Ox car-An autonomous car

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***Abstract*- The objective is to develop a semi-autonomous vehicle that can detect obstacle, generate a map of unknown environment and find path from generated map. The vehicle is equipped with several sensors to sense whether there is obstacle or not. It continuously sends information collected by sensors to controller via wireless communication module. The controller analyzes information from sensor, formulates corresponding plans, makes appropriate decision and sends instructions to the car. The car actuator drives the car to the direction according to the controller acknowledgment. Thus, it can find obstacle free path. The vehicle is tested with varying destination places in indoor and outdoor environments containing stationary as well as moving obstacles and is found to perform automatic action and generate a map of the unknown place with the help of AI.**

I. INTRODUCTION

Since Turing (1950), the dream of artificial intelligence (AI) research has been the creation of a “machine that could think”. While current expert consensus believes the creation of such a system to still take several decades if not more recent progress in AI has still raised worries about the challenges involved with increasingly capable AI systems, In addition to the risks posed by near-term developments, there is the possibility of AI systems eventually reaching superhuman levels of intelligence, eventually breaking out of human control. Various research agendas and lists of research priorities have been suggested for managing the challenges that this level of capability would pose to society, A strong reason to expect that AI systems will also end up developing roughly human- like mental representations for carrying out different tasks is that the representations of human experts are in a sense an optimal solution to the problems at hand. A human expert will have learned to identify the smallest set of cues that will let them know how to act in a certain situation; their mental representations encode information about how to choose the correct actions using the least amount of thought.

II. SYSTEM ANALYSIS

A. EXISTING SYSTEM

Conventional cars are manual meaning cars don’t have any capability to make decisions on their own. The driver controls the car fully. But the error is to human, and hence human makes mistakes. This is very undesirable in the case of driving as this involves the lives of driver, passengers and passersby and also properties both public and private. This may also result in severe trauma, economic losses and even death. About 1.3 million of deaths occur due to road accidents. Statistics show that about 90% of these accidents occur due to human error. This error is due to misjudgment on roads.

When it comes to technology, self-driving cars have made great strides. Among the many companies developing self driving cars, Google has been one of the most prominent.

Since 2009, Google has been testing a fleet of 32 vehicles. Today, these vehicles log about 10,000 miles every week and have driven over 1.8 million miles since testing began. The technology in these cars is able to detect a car’s surroundings and make adjustments to the way the cars are driving as like in the paper [1] and [2]. The car is even able to detect the types of cars that are driving near it, coming to a stop, for example, if it detects an ambulance passing by. Google hopes to roll out commercially available self-driving cars in four years. However, the technology behind self-driving cars is not accident-free. Google’s fleet has been involved in a total of 16 accidents since 2009, all of which were considered “minor.” Google says that each one of these was due to human error. Additionally, self-driving cars may make erratic moves themselves, swerving suddenly if they feel a poorly parked car is attempting to pull into traffic when it really is not. Therefore, the challenge that remains for developers of self-driving cars is to account for irrational and erroneous human behavior on the roads.

Finally, the concept of self-driving cars raises some major ethical questions, mostly regarding what to do in the case of an inevitable accident with a pedestrian. If a self-driving car is going to run into ten pedestrians, what should it do? Should it keep going and kill the pedestrians, or should it swerve out of the way and kill the driver?

In most polls taken, people were OK with self-driving cars killing the driver to save a greater number of pedestrians, but would not be willing to follow that paradigm if they were the driver. The issue could also turn into a practical problem for self-driving cars and their sales. If self-driving cars are programmed to kill the driver instead of ten pedestrians because that minimizes loss of life, then fewer people are likely to buy self-driving cars. That would mean, however, that the safety benefits that generally arise with self-driving cars are less likely to be realized.

B. PROPOSED SYSTEM

In this project, we present an approach towards mapping and safe navigation in real, large-scale environments with an autonomous car. The goal is to enable the car to autonomously navigate on roads while avoiding obstacles and while simultaneously learning an accurate three-dimensional model of the environment. To achieve these goals, we apply probabilistic state estimation techniques, network-based pose optimization, and a sensor based traversability analysis approach. In order to achieve fast map learning, our system compresses the sensor data using multi-level surface maps. The overall systems run on a modified Smart car equipped with different types of sensors. We present several results obtained from extensive experiments which illustrate the capabilities of our vehicle.

