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Virtual Reality to Implement Driving Simulation for Combining CAN BUS and Automotive Sensors

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Abstract

In this paper, the Unity 3D game development engine is used as the development platform of the virtual reality of the vehicle, and the virtual reality scene of the ring road is constructed, and design the sports car object with third person character to make it real. Unity 3D is a professional cross-platform game development software with powerful virtual reality, VR functions. In order to achieve the realistic effects of the game themes, this study applied 3ds Max modeling software to produce various object models, including: Office building area, Factory area, Residential district, Resort area, School district and Seaside scenery area. The control core of the system consists of two boards： the vehicle signal acquisition circuit and the vehicle signal display circuit. The two boards communicate through the CAN bus protocol as the signal communication channel. This paper combines the interaction between reality and virtual. Create a new experience on the simulation of driving behavior. With the experimental results, we found that the CAN Bus driving simulation platform in this paper is stable, and it is safe and reliable not only zero energy consumption, no air pollution, but also actual driving on the road. Hope to attract more innovative applications, flip the human life style in the future.

Key words: Unity 3D, Virtual Reality, 3ds Max, CAN Bus.

Introduction

If we compare the engine to the heart of the car, the car-mounted communication network can be compared to the vehicle nervous system. The car network system allows the electronic controllers of different devices to communicate and work with each other. The car network with the help of the communication protocol, through the twisted pair wires, coaxial cable or fibres, makes all the electronic control units, sensors, and instruments connected. The types of the in-vehicle network include Local Interconnect Network (LIN), Controller Area Network (CAN), Media Oriented System of Transport (MOST and Ethernet; different network protocols have different functions and serve different purposes.

This paper implemented the "CAN Bus [1, 2] Driving Simulation Problem", which can be used as a training platform for the drivers. When a driver is just getting his license, due to the lack of practice or lack of familiarity with traffic conditions, driving might be dangerous, so that some of the young drivers are becoming afraid of driving. Driving on a new road section or in an unfamiliar area can also sometimes cause accidents. Currently the virtual reality is in worlds trend, both 3D Max [3] and Unity gamed design software are providing many tools for fast and cost-effective 3D scene creation, so that one can at any time have a driving experience close to real. With the help of CAN Bus communication format integrated with sensors, many users can have a better understanding of the in-vehicle network communication.

System Architecture

The system consists of three main parts, as shown on Fig. 1: CAN Bus input signal group, CAN Bus output signal group and Unity 3D virtual reality layout (see the Fig. 1). The system operates by using an electronic tachometer for the vehicle speed simulation, and ADXL335 three-axis accelerometer to detect the vehicle moving direction with the help of HC-SR04 ultrasonic sensor to detect the distance from the car to the front. The controller's core chip is AT90CAN128 by ATMEL. The CAN Bus circuit is created with the help of high-speed CAN transceiver MCP2551, which was developed my MICROCHIP. When the signal, described above, is sent through the CAN Bus to the receiver, the receiver would not only display the signal status information on the LCD and the code table, but also the signal would be also sent to the computer screen through the RS232, which will work in combination with the Unity 3D [4, 5] virtual reality layout.

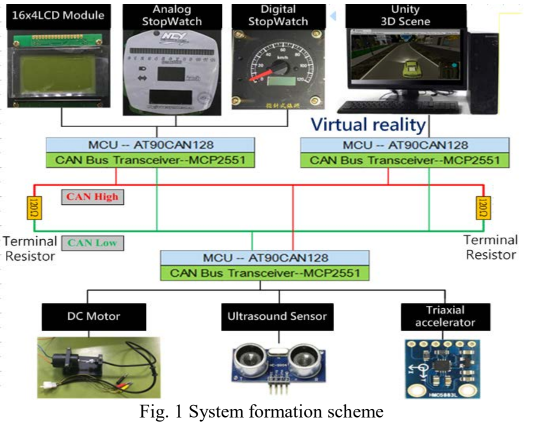

Fig. 1 System formation scheme

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Terminal resistance is 120Ω, which can prevent the data from retiring like echo after arriving at the terminal of circuit, which can affect the interference with the original data; therefore, the terminal resistance can ensure the correctness of the information.

Virtual reality environment production

The virtual reality environment in CAN Bus driving simulation platform is produced using Unity 3D game engine. This is a professional cross-platform game development and scene production software, that be installed on Windows, Mac OS and Linux. The main feature of the Unity game engine is that the game, developed in Unity 3D, can be released to the current mainstream platform, as shown in Fig. 2. For cross-platform use, users do not need any secondary development or software transfer, the product can be sold directly, which saves a lot of development time and effort.

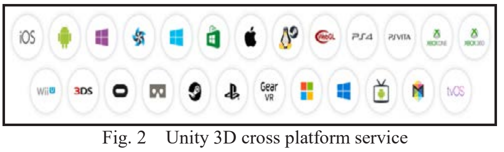

Fig. 2 Unity 3D cross platform service

At this point, we have completed the terrain/scene/camera/physical collision/light/sound scenes. The implementation view is shown on Fig. 3 ~ Fig. 6.


