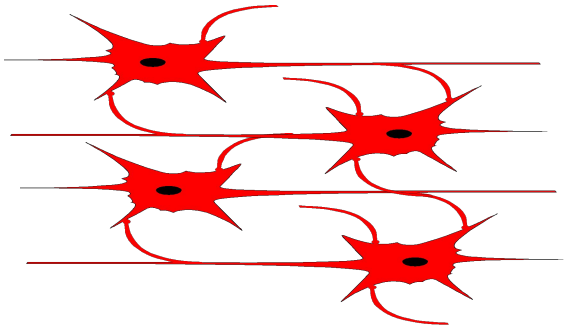
An Artificial Mind via Cognitive Modular Neural Architecture



Pentti O. A. Haikonen

NOKIA RESEARCH CENTER

P.O. Box 407

FIN-00045 NOKIA GROUP, Finland

pentti.haikonen@nokia.com

What is Mind?

Human mind is characterized by

Inner imagery,
Inner speech,
Sensations,
Emotions

An artificial mind should also have these to qualify as a mind of any credibility.

Human Mind

-The human brain processes information with meaning and importance

-There is “an unified experience” the instantaneous sensory information from multiple sensors is bound together and is coupled to the system’s knowledge and emotional state so that a stream of interpretation, meaning and mental responses arises - the flow of inner imagery, inner speech, feelings

-This style of information processing **-cognitive information processing-** is completely different from present day computers

What is Involved in Cognition?

-Meaning and understanding
-Perception and recognition
-Prediction
-Priming
-Attention
-Match/mismatch/novelty detection
-Learning and memory
-Judgement, good/bad
-Pain and pleasure
-Emotions
-Motivation, needs, drives, goals
-Deduction, reasoning, planning
-Language
-Consciousness?

What is Involved in Consciousness?

-Awareness of environment

-Awareness of own body

-Awareness of qualia, how it feels

-Introspection of thoughts, emotions and feelings

-Awareness of past, present and expected future

-Awareness of self, one's own existence

-Awareness and ability to report the existence of one's inner imagery and speech as such

Inner Imagery, Inner Speech

-The flow of inner speech, inner imagery is typical to human cognition

- Inner speech and inner imagery are also understood as verbal and visual thinking

-Inner speech, imagery, emotions and sensations are also the contents of our consciousness

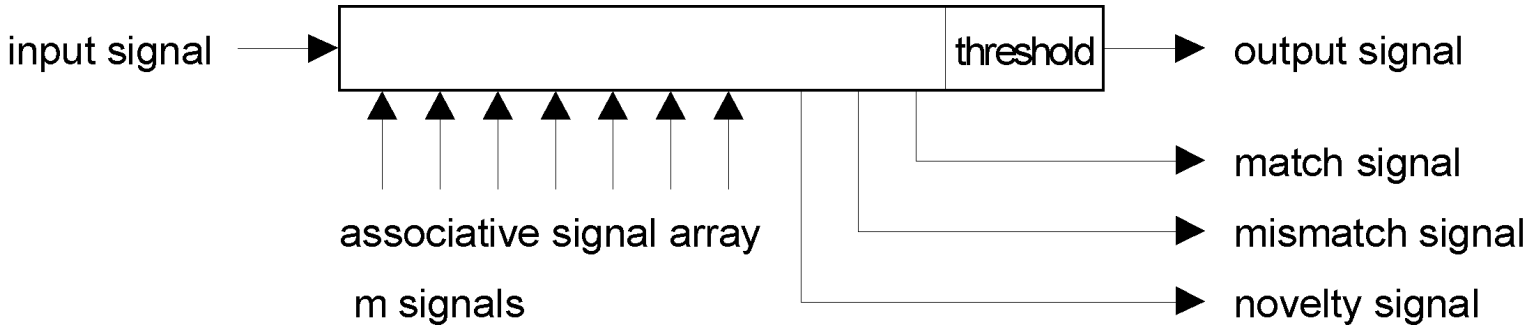
Steps towards Machine Mind

1. Devise suitable information representation method (distributed signal representation)

2. Devise an elementary processing unit for the above (non-numeric associative neuron)

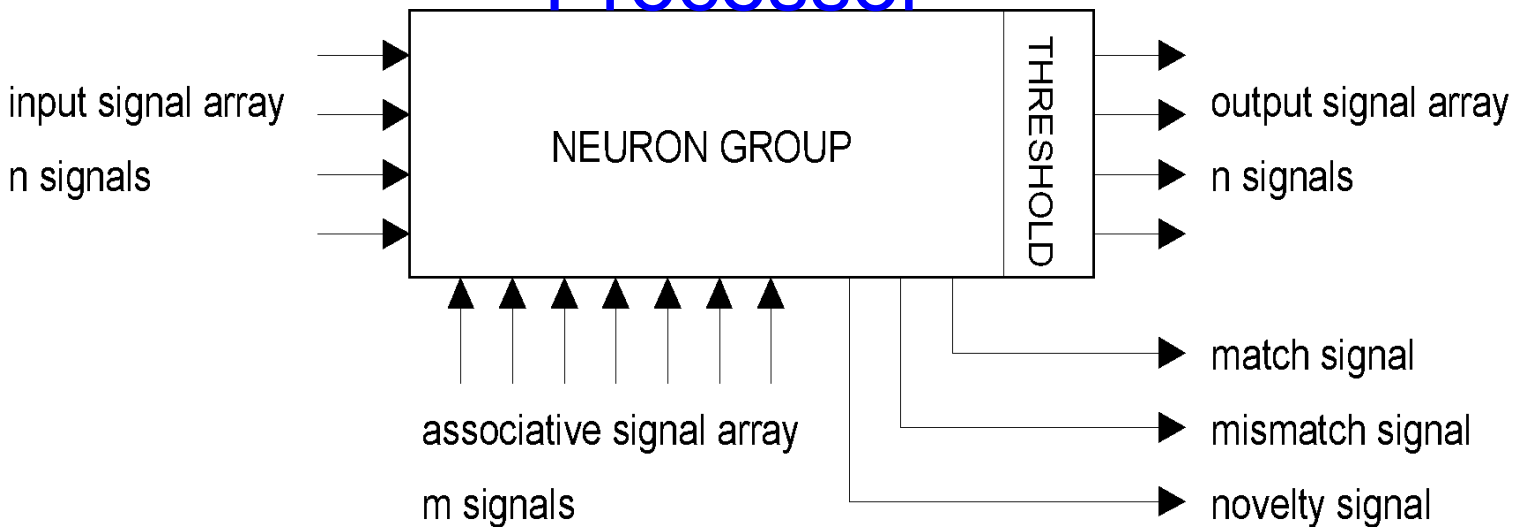
3. Devise system architecture that can support inner imagery etc. and the cognitive processes (reentrant modular architecture)

