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RESEARCH ON AUTONOMOUS DRIVING VEHICLE

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ABSTRACT— Ensuring driving safety and preventing fatal collisions in autonomous vehicles are imperative tasks, highlighting the crucial importance of sharing raw sensor information among these vehicles. This practice enhances their ability to see through obstacles, ultimately safeguarding the driving experience. This paper focuses on developing an autonomous driving system using a Raspberry Pi model with 2GB of RAM. The system employs live image processing to detect road signs, with a specific emphasis on recognizing and responding to stop signs. Upon detecting a stop sign, the system autonomously halts the vehicle. Additionally, the system incorporates lane-following capabilities through image processing, ensuring the vehicle stays within designated lanes. To enhance safety, an ultrasonic sensor is integrated to detect objects, prompting the system to come to a stop when obstacles are identified. This comprehensive approach combines computer vision and sensor technologies to create a functional autonomous driving prototype suitable for real-world applications.

Keywords- Autonomous Driving, Image Processing, Python programming, Raspberry Pi.

I. INTRODUCTION

In the era of advancing technology, autonomous driving systems have emerged as a transformative innovation, promising safer and more efficient transportation solutions. This paper harnesses the computational power of the Raspberry Pi model with 2GB of RAM to create an intelligent vehicular system capable of real-time road sign detection and interpretation. The primary focus lies in the system's ability to recognize and respond to stop signs, ensuring a prompt and automated halt when such traffic signals are detected. Through the integration of live image processing, lane-following algorithms, and an ultrasonic sensor, this paper aims to showcase a holistic approach to autonomous driving, marrying cutting-edge hardware and software components for enhanced road safety and navigation.

As the automotive landscape evolves, the pursuit of autonomous vehicles not only pushes technological boundaries but also underscores the potential for transformative changes in the way we approach transportation challenges. This endeavour serves as a testament to the feasibility of implementing intelligent systems on relatively compact and cost-effective platforms like the Raspberry Pi, demonstrating a significant step toward the realization of safe and efficient autonomous driving technologies.

II. LITERATURE REVIEW

1. S. -H. Lee and C. C. Chung, develops autonomous-driving vehicle control with a composite velocity profile (CVP) planning. An innovative technique of path planning is presented in the vehicle coordinates to allow complete lane change from any position at the origin lane to the center of the target lane. A technique of control is also presented to allow lane-change control design with vehicle speed planning. This article also develops an autonomous-driving control framework with decentralised speed/lateral control using the CVP.

2. Cheng, Jun, Liyan Zhang, et al. This review covers the visual SLAM technologies. They first illustrated the typical structure of visual SLAM. Secondly, the state-of-the-art studies of visual and visual-based (i.e. visual-inertial, visual-LIDAR, visual-LIDAR-IMU) SLAM are completely reviewed, as well the positioning accuracy of their previous work are compared with the well-known frameworks on the public datasets.

3. Levinson, Jesse, Jake Askeland, et al, in this paper, they present a summary of their recent research towards the goal of enabling safe and robust autonomous operation in more realistic situations. First, a trio of unsupervised algorithms automatically calibrates our 64-beam rotating LIDAR with accuracy superior to tedious hand measurements. They then generate high-resolution maps of the environment which are subsequently used for online localization with centimetre accuracy. Improved perception and recognition algorithms now enable Junior to track and classify obstacles as cyclists, pedestrians, and vehicles; traffic lights are detected as well. A new planning system uses this incoming data to generate thousands of candidate trajectories per second, choosing the optimal path dynamically. The improved controller continuously selects throttle, brake, and steering actuations that maximize comfort and minimize trajectory error.

4. Liu, Liangkai, Sidi Lu, et al. In this paper, they present state-of-the-art computing systems for autonomous driving, including seven performance metrics and nine key technologies, followed by 12 challenges to realize autonomous driving. We hope this article will

gain attention from both the computing and automotive communities and inspire more research in this direction.

5. Kong, Jason, Mark Pfeiffer, et al. In this paper, they study the use of kinematic and dynamic vehicle models for model-based control design used in autonomous driving. They analyze the statistics of the forecast error of these two models by using experimental data. In addition, they study the effect of discretization on forecast error. They use the results of the first part to motivate the design of a controller for an autonomous vehicle using model predictive control (MPC) and a simple kinematic bicycle model.

