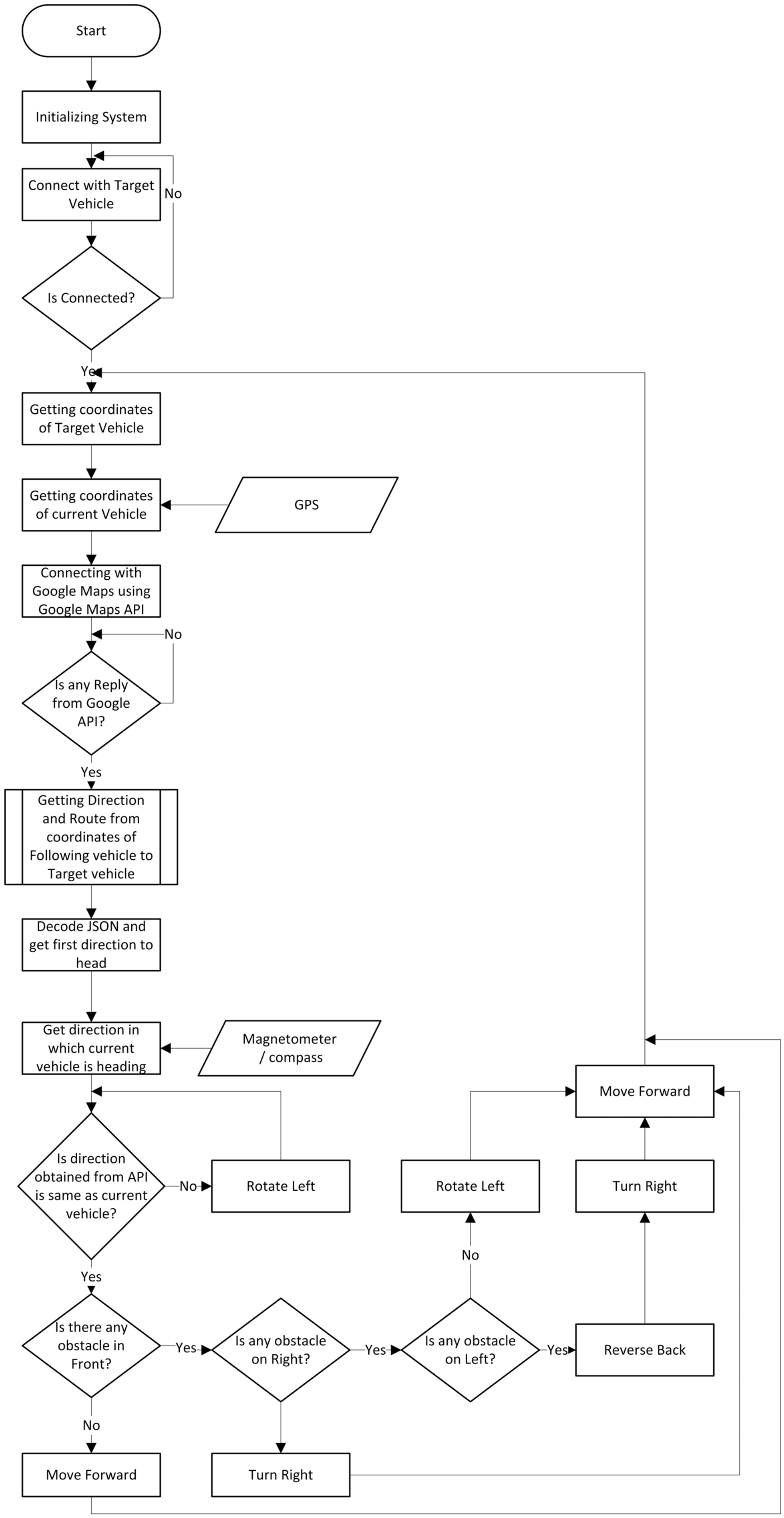

Fig. 4. Flowchart of Designed Robot

Fig. 7. Experiment when taking the wrong turn

route it may find unknown obstacles from the existing location to the destined location, hence the robotic vehicle must avoid the obstacles and follow an optimal route to reach the destined position. The potential applications of this robotic vehicle are to use these types of autonomous vehicle on highways or heavy traffic roads. These types of autonomous vehicles can also be used when a driver travels to the new areas. It is an improved navigation system for autonomous vehicles.

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