Intelligent Driving System Using Artificial Intelligence

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Abstract-The project aims to build a monocular vision autonomous car prototype using Raspberry Pi as a processing chip and Arduino as a hardware interface. An HD camera coupled with an ultrasonic sensor is utilized to facilitate required data from the real world to the car. Avoiding possibilities of accidents and other human errors, the car can commute from one place to another in an intelligent and safe manner. Many existing algorithms like neural networking, deep learning and machine learning are combined together to provide the necessary control to the car. The main reason to use machine-learning algorithms in this project is to involve the basic functions and methodologies of AI. Here, literacy in AI and computer science will become as crucial as classic literacy such as reading or writing. By implementing parallelism with this process, we developed a new AI concept in order to uphold AI literacy. The concept comprises modules for different age groups on different educational levels. Fundamental AI/computer science topics addressed in each module are, amongst others, problem solving by search, sorting, graphs and data structures.

I. INTRODUCTION

The Intelligent Driving System, as the name suggests, is an intelligent system that combines multiple technologies to make the driving experience safer. Prevention is better than cure and the primary focus of the Intelligent Driving system[1] is to avoid danger and try to prevent collisions with other cars, people or objects. The next line of defense is to actively master difficult situations with the car. When it is too late to prevent an accident, the system helps to mitigate the consequences of accidents for all road users. The system includes active blind spot assistance, active lane keeping assistance, Pre-Safe Brake[2], Sign Detection and Attention Assist[2].The intelligent driving system has three integrated radar systems for short, medium and long distances. When other cars are dangerously close, a warning signal will go off to alert the driver. The system helps keep drivers a safe distance from other cars. It can also detect if a driver's hands are on the wheel and set off a warning signal if they are not. If a rear-end collision is imminent, a warning sound will automatically go off and passenger seats will automatically adjust for the optimal position to avoid whiplash, the car's brakes will automatically slow down the car to prevent a collision with the car in front.

The brake system[2] is equipped with sensors that monitor objects[3] and people outside the car and identifies those that are in danger of colliding with the car. The brake pressure is automatically adjusted to compensate for both the driver's excessive or insufficient pressure in order to bring the car to a stop just before it hits the object and autonomous full braking is activated if the driver fails to react. Assisted systems like the Intelligent Driving system is not an autonomous system that takes control from the driver. However, there may be moves towards more semi-autonomous and even fully autonomous cars in the future.

II. LITERATURE SURVEY

In this section, the existing work on autonomous car driving are surveyed the advantages and limitations. The following papers have been analyzed and studied in order to develop an effective autonomous car driving.

A. Autonomous RC Car Using Neural Network and Deep Learning[1]

The project aims to build a monocular vision autonomous car prototype using Raspberry Pi as a processing chip and Adriano as a hardware interface. An HD camera coupled with an ultrasonic sensor is utilized to facilitate required data from the real world to the car. Avoiding possibilities of accidents and other human errors, the car can commute from one place to another in an intelligent and safe manner. Many existing algorithms like neural networking, deep learning and machine learning are combined together to provide the necessary control to the car. Here Object recognition algorithm is used which consists of digital image features that are also called Haar like features. The features get their name from their intuitive similarity with Haar wavelets and were used in the first real-time face detector. A collaboration with an alternate feature set based on Haar wavelets instead of the usual image intensities was stated in the publication by Papa georgiouetal. Viola and Jones adapted the idea of using Haar wavelets and developed this algorithm. This algorithm mentioned above deals with adjacent rectangular areas at a certain location in a detection window. It adds up the pixel intensities in each area and calculates the difference between these sums. This difference is then used to differentiate subsections of an image. For example, suppose say we have an image database with human faces. It is a general observation that in all the given faces, the area of the eyes is darker than the area of the cheeks. Hence, face detection consists of a regular Haar feature which is a set of two adjacent rectangles that are positioned above the eye and the cheek area. The rectangles are in a position with respect to the detection window that acts like a bounding box to the target object. In this case the target object is the face.

