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Features of Self-Driving Car

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ABSTRACT: A Self-driving car is a mobile machine that can detect obstacles, lanes, and other signs. A self-driving car is one kind of autonomous robot which detects objects and drive safely without any human intervention. Autonomous vision-based robots are smart and intelligent robots which take visual data so as to process it and to provide the appropriate output. These kind of autonomous robots are totally independent and don't need any kind of human intervention since they are preferred with instructions. The self-driving car is such a kind of robot that is designed on Raspberry Pi using OpenCV/Python, which is used for object detection based on its color, size, and shape. The car detects only one single object at a particular time.

KEYWORDS: Image Processing, Raspberry Pi, OpenCV/Python, Arduino, Ultrasonic Sensor, Hough Transform.

I. INTRODUCTION

A self-driving vehicle is a car that is meant to pursue a line or way as of now pre-dictated by the client. The plans may shift from basic line detecting circuit to sweeping vision frameworks. The decision of these plans would be reliant upon the detecting exactness and adaptability required. From the mechanical perspective, an autonomous car has been actualized in a semi to completely self-sufficient plants. These cars are made mostly for personal use but can also have commercial use. It should carry people as our own personal cars do now. Aside from lane following capacities, these cars ought to likewise have the ability to explore intersections and settle on which intersection to turn and which junction to overlook. This would require the car to have 90 degrees turn and furthermore intersection counting abilities. To add on to the multifaceted nature of the issue, sensor situating likewise plays a job in enhancing the car's execution for the assignments referenced before. The self-driving car will be regularly utilized as a mode of transportation in our daily routine. Essentially, an autonomous car is a self-working robot that identifies and detects objects. The control framework utilized must detect the object and maneuver the robot to remain on course while always adjusting the wrong moves utilizing input instrument, in this manner shaping a straightforward yet powerful closed-circle framework.

Traditionally, human drivers use to drive the vehicles or cars but now the machine or the automation mechanism will the car to automatically drive. It will detect the obstacles and stop, change lane in case of need and detect signals, thus the driver now has to do nothing and just sit ideally for the car will drive itself and reduce human efforts.

II. LITERATURE REVIEW

In its present structure, the car is sufficient able. It can pursue movement in any direction i.e. forward, reverse, right and left. We should manufacture a car that has an obstacle detection mechanism, lane detection mechanism, vehicle detection, and signal detection mechanism. Thusly, for obstacle detection, we are using ultrasonic sensors. For the vehicle, lane and signal detection we will be using image processing. The weight of the structured car is around 300 gram and it tends to be lighter. The structured car has one ultrasonic sensor to detect an obstacle and its distance and one pi camera module to detect the surroundings using image processing. Microcontroller ATMega16 and driver L298 were utilized to control bearing and the engine starts and stop. The car is constrained by the microcontroller. It performs alter the engine course by offering sign to driver IC as indicated by gets signals from sensors. The car pursues the line by utilizing the camera module with algorithms working on it. There is only one Ultrasonic sensor used in the autonomous car. This ultrasonic sensor helps detect the obstacle in the front and sends that perusing to Arduino and afterward controls the car development.

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An Arduino nano is connected to the ultrasonic sensor to detect the obstacle ahead. This connection mentioned uses embedded C language for monitoring. The Arduino is further connected to the Raspberry Pi microcontroller which through motor driver circuit is connected to the motors. The car overall uses 4 motors to drive the car, each connected to one of the wheels. For the car movement different subset of motors present in the system works in synchronization. The front two wheels move in synchronization for the car to move forward whereas they move in the opposite cycle to move backward. The right turn is performed by keeping right side motor wheels to be at rest and the left motor wheel in motion for a short instance of time and a similar concept is followed for taking a left turn where the left motor wheels are kept at rest and make the right motor wheelset move. For controlling the engines to explore through its way, the microcontroller is utilized. The mechanical constructional structure and hardware interfacing with the microcontroller of the car model must be introduced in this undertaking alongside PC side programming.

A Self-driving car is an electronic framework that can distinguish and pursue and detect an object. An average speed of the vehicle is 100 km per hour. Programming language of image processing using Python 3. The image processing method is a combination of methods of object detection, feature intuition, color spaces, and HOG (histogram of the oriented gradient). The result shows this algorithm needed to add some method that can change the parameters during day and night adaptively. Because constant parameters can only be used in the same lighting conditions.

Steps for identifying the lane can be defined as First

things are capturing the image, then make a selection from the color, after that mask the region, implement canny edge detection, using Hough Transform, and the lane is identified. The Hough transform is an image extraction technique used in image analysis, computer vision and digital image processing. Also, it is a popularly used algorithm for detecting edges. Lanes are a crucial part to be followed while driving. Hence the camera module attached to the car model will detect the lane edges and maintain the motor wheels in the lane using the microcontroller.