The Neuron



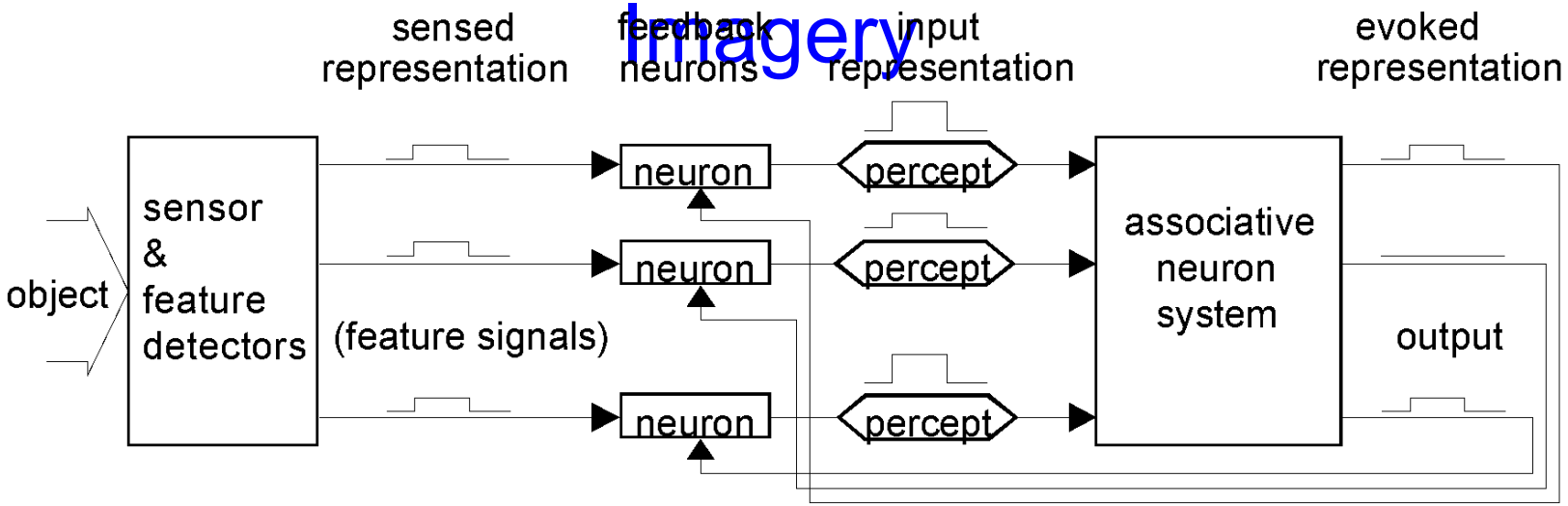
- Preservation of the input signal meaning
- Correlative Hebbian (Associative) learning
- Resolves match/mismatch/novelty states
- Non-numeric

Neuron Group as the Basic Signal Processor



- Association of signal arrays to each other
- Associative evocation of output signal arrays
- Compression or generalization when n < m
- Amplification or priming by the associative signal array
- Resolves match/mismatch/novelty between input and evocation

The Reentrant Loop -Key to Inner Imagery



-**Perception** with and without priming

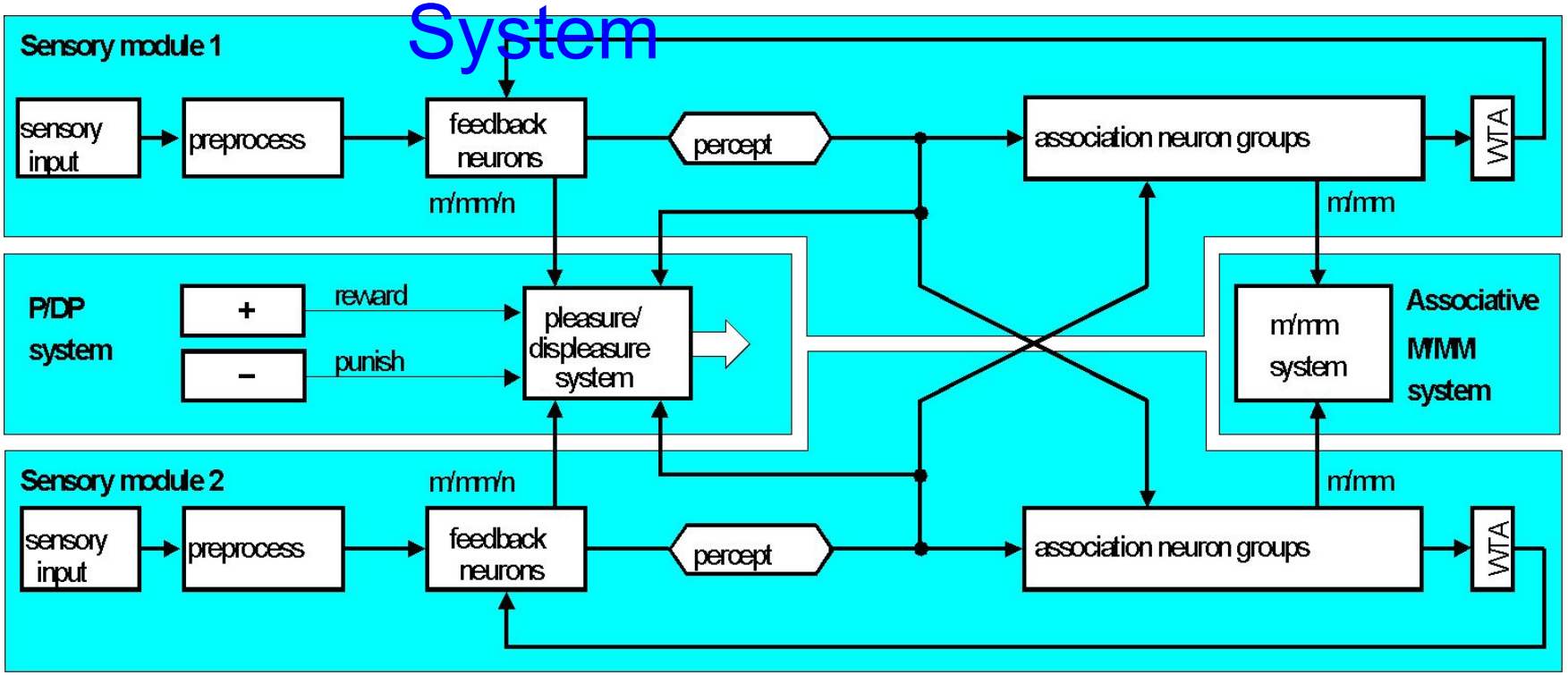
-Reverberating **short term memory**

-Translation of output representations into percepts (inner imagery, inner speech), **Introspection**