6. Barabas, Istvan, Adrian Todoruţ, et al. In this paper, they have investigated the different levels of driving automatization, the prospective effects of these new technologies on the environment and traffic safety, the importance of regulations and their current state, the moral aspects of introducing these technologies and the possible scenarios of deploying the autonomous vehicles.

7. Zhang, Sumin, Weiwen Deng, et al. This paper proposes a novel method that dynamically plans trajectories, with the aim to achieve quick and safe reaction to the changing driving environment and optimal balance between vehicle performance and driving comfort. With the proposed method, such complex maneuvers can be decomposed into two sub-maneuvers, i.e., lane change and lane keeping, or their combinations, such that the trajectory planning is generalized and simplified, mainly based on lane change maneuvers.

8. Mozaffari, Sajjad, Omar Y. et al. In this paper, they provide a comprehensive review of the state-of-the-art of deep learning-based approaches for vehicle behavior prediction in this article. We firstly give an overview of the generic problem of vehicle behaviour prediction and discuss its challenges, followed by classification and review of the most recent deep learning-based solutions based on three criteria: input representation, output type, and prediction method.

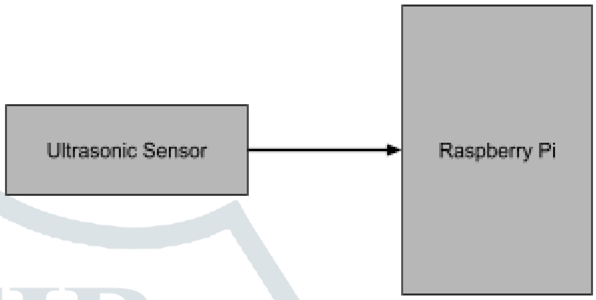
9. Zhang, Qixun, Huan Sun, et al. This paper proposes a novel sensing and communication integrated system based on the 5G New Radio frame structure using the millimeter wave (mmWave) communication technology to guarantee the low-latency and high data rate information sharing among vehicles. And the smart weighted grid searching based fast beam alignment and beam tracking algorithms are proposed and evaluated by the developed hardware testbed.

10. Choi, Woo Young, et al. In this paper, they present an innovative approach, i.e., horizon wise model-predictive control (H-MPC), to solve the model-predictive control (MPC) problem of a linear time-varying (LTV) system. In H-MPC, we regard the time-varying parameters as time invariant within the prediction horizon. To solve the MPC problem of the time-varying system, the decision variable is decomposed into two terms: one for linear time-invariant optimization and the other for compensating LTV uncertainties with an introduction to a uniform compensation condition. The proposed H-MPC solves the time-varying problem by removing the uncertainty due to the future parameter variations within the horizon and by updating the time-invariant MPC at each sampling time.

III. METHODOLOGY

The autonomous driving vehicle utilises a Raspberry Pi model with 2GB of RAM as its core processing unit. The system employs live image processing to detect road signs, specifically focusing on recognizing stop signs. Upon detecting a stop sign, the system triggers an automatic halt. Additionally, the vehicle utilises image processing to follow lanes autonomously. Simultaneously, an ultrasonic sensor is employed to detect objects in the vehicle's path, prompting an automatic stop if an obstacle is detected. This integrated approach ensures real-time decision-making for safe and autonomous navigation, combining image recognition for road signs and lanes with sensor-based object detection for enhanced situational awareness.

