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Netra : Object Recognition Model Based on Artificial Sensory Physiology

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Abstract:

Artificial sensory physiology attempts to deal with creation of artificial systems which are identical to biological beings with respect to sensory data gathering, recognition of information and response. The paper describes a computer procedural model named *Netra* based on psychological principles, physiology of sensory organs and response of an organism in specific environment. Recognition of an object is done on the basis of classifying the information received by visual sensors and processing the information, using an improvised algorithm which utilizes optimum information required to correctly identify an object. The procedure shows efficiency in process of identification of an object which is attributed to processing of prioritized information.

Index Terms - recognition model, sensory physiology, analyzer, local reasoning.

I. INTRODUCTION

The process of recognition of object by brain is still largely unknown. An exact replica of a system which identifies an object in exact fashion as brain of an organism (especially higher order mammals) has not been possible yet. Recognition of an object is not a standalone process which can be done only by testing for some specific properties of the object. Recognition of an object is done as a whole and determined by the factors such as when, where, why an object is present and how does it completes its function. A large number of models presently deal with specific parameters to answer above questions. Obviously all these questions are not applicable always so only when the need is to test for a specific question arises, the test should be performed. This procedure collects information from all available sources and processes the information in stages. Each stage yields result which is more refined from the previous one and collective results are used to decide the identities The proposed procedure makes the search of frequently analyzed object quick with the help of prioritizing the information .The procedure includes the properties of biological systems to analyze an object and quality of computational and database systems in form of large memory, efficiency and continuous processing. The paper is organized in following order. Section II discusses background work. Section III defines the proposed model in detail. Results are given in Section IV. The paper is concluded in Section V and future work is mentioned in Section VI.

II. BACKGROUND STUDY

Whenever a new object or process is encountered then unconsciously a complete set of instructions is followed. In case of living beings, an object in not remembered in form of an object but as a collection of some basic information which is distributed to various regions of the brain.

Earlier psychologists involved in study of perceiving objects believed, before the process of object recognition and categorization could begin, the brain must first separate the figure in the image—such as a tree, or a piece of fruit—from its background. However, new research shows we actually categorize objects before we identify them. It means that, by the time individual even realizes what it is looking at the brain already knows what that thing is.[1].It's important to understand the complexity of the human brain. The brain consists of cells called neurons. Neuron has a cell body, a long part called axon and at the very end a chemical goes across a gap (synapse) where it triggers another neuron to send a message. Figure 1 illustrates the basic structure of neuron [2]. The brain processes a data collected from various source. It has been shown that the supplementary motor area, or SMA, was stimulated when the brain planned a certain finger movement. But when the plan was physically executed, a change occurred in the primary motor area alone

with the SMA[3]. Similarly, it was found that the SMA was activated during the mental and physical performances while the rolandic region, which separates the parietal lobe from the frontal lobe. On the side of the frontal lobe, the primary motor area is located here as the primary sensation area is lo

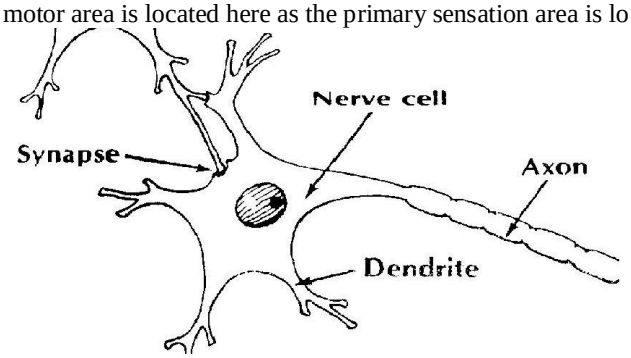

Figure1. A Neuron

cated on the side of the parietal lobe.[4].This shows the interrelated functioning of information.

Recent conceptual and technical advances, has lead us to reconsider closed-loop methods. For instance, a study by Lewi et al. [5] does not only show how to measure receptive fields more efficiently but more importantly suggests an approach to do so in an optimal, most time-saving way. If the challenges and caveats of closed-loop experiments and adaptive-sampling strategies can all be properly addressed, substantial advancements are to be expected in measurement efficiency and experimental design, similar to what has already become possible in other biology cal research areas [6].