-Grounding of meaning

-Percept - the "official" output to other modules

The Cognitive System

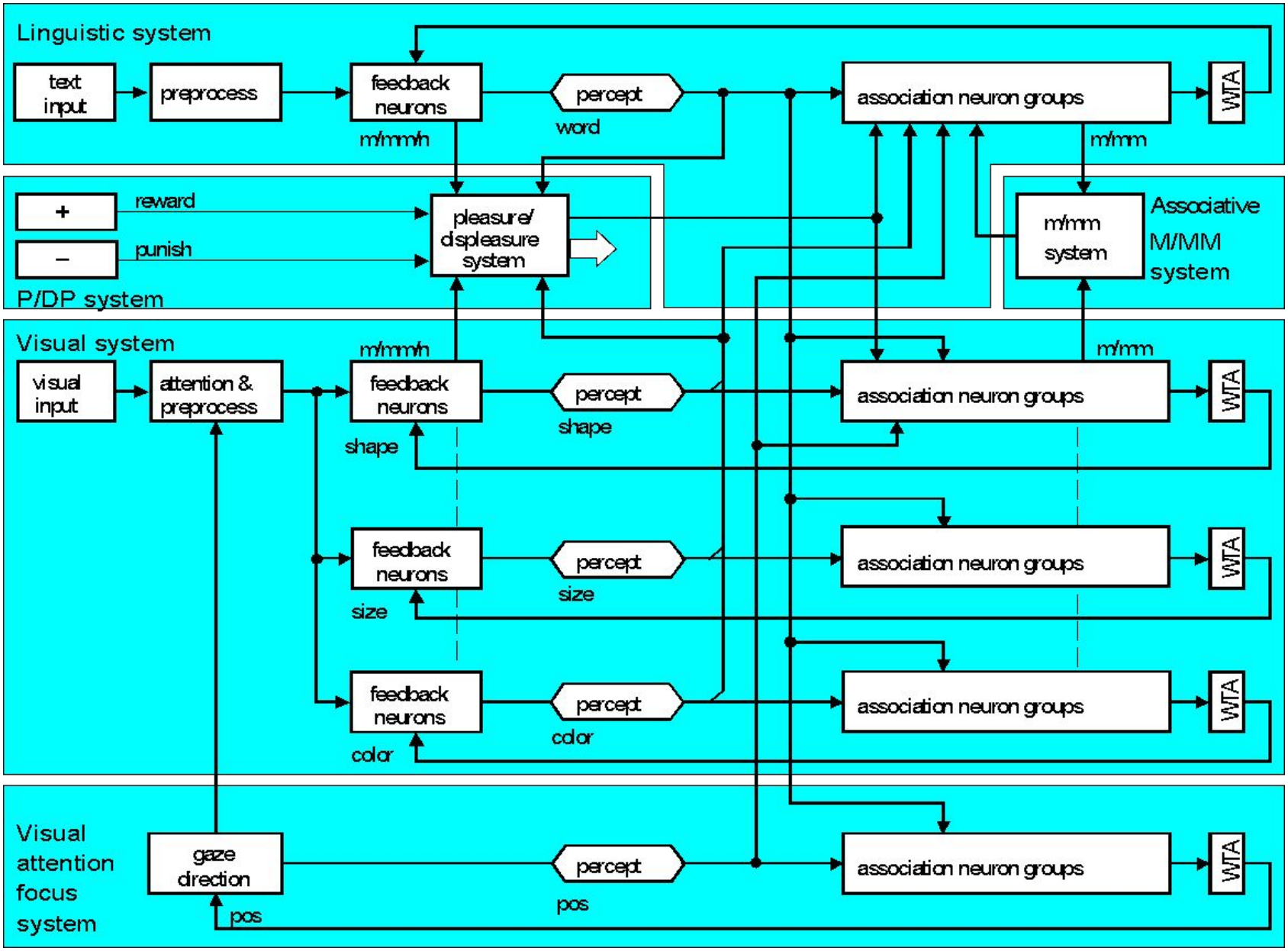


The complete system consists of:

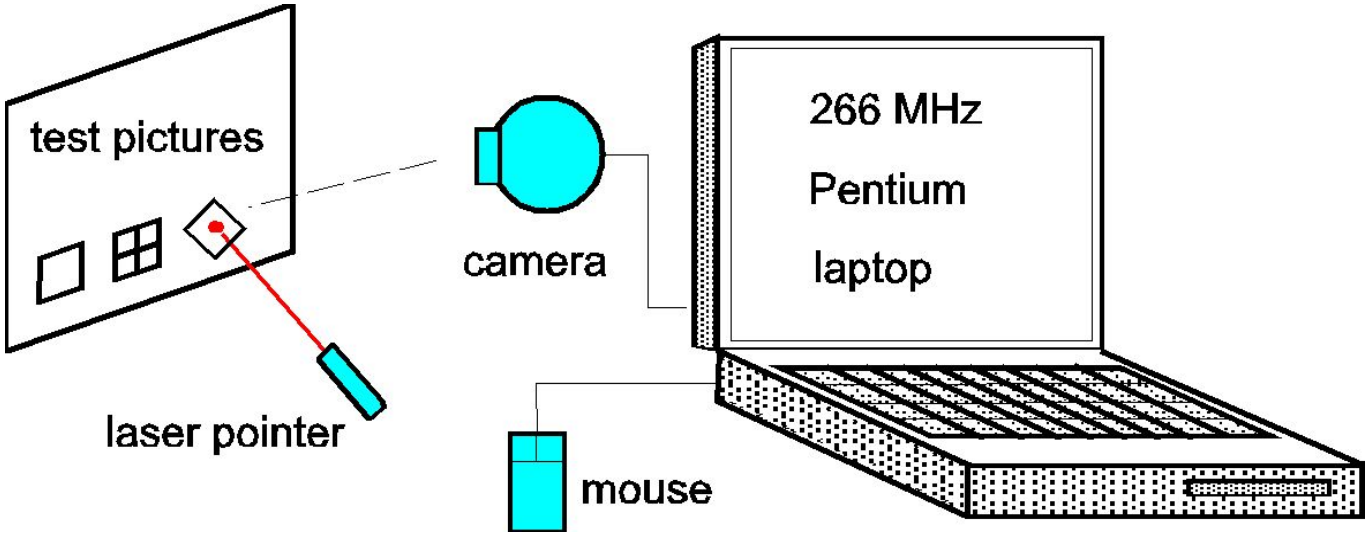
-Multiple associatively cross-connected sensory modules

