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GESTURE RECOGNITION BASED ON CONVOLUTIONAL NEURAL NETWORK

INTRODUCTION

This project is gesture recognition based on i.mx6ull. The main task is to write the program of convolutional neural network by C language on i.mx6ull(i.MX6ull is an application processor with low power consumption, high performance and low cost based on ARM cortex A7 core product by NXP). The camera is not used in this gesture recognition. Here we use a module called GY-AMG8833 IR, an 8 * 8 infrared thermal imager.

I. Preparation for development

The specific operation as follow:

1. Set processor mode to SVC(Supervisor). The specific operation is to set the 0 to 4 bits of CPSR register to 10011.

2. Set SP pointer. SP pointer can point to internal RAM or DDR. In this project, it points to DDR. The stack growth mode of A-7 series processors is downward growth. DDR used in this project is 512MB, and the range is 0x800000000- 0x9fffffff. In this project SP pointer set to 0x80200000.

3. Jump to the main function of C language.

4. Define the register address to facilitate direct operation of the register.

II. Embedded Drive Development

Here need to write the driver of GY-AMG8833 IR. This module uses IIC to communicate with the main control. After the relevant registers are configured. The module sends 64 data to the processor. These data are the tested temperature data. The 64 data are transformed into an 8 * 8 matrix as the input of the subsequent convolutional neural network. So here need to typedef a structure used to save data, gesture type, data size. Since gesture recognition is different from image recognition, it is necessary to input several groups of data as a whole. It means, the input array must be a three-dimensional array. This module can detect up to 10 groups of data per second. Therefore, 10 groups are selected here as a whole. In order not to write meaningless data, an external interrupt needs to be used here. Whenever an interrupt occurs, DMA is used to read 10 groups of data in the registers of IIC which is used to receive data from the module. The main purposes of using DMA are as follows: first, try to avoid staying in the interrupt function for too long. Therefore, the interrupt is only used to enable DMA, which is used to read the data in the register then save the data into the memory space; second,when realizing DMA transmission, the DMA controller is directly in charge of the bus. That is, before DMA transmission, the CPU should hand over the bus control to the DMA controller, and after DMA transmission, the DMA controller should immediately hand over the bus control back to the CPU. So the other work will not affect the writing of correct data into the structure. After the module driver and additional functions are written, the convolutional neural network can be written next.

III. Convolutional neural network

Write a convolution neural network program, including feedforward operation and error back propagation. It is used to update the network parameters for the purpose of learning and classify the data so that any gesture can correspond to the processor task. But before that, we need to prepare some matrix operation functions. In this way, the operation process of convolutional neural network described in C language will become simpler.

IV. Burn the program into i.mx6ull

In order to burn the program into i.mx6ull need to do the following things:

1. Write a "Makefile" to generate a binary file.

2. Add some data to the beginning of the binary file. Because some data structures are required when users burn images into i.mx6ull. It mainly includes the following data: Vector table of image,Boot data, Device configuration data (DCD)

3. Finally, burn load.imx to the SD card, and its starting address is 0x400.

SUMMARY

This topic uses convolutional neural network deep learning algorithm technology to design a gesture recognition. The main task is to build a model that can match events with the gesture.

References

1. i.MX 6UltraLite Applications Processor Reference Manual Document Number: IMX6ULRM Rev.1, 04/2016

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