The obstacle detection would also be using HOG for identifying the objects ahead. Histogram Oriented Gradients (HOG) is one of the feature descriptors in image processing for object detection purposes. It calculates the state of the direction of change in gray level (gradient) in the local part of an image. This method is similar to the edge orientation histograms, scale-invariant feature transforms and shape contexts, but the difference is in computational technique which divides the image into several parts (dense grid) and using the overlapping normalization on local contrast to improve the accuracy. The object type is recognized and the distance with the object is calculated using sensor and hence accordingly, the actions are performed. If the object is a moving object such as another vehicle then the car model can follow the leading object whereas if the object ahead is stationary then the car model has no other choice than switching to another lane. Also in the interim, the traffic lights and traffic symbols visible in the site of the camera module are as well detected and the car model is controlled accordingly.

Paper presents the structure and execution of the self-driving car model. It works as the name indicates. It is customized to pursue a dull line on the white foundation and recognize turns (or) deviations and change the engines fittingly. The way is detected by the camera module attached to the head. In this framework, each back wheel has a devoted engine while the front wheel is allowed to pivot. A few running tests are made on the robot to confirm the capacity to detect the object by picking the right way and accomplish the objective position.

A robot has been worked in that can ceaselessly follow a specific item. For this, a dream framework has been set up and interfaced. Through this vision framework, the data of the article is gotten. Thus, the equipped engines structure this instrument.

A car model is structured on Raspberry Pi utilizing OpenCV, which is utilized for item discovery dependent on its shading, size, and shape. Here just a solitary item is being recognized at once. The following of the article depends on the division of the picture into virtual networks. The development of the car model depends on the situation of the item in the network. An arm is fused to pick the article once it is stationary. In the wake of picking the article, it would be dropped into its separate hued compartment which has a predefined position.

It likewise contains a 5 inch 800*480 Resistive HDMI Touch screen for I/O information. The perceived signals are utilized to control the movement of a versatile car model progressively. The portable robot is assembled and tried to demonstrate the viability of the proposed calculation.

The equipment and programming of the robot appear in the paper. Real-time limitations are examined in this paper, identified with the built robot. The acquired outcome demonstrates the conceivable outcomes of following the single line utilizing Raspberry Pi and Linux working framework.

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III. PROPOSED SYSTEM

In the proposed system Camera captures a video of the surroundings and then breaks them into frames and digitally processes the images in OpenCV installed in Raspberry Pi by using a specific algorithm where an object is detected and a command is serially sent to the Raspberry Pi where the motor performs different operations based on a decision-based system. A Motor driver circuit is used to connect motor and Raspberry Pi because the motor driver circuit helps the motor to drive because the output from the controller is not compatible enough to drive motors that are connected to the car wheels.

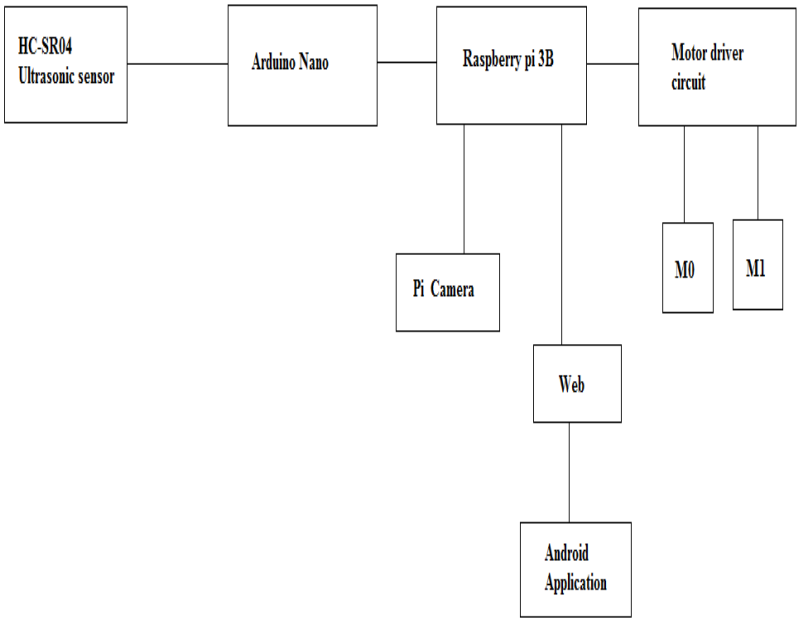

Fig. 1 block diagram of the proposed system

Operation of this assembly consists of a series of steps.

A. **Initialization:** Initially we set up the serial communication that will be used later for the interface between the camera and the microcontroller, the video capture, and the program variables.

B. **Image and Video Processing:** Continuous video frames are taken and then the input is saved as screenshots. Each frame is then converted into the black and white frames. For the accurate results, contrast stretching on each frame is performed to make the dark and dull black region darker and the bright region brighter. This will enable the detection of the objects or obstacles better.

C. **Estimation:** Now, after working on each frame we try to detect the objects or obstacles and this done by estimating the position and distance of the obstacle from the car. The threshold values are set and thus the detection of the position of the obstacle is possible.