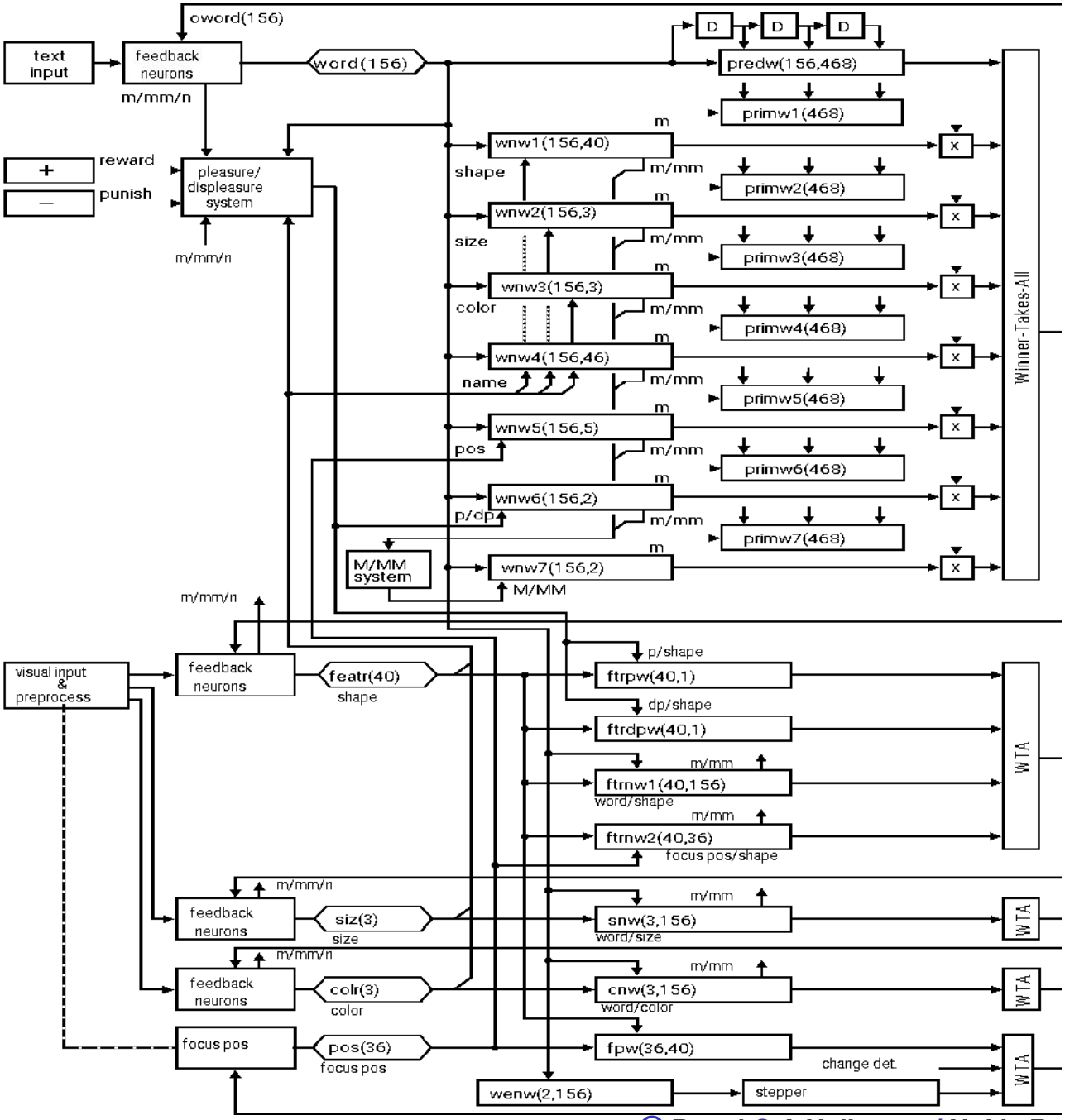
-Pleasure/displeasure system

-Match/mismatch/novelty detection



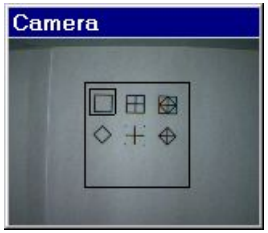
The Simulation System

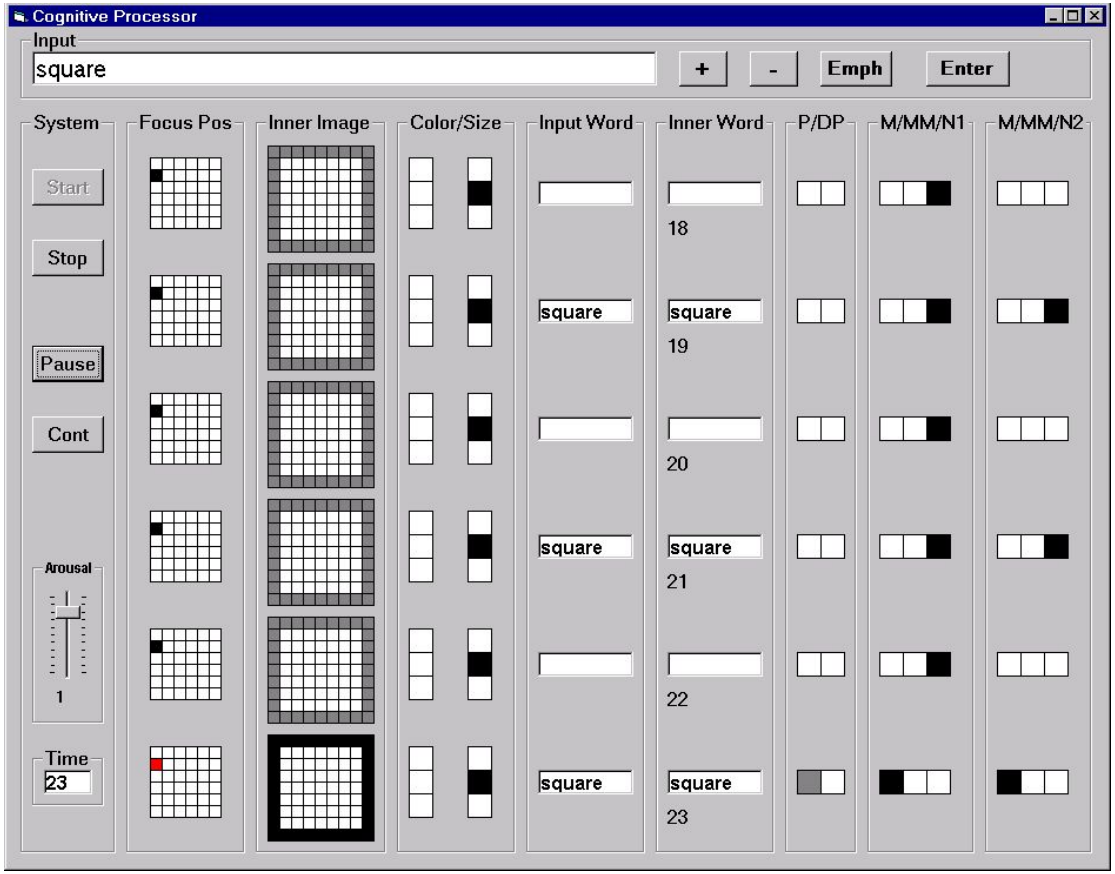




The Simulation System

Naming entities



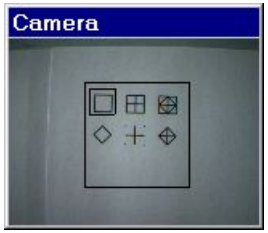


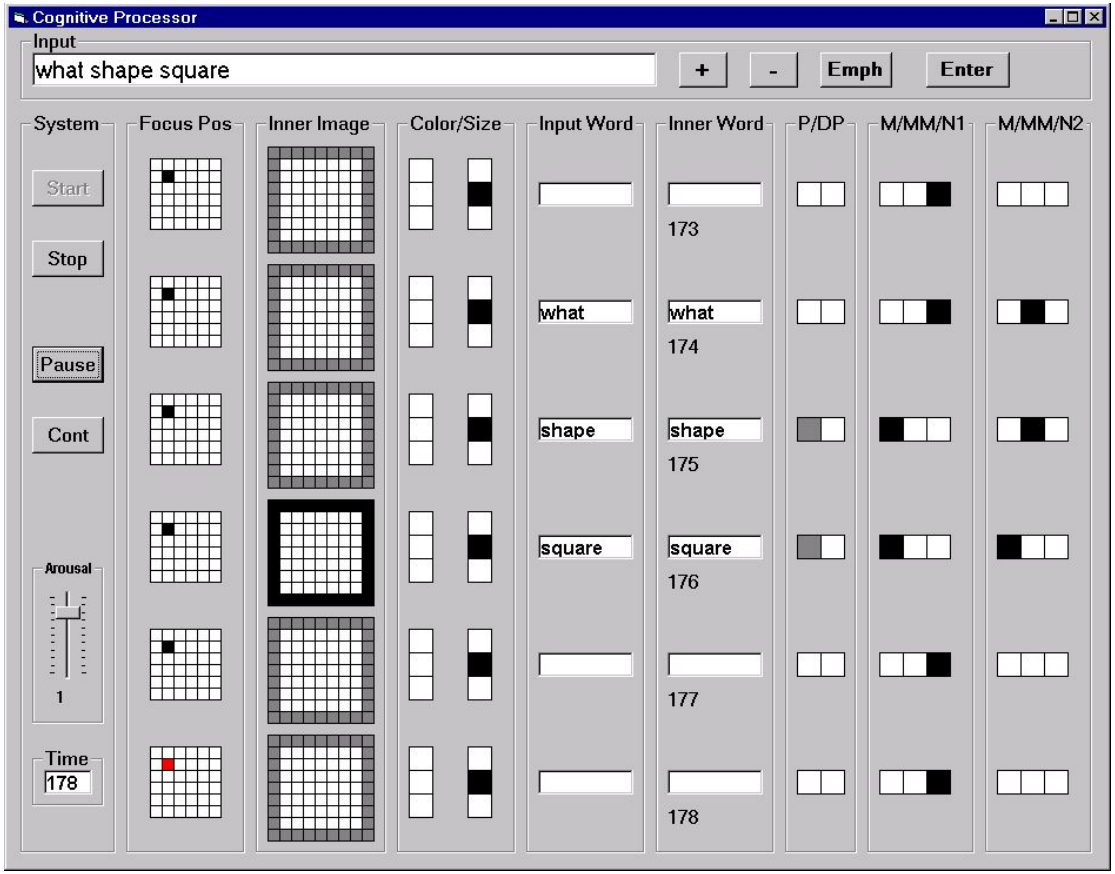
1. Point the object with a laser pointer
2. Type in a name
3. Push "Emph" and "Enter"

time

The Simulation System

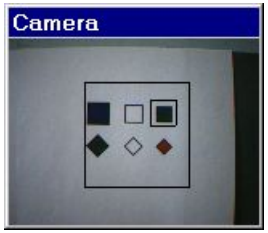
Teaching categories; category "shape"