Memory also represents a change in which individuals are because it is predictive in nature. Remembering things is easy if one has been exposed to similar things before, The knowledge gained in one field can be beneficial in case it is related to new knowledge being imbibed[7].Thus brain is not a simply a information processor but a network processing information.

III. PROPOSED APPROACH

This system is dependent on sensors for gathering data about the environment. After collection of data system creates a single list of information by combining information obtained from all sensors .The generated information is further refined by removing irrelevant information and also preparing of packets of information.

This information is arranged on priority basis, and transmitted in blocks depending on the level of prioritized data.

First task in case of analyzing of information is to decide "what does the given information refer to?". The above process is followed by the determination of "Purpose of Object". The further refinement of information can be done by analyzing the results of next processes which decides basic functional methodology", "acceptability with respect to time and acceptability with respect to place".

If the provided information at one level is insufficient then a set of Test Cases is generated which is provided to that level by the receptors or previous process. If the result generated at one level matches observation of previous level, then result is treated as correct. (Multi Level Check of Results is also considered in case of refined recognition).

Anything which is recognized by the system, has a log record giving detail regarding how frequently the same information is received by the system .This log is helpful in prioritizing search for determination of objects.

3.1. Description of LEVEL I:

This level is concerned with the collection of information by receptors.

Each receptor comprising of sensor and string generating system, generates a string of information. The information is specific to a specific receptor. The string is formed with the highest priority information in the beginning. Receptors can also send its information to various analyzers directly if it is demanded by an anlyser, thus bypassing other levels which don't requires its information. There are 5 receptors as described below.

3.1.1 Visual Receptor: This receptor records information pertaining to general shape, color and brightness. The general shape recognition has highest priority. The general shape is decided by using linear principle manifolds for learning low dimensional representations for visual recognition.

3.1.2 Audio receptor: This receptor is called in action by demand of visual receptor or if can be distinctly analyzed. This is second priority receptor and the string generated by it contains information regarding loudness, and frequency. On the basis of priority of sound heard, the sounds with "like sound" tag have high priority. This tag is decided on the basis of previous searches and recognitions made.

3.1.3 Touch receptor: It is activated only when any test case requires it or visual receptor demands it without issuing any "warning or emergency flags" .The string test for hardness on scale and also information regarding moisture content.

3.1.4. Smell receptor: It is usually inactive since it requires a large amount of memory. This receptor is used as confirmation for results of other receptors based on the previous knowledge.

3.1.5. Taste receptor: It is occasionally used and in case where some confirmation case only. Since this is for conformational case, so priority is set to null.

3.2. Description of LEVEL II:

After all the strings are formed by the receptors, they are sent to the primary analyzer. The function of primary analyzer is to optimize the length of string. It combines all ministrings from different receptors to form the main string;