B. The Efficiency of PRE-SAFE Systems in Pre-braked Frontal Collision Situations[2]

In a real accident situation, conditions could, however, be different. In accident situations, passenger car occupants are already exposed to lateral or longitudinal acceleration forces resulting from emergency braking or skidding. These accelerations lead to occupant displacements and thus to situations in which occupants are no longer in their initial positions when the collision occurs. This naturally affects the protective efficiency of the restraint systems. The development of modern systems to prevent accidents or reduce their severity will cause such situations to occur much more frequently in the future. Autonomous emergency braking systems accordingly reduce the impact energy on the one hand, but have a considerable influence on the occupants' interaction with the car on the other hand.

C. Development of pre-crash safety system with pedestrian collision avoidance assist[3]

A new pre-crash safety (PCS) system with pedestrian collision avoidance assist has been developed. This system is capable of detecting both vehicles and pedestrians, and helps the driver to avoid a collision by automatically braking the vehicle by up to 40 km/h, one of the highest rates of deceleration for a PCS system in the world. Pedestrian detection is enabled by a sensing system that combines millimeter wave radar and a stereo camera. This system is capable of stable object detection regardless of day or night. At night, the system uses near infrared projectors to enhance the detection performance of the camera. This paper describes the core technology for achieving this system, including brake control technology for decelerating the vehicle by up to 40 km/h to help avoid a collision, and recognition technology capable of detecting pedestrians walking quickly across a road. The collision avoidance brake control technology achieves higher and more accurate deceleration than conventional systems, and is robust against variations in brake effectiveness. These variations are suppressed by the control algorithm, which uses the distance to the object and the deceleration as feedback parameters. As a result, the target deceleration performance may be achieved even under certain conditions of brake effectiveness variation.

D. Advanced Driver Assistance Systems[4]

A lane departure warning system (LDWS) is defined as system that warns the driver when an unintentional lane departure is about to occur. This system can assist drivers to maintain proper driving within the lane and also warn the driver when the vehicle is departing from current lane so that driver is alerted to take appropriate action. To demonstrate our system, we developed a prototype which completely depends on image processing algorithms. To analyze the computer vision, image processing algorithms are necessary. All algorithms are developed with minimum dependency on OpenCV which is an open source computer vision library by Intel. Edge detection plays a vital role in Lane departure warning system, through which lanes are detected. The algorithm adopted for this process is the canny edge detection algorithm. To make the output more precise, morphological operations are carried out over edge detected output.

E. Autonomous cars[5]

There seems to be a lot of potential for autonomous cars are it transport or research. But the key lies in the safe implementation of this technology. And safe implementation can only be done by applying stringent rules and standards. As it takes a lot of time for people to trust a completely new technology and one single accident can completely bring down the reputation of this industry. On the other hand this technology will be very handy in solving many traffic related problems such as parking and traffic congestion, accidents by considerably reducing the travel stress. For military purpose autonomous cars can be a boon. It can considerably reduce the casualty, can play vital role in search operations, clearing mines and providing supplies to troops.

With increase in electronics and computerization of the cars there is more concern of cyber-attacks. There should be proper fail safe plans if the cars are lost from the grid or connection is lost with the controller. Keeping the high cost of sensors and equipment's used in Autonomous cars more research should be done to introduce new technologies by which this cost can be brought down. This can also be a big challenge.

F. Self Driving Cars: A Peep into the Future[6]

The functionality of the entire system is divided into obstacle sensing, locomotion, traffic light detection, information to the user and the navigation of the car. The driverless car will help eliminating accidents. Since it is powered by green energy, it will not contribute pollution and global warming. The energy source is renewable and will not face problem due to scarcity of conventional fuel in future.

III. ISSUES IN EXISTING SYSTEM

Self-driving vehicles are the future of the highways, back roads and streets of the world. The only question is whether or not we can all expect to go along on a bumpy ride while the technology is being rolled out. There are many scenarios that self-driving vehicles just aren't ready to overcome yet. How far away are we from perfect self-driving automobiles? Take a look at the five problems self-driving cars need to overcome before they can become mainstream products.

1. They Won't Work Until Cars Are as Smart as Humans

Computers have nowhere near human intelligence. On individual tasks, such as playing Go or identifying some objects in a picture, they can outperform humans, but that skill does not generalize. Proponents of autonomous cars[5] tend to see driving as more like Go: a task that can be accomplished with a far-lower-than-human understanding of the world. "Human driving will probably disappear in the lifetimes of many people reading this, But it is not going to all happen in the blink of an eye."