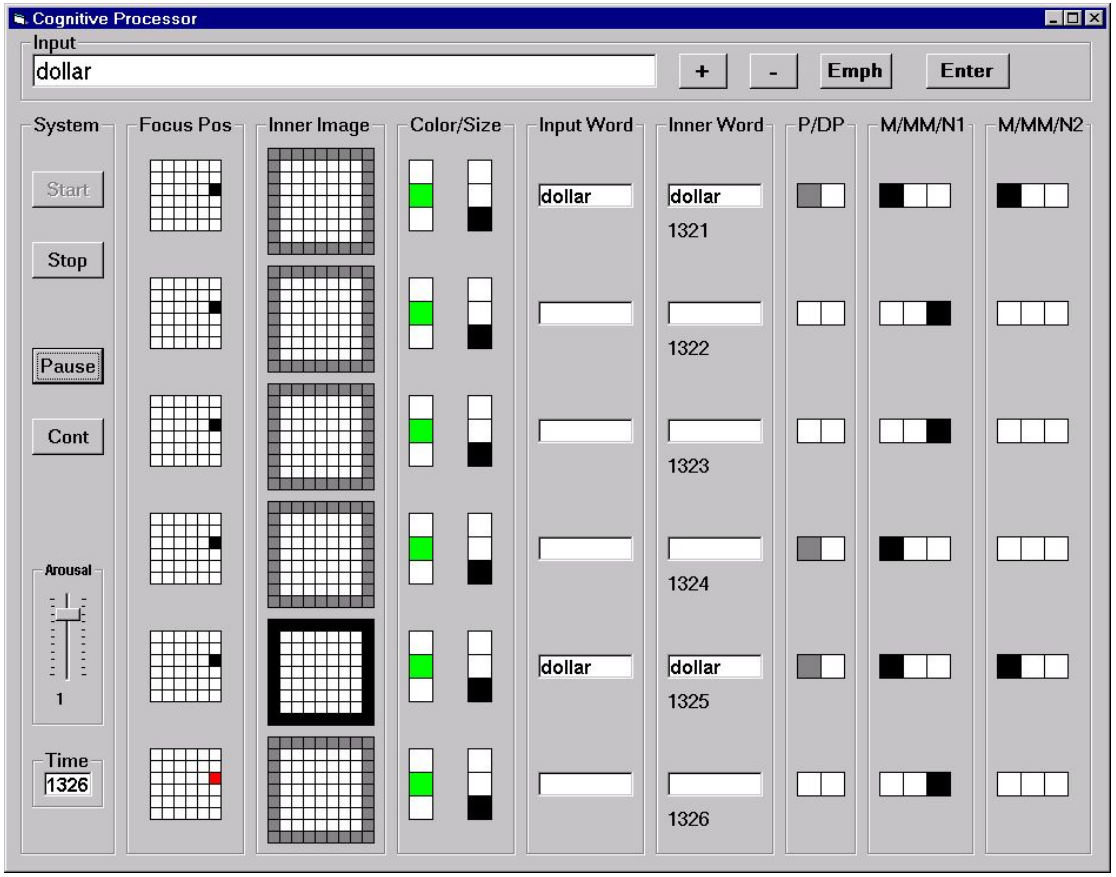




The Simulation System

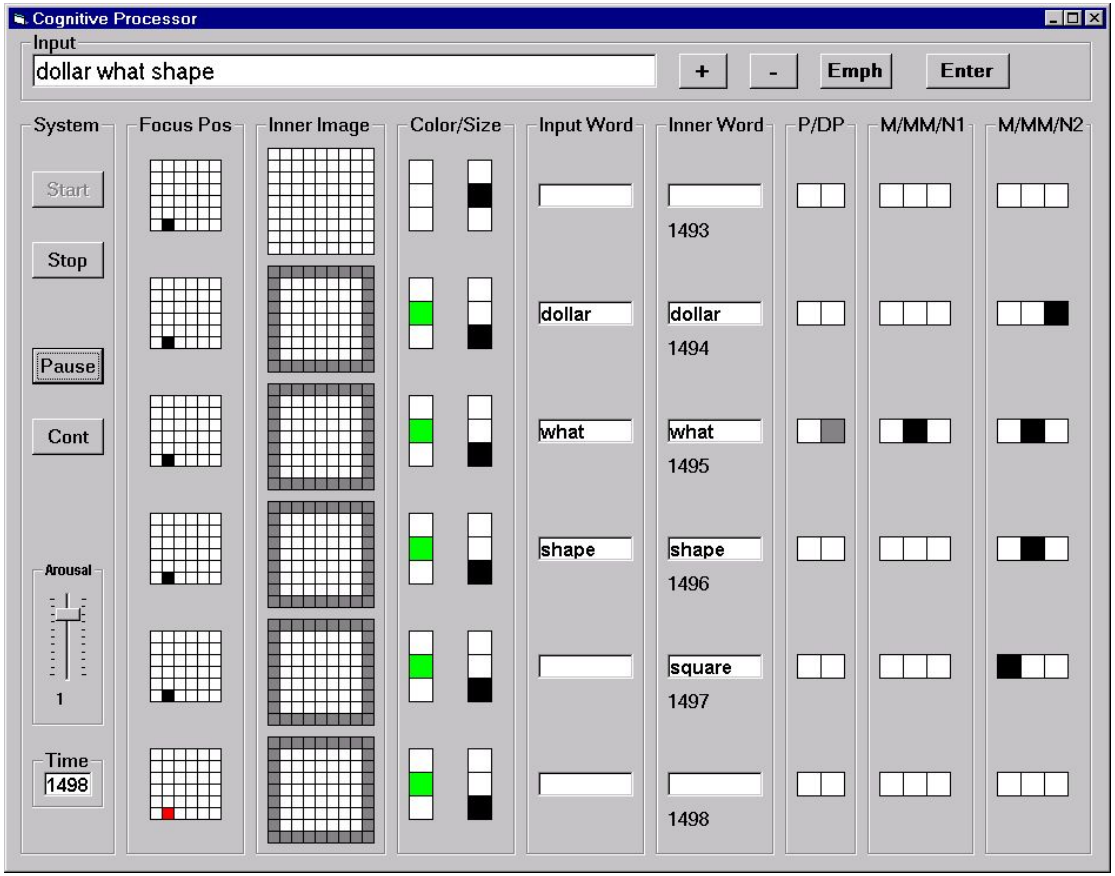
Naming an entity with shape, color and size attributes





