

# Applying Path Finding Technique of an Black Army Ants in Changing Lane of Self Learned Autonomous Car by using Agent Based Modeling

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**Abstract**—This paper presents how an Autonomous car changes its lane and reach to its destination without any collision with other cars ,we have done this research by using net logo model, this paper research took inspiration from the Brazilian black army ants path finding technique which are naturally blind and find their path by the chemical trail which are called Pheromones ,this pheromones are created by the leader ants ,we will find out how other ants follow those pheromones trails and don't collide with each other and follow the same direction by being blind. We applied this technique with an autonomous car which follows the leader cars trail and changes its lane without any collision. Trails have been created by the sensor and GPS. Those cars will have 6 sensors to avoid Collations. We think this kind of research has not been done before .so we want to present some models with Net-logo how this technique can be done in real life situation by the path finding concept.

**Index Terms**—Agent based modeling, path finding technique, rate of attraction, Finite state diagram, graph.

## I. INTRODUCTION

This Project is based on the nature technique of ants which can be applied to the autonomous car because those ants cannot see they follow their food or predator by following trails this is how an autonomous car will follow the trails without any collision and reach to its destination swiftly.

*Eciton burchellii* is a species of New World army ant in the genus *Eciton*. This species, one of the most extensively studied ant species, consists of expansive, organized swarm raids that give it the informal name *Eciton* Army Ants. The colony lives in bivouacs, which are routinely moved as the foraging paths change. The colony raids are maintained by the use of pheromones, can be 200 meters (660 ft) long, and employ up to 200,000 ants.this pheromones helps to find the raid of distract ants and it's also help to maintain the raid by following a same trails towards to food as well.

*Eciton burchellii* is polymorphic,they are blind by nature and they doesn't have smell organ the main substance is the pheromones which helps them attracts to each other . when the 1st ants leaves the nest ,it creates a chemical chain which is pheromones and leaves it to its path so that he can get

back with his food without getting lost but this pheromones also helps to the other ants to follow the path and similarly they also creates the same pheromones throughout the path . This is called a path finding technique.

The importance of this project is so much because the autonomous car can easily roam around without any GPS or sensors in the future by the help of this army ants technique. this path finding technique is so workable that a few more research and experiment can make a world changing technology .our scientist does only rely on technology research they doesn't follow the real life nature rules , this kind of nature rules can help us to identify the new way of technology .

this generation of science are accepting this kind of new technologies for the betterment of the people and the citizen,they even made rules of it so that it can move around freely and learned on his own if its developed by the AI machine learning technology.

A formal classification system for automated cars has been proposed by the National Highway Traffic Safety Administration:

Level 0: Driver has complete control of vehicle at all times.

Level 1: Some vehicle controls are automated, e.g. automatic braking.

Level 2: Two or more controls can be automated at the same time, e.g. cruise control and lane keeping.

Level 3: The driver can cede control in certain circumstances.

Level 4: Driver not expected to play any part in the driving process at all.

The world most successful software company like Google build a autonomous car in december 2016 and named it WAYMO and after few months later another car manufacture company named TOYOTA build a TOYOTA concept i car which is more advance and self learned autonomous car

Based on Google's own accident reports, their test cars have been involved in 14 collisions, of which human drivers were at fault 13 times. It was not until 2016 that the car's software caused a crash.

so from this inventions we can understand how much valuable the autonomous car is to the scientist and for the software companies even quantum scientist willing to merge together with the car manufacturer, that is how we got interest to work on autonomous car lane changing concept so that we can understand and experiment perfectly how and autonomous car and how a autonomous car will change its lane and doesn't collide with each other .

we will brief in our paper.

#### A. contribution

this paper presentation is being well organized so that scientist or other people who are interested on this topic can easily understand about our point.

We try to cover our experiment as much as we can ,we use agent based modeling in net logo so that we can see whether it is going to work or not in real life . our experiment works as we thought, because ABM is such kind of platform where we can experiment our project and we did it with the perfect eligible parameters, behavior ,size , world.

