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AUTONOMOUS RACING CAR – WHICH CAN DETECT THE TRACK AND SIGN BOARDS USING MACHINE LEARNING

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ABSTRACT:

The rise of technology has drawn attention to self-driving cars. Although a commercial autonomous vehicle still have not appeared on market, autonomous race cars are already fighting for the podium. One of the leading series is Roborace, a special series under FIA specifically to autonomous racing. Season alpha of the series was held in 2019 with two teams competing, Technical University of Munich and Arrival. Autonomous driving functionality contains a holistic software structure containing multiple individual driving functions. The main aim of this paper is to design a Racing Car, which can detect the track and sign boards using image processing and machine learning. To develop this system using raspberrypi3 processor and pi camera.

Keywords:
Raspberry pi3, SD card, Pi camera. L293d motor driver, DC motor. Machine learning

1. INTRODUCTION:

Robots are one of the most fascinating machines that humans have ever developed. They are complex machines which involve the integration of many different bodies of knowledge - dynamics, kinematics, artificial intelligence, computer vision, control theory, optical engineering and many more. This makes robotics as interdisciplinary a field as there can be. Having mastered stationary robotic arms in the past decades, interests have shifted towards a more interesting, albeit more difficult, topic - mobile autonomous robots. These captivating machines have raised hopes of exploring extraterrestrial planets, replacing human workers in dangerous environments and offering assistance to humans with laborious tasks.

The autonomous software is still in its initial stage. The software can only carry out functions of basic driving, more development is needed until an autonomous racer can defeat a human driver, and more development is needed until an autonomous vehicle can be mass-produced and serve the public. Nowadays, numerous functions are being developed to further enhance autonomous driving functions.

This system uses image processing based machine learning algorithm, pi camera to detect the track and sign boards. The electric vehicle follow the track and sign board moves accordingly

The SD card is a key part of the Raspberry Pi; it provides the initial storage for the Operating System and files. Storage can be extended through many types of USB connected peripherals. The machine learning algorithm, some predictions along with designed project to improve the performance.

2. LITERATURE SURVEY:

In previous work the speed bumps are detected using accelerator meter and GPS. Add in few, research on speed bump detection was also carried using LIDAR and IR detected.

Mohit Jain, Ajeet Pal Singh, Sushant Bali, SanjitKaul, "Speed-Breaker Early Warning System: This paper gives the overview and detection of speed bumps using accelerometer.

R. Fernande, Junyoung Lee, Dongwook Kim, Giacomo Soprani, Pietro Cerri, Alberto Broggi, "Environment-Detection-and-Mapping Algorithm for Autonomous Driving in Rural or Off-Road Environment", and IEEE Transactions on Intelligent Transportation Systems, Vol. 13, No. 2, June 2012: In this project, Environment-detection-and mapping algorithms have been designed lane, pedestrian crossing, speed-bump detection algorithms and obstacle detection algorithm using LIDARs.

In [2] author proposed "Lane Detection Method with Impulse Radio Ultra-Wideband Radar and Metal Lane Reflectors " a lane detection method that uses an impulse radio ultra-wide band radar with high- range resolution and metal lane markers installed at regular intervals on the road. Lane detection and departure is realized upon using the periodically reflected signals as well as vehicle speed data as inputs. For verification, a field test was conducted by attaching radar to a vehicle and installing metal lane markers on the road. Experimental scenarios were established by varying the position and movement of the vehicle, and it was demonstrated that the proposed method enables lane detection based on the data measured.