The Simulation System

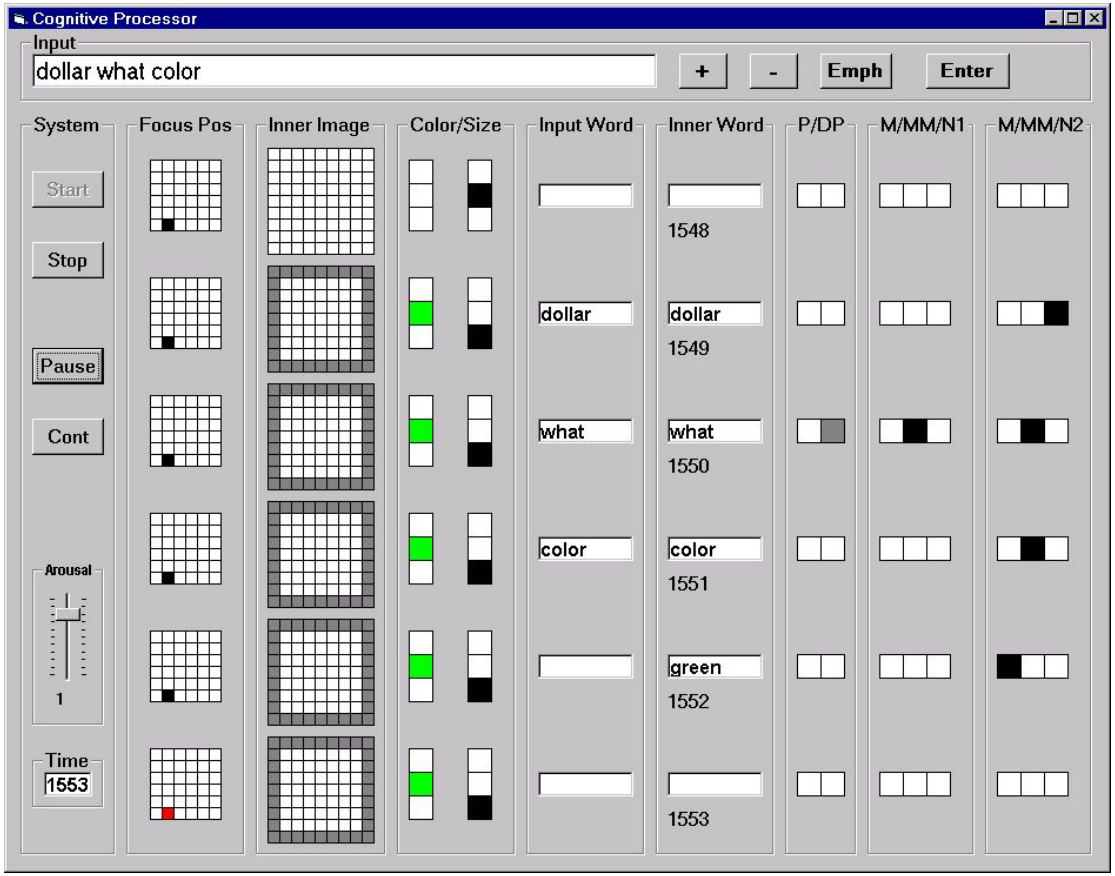
Deduction by evoked inner imagery, answering a question



The word “square” has not been explicitly associated to “dollar”!

The Simulation System

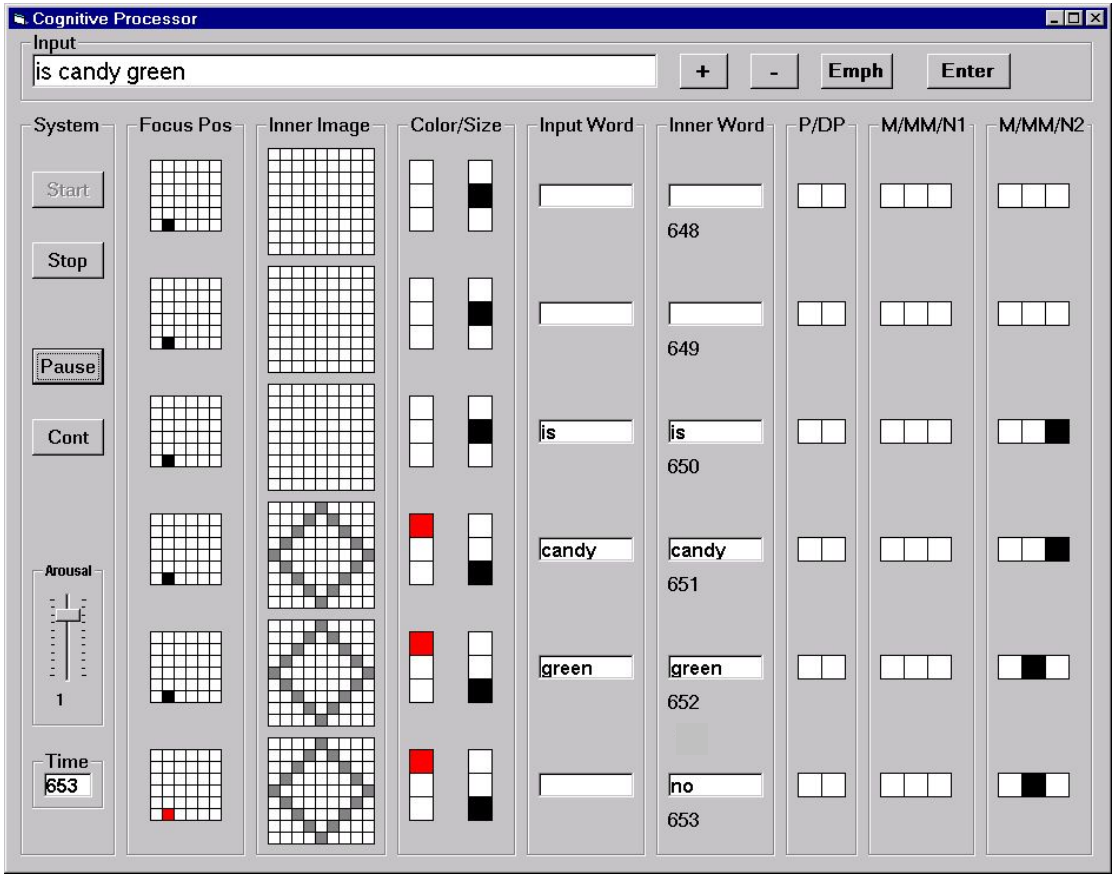
Deduction by evoked inner imagery, answering a question



The word “green” has not been explicitly associated to “dollar”!

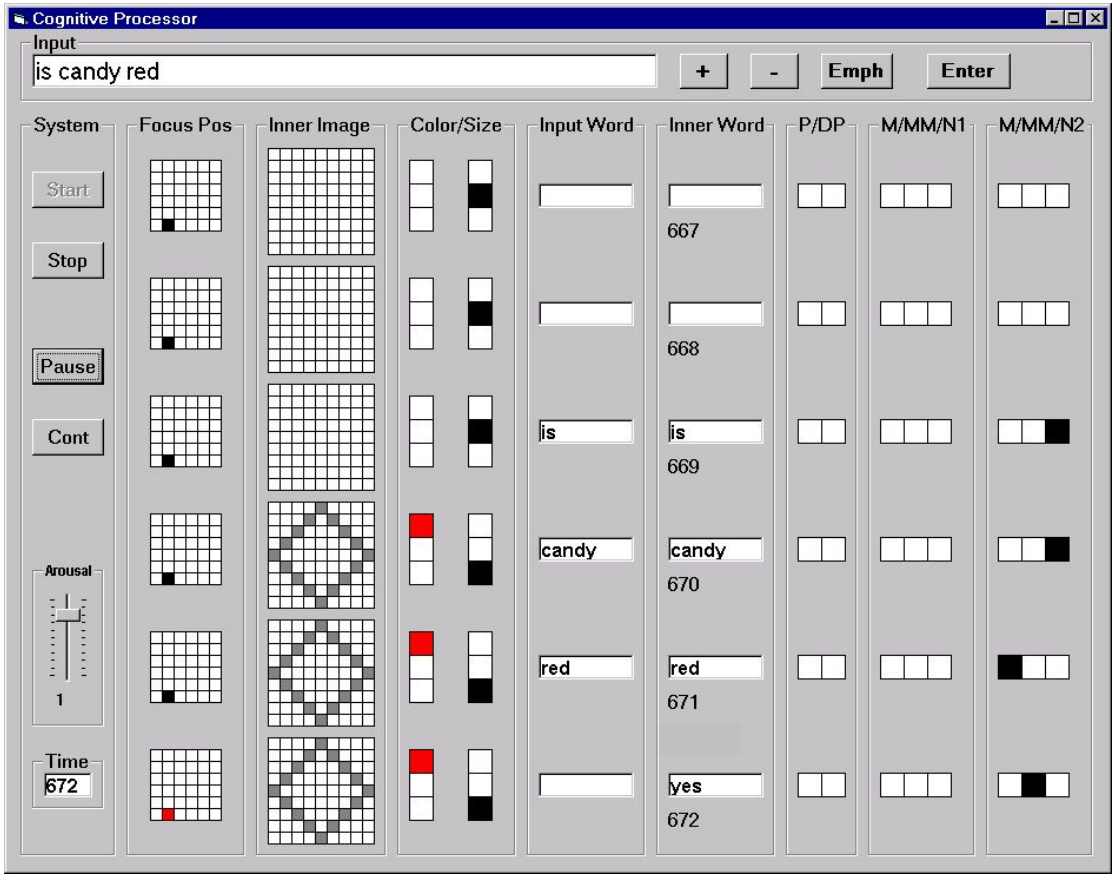
The Simulation System

Deduction by evoked inner imagery, contradiction detection



The Simulation System

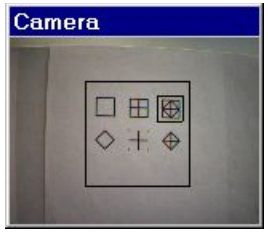
Deduction by evoked inner imagery, affirmation detection