We used line graph to see the outcome of our results and we mention it in our papers. our target is to see where the autonomous changes its lane without any collation with each other and doesn't get distracted just like the path finding technique. And we also mentioned our future work in this field. Brief details of our project is in below.

## II. BACKGROUND/LITERATURE REVIEW

An autonomous car is a vehicle that is capable of sensing its environment and navigating without human input. Many such vehicles are being developed, but as of February 2017 automated cars permitted on public roads are not yet fully. No one has been yet tested by the path finding technique.

autonomous car are being treated as the most successful technology in this modern era. Because by the autonomous car concept many scientist are including some more features like brain optimization, self learned or modern delivery program on it.

There are more such topic in autonomous cars , lots of scientist is working on building in this kind of autonomous car projects.

Many of them are working on the circuit advancement, sensor development.

## III. MODEL

To initialize the whole project presentation we did modeling in Agent Based Modeling in Net logo .Thus our research was based on to see whether it changes its lane correctly or and and to see also the car configuration,so that the netlogo experiment can be applied with the worthy stuffs.so we have gone though with different experiments and result which were not so satisfactory but we have found lots of results which are so effective,we have used those experiment into our project to

see the result and it shows us the perfect way which can lead us to the final output which we were looking for .

so a brief description about model specification and Agent rules has been described below.

#### A. Model Specification

Agents will be created by Breed, which will be same ant breed so that's no other agent behavior include in the world. One will be Leader and another one will be Followers .there will be multiple leaders and multiple followers which can be control by the button in the interface section.

there are six leaders the world,the six leaders were declared in the code.it can be increased for the better results.

The world contains Nest and Food.

Nest is positioned in the world nest-x 10 + min-pxcor position and nest-y -10 position from where ants will be created.

Food is positioned in the world set food-x max-pxcor 10 position and food -y 40 positions from where ants will stop.

Agents will come out from the nest and wiggle around. wiggle angel can be increase o decrease by the button. and then it goes to the food and stop. As a leader and follower in the

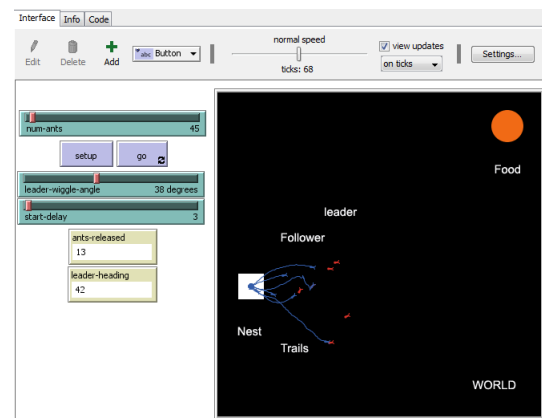


Fig. 1. Figure 1

world. Its been shown below in Figure 1 world. Leaders are colored as RED and Followers are as blue. Leaders will lead and Followers will follow those creating Blue Pheromones Trails till they reach Food. Back end ants follow the closer line trials so that they cannot get lost from the line.

#### B. Model Rules

Agents will have breed of behaviors. Agents will start from Nest and stop at food.

Wiggle angle helps follower ants to move individually here and there so that others follower ants face difficult to find trails. This creates a rough trails in the world and other ants attracts, but this wiggle angle also helps to identify the distract rate of ants so that we can find it gets lost or not. Leader will follow to the food and followers will follow the leaders by creating pheromones or lane trails. Number ants can be increase or decrease by the Num Ants button. We can also decrease or increase the start time delay by other button.

Which is also shown in the figure 1 .This will be the Agent behavior throughout the project.

#### IV. EXPERIMENT RESULT

We took line graph to see the results with individual numbers and rating of the agents so that we can find the attract and distract rate corresponding with the inter agent distance .this experiment bring us to the edge of the research so Let's take a Line graph ( figure 2) where X-axis is Num Ants and Y-axis is distance(meter) from Nest to food.