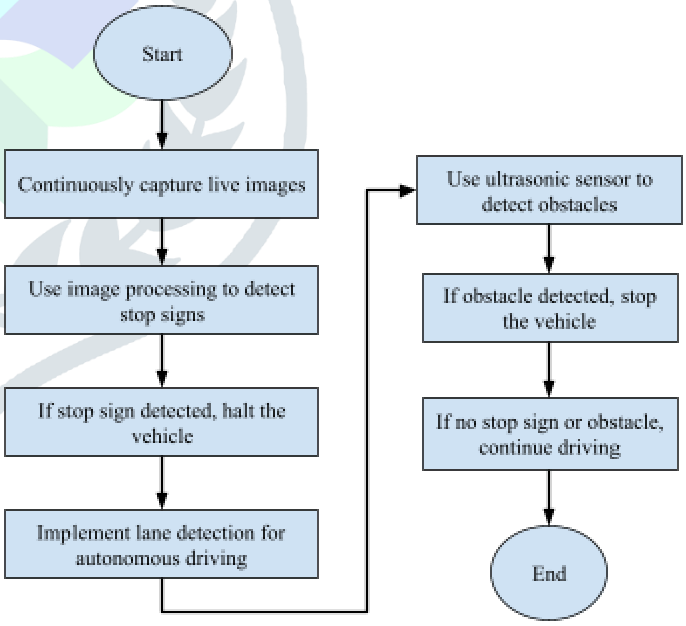
BLOCK DIAGRAM



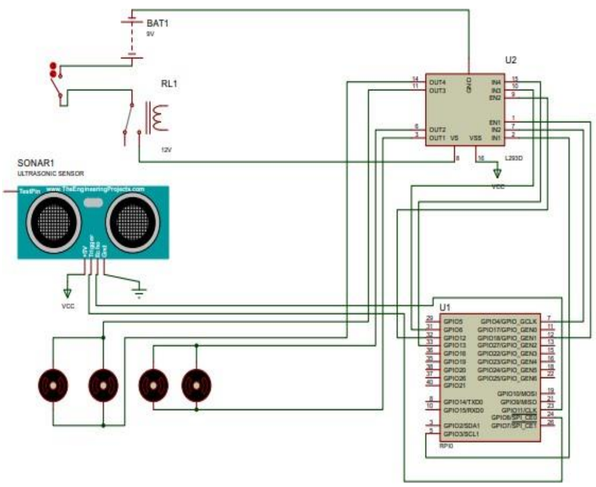
DESCRIPTION

In this Block diagram we have used the Raspberry Pi as a microcontroller. In input devices we have used the Ultrasonic sensor connected to the microcontroller.

FLOW CHART



CIRCUIT DIAGRAM



WORKING

The paper title is "AUTONOMOUS DRIVING VEHICLE." In this autonomous driving vehicle paper, the Raspberry Pi model with 2GB of RAM serves as the central processing unit, leveraging Python software IDE for programming. Live image processing is employed to detect road signs, with a particular focus on recognizing stop signs. Upon detection, the system triggers an automatic halt. Moreover, image processing algorithms are utilised for autonomous lane following. Simultaneously, an ultrasonic sensor enhances situational awareness by detecting objects in the vehicle's path, prompting automatic stops when obstacles are identified. This integrated approach ensures real-time decision-making for safe navigation, combining image recognition for road signs and lanes with sensor-based object detection.

IV. SYSTEM REQUIREMENT

HARDWARE REQUIREMENT

1. Raspberry Pi-4 Model
2. Ultrasonic Sensor
3. Wheels
4. BO motor
5. L7805CT
6. PC HD webcam
7. L293D Motor Driver.
8. Lithium-ion battery.
9. High Watt Battery

SOFTWARE REQUIREMENT

1. Python Software IDE

V. EXPERIMENTAL SETUP & RESULT

EXPERIMENTAL SETUP

Fig. shows the experimental setup of the system

RESULT

The results of this paper demonstrate the successful implementation of an autonomous driving system capable of real-time decision-making for safe navigation. Through live image processing, the system effectively detects and recognizes road signs, specifically focusing on identifying stop signs, leading to automatic halts when necessary. Additionally, the integration of image processing for lane following ensures smooth autonomous navigation. The utilization of an ultrasonic sensor enhances situational awareness by detecting obstacles in the vehicle's path, prompting immediate stops to avoid collisions. Overall, the paper showcases the effectiveness of combining image recognition with sensor-based detection to create a robust autonomous driving solution capable of navigating safely in dynamic environments.

VI. CONCLUSION

This paper represents a significant stride towards the realisation of efficient and safe autonomous driving systems. By leveraging the computational capabilities of the Raspberry Pi model with 2GB of RAM, the developed system successfully addresses critical challenges such as road sign detection, stop sign recognition, and obstacle avoidance through innovative image processing and sensor integration. The demonstrated advantages, including enhanced safety, improved traffic flow, cost-effectiveness, real-time object detection, and technological innovation, underscore the paper's contribution to the ongoing evolution of intelligent transportation solutions. As autonomous driving continues to shape the future of mobility, this paper stands as a testament to the potential for accessible and advanced technologies to redefine our approach to vehicular navigation and safety.

VII. REFERENCE

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