Intelligent Path Planning for Robots and Practical Implementation of Programmable Headlights for Autonomous Vehicles

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Abstract

The ability to move is essential for the development of intelligent robots for autonomous navigation. Neural networks outperform traditional methods in modeling complex relationships and identifying patterns, but current systems are limited to specific robots and sensors. This paper presents a universal method for interpreting data from different 2D sensors, predicting distances between robots and walls, and using neural networks for navigation. The goal is to create a versatile algorithm that can be applied to different robots and programmable lamps, reducing accidents. The thesis also explores programmable lamps that block light from reaching the eyes of passengers, using one network to determine free space using odometry data and another to find safe paths while avoiding obstacles. Simulated path examples will be presented.

Keywords: Arduino, Artificial Intelligence (AI), Finds, Findpath, VFH, RBF .

1. Introduction

A robotic system that is mobile is referred to as a robot. In addition, he qualifies as fully independent if he is built to complete any task without the assistance of a person. In the interim, every operation carried out with outside or public aid Reduce the robot's autonomy with an external tool. These interventions can be carried out remotely, provide access to the entire environment, or only a portion of it that isn't on board the robot [1].

In this study, a robotic path finding projector and the algorithms used on lamps will be built and applied as a new innovation by directing the light beam towards the road. These developments began with gas and oil lamps in previous centuries, and they have a lifespan, but the problem is that they were bright in a way that affected other drivers. These modern sources provide bright and comfortable color temperatures, which enhances the driving experience. However, despite the advances in lighting technology, the only option currently available to most drivers is to switch between high and low beams [2], High beams also greatly reduce contrast in fog and mist, and cause distracting bright streaks in rain. Even after 130 years of headlight development, more than half of all vehicle and traffic accidents occur at the same time.

2. Methodology

This paper presents a control strategy based on the idea of robotic trajectory tracking and the calculated torque method. The simulation module designed in this project consists of two separate three-layer neural networks, one of which is used to calculate the mass matrix of the manipulator estimated by the used algorithm, and the other network is also trained to calculate the estimated centrifugal torque vector. These results will be used in the process of determining the light path of programmable lamps and determining the light direction. The simulation results also demonstrate the ability of the proposed control simulation to learn the nonlinear dynamics of the manipulator using the RBFN algorithm and Vector Field Histogram and was able to force the final effect to follow the desired position path in the XY plane. However, the typical learning speed of the controller can be considered fast Finite-State Machine [3].

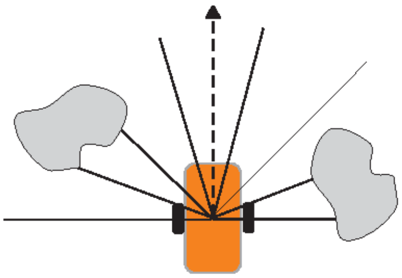

Fig.1. Polar graph used in VFH algorithm

In (Fig.1) a real-time obstacle avoidance method for mobile robots was described. This method, called vector field graph (VFH), allows detecting unknown obstacles and avoiding collisions while simultaneously guiding the mobile robot towards the target. In this stage, we will take advantage of this previously built technique and apply it to programmable lights by avoiding collisions with "air dust" or falling snow through the existing camera system which first detects all particles by illuminating them in a very short period of time, their future positions are predicted, and then the rays intersecting them are interactively turned off. The time between image capture and interactive illumination is the system latency.

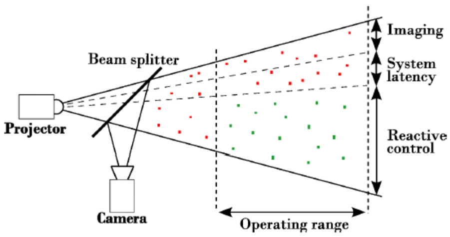

Fig.2. Using path finding technology in the lamp programming and light path determination process

We demonstrate using quantum simulations that the light production rate of an ideal system is not significantly affected by a wide range of precipitation types and rates. Based on the lessons learned from the simulations, Fig. 2 shows a prototype of the system and describe the trade-offs between the algorithm used, hardware speed, achievable light production rate, and accuracy needed to make the system viable as automotive head lights [4].

