

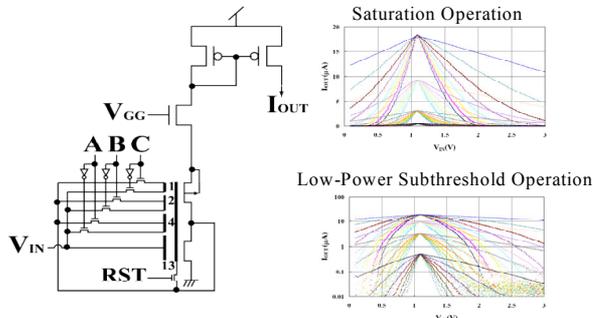
# Development of Human-Intelligence Systems using Right-Brain Computing VLSI

(右脳的コンピューティングVLSIを用いた柔軟な認知・理解システムの開発)

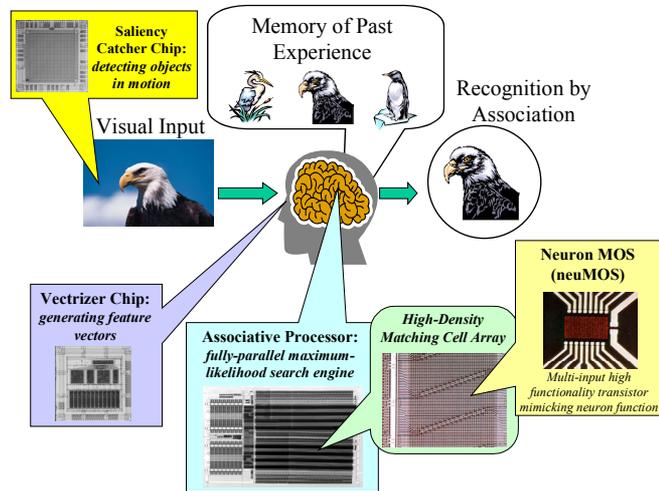
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*Seeing and recognizing objects and taking an immediate action* is a very natural response of humans, or biological systems in general. However, even for state-of-the supercomputers, this is an extremely difficult task. A digital computer is nothing more than a calculator of vast capacity, solving any sort of problems in terms of sequential numerical computation. The scheme is very different from the brain processing. The purpose of our research is to develop a VLSI system that works like our right-brains. Namely, the chip recognizes the object, not by computation, but by association with the experience in the past. It recalls the maximum-likelihood event in the past memory in an immediate response to the input. Since such association is carried out by fully-parallel on-chip processing, the response is extremely fast even at low-powers of operation. If such a powerful associative function is utilized in combination with the logic processing capability of a conventional digital CPU chip, human-like intelligent systems would be materialized. This is somehow analogous to the collaboration of the logic-intensive left brain and the intuition-driven right brain in our brains.

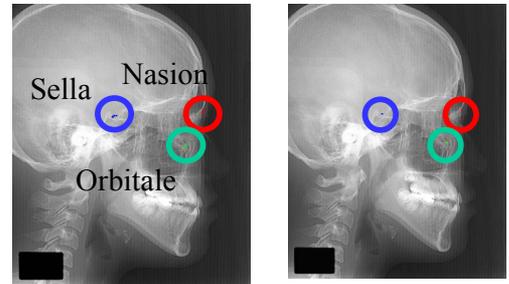
In the 21<sup>st</sup> century, we will soon encounter an aging society. What we really need, I believe, is not the development of sophisticated game machines of super virtual reality, but to develop an electronic system that is capable of communicating with ordinary people and helping them, and serving the welfare of the socially disadvantaged. Our chip will certainly play an essential role in building such systems.



Circuit example of an associative primitive and measurement results.



Right-brain computing VLSI system for human-intelligent systems



By Our System      By Three Expert Dentists

Recognition of anatomical landmarks on a medical X-ray pictures based on the expertise knowledge of doctors (Simulation experiments of our hardware recognition algorithm).

Our research includes the following projects ranging from hardware issues to software issues, all going to be merged inseparably:

- **High-density low-power Analog Associative Processor**
- **General-purpose digital Associative Processors**
- **Analog flash memory technologies for vast memory storage and associative primitives**
- **Vector representation algorithms and feature vector generation VLSI's**
- **Hardware-friendly image recognition algorithms**
- **ASPL (Association Programming Language) for combining the right and left brain processing at the system level**