Distance from nest to food measured by Meter 0,1,2,3,4,5,6 and the population of Ants(Num Ants)was measured corresponding by the numbers.

Blue line in the graph is Distance from each other Ants which is called inter agent distance.

Red line is Density of Ants(agents) and Green line is Distract Rate of ants from each other.

so when distance is 1 meter from the nest, their density and distance are same that's why their distract rate is low but when distance is high density is low their distract rate become high.

Meter	Inner Distance	Density	distract rate
0	23	44	55
1	33	55	55
2	54	55	77
3	67	67	89
4	89	88	98
5	99	89	120
6	130	99	140

Fig. 2. Numerical Range

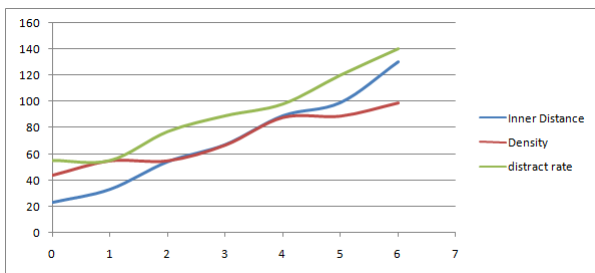


Fig. 3. Figure 1

If the inner distance range is high the distract rate will also be high.

here is the Numerical range and Graphical outlines of each outcomes .

So this experiment shows us that the high range of density has the high chance not to distract but if distance is high or too far then the rate of distract increase and it can collapse or collide with other agent .

#### V. APPLICATION ON AUTONOMOUS CAR

Driver-less cars sense their surroundings using technology such as lidar, radar, GPS, and computer vision.

The sensory information is then processed to navigate appropriate pathways for the vehicle to take, avoiding any obstacles and also obeying the road signs.

The car uses a digital map, which can be constantly updated according to sensory input. This allows the vehicle to adapt to changing situations, as well as travel through previously unknown territories.

Just like a human, self-driving cars need to have sensors to understand the world around them and a brain that collects, processes and chooses specific actions based on information gathered.

The same goes for self-driving cars, and each autonomous vehicle is outfitted with advanced tools to gather information Autonomous car have 8 sensors front ,left and right front,back,left and right back,left and right middle.

Including

1)Long range radar

2)Park assistance

3)GPS

4)LIDAR

5)Sensor Camera

6)Artificial Intelligence based Programmed machine Learning

Artificial Intelligence has many applications for these vehicles; among the more immediate and obvious functions:

a) Directing the car to a gas station or recharge station when it is running low on fuel.

b) Adjust the trips directions based on known traffic conditions to find the quickest route.

c) Incorporate speech recognition for advanced communication with passengers.

d) Eye tracking for improved driver monitoring.

e) Natural language interfaces and virtual assistance technologies.

recently the world most successful software company like Google build a autonomous car in December 2016 and named it WAYMO and after few months later another car manufacture company named TOYOTA build a TOYOTA concept i car which has the YUI programmed artificial intelligence and more advance and self learned autonomous car. This is designed by following those equipment.

##### A. Advantages

a) Without the need for a driver, cars could become mini-leisure rooms. There would be more space and no need for everyone to face forwards. Entertainment technology, such as video screens, could be used to lighten long journeys without the concern of distracting the driver.

b) Travelers would be able to journey overnight and sleep for the duration.

c) Traffic could be coordinated more easily in urban areas to

## VI. FUTURE WORKS

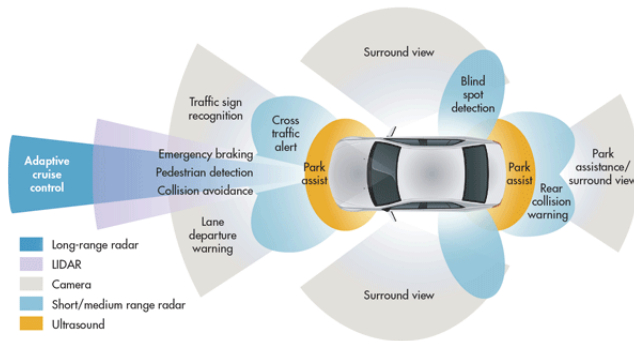


Fig. 4. Figure 1

prevent long tailbacks at busy times. Commute times could be reduced drastically.