2. They Won't Work, Because They'll Get Hacked

Every other computer thing occasionally gets hacked, so it's a near-certainty that self-driving cars will be hacked, too. The question is whether that intrusion—or the fear of it— will be sufficient to delay or even halt the introduction of autonomous vehicles[5]. The obvious counterargument is that data lapses, hacking, identity theft, and a whole lot of other things have done basically nothing to slow down the consumer internet. A lot of people see these problems and shrug. However, the physical danger that cars pose is far greater, and maybe the norms developed for robots will be different from those prevalent on the internet, legally.

3. They Won't Work as a Transportation Service

Right now most companies working on self-driving cars are working on them as the prelude to a self-driving-car[6] service. So you wouldn't own your car; you'd just get rides from a fleet of robo-cars maintained by Waymo or Uber or Lyft. One reason for that is the current transportation-service companies can't seem to find their way to profitability. In fact, they keep losing insane amounts of money. Take the driver out of the equation and maybe all of that money saved would put them in the black. At the same time, the equipment that's mounted on self-driving cars to allow them to adequately convert physical reality into data is extremely expensive. Consumer vehicles with all those lasers and computers on board would be prohibitively expensive. On top of that, the question of calibrating and maintaining all that equipment would be entrusted to people like me, who don't wash their car for months at a time.

4. They Won't Work, Because You Can't Prove They're Safe

Commercial airplanes rely heavily on autopilot, but the autopilot software is considered provably safe because it does not rely on machine-learning algorithms[3]. Such algorithms are harder to test because they rely on statistical techniques that are not deterministic. Several engineers have questioned how self-driving systems based on machine learning could be rigorously screened. Regulators will ultimately decide if the evidence that self-driving-car companies such as Waymo have compiled of safe operation on roads and in simulations meets some threshold of safety. More deaths caused by autonomous vehicles, such as an Uber's killing of Elaine Herzberg, seem likely to drive that threshold higher.

5. They'll Work, But Not Anytime Soon

Last year, Ford announced plans to invest $1 billion in Argo AI, a self-driving-car company. So it was somewhat surprising when Argo's CEO, Bryan Salesky, posted a pessimistic note about autonomous vehicles on Medium shortly after. "We're still very much in the early days of making self-driving cars a reality," he wrote. "Those who think fully self-driving vehicles will be ubiquitous on city streets months from now or even in a few years are not well connected to the state of the art or committed to the safe deployment of the technology."In truth, that's the timeline the less aggressive carmakers have put forth. Most companies expect some version of self-driving cars in the 2020s, but when within the decade is where the disagreement lies.

6. Self-Driving Vehicles Will Mostly Mean Computer-Assisted Drivers

While Waymo and a few other companies are committed to fully driverless cars or nothing, most major carmakers plan to offer increasing levels of autonomy, bit by bit. That's GM's play with the Cadillac Super Cruise. Daimler, Nissan, and Toyota are targeting the early 2020s for incremental autonomy.

7. Self-Driving Vehicles Will Work, But Make Traffic and Emissions Worse

And finally, what if self-driving works, technically, but the system it creates only "solve[s] the problem of 'I live in a wealthy suburb but have a horrible car commute and don't want to drive anymore but also hate trains and buses,'" as the climate advocate Matt Lewis put it. That's what University of California at Davis researchers warn could happen if people don't use (electric-powered) self-driving services and instead own (gasoline-powered) self-driving cars[6]. "Sprawl would continue to grow as people seek more affordable housing in the suburbs or the countryside, since they'll be able to work or sleep in the car on their commute," the scenario unfolds. Public transportation could spiral downward as ride-hailing services take share from the common infrastructure. It would certainly be a cruel twist if self-driving cars managed to save lives on the road while contributing to climate catastrophe. But if the past few years of internet history have taught us anything, any technology as powerful and society-shaping as autonomous vehicles will certainly have unintended consequences. And skeptics might just have a handle on what those could be.

IV. PROPOSED MODEL

The project will work on a simple RC car and with many modification make it an autonomous car model. The input should be received by Raspberry PI through camera (visual) and sensors (physical).