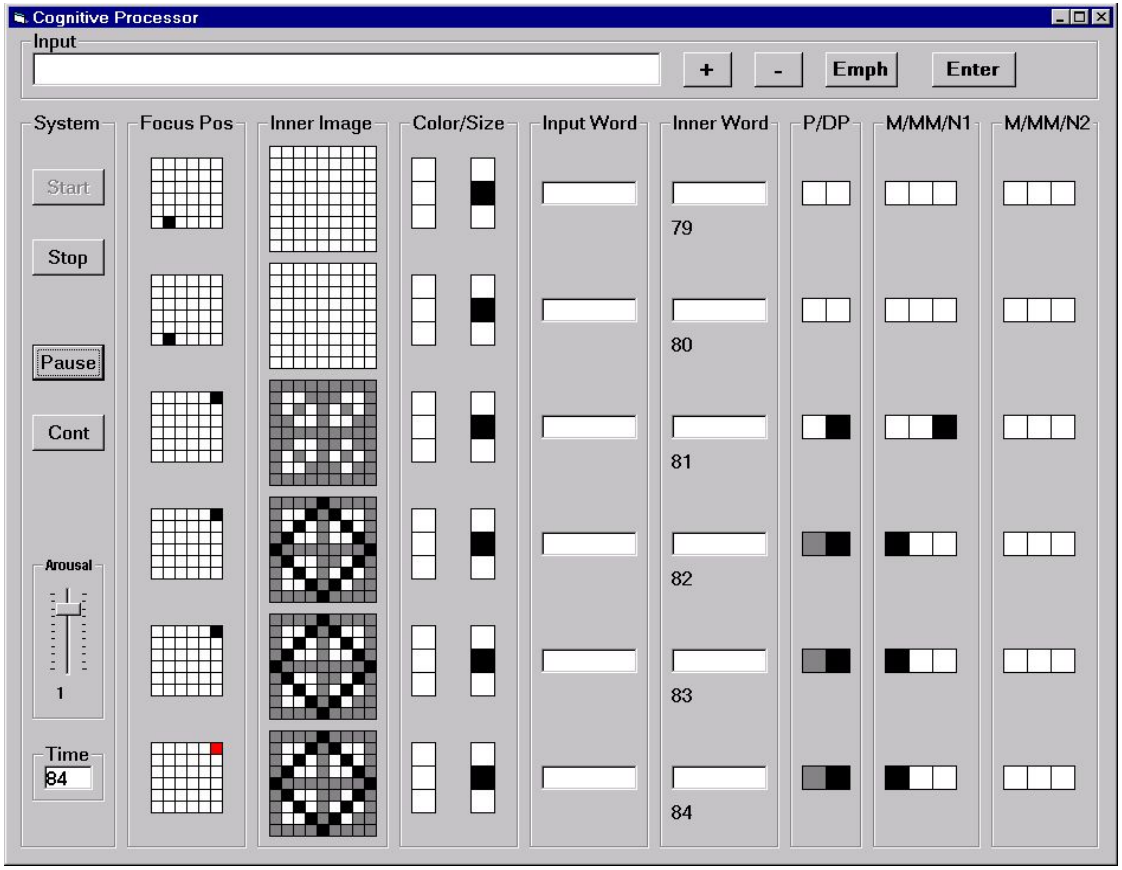


The Simulation System

- emotional significance;

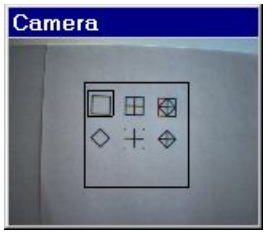
detection of an emotionally significant entity from noise

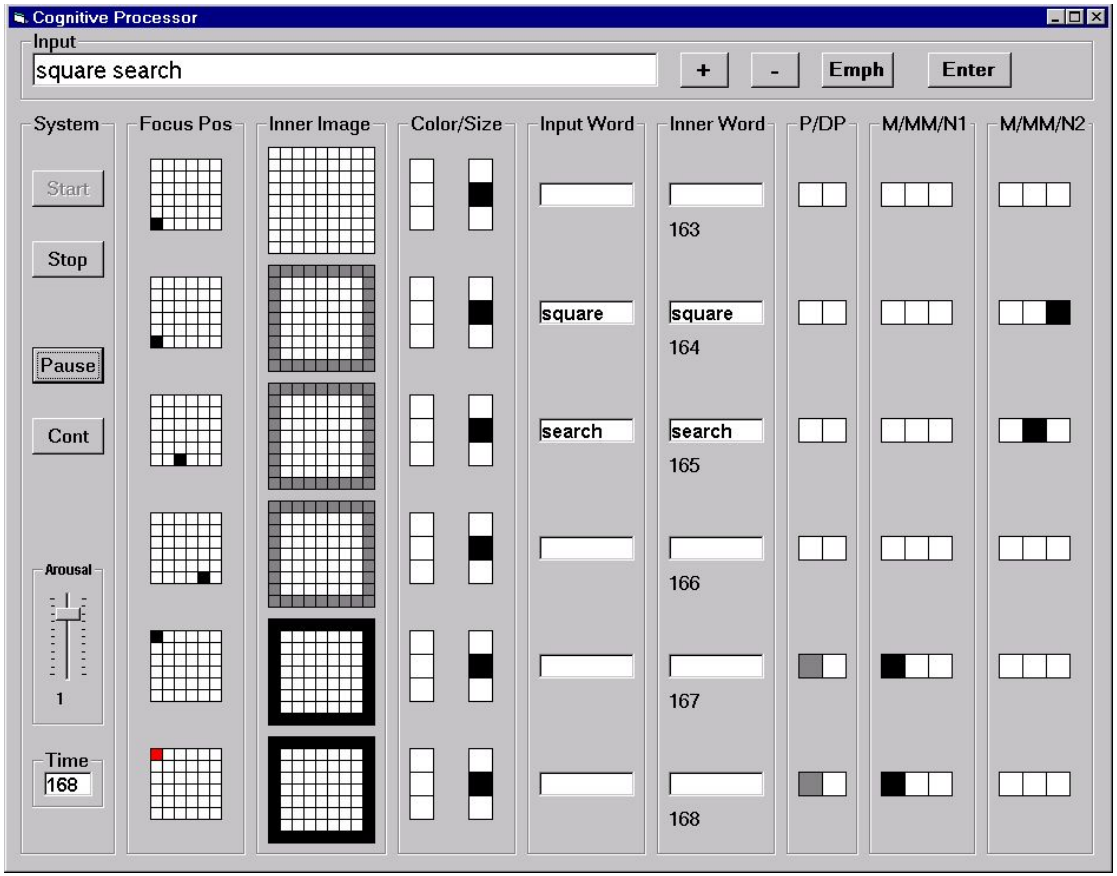




The Simulation System

Visual search of a given entity; the search is completed when a sensed object matches the inner image of the object to be searched. No pattern matching is done however!