3. IMPLEMENTATION:

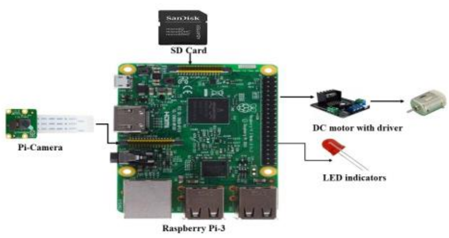

Fig: 3.1 Block Diagram of Autonomous Racing Car

DC motors and Pi camera are attached to the Raspberry pi and some predictions are added in raspberry pi using Machine learning algorithm. There will be a central point with predictions on the line on which Robot moves by detecting its track, sign boards and these predictions will help the Robot to move easily.
The Raspberry Pi has a dedicated camera input port that allows users high-resolution photos. Using Python, machine learning and specific libraries written for the Pi, to identify the real time photos and also create a dataset.
The dataset consist of more number of images like track and signboards. The controlling device of the whole system is Raspberry Pi. The raspberrypi3 processor take the input from pi camera and it will compare with the data set based on that the racing car will identify the track and sign board and moves automatically.

4. RELATED WORK:

The brief introduction of different modules used in this project is discussed below:

4.1. Raspberrypi3:

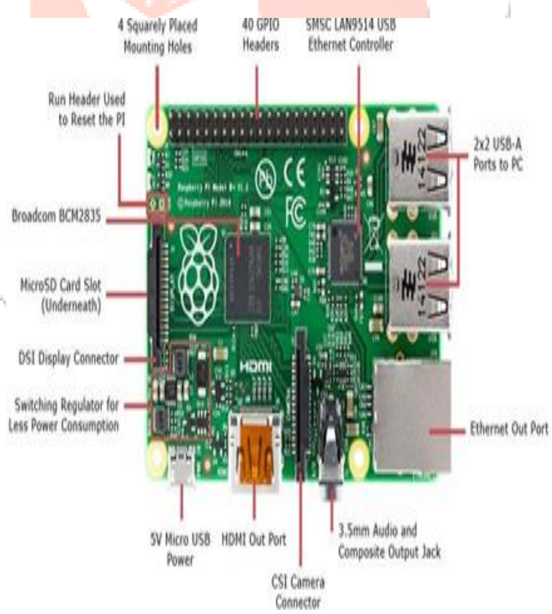

Fig: 4.1 Raspberry pi3

Credit card size computer, HDMI, Ethernet & 4 USB ports, 1GB RAM, Micro SD Socket, 40 GPIO, Raspberry Pi 3 Featuring the ARM1176JZF-S Running at 1.2 Ghz, with 1 GB of RAM .The RASPBERRY Pi 3 is a credit card sized computer that plugs into your TV and a keyboard, it's like a little PC which can be used for many of the things that your desktop PC does, like spreadsheets, word processing and games. It also plays high definition video. The design is based around a Broadcom BCM2837 SoC, which includes an ARM1176JZF-S 1.2 Ghz processor, VideoCore IV GPU and 1 GB RAM. The design does not include a built in hard disk or solid state drive, instead relying on a microSD card for booting and long term storage. This board is intended to run Linux kernel based operating systems.

4.2. Rechargeable Battery:

Fig: 4.2 Battery

A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electrochemical reactions are electrically reversible. In this project we presents a 12v chargeable battery to run the robot.

4.3. Pi camera:

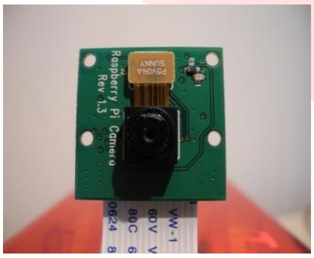

Fig: 4.3 Pi camera

The camera consists of a small (25mm by 20mm by 9mm) circuit board, which connects to the Raspberry Pi's Camera Serial Interface (CSI) bus connector via a flexible ribbon cable. The camera's image sensor has a native resolution of five megapixels and has a fixed focus lens. The software for the camera supports full resolution still images u p to 2592x1944 and video resolutions of 1080p30, 720p60 and 640x480p60/90.

4.4 DC motor with L293 motor driver

Fig: 4.4 DC motor

A DC motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).

4.5 L293d motor driver:

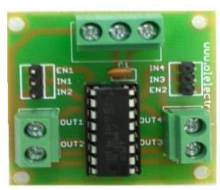

Fig: 4.5 Motor driver

The **L293D** is a popular 16-Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. A single **L293D** IC is capable of running two DC motors at the same time; also the direction of these two motors can be controlled independently.