Important Modules and Algorithms

1. Modules.

- Raspberry PI 3 model B+
- Arduino UNO MEGA 3
- PI Camera
- System

2. Algorithm.

Cascade Classifier (HaaropenCV)

Object recognition consists of digital image features that are also called Haarlike features.The features get their name from their intuitive similarity with Haar wavelets and were used in the first real-time face detector.

A collaboration with an alternate feature set based on Haar wavelets instead of the usual image intensities was stated in the publication by Papageorgioueal. Viola and Jones adapted the idea of using Haar wavelets and developed this algorithm. This algorithm mentioned above deals with adjacent rectangular areas at a certain location in a detection window. It adds up the pixel intensities in each area and calculates the difference between these sums. This difference is then used to differentiate subsections of an image. For example, suppose say we have an image database with human faces. It is a general observation that in all the given faces, the area of the eyes is darker than the area of the cheeks. Hence, face detection consists of a regular Haar feature which is a set of two adjacent rectangles that are positioned above the eye and the cheek area. The rectangles are in a position with respect to the detection window that acts like a bounding box to the target object. In this case the target object is the face.

During detection phase of the Viola Jones object detection framework, a window of the size of the target is moved over the input image. For each subsection of the image, the Haar-like feature is calculated. This difference is then tallied with a learned threshold that differentiates non-objects from objects.

This type of Haar-like feature is just a weak learner or classifier which means that its detection quality is just a little better than random guessing. Therefore, a huge quantity of Haar-like features are needed to describe an object with sufficient accuracy. The Haar-like features are hence, arranged in a classifier cascade in the Viola Jones object detection framework in order to generate a strong learner or classifier. The key plus point of a Haar-like feature over most other features is its calculation speed. A Haar-like feature of anysize can be calculated in constant time (2- rectangle feature requires roughly 60 microprocessor instructions) due to the usage of integral images.

V. EXPECTED RESULT

The prediction on the testing samples returns an accuracy of 85% compared to the accuracy of 96% than that of the training samples. In actual driving situation, predictions are generated about 10 times a second (streaming rate roughly 10 frames/s).For the aspect of distance measurement, the ultrasonic sensor is only used to determine the distance to an obstacle in front of the RC car and provides accurate results when taking proper sensing angle and surface condition into considerations. PI camera provides good enough measurement results (i.e if we know the accurate or actual distance ,we will have a sense to stop the RC car). The accuracy of the distance measurement could be influenced by the following factors

- errors in actual values measurement
- object bounding box variation in detecting process
- errors in camera calibration process
- non-linear relationship between distance and camera co-ordinates the further distance,

The more rapid change of camera co-ordinate, thus the greater the error. Overall, the RC car could successfully navigate on the track with the ability to avoid the front Collision and, respond to stop sign at traffic light accordingly.

VI. CONCLUSION

As more cars involved in the road, car accidents rates are increasing. An alert system has been developed to combat this issue. The “Intelligent Driving System Using AI” consists of a great collection of functions such as Active Blind Spot Assist[3] – which can warn driver if it detects a car in driver’s blind spot, Attention Assist[2]- it will be designed to alert driver when they begin showing signs of fatigue behind the wheel and Lane Keeping Assist[2]- it will stop driver drifting across into other traffic. With these potential functions in “Intelligent Driving System” we can improve driver’s behavior and decision making, thus we can reduce car accidents.

REFERENCES

[1] Autonomous RC Car Using Neural Network and Deep Learning-Amita Jajoo, Akarsh Kapasi, Anup Kalyanshetti, B Niket(2018)

[2] The Efficiency of PRE-SAFE Systems in Pre-braked Frontal Collision Situations- Prof. Dr. Rodolfo Schoeneburg,Karl-Heinz Baumann,Michael Fehring(2013)

[3] Development of pre-crash safety system with pedestrain collision avoidance assist - Hideaki Hayashi, Ryo Inomata, Takeshi Nanami(2013)

[4] Advanced Driver Assistance Systems – L&T Technology services(2015)

[5] Autonomous vehicles: the future of automobiles-Rajasekhar MV, Anil Kumar Jaswal(2016)

[6] Self Driving Cars: A Peep into the Future: T.Banerjee, S.Bose, A.Chakraborty, T.Samadder,Bhaskar Kumar, T.K.Rana(2017)