IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 6, June 2016

Automated Lane Changing using Automated Vehicles with Disruption Minimization

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Abstract: Our project is mainly considered for automated vehicles, utilizing small microcontroller named as Beagle Bone black this project portrays such an algorithm to alleviating the interference of traffic flow by optimizing for the number of safe lane alterations. Our project is doing all these things with low cost by using small micro controller named as Beagle Bone black. It's like a minicomputer can boot within 20 sec. It is having capability of tolerating network connection. Here we are using two android phones for accurate positioning, for remote operation like a TCP protocol full duplex communication. Once the app we created will be getting on, data will be hardcoded by using PHP script. Analogously, another vehicle also will be having yet another android app so that the cloud contains both vehicles' data. Distance will be calculated using the Beagle Bone black which will navigate the vehicle depending upon the data. The distance between the two vehicles and the speed of both will be calculated using the relative speed by which we will get to know how much meters is travelled per second. So with this the distance between both vehicles is found to be higher for which the lane change can be demanded until accepted limits else lane change request will be refused.

Keywords: Automated Vehicles, Congestion, Lane change Maneuver, GPS, and Distance

I. INTRODUCTION

It seems that traffic congestion has a tendency to become a major challenge for logistic agencies and roadway users across the globe. With the earth's rapid mobility, congestion during rush hours results in redundant time for billions of population. The consequences of congestion delays on the particular professionals are mostly disadvantageous: there is a decline of air quality due to vehicle stalling and drivers' quality of life are affected by having a gamut of non productive time, which results in little time with family and friends, as well as financial losses due to non productivity.

Congestion also has a bad impact on safety, as it results in drivers having to make increased decisions while stop and go traffic. Financial, environmental, and real-estate considerations give an increasingly tough situation to significantly enhance the capacity of roadways by adding additional roads or lanes. Of all basic vehicular maneuvers, lane changing is arguably one of the most difficult ones. There were around 5, 39,000 two-vehicle lane-alterations crashes in USA alone in 1999. An insight of the German in-depth Accident Study from 1985- 1999 displays that, on average, over 5% of accidents occurred during crossing over lanes.

In 2008, 1.7% of the registered highway crashes in the Netherlands were a consequence of scarce lane changing .Lane changing is also complex for automated vehicles. To achieve the promise of high throughput and increased safety, a technique that minimizes the disruption of traffic flow by automated vehicles during lane changes must be implemented to avoid unnecessary slowdowns.

II. RELATED WORK

Our goal is to provide a mechanism that best utilizes available gap to facilitate as many lane changes as possible to optimize capacity. In this paper, we are interested in designing an algorithm that maximizes the number of safe lane changes under homogeneous motorway conditions and assuming that all vehicles are automated.

III. PROPOSED SYSTEM

The project utilizes 2 automated vehicles having android mobile phones each interfaced to a beagle bone black board through a wireless domain and controlled at a web server. The mobiles enable the locating as well as tracking of the mobile system using GPS.
The location data updates and pings the beagle board at every second of interval time. The app created in the mobile will allow the user to apply for a data request and thereby the beagle board should be able to identify the tracking of the predetermined lanes along with their track. This track is followed by the GPS means for topographical obstructions until to a point where the lane change request is executed. Whenever the process of tracing the two vehicles to communicate themselves synchronously, the app applies the designed logic in order to prevent two simulated vehicles from crashing against each other, i.e., to enable GPS tracking both the apps in the respective vehicles should be ON. Otherwise, if either or both of the app are turned off, the data requested is not made to entertain in the system that is having its app turned OFF. The request demand, if not activated, does not stop the System from executing location based data updates. Using the distance measurements and formula from literature, the

IJARCCE

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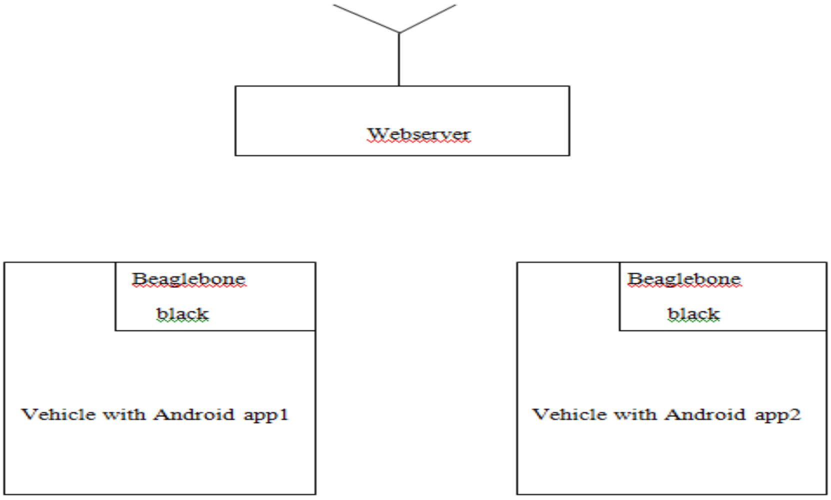

Figure 1 : Block diagram of the proposed automated vehicle tracking.

speed of each of the two vehicles under test can be determined.