5. CONCLUSION:

This paper presented the autonomous software used by the racing cars. Using model-free algorithm extension to current planning software. Instead of simply replacing human controls, developers should make use of the integrity between hardware and software. The further development of autonomy will push the automotive industry into a new era, allowing cars to achieve tasks unachievable with a driver. Autonomous racing is necessary in this development because it can provide a safe environment for researchers to push their software to the limits. There are still problems that need solving before a commercial self-driving vehicle that can be mass-produced hitting the market. Autonomous racing provides a perfect environment for engineers to test their resolutions.

6. ACKNOWLEDGEMENT

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future..

7. RESULTS:

The proposed setup has been developed and is similar to real time scenario with the following concerns like:

- Real time detection for sign board
- Real time detection of track

REFERENCES:

[1] J. J. Rolison, S. Regev, S. Moutari, and A. Feeney, "What are the factors that contribute to road accidents? An assessment of law enforcement views, ordinary drivers' opinions, and road accident records," Accid. Anal. Prev., vol. 115, no. March, pp. 11–24, 2018, doi: 10.1016/j.aap.2018.02.025.

[2] D. H. Kim, "Lane detection method with impulse radio ultra-wide band radar and metal lane reflectors," Sensors (Switzerland), vol. 20, no. 1, 2020, doi: 10.3390/s20010324.

[3] D. Clarke, D. Andre, and F. Zhang, "Synthetic aperture radar for lane boundary detection in driver assistance systems," IEEE Int. Conf. Multisens. Fusion Integr. Intell. Syst., vol. 0, pp. 238–243, 2016, doi: 10.1109/MFI.2016.7849495.

[4] D. Felguera-Martı́n, J. T. González-Partida, P. Almorox-González, and M. Burgos-Garćıa, "Vehicular traffic surveillance and road lane detection using radar interferometry," IEEE Trans. Veh. Technol., vol. 61, no. 3, pp. 959–970, 2012, doi: 10.1109/TVT.2012.2186323.

[5] J. Jung and S. H. Bae, "Real-time road lane detection in Urban areas using LiDAR data," Electron., vol. 7, no. 11, pp. 1–14, 2018, doi: 10.3390/electronics7110276.

[6] S. Kuutti, R. Bowden, Y. Jin, P. Barber, and S. Fallah, "A Survey of Deep Learning Applications to Autonomous Vehicle Control," IEEE Trans. Intell. Transp. Syst., pp. 1–22, 2020, doi: 10.1109/ tits.2019.2962338.

[7] Nurhadiyatna and S. Loncaric, "Multistage shallow pyramid parsing for road scene understanding based on semantic segmentation," Int. Symp. Image Signal Process. Anal. ISPA, vol. 2019- Sept, pp. 198–203, 2019, doi: 10.1109/ISPA.2019.8868554.

[8] Baheti, S. Gajre, and S. Talbar, "Semantic Scene Understanding in Unstructured Environment with Deep Convolutional Neural Network," IEEE Reg. 10 Annu. Int. Conf. Proceedings/TENCON, vol. 2019-Octob, pp. 790–795, 2019, doi: 10.1109/TENCON.2019.8929376.

[9] Y. Peng, W. Han, and Y. Ou, "Semantic Segmentation Model for Road Scene Based on Encoder-Decoder Structure," no. December, pp. 1927–1932, 2019.

[10] F. H. Ljubo Vlacic, Michel Parent, Intelligent Vehicle Technologies, Theory and Applications. 2001.

[11] Y. Gu, Q. Wang, and S. Kamijo, "Intelligent Driving Data Recorder in Smartphone Using Deep Neural Network-Based Speedometer and Scene Understanding," IEEE Sens. J., vol. 19, no. 1, pp. 287–296, 2019, doi: 10.1109/JSEN.2018.2874665.

