Flowpro Computing Machines

Executive Summary of US Patent 10,181,003 Technology
"Processing Circuits for Parallel Asynchronous Modeling and Execution"
January, 2020

Preface

Flowpro Computing Machines are a disruptive computer chip technology. By using Flowpro Computing Machines as a common hardware and software design and execution technology, computing devices will become far more power efficient, more intelligent and enjoy shorter chip design development time. US Patent No. 10,181,003 describes creating and running computer chips that process millions of independent tasks (jobs) simultaneously. These same Flowpro Machine chips will usher in a new dawn of Parallel Artificial Intelligence research.

Introduction

A Computing Machine is an integrated circuit, i.e., a chip, such as an Intel Pentium processor. A 'PC 'and a 'Cell-Phone 'are Computing Machines which consists of many 'chip' Computing Machines working in harmony. All of these Computing Machines are built upon a fundamental computational model called a Turing Machine. Turing Machine logic circuits cannot be directly implemented in a chip and must be converted to other mathematical forms of logic circuits such as Boolean and State machines. This logic conversion is error prone and a complicated process. A Turing Machine is not a parallel Computing Machine, so it takes multiple Turing Machine devices to compute in parallel.

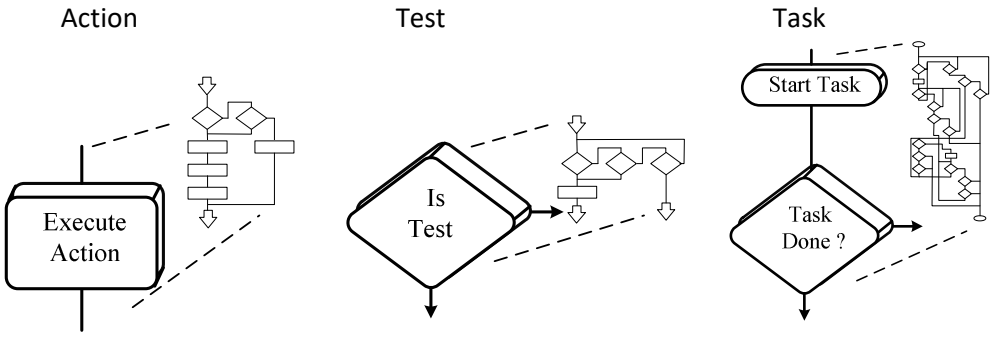
The term Flowpro Machine was introduced with the publishing of US patent 10,181,003, "Processing Circuits for Parallel Asynchronous Modeling and Execution". A Flowpro Machine is a fundamental 'parallel' computing model. But, Flowpro Machine logic circuits can be directly implemented in a chip and do not need other mathematical forms of logic circuits. A Flowpro Machine design begins with creating parallel asynchronous (independent) 'decision' flowcharts describing the operation of a device such as a cell phone, then compiling and downloading those Flowpro Machine flowcharts to a chip. The resultant Flowpro Parallel Computing Machine chip then provides parallel processing and the most power efficient architecture for devices.

Background

Derived from the words flowchart programming, FloPro Software was introduced in 1981 as a parallel design system that later became Flowpro. Thousands of Flowpro real-time control systems were installed at General Motors Powertrain manufacturing facilities in the 1990s and early 2000s. Later, Flowpro Software became hobbyist robot and LED programming software until it was discontinued in 2013. In 2014, research of what was to become a new Computing Machine, later called a Flowpro Machine, began in earnest. As a result of the research a patent was applied for in May 2018 and US Patent 10,181,003 was granted on January 15, 2019.

Flowcharts

For many years Flowcharts have been overlooked by the computer science community mostly because of past misconceptions of flowcharts. Many have written that flowcharts are extra work, produce spaghetti code, use the dreaded "GO TO" and are therefore old-school. Flowpro Machines overcome these past misconceptions. With Flowpro the flowcharts are the program, so they are always up to date. Most assume that there is one large flowchart that represents (i.e. models) the entire application. By leveraging Flowpro's inherent hierarchical parallelism and using many small flowcharts and flowchart objects, applications are easier to understand and reuse. Flowpro's flowchart objects eliminate spaghetti code, enhance software readability while localizing variables, and further exposing the parallelism of an application. With only three object types, Action Object, Test Object and Task Object, building objects is easy and straightforward.



Flowpro flowcharts execute extremely fast and are not dependent on the graphical placement of the flowchart elements (blocks or objects) but solely upon the flow lines connecting flowchart elements.

Flowcharts are universal and can be adapted (labeled) for any domain (field) task or problem. They can have as much or as little detail as required. Regardless of the detail, Flowpro Machine flowcharts all execute to the same simple rules of construction and execution while democratizing software and hardware design by making both a common language, simpler to construct and more understandable.