d) Reduced or non-existent fatigue from driving, plus arguments over directions and navigation would be a thing of the past.

e) Sensory technology could potentially perceive the environment better than human senses, seeing farther ahead, better in poor visibility, detecting smaller and more subtle obstacles, more reasons for less traffic accidents.

f) Speed limits could be increased to reflect the safer driving, shortening journey times. Parking the vehicle and difficult maneuvering would be less stressful and require no special skills. The car could even just drop you off and then go and park itself.

g) Autonomous vehicles could bring about a massive reduction in insurance premiums for car owners.

h) Efficient travel also means fuel savings, cutting costs. Reduced need for safety gaps means that road capacities for vehicles would be significantly increased.

i) Passengers should experience a smoother riding experience. Self-aware cars would lead to a reduction in car theft.

### B. Advantages of using Pathfinding technique

a) learning fast how to avoid collision and find the best way.

b) changing the lane smoothly and swiftly

c) changing the lane on worst case scenario like JAM , huge traffic.

d) self learning experience .

e) Decision making in every situation using AI .

There are some disadvantages too which should not be neglected because besides advantages we should also focus of the project disadvantages too.

1) Truck drivers and taxi drivers will lose their jobs, as autonomous vehicles take over.

2) Driver-less cars would likely be out of the price range of most ordinary people when generally introduced, likely costing over 100,000 dollar or more than that.

3) Machine Malfunction can occur real life worst case scenario.

4)

Recent scientist have already created lots of autonomous cars with advance facilities and equipment which took the usage of technology in whole new level in the science world. They included lots of feature ,these are the top most main technology equipment which they used in the autonomous car.

Domi is as autonomous car living room , it can have both car and living room facilitated automated system , which have the different and unique technologies including artificial intelligence on it.

These days, its easy to fall into the trap of thinking that anything really important in tech only happens in the cloud. After all, thats where all the excitement, investment and discussion seems to be. And there are indeed innumerable efforts to not only build software for the cloud, but also to use the cloud to completely reinvent companies or even industries.

As important as these cloud-based developments may be, however, they shouldnt supercede many of the equally exciting capabilities being brought to life on the edge of todays networks. While these endpoints, or edge devices, used to be limited to smartphones, PCs and tablets, theres now an explosion of new options for creating, manipulating, viewing, analyzing and storing data. From VR headsets to smart digital assistants to intelligent tractors, the range of edge devices is enormous and shows no signs of slowing down anytime soon.

we are creating more way of scope to enhance the box and think for the betterment of the people , we are still working on the concept which can show you the results of not having error or miss calculated algorithm function .

more country is supporting on driverless cars that is why there countries like Florida California,Michigan,Nevada

In 2015, two more states are set to join the four above: Washington D.C,Virginia

this brazillain black ants concepts leads us to a new concept of building a autonous which can even fly and swim under water freely without any obstacle or problems

The most important thing for people to realize is that consumers are worried that autonomous driving is not safe. It will be safe, confirms Winter.

At its core, Artificial Intelligence is a complex algorithm that mimics how the human brain learns. Instead of hard-coding an autonomous car with thousands of If-Then statements, software engineers create an algorithm that outlines to the cars onboard computers various examples of what is right, wrong, safe, and unsafe for the car to perform.

This type of approach to automotive engineering may seem counter-intuitive, but in reality, artificial intelligence algorithms are the only solution to the dynamic driving conditions of public roads.

Self-driving cars are rapidly evolving as we see unimaginable innovation in hardware, software, and computing capabilities.

However, as we progress toward advanced automobiles, one of the limiting factors restricting the growth of this field is Artificial Intelligence and machine learning.