Fig. 3 Unity 3D Scene Area 1


Fig. 4 Unity 3D Scene Area 2


Fig. 5 Unity 3D Scene Area 3


Fig. 6 Unity 3D Scene Area 4

Developing CAN Bus driving simulation platform

CAN Bus driving simulation system is mainly installed as shown in Fig. 7 (1) power supply, (2) electronic tachometer, (3) ultrasonic sensor, (4) three-axis accelerometer, (5) 16x4 text LCD, (6) digital code table, (7) pointer code table, (8) AT90CAN128 template, to receive the sensor signal, (9) AT90CAN128 template, receives through the CAN Bus signal from the (8)number template, and then the signal is sent through the RS232 to Unity3D screen, to complete the entire test platform architecture.

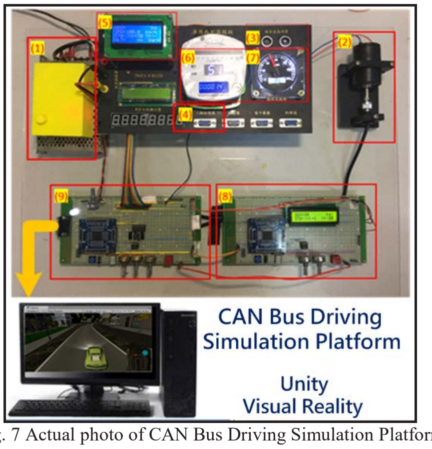

Fig. 7 Actual photo of CAN Bus Driving Simulation Platform

Experiment results and testing of the functions

Turn the simulation platform power on, turn the Unity 3D screen on and connect the RS232 cable to the computer, before starting the Unity 3D implementation. The LCD screen information of the three-axis accelerometer, the electronic tachometer, digital and traditional odometer and the computer display are shown on Fig. 8.

Fig. 8 Testing the functionality of the Driving simulation platform

A. Simulation of the three-axis accelerometer steering wheel

When the user turns the three-axis accelerometer controller to the right, the signal of the three-axis accelerometer is transmitted to the CAN Bus signal receiving board via the CAN Bus signal acquisition board and then via the RS232 to the Unity game engine. The program is written using C#, which lets the Unity 3D third person character controller image (the car) simulate the right turn of the steering wheel, as shown in Fig. 9 and Fig. 10.

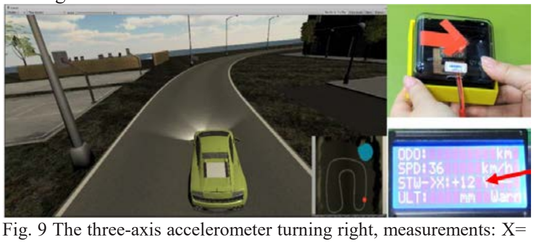

Fig. 9 The three-axis accelerometer turning right, measurements: X= +12 degrees, the car is turning right following the road direction

Fig. 10 The three-axis accelerometer turning right, measurements X= +32 degrees, the car is turning right following the road direction

B. Electronic tachometer simulation

The three-axis accelerometer simulates the engine speed changes in Unity 3D, controls the acceleration and deceleration of the vehicle. When the user is pushing the three-axis accelerometer controller forward or pulling backwards, the three-axis accelerometer sends signal through the CAN Bus signal capturing board to the CAN Bus signal receiving board and then passing it to the Unity game engine by RS232. As the program was written in C#, the Unity 3D third-person character controller (car) simulation engine can successfully simulate the acceleration and deceleration of the engine, as shown on the Figs. 11 and 12.

Fig. 11 Pushing forward the controller of the Y axis of the three-axis accelerometer

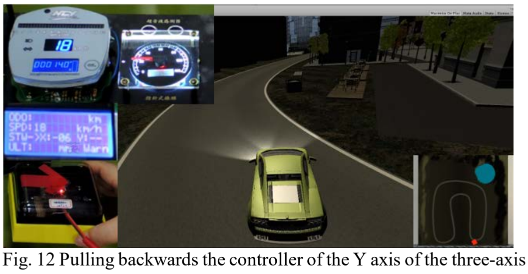

Fig. 12 Pulling backwards the controller of the Y axis of the three-axis accelerometer

During the test, the car in Unity 3D environment, can accelerate and decelerate correctly depending on the user pushing forward or pulling backwards the three-axis accelerometer controller, the test was successful.

Conclusion

The core of the system consists of two main boards, namely, the vehicle signal sensing circuit and the vehicle signal display circuit, the signal exchange between the two boards is made through the controller area network (CAN Bus) communication protocol, which acts as a signal communication pipeline. The two-board embedded microcontrollers use the eight-bit, high-performance RISC chip AT90CAN128 from Atmel (ATMEL) as the core control chip, the main reason for using this chip is that it implements 2.0A & 2.0B communication protocols of the controller area network bus (CAN Bus), and no external CAN controller (such as MCP2515 and other chips) is needed. This thesis combines the interaction between reality and virtual elements, which can make the users have the new experiences while using the driving simulation platform.

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