Algorithm:

Step 1: Turn ON the app in both the automated vehicles. The data is now requested from the GPS by the app.

Step 2: The data in the GPS is initialized within the app.

Step 3: Check to see whether the data from the GPS arrives in the app of both the vehicles. If true, then proceed to step 4. If not then go the last step.

Step 4: Write the data received from the GPS in the app of the android mobile into the web server located in host location.

Step 5: The user will be allowed to access the web server in order to change the lane of the automated vehicle .

Step 6: Check to see that the vehicles possessing the apps are having a distance of over 100m of separation distance. If so go to next step and if not so then the flow of control is passed to the last step.

Step 7: The vehicle takes the control of the app and allows the user to change the track of the lane.

Step 8: The request for lane change is terminated.

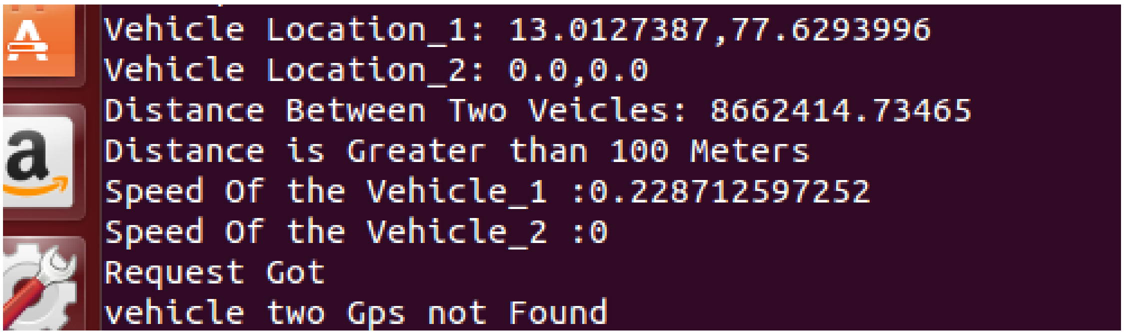

Figure 2: Command when the vehicle 2 GPS is OFF

The request from vehicle 1 is sent but the app in the vehicle 2 is turned off. The screen will prompt “vehicle two Gps not found” as shown in Figure 2. This will result in no lane change.

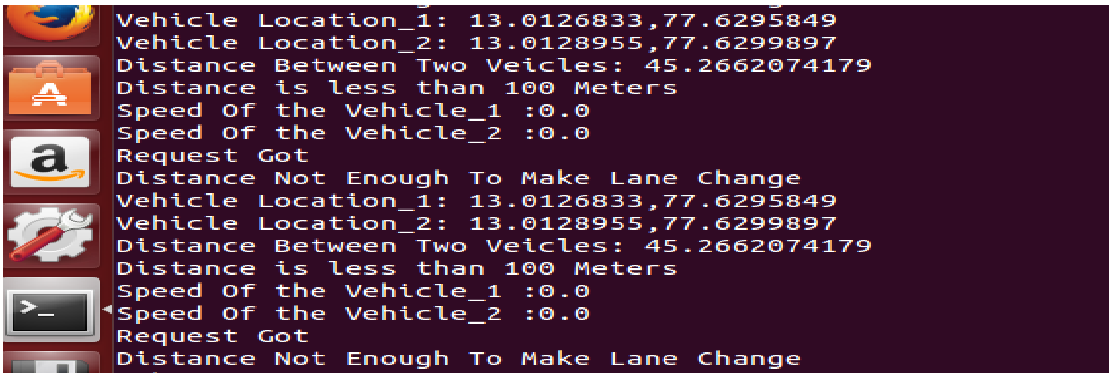

Figure3: Decision making from beaglebone not to change the lane

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The distance between the two vehicles is below 100 meters and though the request has been sent, the lane change cannot be activated as shown in Figure3. In this figure, we see their distance is around 45.266m. A prompt has appeared on the screen "Distance Not Enough to Make Lane Change".