Parallelism

Parallel programming is only now beginning to be exploited. Other systems have achieved approximately 25,000 parallel computing machines across multiple chips. A Flowpro Machine will consist of hundreds of thousands, possibly millions, Flowpro Machines per chip. For instance, would a Flowpro Machine for every pixel be a practical way to do object recognition? The key to managing the hyper-parallelism of a Flowpro Machine network is hierarchy. Hierarchy means building and executing Flowpro Machines, within Flowpro Machines, within Flowpro Machines and so forth to any level of depth required. Now consider that each Flowpro Machine consists of its own circuits that only consume power when that Flowpro Machine is activated. Clock-less asynchronous design fits very nicely with hyper-parallel neural network applications.

A Flowpro Computing Machine application is an evolution of parallel events (not program States) that determine the outcome of the computing machine application.

Hardware

Flowpro Machines are made up of proprietary flowchart Action blocks, Test blocks and Task block circuit structures that are generated when the Flowpro Machine flowcharts are compiled. Dependent on the target execution technology, standard circuit structures are generated for FPGA's chips or ASIC chips, as described by patent 10,181,003.

Turing Machine logic circuits primarily use a synchronous hardware design approach that requires a power consuming Master Clock signal. Flowpro Machine logic circuits are parallel asynchronous circuits that are Clock-less Flowpro flowchart Action, Test and Task circuits and do not require a Master Clock signal. Past asynchronous (clock-less Turing Machine) chip design, even with its advantages, have not worked out because designing asynchronous circuits was complicated and required special tools to be used in the chip design flow. Patent 10,181,003 overcomes both of these problems by using parallel event driven flowcharts to model and execute a Computing Machine. Companion patent 9,003,383 imports existing design code (C, Python, Verilog, etc.) so that existing designs can reasonably be brought forward and parallelized into Flowpro Machines. Flowpro Machines are one language and one model from requirements through execution and provides linking from a requirement to a transistor.

Putting Flowpro Machine execution into terms that are used by Turing Machines helps to understand the concepts and advantages. A typical Turing Machine compute cycle fetches the compute instruction, determines what the compute instruction is and then performs the computation, 'fetch-decode-do'. Sometimes Turing Machines use a technique called a pipeline to eliminate some fetch cycles and hence slightly speed up the overall machine. Flowpro Machines do not have a fetch cycle, because specific hardware is created for each Block of a Flowpro Machine flowchart. A Flowpro Machine only needs to 'decode-do', a two-step cycle versus three-step cycle for Turing Machines. Flowpro Machines are therefore faster than Turing Machines. A Flowpro Machine is an image of the flowchart that is built with transistors and runs at propagation delay speeds. In other words, each Flowpro Machine can be considered an asynchronous pipeline of execution.

Ordering

Ordering simply means, putting the steps of any process into a sequence (an order) determined by some sort of formula. The Blocks of each Flowpro Machine flowchart are automatically ordered based on the flow lines from one block to another. Flowpro Machines have the ability to be 'ordered on-the-fly', i.e., while executing. Any group of running parallel Flowpro Machines can be put into a sequence of executing one running Flowpro Machine after another. This ensures that this group of Flowpro Machines do not block or starve data while communicating between themselves or external to the group. This is a powerful programming paradigm that is new and set to fully exploit.

Important Concepts

Fundamental Turing Machines are a 'fixed' configuration of hardware whose function is programmed and re-programed through software. Fundamental Flowpro Machines are a 'variable' configuration of hardware whose function is programmed and reprogrammed through software but whose hardware configuration is dependent on the function being programed. The resultant size and configuration of Flowpro Machine hardware is related to the magnitude of the application.

Flowpro Machine flowcharts can be compiled and downloaded to Turing Machine hardware for multi-tasked execution or to Flowpro Machine hardware for true parallel asynchronous execution.

A Flowpro Machine is equivalent to a Turing Machine in that any computation (a program) that can be realized by a Turing Machine can also be realized by a Flowpro Machine.

US Patent No. 10,181,003 not only covers computing machine chips but also chemical and biological computing machine systems that are built with Flowpro Machine structures.

Advantages

Flowpro Machines use power more efficiently than Turing Machines. This is because Flowpro Machines are asynchronous in both the design (model) and the implementation (execution).

Flowpro Machines save hardware. Flowpro Machine hardware is sized and configured by the size of the software application.

Flowpro Machines execute faster. Flowpro machines have a simple compute cycle, and they operate at propagation delay speed and are not tied to Master Clock timing.

Flowpro Machines democratize the design of computing systems. Meaning that because of the universal nature of flowcharts, all stakeholders can contribute to a more accurate model, which saves money and debug time.

Flowpro Machine flowcharts are a common software and hardware design model. Communication across the design team is improved and therefore saves money.

Flowpro Machines are more secure. The power and EMI signatures of Flowpro chips are harder to detect in a Clock-less parallel system. True Parallel systems like Flowpro Machines allow completely independent communication, monitoring and authentication tasks in hardware.

Using Flowpro Machines, hyper-parallel Artificial Intelligence research can begin.

Contact

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