The Research About Vehicle Recognition of Parallel Computing Based on GPU

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Abstract Vehicle recognition is the important content of intelligent transportation system, there have been many researches on vehicle recognition, and the technology of vehicle recognition based on CPU and DSP cannot meet the needs of the present. This article is about the study of Vehicle recognition and how to realize the GPU algorithm on the CUDA transplantation, make the algorithm parallel, thus speeding up the computation efficiency of vehicle recognition. This thesis is based on the Jeston TK1 development board as the experimental object, achieving high efficiency of GPU image processing.

Keywords GPU · Image processing · Parallel computing · Vehicle

1 Introduction

Intelligent Transportation System (ITS) is an important part of modern transportation; it will be the important direction for future development of science and technology. And the vehicle recognition is the important part of ITS. It is mainly used in highway toll collection, parking management; traffic supervision and so on [1]. There have been many kinds of technology about vehicle recognition. The technology based on image processing is widely used as it is simple and feasible. The Back Propagation (BP) neural network algorithm is a kind of vehicle recognition based on feature extraction. We will remove background noise and extraction the vehicle features. And then use the three layers BP neural network to make the vehicle

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identification [2]. However, in the complex environment, it requires accurate and timely, the algorithm is complex and takes much time. If only using the CPU processing has been difficult to meet the current needs. So it is necessary to use the GPU to do the vehicle recognition. The performance of GPU is increasing at a rate 2.8 times per year. It is faster than the CPU performance of 18 months to double the much faster. The application field of GPU is mainly in virtual reality, computer simulation, computer games and so on [3]. GPU plays a very important role in image processing, if the CPU on the image processing algorithm is transplanted to GPU, the speed will be faster. This paper will introduce the research and development of vehicle recognition first, and then will focus on the introduction and implementation of BP neural network algorithm in recognition of vehicle type. There are many kinds of vehicles on the market; there are cars, vans, trucks, tricycle, crane and truck mixer and so on various models. What we have to do is mainly to solve the three kinds of models are common on the market, namely the cars, vans and trucks. Finally, this article will introduce how to realize the vehicle recognition on Linux based on Jeston TK1.

2 The Introduction the Vehicle Identification Technology

Vehicle identification is the important part of intelligent transportation system; the technology has been relatively mature. In general the vehicle type recognition main recognition car, bus and truck three models. It can achieve the vehicle recognition by some methods. First, it can use the radio waves or infrared, in short, it uses the infrared to scan the body shape of the vehicle, and then analysis the body shape to make sure what kind of vehicle it is; Secondly, through the radar to detect vehicles, the main principle of vehicle recognition is the Doppler effect, but the disadvantage of this method is that the cost is relatively high, the technology is relatively more complex; Thirdly, it can measuring the weight of vehicle, the main principle is to detect the gross vehicle weight and axle load, this method often needs to use the other methods together; Fourthly, the widely used method is the induction coil, when the vehicle across the load, the induction coil will have the waveform, and the different vehicles will have different waveforms [4]. The last method is based on image processing method to detect vehicle. With the development of science and technology, image processing technology is developing rapidly [5]. The application of image processing in machine vision has become more and more mature. The main principle of the machine vision recognition models is to use the roadside cameras. The cameras catch the image of vehicle, after image processing to extract characteristic value, at last, through pattern recognition it will know what kind of vehicle it is.

3 The Study of Vehicle Recognition Algorithm

The most important part of vehicle recognition is how to recognition what kind of the vehicle is after get the body information. The machine vision is different from the people's visual, the machine only know the number "0" and "1". After the camera gets the picture, it will be transformed to the digital signal by the image processing. The image processing includes the grey image, image segmentation and the image in painting. At last the picture will be something like the Fig. 1 [2].

The key to this article is not the image process ignite point is how to realize what kind of the vehicle is after image processing: big, middle or small. The researcher wills analysis the ratio between height and length. Just like the Fig. 2.

The BP Neural network algorithm is the other method that widely used in this kind of project, the researchers will construct the structure of neural network according to their own needs [6]. In this paper, we used three layers BP network, the input nodes and output are both for 3 [2]. We will see that different kind of vehicle have different ratio, there are three ratios: the top to the length, the top to the height and the front to the back. The machine will analysis these dates to discriminate the vehicle are small, middle or big.