Figure (Fig.3) shows how the system works and how the light is blocked from other cars.

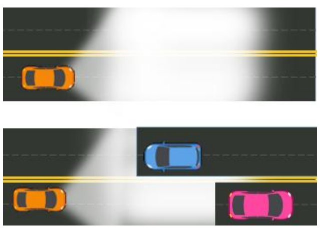

Fig.3. Using pathfinding technology

3. The Prototype

The glare from headlights, particularly high beams, of oncoming vehicles is at best a major distraction and at worst a temporary blindness. Trucks and other vehicles with high-mounted headlights are among the worst offenders. Although glare is not often considered a major cause of accidents, hundreds of fatal nighttime crashes are attributed to it as a contributing factor each year, as shown in (Fig.4). Glare is a particular problem for older adults, who often take longer to recover from the glare than a 16-year-old while high beams are a nuisance to other drivers, they are helpful on narrow, winding, poorly lit roads, especially in rural areas where wildlife routinely crosses the road [5] .

Fig. 4. Prototype and Control Process of Programmable Headlights

The programmable headlight can be controlled with such high spatiotemporal resolution that light rays directed towards any driver in any number of lanes can be disabled to prevent glare. The precision and speed of our beam control is several orders of magnitude better than existing LED based headlights.

Vehicles are recognized and the lighting is removed from the limited areas around drivers or the eyes of drivers of vehicles in front of the vehicle while maintaining lighting in other areas. This will allow drivers to use the high beams without worry. The center row shows the vision while driving towards the prototype. Reduced glare when the anti-glare feature is activated in our headlights. Anti-glare headlights allow the driver to see other vehicles on the road better. Glare in the rearview mirror from a vehicle coming from behind will not affect the driver while driving, and the taillights are detected to avoid illuminating the rearview mirror.

4. Neural Research methodology

Neural networks have been at the forefront of growth in recent years due to their versatility, opportunities and most importantly their dynamic nature. A robot path simulation system for path planning with the help of neural networks has been proposed as a comparative study. Various parameters such as training time, network performance and expected distance are taken into account after iteration to obtain the optimal dataset using probabilistic roadmap algorithm [6] .

The parameters from the simulation system are taken and the performance of the robot path determination process is applied in the process of determining the path of light emitted from standard car headlights which improves the driver’s vision at night by illuminating the road and the surrounding environment and disabling the light beams directed towards any driver on the road (other cars coming the opposite way) allowing the high beams to pass without any noticeable difference to the drivers on the road.

5. System Architecture

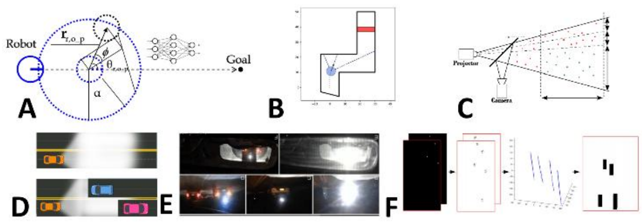

Fig.5. At night, fog and rain appear as a shimmering (distracting) pattern that reduces the driver's visibility while driving (top). We propose an interactive system (bottom) that deactivates light rays that only intersect with particles such as raindrops, snow and hail, reducing the visual impact of precipitation.

A: In this step, the system simulator is programmed and prepared, where the path detection algorithms are trained and the robot path is determined, which in turn will be used in the process of determining the light path using programmable lamps. Here, we will create a system using the Python language, through which the algorithms used in the hybridization process will be determined, which we will use the parameters in step B.

B: After taking the parameters from the previous step, we train the neural network here, which in turn will determine the path of the robot and its launch from the starting point to the target point according to the path that will be determined by the parameters and by the neural network that was previously trained. After that, the process of taking the training results resulting from this step and applying them to the system will determine the light path in the next step.