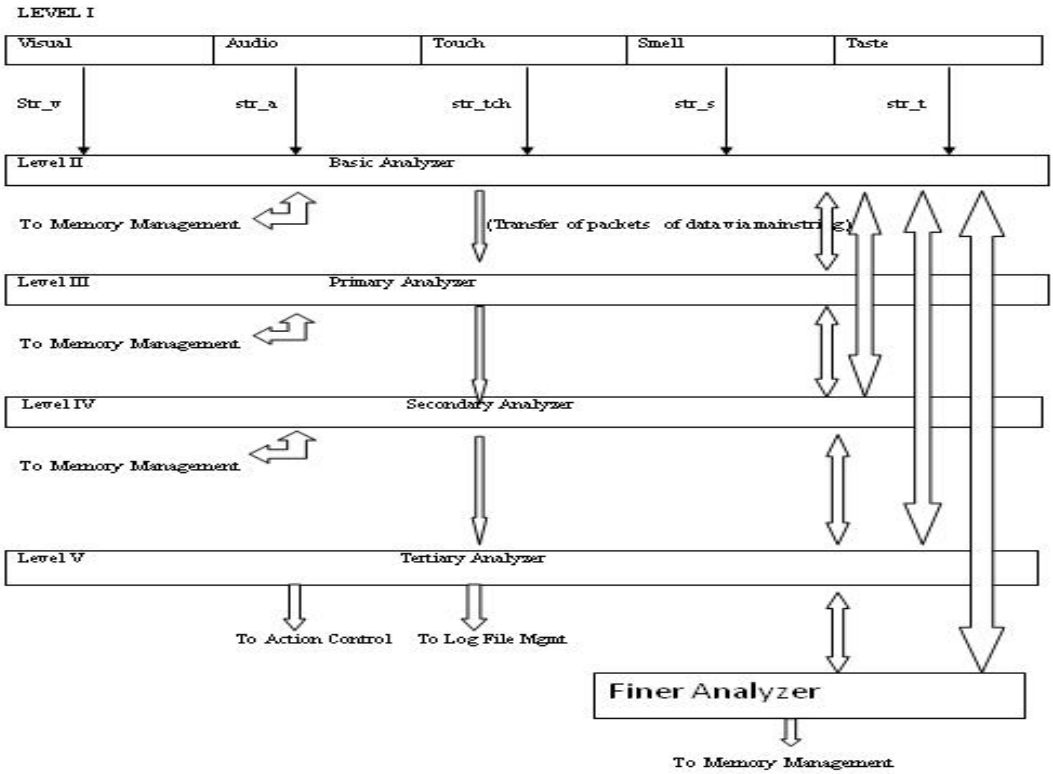

Figure2: Architecture of the System

ministrings from different receptors to form the main string; all irrelevant data is deleted. Except in case of emergency flag raised by some receptor, it is allowed to decide and divide priority equally in normal conditions, things belonging to "like flag" category is more acceptable. It also divides the main string into various packets as these packets are prioritized.

3.3. Description of LEVEL III

The primary analyzer decides the basic properties of object. The data received from the receptors is sent to the memory management since the data is well organized due to maintenance and sorting according to Log files so search yields the most basic results and limit our search to a range only. The main task here is to get a general idea about the object. The question most probably to match this segment is to partially know about "what is this object" If the string is too common in Log files then the object can be recognized quickly. For example seeing a car on road daily set the priority of car high and it can be recognized quickly on the basis of our search.

3.4. Description of LEVEL IV:

This level helps in recognition of object by deciding "why this object occurs at this condition". Many a time's recognition of an object is done on the basis of the occurrence of an object at particular conditions. In some cases as the answers from the primary analyzer are not sufficient so this stage reduce the number of searches to a predefined range. In case of anomaly this analyzer sends its set of generated test cases directly to analyzer or the next analyzer.

3.5. Description of LEVEL V

If the recognition of objects in above analyzers doesn't yield a single result then finer refinement of information is done at this level. It involves local reasoning which refers to use of a particular object in a scenario is defined. Global reasoning provide solution to problems such as "where is the object present". This analyzer is used rarely so it also maintain information of surroundings and hence requires minimum memory overhead, this information help this analyzer to resolve doubts without wasting anytime in determining these factors at the time of recognition.

The result generated is used to keep track of how often an object is viewed .If same strings are generate each time an object is viewed then the highest priority packet is set to identify the object and only the generated test cases of lowest priority are checked. This yield more specific answers.

The efficient memory organization is done by arranging strings of similar objects together and with highest priority together. For instance in case of emergency flags enabled it is not necessary to decide the exact model of car and this processing can be done later on also but identification of moving of a big object on out trajectory is to be done.

3.6.Finer Analyser:

This is used to determine the most basic information's which can be obtained from the new object seen .These properties obtained can be used in future to assess new objects. This analyzer's implementation has been reserved for future.