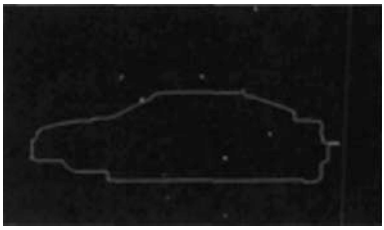

Fig. 1 The body characteristics of vehicle

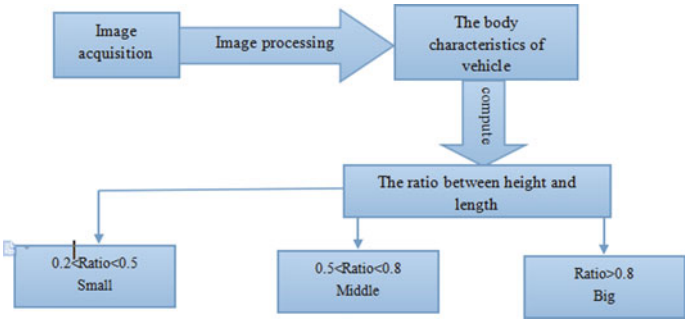

Fig. 2 The block diagram

4 The Realization on Gpu Parallel

Whether it is based on image processing to recognition on matlab or based on BP neural network algorithm, it needs the complex compute on image processing. The image processing includes moving target detection, image gray, image enhancement, image filtering, edge detection, image inpainting and contour extraction [7]. In the past, the researchers will achieve this purpose on pc, like matlab or CPU. These are success in theory, we need to put these theory into practice by put it into the development board. In past, people will use DSP to work for it. In this paper, we will introduce a new development board based on arm which will make the algorithm paralleled like GPU. GPU has powerful multithreaded and parallel processing ability. It will reduce the time on computing.

4.1 The Development Board and Environment Built

In this paper, the development board is the NVIDIA Company released in March 2014 named Jeston Tegra K1. It is claiming to be the first embedded super computer in the world, it is based on Linux, it has 192 CUDA kernel core. And it will be widely used in robot, automatic car and machine visual. The Fig. 3 is the shape of the board.

This board only supports the 64 bit Ubuntu- 12.04 operating system, in this system; we need to download the CUDA6.0 for Ubuntu. We can see the board has almost the entire interface we would use. It has the USB3.0, mini PCIe, HDMI1.4, RS232 serial port and the Gigabit Ethernet. We can develop many things on this board; however, we just use it for the machine vision.

First, it should be connect with pc by the USB and the cable, it should be worthy of attention that the cable is crossover. And then we use the VGA-HDMI line to connect

Fig. 3 Jeston TK1 board

the display, then we can see the Ubuntu on the display. Before we work with the project, we should download the CUDA for the board which is called the CUDA for Tegar could be found on the website of the NVIDIA. It does not need the graphics card of NVIDIA, because the project will be built by cross compiler. Before the compile, the researcher should SCP some library files from the board. The cross compiler means that it uses the pc to build the project but run on the board.

4.2 The Algorithm Parallel

CUDA is the most the most simple and effective to achieve the GPU parallel, it is developed by NVIDIA Company. Its language is just like the C/C++ language. In CUDA language, it would set up a kernel to make the function parallel. This function should only run on GPU without Pumas in this example [8]. Different from the C/C++ language, it is "_global_void", it is proper belongs to the CUDA language; it means the function should only run on GPU. GPU parallel means it will process all of the pixel point at the same time. Each of the processing is independent, we can see the image as a lot of small image, and each image is one pixel point. Then we can merge the point together as the image after the image processing [9].

5 The Peroration

Vehicle recognition occupies an important position in the intelligent transportation system in the future; the method based on image processing will be a hot research. In order to make the image processing more quickly and efficient, it is necessary to make the algorithm parallel. Whatever using GPU parallel computing ability, it can improve the speed of image processing, to meeting the high efficiency of vehicle recognition efficiency.

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