[12] Chengfa Fan, Xiuqing Ye, and Weikang Gu, "KRUS: a knowledge- based road scene understanding system," pp. 731–733, 2002, doi: 10.1109/I cpr.1998.711249.

[13] W. Won, T. H. Kim, and S. Kwon, "Multi-Task Deep Learning Design and Training Tool for Unified Visual Driving Scene Understanding," no. Iccas, pp. 356–360, 2019.

[14] Y. Sun, H. Lu, and Z. Zhang, "RvGIST: A holistic road feature for real-time road-scene understanding," SNPD 2013 - 14th

ACIS Int. Conf. Softw. Eng. Artif. Intell. Netw. Parallel/Distributed Comput., pp. 649–655, 2013, doi: 10.1109/SNPD.2013.86.

[15]V. Vo, L. Truong-Hong, and D. F. Laefer, “Aerial laser scanning and imagery data fusion for road detection in city scale,” Int. Geosci. Remote Sens. Symp., vol. 2015-Nov, pp. 4177–4180, 2015, doi: 10.1109/IGARSS.2015.7326746.

[16] J.Byun, B. S. Seo, and J. J. Lee, “Toward accurate road detection in challenging environments using 3D point clouds,” ETRI J., vol. 37, no. 3, pp. 606–616, 2015, doi: 10.4218/e trij .15.0113.1131.

[17] S. Melo et al., “24 GHz interferometric radar for road hump detections in front of a vehicle,” Proc. Int. Radar Symp., vol. 2018-June, pp. 1–9, 2018, doi: 10.23919/IRS.2018.8448029.

[18] D.Craciun, J.E.Deschaud, and F. Goulette, “Automatic Ground Surface Reconstruction from mobile laser systems for driving simulation engines,” Simulation, vol. 93, no. 3, pp. 201–211, 2017, doi: 10.1177/0037549716683022.

[19] M. R. Carlos, M. E. Aragon, L. C. Gonzalez, H. J. Escalante, and F. Martinez, “Evaluation of detection approaches for road anomalies based on accelerometer readings-Addressing who’s who,” IEEE Trans. Intell. Transp. Syst., vol. 19, no. 10, pp. 3334–3343, 2018, doi: 10.1109/ TITS.2017.2773084.

[20] J. M. Celaya-Padilla et al., “Speed bump detection using accelerometric features: A genetic algorithm approach,” Sensors (Switzerland), vol. 18, no. 2, pp. 1–13, 2018, doi: 10.3390/s18020443.

[21] L. C. Gonzalez, R. Moreno, H. J. Escalante, F. Martinez, and M. R. Carlos, “Learning Roadway Surface Disruption Patterns Using the Bag of Words Representation,” IEEE Trans. Intell. Transp. Syst., vol. 18, no. 11, pp. 2916–2928, 2017, doi: 10.1109/TITS.2017.2662483.

[22] Y. A. Daraghmi and M. Daadoo, “Intelligent Smartphone based system for detecting speed bumps and reducing car speed,” MATEC Web Conf., vol. 77, pp. 0–3, 2016, doi: 10.1051/matecconf/ 20167709006.

[23] H. T. Chen, C. Y. Lai, and C. A. Shih, “Toward community sensing of road anomalies using monocular vision,” IEEE Sens. J., vol. 16, no. 8, pp. 2380–2388, 2016, do: 10.1109/JSEN.2016.2517194.

[24] J. K. Lee and K. J. Yoon, “Temporally Consistent Road Surface Profile Estimation Using Stereo Vision,” IEEE Trans. Intel. Transp. Syst., vol. 19, no. 5, pp. 1618–1628, 2018, doi: 10.1109/ TITS.2018.2794342.

[25] H.T.Chen, C.Y.Lai, C.C.Hsu,S.Y.Lee, B.S.P.Lin,andC. P. Ho, “Vision-based road bump detection using a front-mounted car camcorder,” Proc. - Int. Conf. Pattern Recognit., pp. 4537–4542, 2014, doi: 10.1109/ICPR.2014.776.