3.7. Overview of Memory Management:

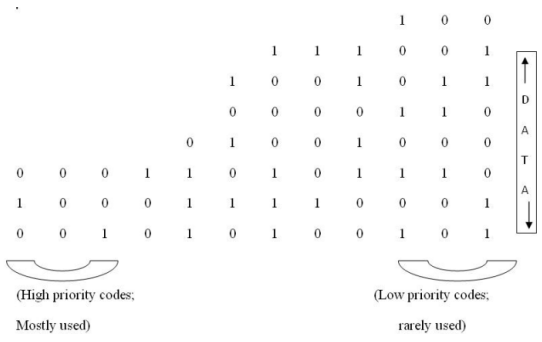

Figure3: Memory Management

The objects with high priority such as basic shapes, sounds, smells, etc have minimum length of strings or high priority code. Also emergency flag dependent signals (such as red color in general, etc) also have high priority codes).This help in quick response in case of any emergency flag is enabled.

The memory management also includes setting of codes for new memory units that are created by new learning. All the new information is stored in a intermediate memory and after codes are assigned to new memory units, it is combined with the main memory, helping in making least distortion in memory management.

IV. RESULT

Netra has been developed using only visual sensors at its core. It is implemented using java. The following intermediate result in figure 4 screenshot shows the reduction in identifier strings with the repetitive conditioning of the system with an object. The initial 36 character long recognition string reduced to 12 character string after 20 iterations are complete. The graph between the effective time in recognition and the number of iterations used is plotted in figure 5. The green line depicts the recognition of an ice cream cone and blue line depicts the recognition for a tennis ball. The circles form the basis of large number objects as a result such objects having circular shape has less recognition time and the recognition time further reduced with similar conditioning of the system.

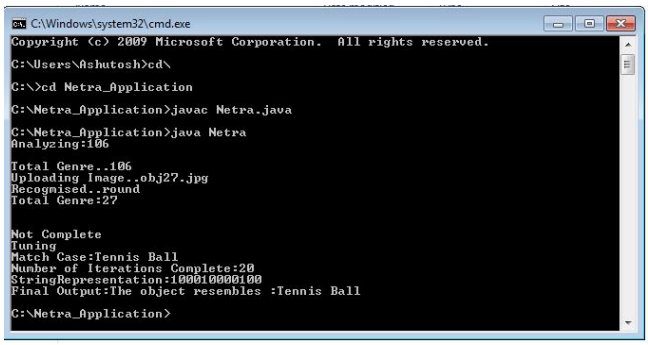

Figure4: Intermediate Result

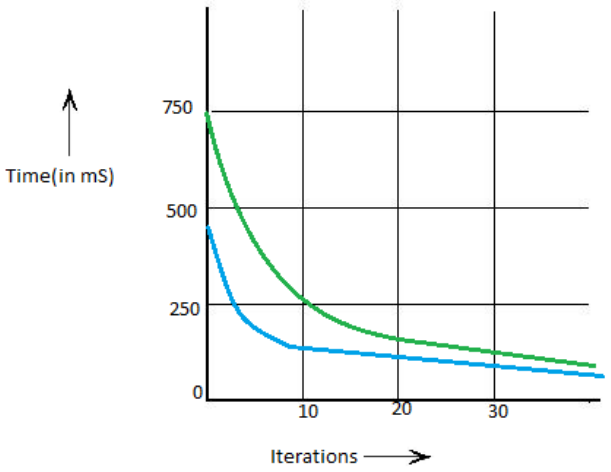

Figure5: Graph between the Effective Time in Recognition and the Number of Iterations

V. CONCLUSION

The proposed system is an effort to apply the process of biological interpretation of objects by means of utilizing various cases on the basis of priority, need and prevailing conditions. The system not only identifies an object but if that object is to be identified again then it also reduces the recognition time. Finally identical to living things who continuously learn new things and experiences on the basis of the prevailing conditions *Netra* manages new information's learnt and also uses it in future recognition of objects.

VI. FUTURE WORK

This procedure can be applied in a variety of fields. One possible field of application is where an item is needed to be identified from a collection quickly, such as finding of a particular good in a shopping mall by a humanoid, or a particular species of flora or fauna in a specified ecological region. The further refinement in functionality of Finer Analyzer can also be done to suite the requirement as per the environment of operation.

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