C. FEASIBILITY

A strong reason to expect that AI systems will also end up developing roughly human-like mental representations for carrying out different tasks is that the representations of human experts are in a sense an optimal solution to the problems at hand. A human expert will have learned to identify the smallest set of cues that will let them know how to act in a certain situation; their mental representations encode information about how to choose the correct actions using the least amount of thought.

Machine learning and deep reinforcement learning like [3], [4] also tries to focus its analysis on exactly the right number of cues that will provide the right predictions, ignoring any ir- relevant information. Traditional machine learning approaches have relied extensively on feature engineering, a labour-intensive process where humans determine which cues in the data are worth paying attention to.

III. DESIGN AND DEVELOPMENT

A. MODULE DESIGN

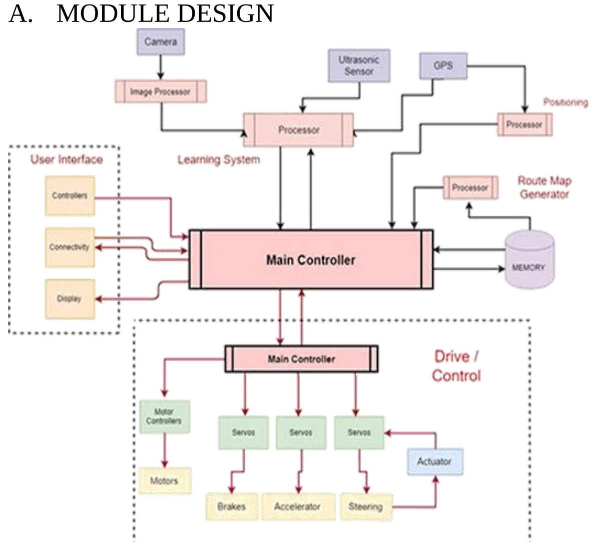

Fig. 1. System Diagram

B. MODULE DESCRIPTION

1) Learning System: This system is equipped with input sources that can learn about the route maps and store infor- mation about the routes which is like we learned from the paper [5]. This is a subsystem which runs parallel always. Information about the routes are to be updated every time. The necessary changes are stored in the memory. This system consists of these modules:

a) Camera: Used to get the live feed of the surroundings. By outfitting cars with cameras at all angles, the vehicles will be able to maintain a 360 degree view of their surroundings. Cameras are able to pick up a lot from lane markings to road signs. This makes cameras advantageous over other technologies employed in self driving cars, because the ability to read signs and see colors will allow cars to navigate modern roads without driver input. Cameras also have a big advantage for both the consumer and manufacturer of the vehicle price. As the quality of cameras and the software interpreting the images advances, cameras are seen as the number one technology to be used in self driving cars, mainly in conjunction with other sensors.

b) Ultrasonic Sensor [RADAR] : Used for collision detection warnings and adaptive cruise control where a vehicle can follow the car in front. An inertial measurement unit (IMU) is an electronic device that measures and reports a body's specific force, angular rate, and sometimes the mag- netic field surrounding the body, using a combination of accelerometers and gyroscopes, sometimes also magnetome- ters. Radar systems use a pulse-Doppler approach, where the transmitter operates for a short period, known as the pulse repetition interval (PRI), then the system switches to receive mode until the next transmit pulse. As the radar returns, the reflections are processed coherently to extract range and relative motion of detected objects.

c) GPS : Used for collision detection warnings and adaptive cruise control where a vehicle can follow the car in front. An inertial measurement unit (IMU) is an electronic device that measures and reports a body's specific force, angular rate, and sometimes the magnetic field surrounding the body, using a combination of accelerometers and gyroscopes, sometimes also magnetometers. Radar systems use a pulse- Doppler approach, where the transmitter operates for a short period, known as the pulse repetition interval (PRI), then the system switches to receive mode until the next transmit pulse. As the radar returns, the reflections are processed coherently to extract range and relative motion of detected objects.

