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FIELD PROGRAMMABLE GATE ARRAY (FPGA) APPLICATION AND FUTURE DEVELOPMENT

INTRODUCTION

With the application of cloud computing, big data and AI technology, CPU alone can no longer meet the computing power needs of all walks of life. Scenarios such as massive data analysis, machine learning, and edge computing require a diverse computing architecture, with different processor architectures and heterogeneous computing technologies such as GPUs, NPUs, and FPGAs to meet the algorithmic and specialized computing needs of specific domains. At present, the two most widely used acceleration components in AI computing platform are GPU and FPGA, but recently FPGA has been frequently favored by various AI giants, such as Microsoft, Baidu are looking forward to the future of FPGA applications.

I. THE SYNOPSIS AND FEATURES OF FPGA

We can think of an FPGA as if it were a massive collection of unconnected digital components. This includes basic components such as multiplexers and logic gates as well as more complex components like DSP cores. When we program an FPGA, we are actually creating connections between these different components to create a complex system. All of this means that we are fundamentally designing hardware when we create an FPGA based design. As a result of this, we can design a number of circuits which run in parallel to each other. This means that FPGAs are capable of performing a large number of different operations at the same time. This is a major advantage over software approaches, which must be run sequentially by a CPU. In addition, we also have much more control over the timing of our design in an FPGA. We can estimate to within a few nanoseconds how long operations will take to complete in an FPGA. Again, we could not do this if we used a CPU to implement our design. As a result of these features, FPGA designs can be much quicker than the equivalent implementation in a micro controller. The drawback is that they tend to be more difficult to work with. If compared with the familiar CPU or GPU, they are essentially the same. They are all a kind of chip. Here are its three main features:

- consists of a large number of logic gate arrays;
- hardware programmability which allows to program the logic gate array repeatedly so that FPGA can change its own hardware structure at the logic level;
- field programmability which means FPGA can be programmed on site without disassembling the chip.

II. APPLICATION OF FPGA

Due to the fact that FPGA has strong flexibility and high computing performance, it has been widely used in communication and network fields to process a large number of network data packets. Another important application area of FPGA is as a hardware test platform before other chips are taped out. That is to say, no matter what kind of digital chip is developed, there is a high probability that FPGA will be used for hardware test in your process. Microsoft Azure is the world's largest cloud investment in FPGAs. Microsoft uses FPGAs for deep neural networks (DNN) evaluation, Bing search ranking, and software defined networking (SDN) acceleration to reduce latency, while freeing CPUs for other tasks. FPGAs on Azure are based on Intel's FPGA devices, which use to accelerate real-time AI calculations. This FPGA-enabled architecture offers performance, flexibility, and scale, and is available on Azure. Azure can parallelize pre-trained DNN across FPGAs to scale out your service. The DNNs can be pre-trained, as a deep featurizer for transfer learning, or fine-tuned with updated weights.

III. FUTURE DEVELOPMENT OF FPGA

In the past few years, FPGA has given new vitality in many new application fields, such as cloud computing and artificial intelligence.

- 5G base stations
- Data Centers
- Neural Networks and Machine Learning

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