D. **Detection:** Now, in this step actually the obstacles or objects are detected. The basic idea is that the sensors compare the current position of the obstacle with its previous position. Thus, the difference in the distance will help to predict when to stop our car so as to avoid the collision with the obstacle.

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E. **Motion:** Now after detecting the obstacle, we have to come up with a decision algorithm that will help the controller to drive the motors accordingly i.e. to stop the vehicle and avoid accidents.

- **Valid Left:** The decision to turn towards left will be considered as valid if there is a necessity to change the lane. This action will be detected as a left turn request. After that, the car will undergo the algorithm and the motors will be signaled to turn towards left thus changing the path of the car.
- **Valid Right:** The decision to turn towards the right will be considered valid if there is a necessity to change the lane. This action will be detected as a right turn request. After that, the car will undergo the algorithm and the motors will be signaled to turn towards right thus changing the path of the car.
- **Valid Straight:** The signal to go straight is when there is no obstacle or any vehicle in the front. Also, there is no stop sign board or any red traffic signal. This will be detected as to move straight forward.

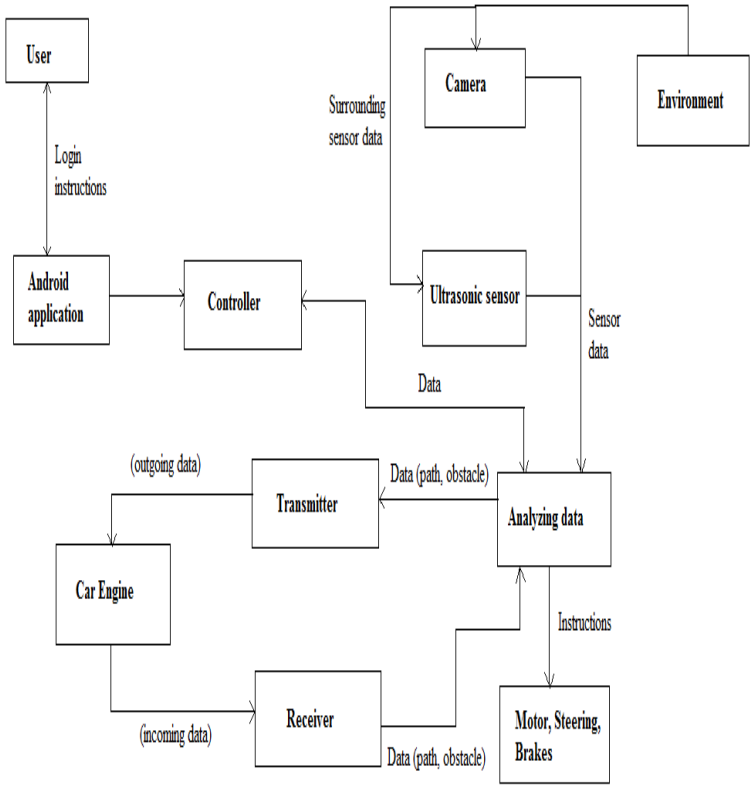

Fig. 2 flowchart of the proposed system

IV. IMPLEMENTATION

Till now, we have implemented the hardware components of the system i.e. we connected all the components and then also implemented the obstacle detection test case. The hardware components we used and those which are connected are, ultrasonic sensor, Arduino, raspberry pi, the motor driver circuit, motors, battery backup, and connecting wires. Later we will also be connecting the Pi camera. With the help of Raspberry Pi microcontroller and due to the motors which are connected to the wheels of the car our car also moves in the forward, backward, left and right directions. The line of codes run on Raspberry Pi with the help of wifi which then helps us in the movement of the car in the above-mentioned directions. The ultrasonic sensor helps detect an obstacle which lies in front of the car, thus making the car to come to rest and avoid collision with the obstacle.

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The connections are made as follows: The Ultrasonic sensor is connected to Arduino Nano microcontroller so that it can detect the obstacle. The coding for detection of an obstacle is made in Embedded C and the code is stored in Arduino. Then the Arduino is connected to Raspberry Pi microcontroller which is connected to the motor driver circuit. The motor driver circuit is then connected to the motors which are connected at each wheel of the car. The motors are of 12V and the microcontroller can handle only 3V, thus the motor driver circuit is used to make the conversion of Voltage. After the car starts its movement in the forward direction and later it detects any obstacle in its path it ceases to move i.e. it comes to a halt at a particular distance from the obstacle thus avoiding an accident.
Later implementation will be that the camera module will be connected to Raspberry Pi for the image processing part i.e. to accomplish the remaining test cases.

V. CONCLUSIONS

The concept we used in this paper makes use of raspberry pi kit along with a pi camera to track the objects or the obstacles and path effectively. The car movements are accurately measured with the help of Ultrasonic sensors. The Pi camera is not only used for color object detection but also for obstacle detection and the detection of path and lane for the car to drive effectively and without collision with obstacles and other vehicles.

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