2) User Interface: This system act as the medium of interaction between the user and the car. It consists of all the modules through which a user can communicate with the car. This system consists of these modules:

a) Controllers: These include the general controllers that are generally equipped in an automatic car. They include the infotainment system controls and all the controllers that are on the steering wheel. They will be used to get inputs from the user. They will be directly given to the system where it will be processed.

b) Display: Used to display the user interface. It will be an LCD screen of showing pictures 7" wide.

c) Connectivity: Users will have access to information about the car through connecting their mobile phones or connecting the car to internet. Car is enabled with Bluetooth and Wi-Fi as inbuilt. As there is a local server that is running inside the car to inter connect between each system. This will be used to transfer data between different cars. There is a localized intranet system through which, each car will be able to communicate with other cars, so as to share details about the route, details about the road or even the traffic in the traveling route. Bluetooth will enable users to connect their mobile with the car, so they can have details about the car in their mobile. Infotainment system too can be controlled using Bluetooth or Wi-Fi. Streaming music or media is easy as both these connectivity options are fast and reliable.

3) Drive/Control: This system drives the car. Mainly the hardware that control or decide the movement of the car. This system consists of these modules:

a) Motor Controllers: These convert the commands given from the processor into control signals for the motors. Motors cannot be connected directly to the main system. It needs a controller that converts the digital signals to analogue signals.

b) Servos: Generally DC motors that can accurately turn to a certain angle or perform the given rotations.

IV. TESTING

System testing is performed by a series of unit testing on each module and integration testing on each combined module. Testing is an essential step of system development where errors are detected and corrected. Efficiency of system is improved by performance analysis. Testing is performed before implementing it for usage so that system is reliable. Unit testing is important as integration testing because it helps to find errors and ensures that each developing step is correct. Unit test make integration testing easier. So, we build the system as modules such as [6] and [7]

Fig. 2. Prototype of the system

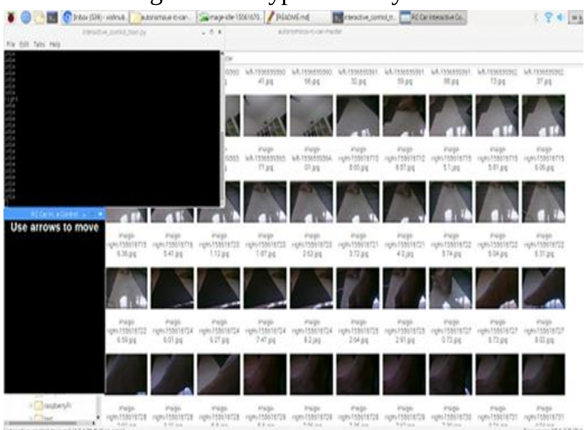

Fig. 3. Collecting the image frames

In our system we tried to do the training by running a prototype on artificial environment. We created the Also, we implemented the codes for unit testing, RADAR and streaming the videos are tested as units using the unit test code. So that we could get the output and verify it is working properly.

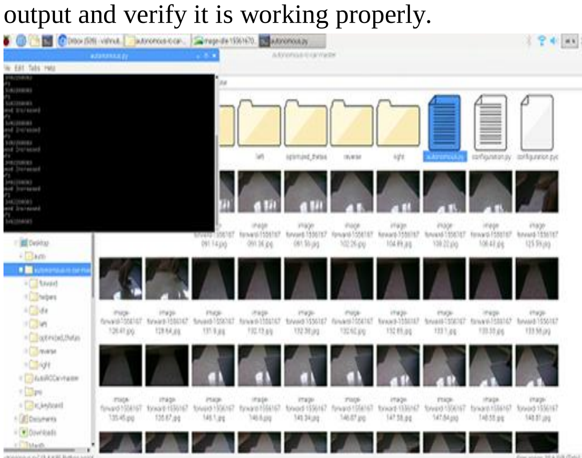

Fig. 4. Training the neural network using the collected data

Also, the neural network is tested by taking the frames from video and, that is used to run the car automatically. The neural network is tested on the environment alone and verified that it is working properly. The real challenge for us was to train the neural network. For training the system we need to get the data set also, it needs to be precise and want get a minimum of 80 percentage accuracy to run on the real time environment.

