Chapter 4

An Advanced Architecture of a Massive Parallel Processing Nano Brain Operating 100 Billion Molecular Neurons Simultaneously

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ABSTRACT

Molecular machines (MM, Badjic, 2004; Collier, 2000; Jian & Tour, 2003; Koumura & Ferringa, 1999; Ding & Seeman, 2006) may resolve three distinct bottlenecks of scientific advancement (Bandyopadhyay, Fujita, Pati, 2008). Nanofactories (Phoenix, 2003) composed of MM may produce atomically perfect products spending negligible amount of energy (Hess, 2004) thus alleviating the energy crisis. Computers made by MM operating thousands of bits at a time may match biological processors mimicking creativity and intelligence (Hall, 2007), thus far considered as the prerogative of nature. State-of-the-art brain surgeries are not yet fatal-less, MMs guided by a nano-brain may execute perfect bloodless surgery (Freitas, 2005). Even though all three bottlenecks converge to a single necessity of nano-brain, futurists and molecular engineers have remained silent on this issue. Our recent invention of 16 bit parallel

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The core architecture of a nano-brain whether operating in a nano-factory, functioning as a nano-surgeon or nano-computer could be the same. The architecture may consist of a control unit connected to all execution parts following one-to-many communication principle. In our recently described proto-nano-brain (Bandyopadhyay, 2008), we have demonstrated this principle in practice. The principle states that, if a large number of molecules are connected radially to a single molecule then by tweaking the central molecule one can logically control all radially connected units at a time. To control the logic operation of a large assembly, we need to control only the central molecule, which we name the central control unit (CCU). Currently, the CCU can send only one instruction without any external interference. The reason is that a CCU, which is a molecular switch could be excited to a particular state, and only other possible transition of this molecule would be returning back to the normal state. Therefore, remotely, without any human interference CCU can send only one instruction. We wish to develop it in such a way that it is able to send a series of logical instructions to the execution units (EU) during its operation. Only then, the complete architecture would execute series of operations one after another by itself, independent of any external stimuli or human interference (Koumura, 1999). This is important as it is not practical to instruct the control unit of a nano-factory several times for completing the task, or instruct the control unit of a nano-computer at every stages of its derivation of a math problem, or advise the control unit of a nano-surgeon its next move during a brain operation.

The fundamental element that constitutes a molecular nano-brain is a molecular neuron. A neuron is an analogue switch. Beyond a threshold voltage, continuous increase of applied bias should generate more than two conducting states in a neuron-like molecule. Unfortunately, almost all reported practical single molecule switches are binary (Chen, 1999). We reported the first 2-bit single molecule switch operating reversibly.
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