[[1]](#footnote-1)

Navigate Mobile Car in Simulation

# Introduction

**A. *Background about car navigation***

Autonomous navigation refers to a vehicle's ability to determine its own course and follow it without human intervention. In certain cases, remote navigation aids are required for planning, whereas in others, the only data used to compute a path is input from sensors located on the vehicle itself. On-road car accidents are primarily caused by human error while driving. Numerous in-car distractions, such as using a phone or eating while driving, or more significant blunders like drunk driving or abusive use of high speeds are to blame for these errors. Road traffic collisions frequently result in people being hurt or even dying. Autonomous vehicles may make roadways safer using sensors and actuators to identify and avoid hazardous situations. In addition, they could provide transportation for persons who are physically unable or have visual impairments, as well as increase the effectiveness of freight transportation and traffic flow in major cities. In this approach, research teams who focus on issues related to autonomous vehicles desire a robotic platform that can function in urban settings and on highways. The numerous potentials use of this platform and the requirement to conduct tests on actual settings to validate novel intelligent robotic techniques and algorithms readily explain this goal.

The navigating became more difficult as soon as the first cars hit the roadways. The safest method to get to your destination isn't to look at a map while you're driving. Furthermore, there was a good chance that your map was out-of-date. Consequently, you found yourself stuck at a gas station next to a closed road while frantically looking for a suitable detour. Tier Avto, one of the early "navigation systems," was a dashboard-mounted device. You could update your path without using the cloud because your glowbox had all your possibilities. Maps on rolls were utilized in this system. You manually set your current position after inserting them into the gadget. A cable connected the device to the speedometer. The map marker followed your movements as you moved. However, it is debatable if we can term this system navigation. As the sole routing algorithm remained in your mind. The first map-based navigation system was released by Honda in the 1980s. In place of GPS, it used a gyroscope to calculate your location using two wires and a stream of helium. Instead of using digitized maps, the Electro Gyrocator used map overlays. Your present location could be seen as a dot on the CRT display. A 16 bit computer was used for all calculations and determining the direction of movement. It was highly pricey when compared to modern navigational systems. The price was a staggering $2,746 (hold your hats), which is equivalent to more than $7000 in today's currency.

**B. *Procedure of the project***

The study primarily covers how to move a car to its destination utilizing mobile kinematics and inverse kinematics methods. And using mobile kinematics to implement the control car function and the navigate car function. Control car has a car position variable and a turn angle variable that sets the controls of the car and turns near obstacles. CarPos which deals with the position of the car and drawn from the navigate car function turn\_angle which is also written from the navigate car i.e. navigate car and CarPos and CarOrn are used to set the orientation of the car position and turn\_angle will be returned to the control function of the car. The working of these functions will be pulled from the navigate car function. The ideal location is [0,0] to [9,-9]. And also We have used Vector Field histogram algorithm based on range sensor values, computes obstacle-free driving directions for a robot.

Diagram, engineering drawing

Description automatically generated

Fig.i

**C. *Breif Summary of the project***

The project's brief explanation focuses on navigating the car employing couple functions such as control car and navigate car using mobile kinematics and inverse kinematics functions. Where the car must detour itself when there is an object in front of it in order to reach the destination correctly, and using the carPos and CarOrn for defining the oreintation and implementing it using the provided functions before returning to the Car control function. We have utilized vector field histogram algorithm.

# Project description

## **Describe the procedure**

## We must load main.py into the newly constructed pybullet environment.

1. Following the loading of the main file, we must implement two functions titled Car control function and Car navigation function. utilizing mobile and inverse kinematics, as well as the vector field histogram technique.
2. We need to assign the CarPos and turn angle in the car control method. By default, we will assign the angle. and carPos will be taken from the car navigate function, where the turn angle function is also drawn, and there in the car navigate function we will assign the carOrn where the oreintation will be set in the car navigate. we will be assigning some velocity for the car and some default turning\_angle.
3. The vector field histogram technique will be applied in the automobile navigate function for sensor data, allowing the car to distinguish nearby objects.
4. If the sensor readings are greater than the default value, the car will turn the angle in another direction; if the sensor readings are less than the preset value, the car will travel with the default angle.
5. The vector field histogram (VFH) algorithm computes obstacle-free steering directions for a robot based on range sensor readings. Range sensor readings are used to compute polar density histograms to identify obstacle location and proximity. Based on the specified parameters and thresholds, these histograms are converted to binary histograms to indicate valid steering directions for the robot. The VFH algorithm factors in robot size and turning radius to output a steering direction for the robot to avoid obstacles and follow a target direction.
6. In this manner, the car will reach its objective by overcoming the barriers.