Integrating all the unit codes and, running it as a system was one of the major difficulties. When we tried to do it by threading, the system was breaking continuously. After lots of efforts and work we managed to run it as a whole system. Then we tested it on different artificial environments and, gathered all the data sets and outputs. And selected the most accurate one for the processing of the system in real time environment.

V. RESULT AND DICSUSSIONS

We proposed an intelligent system that can learn the routes of travel so that it can improve the quality of living people. As the implementation cost is low compared to other AI cars, this is one simple and useful system for those daily commuters who are tired of driving through daily routes over and over again.

A Raspberry Pi acts as the central node of the system where the decisions are taken and also an Arduino is connected as slave to the Raspberry Pi so that it can drive the car with the information passed from Raspberry Pi. Learning is done using Digital Image Processing and Rotary Encoders. Map generated was used to drive the car along the path that was recorded, reinforcing with obstacle detection and traffic detection with the help of ultrasonic sensors and Digital Image Processing.

The prototype has a pi camera and sonar in front of it. Also, there is an Arduino connected for controlling the car. The basic step in our process is to capture the image frame by frame from the streaming video when the car is in learning mode. When there is a key press or an action given, the frames will be taken and it will be saved in npz format as numpy array.

Then using this data, training is done and model is created for processing of the neural network.

Using the model the car is driven on autonomous mode with the neural network. The car drove through the destined route without going off the road. And when there is an obstacle in

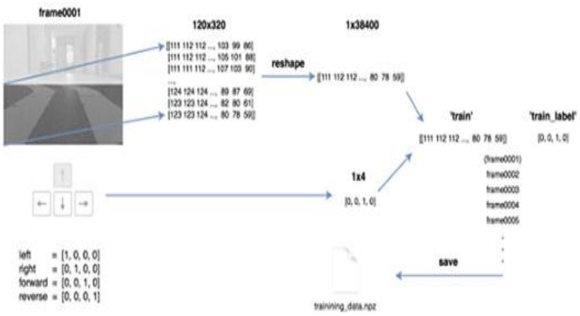

Fig. 5. Convertingthe image frame to numpy array

front, sonar detects it and the distance between them becomes less than 30 cm. The car stopped.

When the car is on learning mode we save the route it had traveled and generates a map to the destination. When we go to the same route it will get an accurate position than GPS [8]. The map is saved using the tuple method. The angle of rotary encoder and distance is fed in to the tuple. Using this the accurate map is developed and saved. It is referred when that particular destination is chosen

Also, the system detects the stop signal and traffic light when it is in autonomous mode. The trained images of stop sign and traffic lights have been saved as cascade classifiers, these classifiers are called during the autonomous mode when it detects the stop or traffic light and using the monocular vision method like [9] .

Fig. 6. When stop sign or traffic light is seen on the camera

VI. CONCLUSION

In this project, we present an approach towards mapping and safe navigation in real, large-scale environments with an autonomous car. The goal is to enable the car to autonomously navigate on roads while avoiding obstacles and while simulta- neously learning an accurate three-dimensional model of the environment. In order to achieve fast map learning, our system compresses the sensor data using multi-level surface maps. The overall systems run on a modified Smart car equipped with different types of sensors. We present several results obtained from extensive experiments which illustrate the capabilities of our vehicle.

In conclusion, upon addressing the mechanics of the driver- less car as well as its benefits and potential issues, it is quite interesting to see how the world will actually become by the year 2040. Because the furute is AI [10] .Will the rite of passage of attaining one’s driver license cease to exist?

It is truly in the reader’s discretion to determine and weigh the impacts that the driverless car will have on society in the future. Until then, it is fascinating to see the effects this creation will have on the states in which it is legalized as well as on the people that have chosen to experiment with it.

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