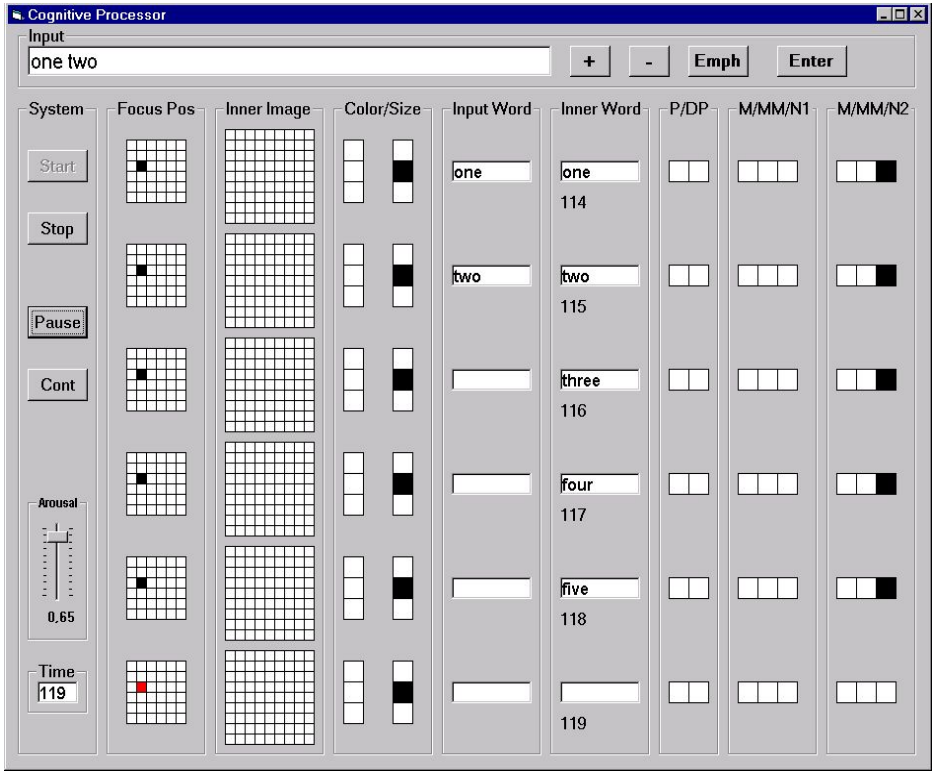


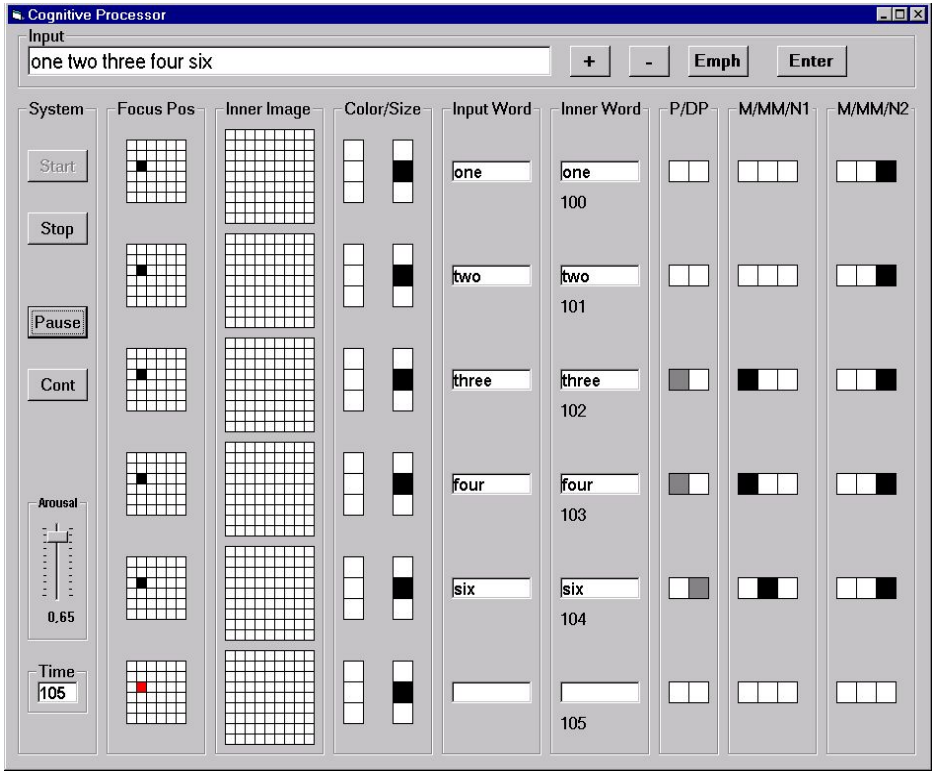


The Simulation System

-Verbal sequences, reproduction

-Sequences as serial associative prediction; detection of mismatch between prediction and actual percept





Conclusions 1

A modular non-numeric neural network has been devised that

-Operates with inner imagery, inner speech

-Acquires information via perception

-Acquires information about its inner states via introspective perception

-Is able to learn and generalize (and fast!)

-Has cognitive functions similar to human brain

What remains to be demonstrated:

-Actual motor output systems

-The effect of needs, drives, planning, will

-Personal history, sense of time

-Self concepts

Conclusions 2

TOWARDS CONSCIOUS MACHINES?

This system has the flow of inner imagery and inner speech, the hallmarks of human consciousness

However, the system is not yet able to report on its own that it exists, that it has inner imagery and inner speech

A system's ability to report on its own that it has inner speech, produced by the system self, could be used as a test for machine self-consciousness

The author would like to see the Turing test be replaced by this one.

Thank You !

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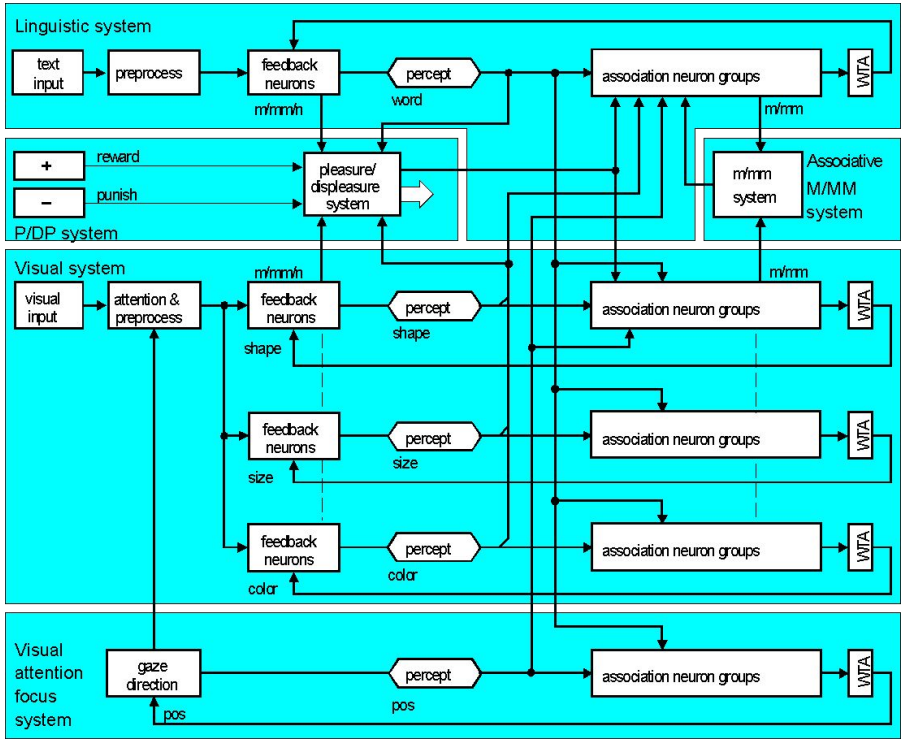

Dr. Pentti O. A. Haikonen
principal scientist
Cognitive Technology

NOKIA RESEARCH CENTER

P.O. Box 407

FIN-00045 NOKIA GROUP Finland

pentti.haikonen@nokia.com