C: The training results from the previous step will be fed into the controller used in the current system, which will determine the path of the headlights of standard cars, which in turn can improve the driver's vision at night by illuminating the road and the surrounding environment. It will block the path of light directed at other drivers, which reduces driver fatigue and makes roads safer. This is done according to a set of sensors and tools connected to each other and using more than one smart controller with artificial intelligence techniques, which will give tangible results, making the device a real innovation and this approach is applicable and effective.

E: In (Fig.5)(E), Imagine driving at night in heavy rain. Sparkling raindrops, drizzle, and foggy windshields all contribute to poor visibility, making the driving experience uncomfortable at best and dangerous at worst. We present a sophisticated imaging and illumination system that reduces light reflections to the driver, as well as the scattered light that affects nearby and oncoming drivers [7].

F: In (Fig.5)(F),We do this work in building an integrated system through which the process of building a more advanced system is done, where in this step we create a system that determines the path of light using path determination techniques so that when it rains or fog forms, this technology will penetrate the path of fog and make the vision clearer while driving as in (Figure 6), which enhances the current innovation as a new technology in applying path planning (Fig.6) and applying this technology to programmable lights[8].

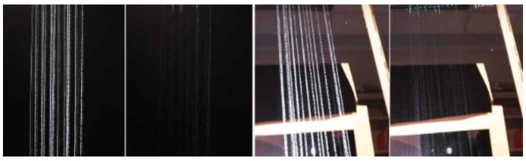

Fig.6. The diamonds falling from a place as a substitute for rain were illuminated by a halogen light and photographed for comparison at different distances. The graph shows that the water droplets are invisible.

6. Experiment Results

Computer simulation results for anti-glare headlamps. Detection and prediction are assumed to be perfect, and vehicles are moving toward each other in two-lane roads at a relative speed of 170 km/h.

. Left: Light transmission rate as a function of distance between vehicles during different time periods of the system as in (Fig.7). Right: Light transmission rate for DMD-based and LED-based anti-glare headlamps at different time periods. Simulations show that shorter transition times and higher resolution results in higher light transmission rates and better resolution, which will be especially important on winding, multi-lane roads with multiple vehicles [9].

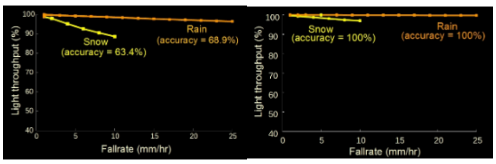

Fig.7. Results of computer simulations The figure shows the system features compared to the time of light particle transmission, updates and initialization frames.

7. Conclusion

Automotive headlights should not be devices that can be either fully on or off. They should adapt to the surrounding conditions for safety during times of good visibility. Adjustable headlights should not be limited to a single task. They should perform several different functions to support the driver in diverse road conditions. The prototype here gives our headlights unprecedented control over the direction and timing of the light. It has been demonstrated that headlights are flexible and suitable for many tasks: allowing high-beam driving without disturbing other drivers. We need to develop a more advanced algorithmic and software hybridization process before bringing our headlight design to market.

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Authors Introduction

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From Iraq, Basra, a university professor at the University of the Multaqa Al Nahrain , he is a computer engineer and a current PhD student, as well as an experienced professional in web and mobile application development, specializing in robotics, artificial intelligence, the Internet of Things, and emerging innovations. With a degree in robotics from Stanford University and patents in artificial intelligence and microchip innovation, he is a recognized expert in this field. The author of 8 scientific books, Farkad has showcased his expertise globally through seminars, conferences, and platforms such as TEDx, Stars of Science, and EXPO. He was selected as one of the Arab Youth Pioneers in the Emirates, and was also selected in Forbes Middle East magazine. In addition to his skills, he is also talented in drawing, mechanical engineering, and architecture, reflecting his diverse abilities and commitment to spreading knowledge and innovation. linktr.ee/farkadadnan

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