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A RASPBERRY PI SELF-DRIVING CART BASED ON OPENCV AND DEEP LEARNING

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ABSTRACT

The self-driving trolley created in this thesis uses cameras and ultrasonic sensors to obtain roadway information, and a deep learning based target recognition algorithm to find out which are the targets in the data obtained, so that the trolley can drive itself on a simulated roadway with functions such as obstacle avoidance and traffic signal recognition. Originally the car used a Raspberry Pi 3b+, but here the jetson nano, which is better than the Raspberry Pi 3b+, is used to implement it.

KEYWORDS: Autonomous driving; Deep learning; Target recognition algorithm; QR code.

1. INTRODUCTION

The development of self-driving cars has been very rapid in recent years, and many countries are hoping to make great progress in this area, and there has now been a considerable breakthrough in self-driving cars. Self-driving taxi fleets have long been in trial operation, and with experts predicting that in the future 80% of all cars will be self-driving cars, the prospects for their development are good. It is under the joint control of systems such as artificial intelligence and visual computing, allowing computers without human active control to operate motor vehicles automatically and safely.

We can't live without QR codes nowadays, which have become a very popular form of coding in recent years. 2D codes are high-density codes that are more fault-tolerant, more reliable, more informative and have a better encoding range than traditional Bar Code barcodes, and their cost and durability meet the needs of the public. This is why this paper has chosen the 2D code, which has been a big hit in recent years, to complete the self-driving trolley.

2. MATERIALS AND METHODS

Opencv is a cross-platform computer vision library distributed under the BSD license that is lightweight and efficient and can run on all major operating systems[1]. The Opencv-based camera tracing algorithm has a low cost and fast recognition capability. stm32 microcontroller is a new processor with a high processing speed and very rich built-in resources, essentially enabling zero waiting[2]. As the jetson nano was found to be a better performer than the "petite" exterior and powerful "heart" of the Raspberry Pi 3b+, the jetson nano was used here to replace the Raspberry Pi 3b+ in order to better achieve the goal.

The car adopts Openmv camera module, ultrasonic sensor and jetson nano hardware, through the camera and ultrasonic sensor to obtain road information, based on deep learning target recognition algorithm to find out which are the targets in the data obtained, so as to achieve the car on the simulated road can avoid obstacles, identify traffic signals, artificial intelligence recognition of different signs and slow down and stop, etc. functions of autonomous driving, simulating real situations of vehicles and realising the safety of vehicle driving[3].

The car system consists of 4 main subsystems: signal input subsystem (Openmv camera module, ultrasonic sensor), jetson nano (Opencv) image processing subsystem, trajectory processing subsystem, control car system (stm32 microcontroller, motor).

2.1 Signal input subsystem
The signal input subsystem is responsible for transmitting the recognised images (2D codes and other signs set on the simulated road) and video information to the chip. The current road condition is obtained via the Openmv camera module and the ultrasonic sensor module. The multi-threaded TPC program receives the video frame data and the ultrasonic data, converts the image frames into a grey-scale image code and transmits them to jetson nano via USB.

2.2 Image processing subsystem
The image processing subsystem is mainly responsible for target identification of the received information, finding out which are the targets in the obtained data by means of deep learning based target identification algorithms, and then running the corresponding program. The trained program analyses the current received situation and passes the correct instructions to the control small car system (sending instructions to the stm32 microcontroller via USB).

2.3 Trajectory processing subsystem
The Opencv based camera tracing algorithm is low cost and fast to recognise, so the relevant hardware and software was chosen. The trail processing subsystem takes pictures of the ground with the camera, processes the images frame by frame with Opencv, segments the road area, calculates the control digital quantities, and then converts the digital quantities to analogue quantities with the built-in chip.

2.4 Control trolley system
The control car system is mainly responsible for feeding the commands from the jetson nano and the analogue quantities of the trajectory algorithm to the stm32 microcontroller, which converts the commands into high and low level analogue buttons to control the car so that the car can follow the trajectory on the road itself.

3. RESULTS AND DISCUSSION
A sketch of the trolley control flow is shown in Figure 1 below.

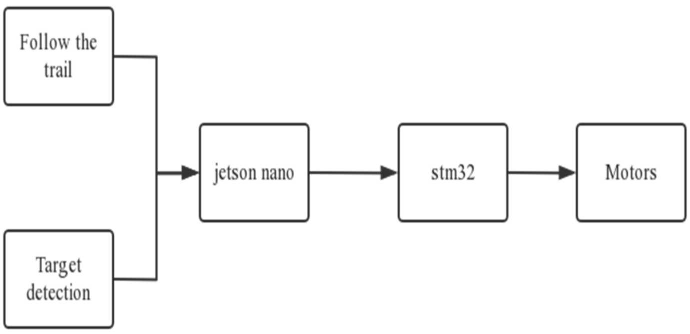

Figure 1:Sketch of the trolley control flow

The general framework of the trolley is shown in Figure 2 below.

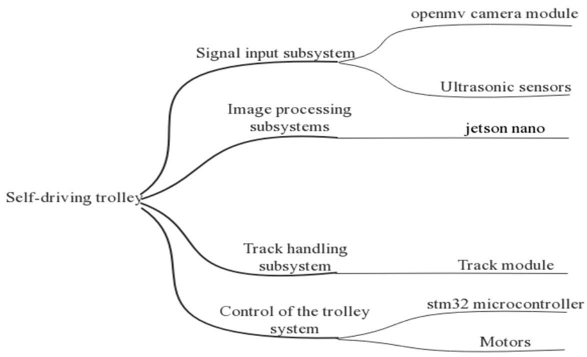

Figure 2:General framework of the trolley

The trolley has the ability to recognise QR codes and also has the ability to carry out artificial intelligence recognition of different signs. It can intelligently recognise left turn, right turn, straight ahead and stop signs (QR codes) and control the direction of the trolley to turn left, right turn, straight ahead and stop at stop signs at junctions, e.g. when a stop sign is detected it can achieve the effect of slowing down and stopping according to the relevant instructions. Of course, it can also recognise different states of traffic lights (red, yellow and green) and intelligently control the car to stop, move forward and slow down to wait. It can also determine the current road conditions and automatically avoid obstacles. However, in practical applications there are significant limitations and the effectiveness of the various functions of the trolley needs to be further improved.

4. CONCLUSION

The innovation of this project lies in the introduction of QR codes to assist the trolley to achieve autonomous driving, and in view of the cost issue the Opencv based camera tracing algorithm was chosen for low cost and fast recognition. However, this project still has many shortcomings and the algorithm can be further optimised or the configuration of the trolley can be upgraded.

5. ACKNOWLEDGEMENTS

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