Diagram

Description automatically generated

Fig.ii

## **Describe the applied algorithm/methods of the project**

The algorithms we utilized to guide the automobile to its ultimate destinations are as follows. Inverse and mobile kinematics, as well as vector field histogram techniques. methods of the project carPos for the position of the car and oreintation of the car and turn\_angle is for turning the car in desired direction and sensor\_readings for sensing the objects using vector field histogram algorithm The fundamental VFH algorithm is an obstacle avoidance strategy that is not completely target-oriented. in other words In other words, it does not always guarantee that the robot will achieve the destination when employed in a given situation.  navigator. The VFH algorithm has been improved using a neural network in this work. and the Fuzzy logic algorithm to overcome the disadvantage of VFH.

Diagram

Description automatically generated

Fig.iii

## **Show the formula or equation or function of calculating the direction of travel and speed.**

Diagram

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## **Include a picture of generated environment of robot**

Graphical user interface, chart, application

Description automatically generated

Environment and robot picture

Graphical user interface, application

Description automatically generated

# results

## **Generated or planned trajectory of the robot moving in the environment**

The object is on the starting point after calculating the obstacles and in the starting position at car is in the (0,0) and then it jumped into (1,1) and (1,2) and then (2,1.5) in the 3,3 position the object is placed and by sensing the object and the car turn angle was updated and came into (3,2) and then continuously the car deviated from obstacles and successfully reached (9,-9)

## **Snapshots of successful and failed navigation**

Fig.1.

Chart, radar chart

Description automatically generatedChart

Description automatically generated

Fig.2Chart

Description automatically generated

Fig.3Chart

Description automatically generated

Fig.4Chart

Description automatically generated with medium confidence

Fig.5Chart

Description automatically generated

Fig.6

A picture containing chart

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# Discussion of results

## **Discuss the advantages and disadvantages of the designed control algorithms**

## Human mistake is to blame for 94% of accidents, resulting in a significant increase in safety.

## Reduced maintenance and expenditures.

## Greater mobility alternatives for the aged, young, and disabled

* enhanced convenience, efficiency, and dependability

### Insufficient resolution during integration

### Improper wheel alignment

### Inequality in wheel diameter

### Variation in the wheel's contact point

## **Discuss the designed trajectory of robot navigation. What are the key parameters and how are the parameters are selected**

**Key Parameters:** Sensor Indications, turn\_angle, Euler, steer, velocity.

# conclusions

By achieving the final destination with the help of mobile kinematics and inverse kinematics and sensing the obstacles with the help of vector field histogram algorithm and reaching the destination successfully we have adjusted the angle when the turning angle detects an object infront which allows to achieve the destination successfully.And outsource application of the project.Accident rates are rising as the number of autonomous vehicles increases. Traffic and speed are also factors that influence autonomous vehicles. This project taught us how to make a route navigation system, as well as how to make prototypes and get rid of Pybullet.

**video link:** [**quicktimeplayer.mov**](https://wichitaedu-my.sharepoint.com/:v:/g/personal/h992w265_wichita_edu/ESiE5JHGBVlFtyifRuRH5gMBmrQ2QJKH7AdOsashXCFGDA?e=tXnNWT)

# References

1. G. Şahin, M. Balcılar, E. Uslu, S. Yavuz and M. F. Amasyalı, "Obstacle avoidance with Vector Field Histogram algorithm for search and rescue robots," *2014 22nd Signal Processing and Communications Applications Conference (SIU)*, 2014, pp. 766-769doi: 10.1109/SIU.2014.6830342..
2. Borenstein, Johann, and Yoram Koren. "The vector field histogram-fast obstacle avoidance for mobile robots." *IEEE transactions on robotics and automation* 7.3 (1991): 278-288.

Burnett GE, Lee K. The effect of vehicle navigation systems on the formation of cognitive maps. InInternational conference of traffic and transport psychology 2005.

John Pike. "GPS III Operational Control Segment (OCX)". Globalsecurity.org. The original version was archived on September 7, 2009. Retrieved December 8, 2009.

Maki K. Habib, “Real Time Mapping and Dynamic Navigation for Mobile Robots” ,International Journal of Advanced Robotic Systems, Vol. 4, No. 3 , pp. 323-338, 2007. 2..

Borenstein, J. and Koren, Y., “Real-time Obstacle Avoidance for Fast Mobile Robots ”, IEEE Transactions on Systems, Man, and Cybernetics , Vol. 19, No. 5, pp. 1179-1187, Sept 1989

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