Unless autonomous cars can interpret the many types of objects and situations surrounding them, they can't make adequate decisions. Instead of developing millions of rules, a sophisticated learning algorithm needed to develop and standardized across the industry.

In the future car development we think our project should help to create a self optimized autonomous car .This path finding technique of black army ants are incredible and surprising so this can make changes to the autonomous car industry we think .so that's why we are giving our project research so much importance.

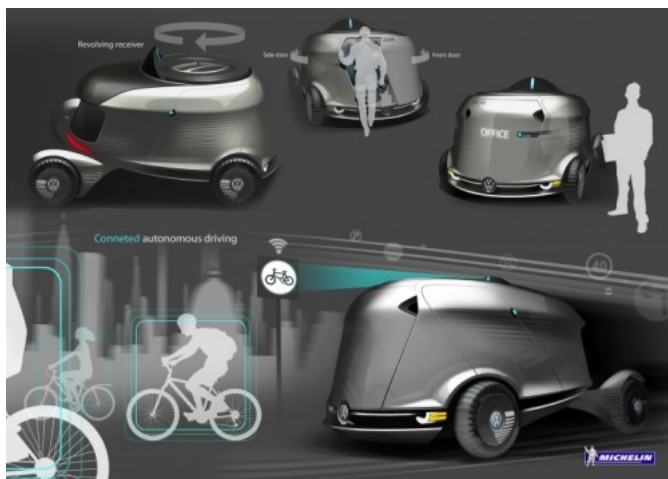


Fig. 5. Figure 1

## VII. CONCLUSION

By doing all that experiment in net logo with agent based modeling we came with a decision that if we apply this path finding technique in automated it could be a big success in this century. because no one has been applied this blind black army ants path finding technique in the autonomous cars .They use to run the autonomous car by GPS and sensors cameras but not with this kind of technique .

Google's vehicles have traversed San Francisco's Lombard Street, famed for its steep hairpin turns, and through city traffic. The vehicles have driven over the Golden Gate Bridge and around Lake Tahoe. The system drives at the speed limit it has stored on its maps and maintains its distance from other vehicles using its system of sensors. The system provides an override that allows a human driver to take control of the car by stepping on the brake or turning the wheel, similar to cruise control systems already found in many cars today.

As of 28 August 2014, according to Computer World Google's self-driving cars were in fact unable to use about 99 percent of US roads. As of the same date, the latest prototype had not

been tested in heavy rain or snow due to safety concerns. Because the cars rely primarily on pre-programmed route data, they do not obey temporary traffic lights and, in some situations, revert to a slower "extra cautious" mode in complex unmapped intersections. The vehicle has difficulty identifying when objects, such as trash and light debris, are harmless, causing the vehicle to veer unnecessarily. Additionally, the lidar technology cannot spot some potholes or discern when humans, such as a police officer, are signaling the car to stop. Google projects plan on having these issues fixed by 2020.

In January 2016, U.S. Transportation Secretary Anthony Foxx unveiled new policy that updates the National Highway Traffic Safety Administration's (NHTSA) 2013 preliminary policy statement on autonomous vehicles. This announcement was made at the North American International Auto Show in Detroit in conjunction with a commitment of nearly 4 billion dollar over the next 10 years to accelerate the development and adoption of safe vehicle automation. The new policy is designed to facilitate and encourage the development and deployment of technologies with the potential to save lives. Within six months, NHTSA will propose guidance to industry on establishing principles of safe operation for fully autonomous vehicles.

world is changing day by day, more people rely on the technology rather than the physical activities. This technology can be very much helpful and can be disaster either. This kind of technology ring the most of the change into the real life scenario because more software companies like Google , Apple wants to take over the car companies so that they can give their best support to brand them and can reach to the high level of the industry as well.

so if we do more research and experiment in this field we think we can achieve more astonishing stuffs for the smart cities of the new world citizens .hope this paper presentation helps people to get attracted in this kind of fields and share their opinion to the world . Because world is our we need to change as we want.

## ACKNOWLEDGMENT

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