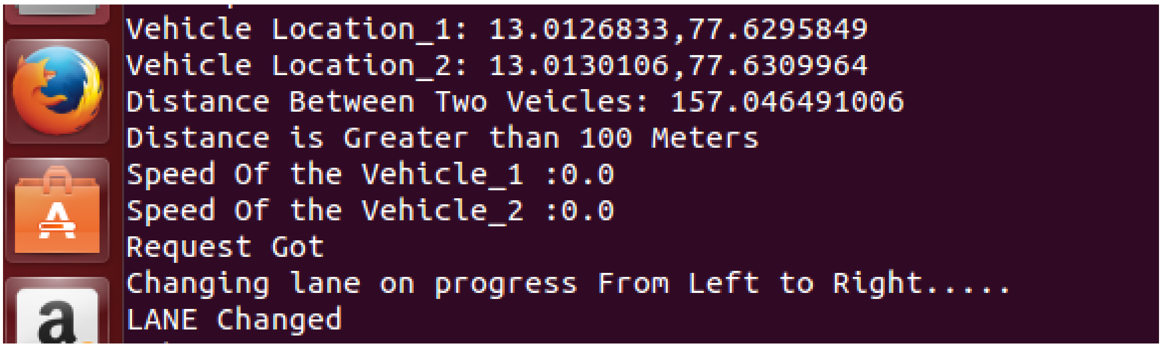

Figure 4: Decision making from beaglebone for lane changing

When the Beaglebone Board has actually got the commands from the apps, then the data is received by the Beagle Board from the web server. When the request is got, the execution of the command has taken place to notice that from the distance between the two vehicles as over 100m as seen in the Figure4.
Thus a condition for lane changing occurs and this takes place subsequently.

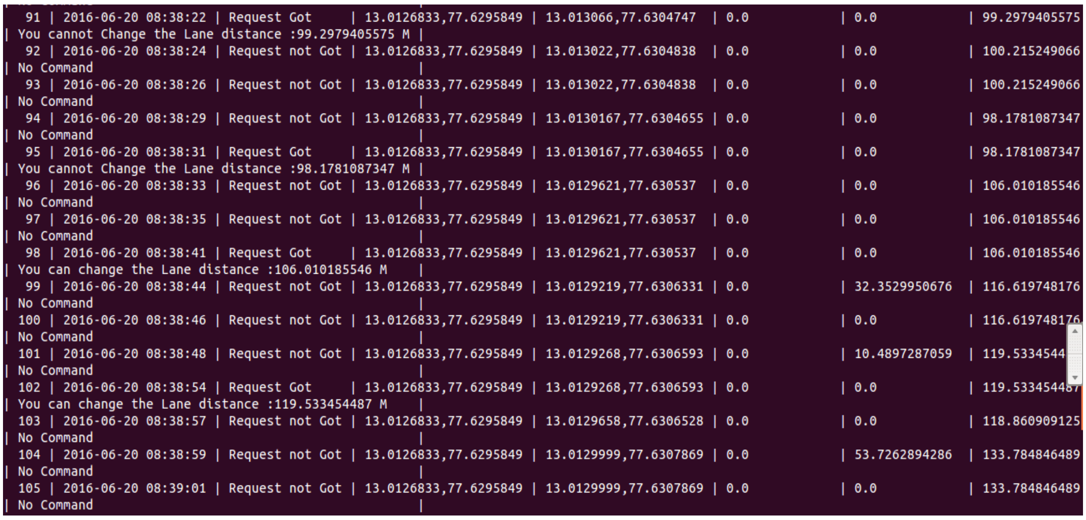

Figure 5: Complete log Report of vehicles (V1 GPS,V2 GPS,SpeedV1,Speed V2,Distance,Command)

On the timeline basis a GPS of the vehicle 1 data, vehicle 2 data among others and its history of dynamic activities is tabulated in a log report as shown in Figure 5.

IV. CONCLUSION AND FUTURE WORK

The lane-changing algorithm has been implemented with the GPS data and calculating the distance between the two devices, which can send the data from their respective vehicle, via the web server. This Web server would be connected to the GPS, which assists in getting the position of the vehicle that is present in the some other lane. The position is taken from the GPS and the data is sent wirelessly through the web server to another vehicle for tracking purposes. The vehicle, which desires to change the lane, receives the data and compares it with the current position of the GPS from the current host vehicle and the distance is calculated from the two GPS data and the lane change is made possible. Considering the importance of the safety systems in road traffic, collision avoidance systems are most likely are in need of improvements continuously. Environmental awareness will always be one of the key factors in these designs, and therefore the relative distance measurements will be an important feature for further studies and developments expected in near future. The results obtained from our studies showed that it is practical to share GPS and sensor information between the vehicles to accomplish relative positioning for lane crossover.

One can use radar camera information to the sensor fusion system as well as with other potentially useful sensors, so that the combined results could be improved even more. Finally, many more tests and analyses should be done to get a better understanding of the noise sources, dependencies of the problem and increase in the accuracy of results to be accomplished. This also can be extended to multiple vehicles also.

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 DOI 10.17148/IJARCCE.2016.5651