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# Cognitive Architecture to Generate Motivational Feelings: A Way to Improve Visual Learning in Robots

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**Abstract**
Expressions and voice pitch of an individual play an indispensable role in different cognitive processes. These factor help humans to learn a lot about different things present in their environment. This paper proposes a way to motivate robot learning through their environment and human around them. This mechanism is based on recognition of other agent's facial expressions and voice pitch analysis by robot. A motivational level can be calculated through these feelings. Motivational level can impel the robots to improve their past learning. This mechanism can possibly help a robot to apprehend its environment and interact with other agents effectively.
**Keywords**: cognition; motivation; facial expression; voice pitch; perception; memory.

## 1. Introduction

Over the past few decade, robot shave moved out of controlled isolation and into homes and work places, where they coexist with the people. One new challenge is to make robots able to learn from their environment instead of having preprogrammed features to survive in the environment. Autonomous robot learning can be useful only if robots are able to recognize about the different things without the help of any master to teach them. It can only be achieved only if robot shave such a cognition system that can learn and perceive thing as humans perceive. A common approach used for autonomous learning is reinforcement learning**.** The way of learning is completely based on numerical reward generation system. Such learning trials cannot be executed in real environments because unrealistic time is necessary and the real system's durability is limited [1]**.** Reinforcement learning is a branch of machine learning concerned with using experience gained through interacting with the world and evaluative feedback to improve a system's ability to make behavioral decisions [2].

Sometimes prior knowledge may not be available, it is desirable to use a learning method in which without prior knowledge, learning and cognition is equally easy for robots as in the presence of any prior knowledge. In this paper, a way to learn from environment and people is described that is based on introducing a motivational feeling. This learning mechanism is mainly based on two factors; facial expression recognition and voice pitch analysis. Recognition of face expressions and emotions may help either to improve interactions with a robot, or to study people's social engagement in collaborative tasks [ 3 ] [ 4 ] Then combination of both of them can be used for the learning purpose. A motivational feeling can be generated at the time of first time learning of anything from environment.

## 2. Related Work

Recent advancements in learning through the recognizing facial expressions has shown that there are various ways for robotic faces ranging from 2D graphical avatars to mechanically controlled robotic faces. Some approaches [5] use a frame-based representation; others [5][6] Use also temporal information. Some work has done in past for robot learning through explicit attention by the human. Specifically, the mode of social interaction is that of a care taker-infant where a human acts as care taker for the robot. The communication skills targeted for learning are those exhibited by infants. The system architecture consists of four subsystems: motivation system, behavior system, perceptual system and motor system [7]. Another attempt is being made to develop a mind-implemented robot that can carry out intellectual conversation with humans.

Facial expressions in to six groups (surprise, fear, disgust, anger, happiness, and sadness) and obtained 70 CC D (charge coupled device) camera-acquired data of facial feature-points from three components of the face (eyebrows, eyes and mouth). Then the facial expression information is generated and input in to the input units of the neural network; network learning and recognition are done by a back propagation algorithm[8] Similarly, voice recognition system to learn about expression are also implemented. Emo Voice [9] is a framework. It is real time speech emotion recognition component. This is an approach for using voice recognition for emotion learning purpose. The idea of facial expression recognition and facial identity are also processed by different neural system [10]**.** These were some approaches used in past for face expression recognition and voice recognition for emotion evaluation.

## 3. Proposed Work

An infant's emotions and drives play a very important role in generating meaningful interaction with the care taker, and regulating these interactions to maintain an environment suitable for the learning process [11]. In this paper, a mechanism is proposed for learning which is started when robot experiences something new in its environment.

Robot recognizes the environment and observes the behavior of a human being. The facial expressions and voice pitch of a person are stimulus for the robot. Based on the stimulus received form the environment, sensory system activates facial expression and voice pitch calculation systems. These system are used to generate a knowledge based stimulus. Stimuli from sensory system is sent to the perception system.

In perception system, a perception is generated on the base of this stimuli. New perception formed is sent to a parallel distributed processing (PDP) system [12]. A parallel distributed processing network is a network of processing units, connected by weighted, unidirectional links [13]. PDP system is used to search and provide all chunks related to the information received from perception system. In PDP system, based on the stimulus received, chunks are retrieved from long term memory. These chunks are retrieved on base of similarity between the stimulus received and chunks already stored in the long term memory. From PDP system information is searched, retrieved and brought back to the information manipulation (IM) system [14].

IM system is used for the manipulation of information. In IM system, if no chunks are received from PDP system, then only the new perception received, is sent for further processing. If some chunks are found, the IM system integrates new chunks with stimuli received from the PDP system shown in figure1. Motivations establish the nature of a creature by defining its needs and influencing how and when it acts to satisfy them [7]. Next task is to measure a motivational level. A motivational level is measured from the data received from the IM system. Motivational level is calculated in the form of percentage. On base of motivational level, percentage of leaning about a particular thing can be measured. After that stimuli from IM system and motivational level calculated are stored to the long term memory.

**Input stimuli from environment**
**If stimuli is not null**
**Activate facial expression recognition system**
**Activate voice pitch calculation system**

***Algorithm 1. Input Stimuli and Activating System***

**Algorithm 1** shows that sensory memory gets stimuli from the external environment and activates facial expression recognition system and voice pitch calculation system.

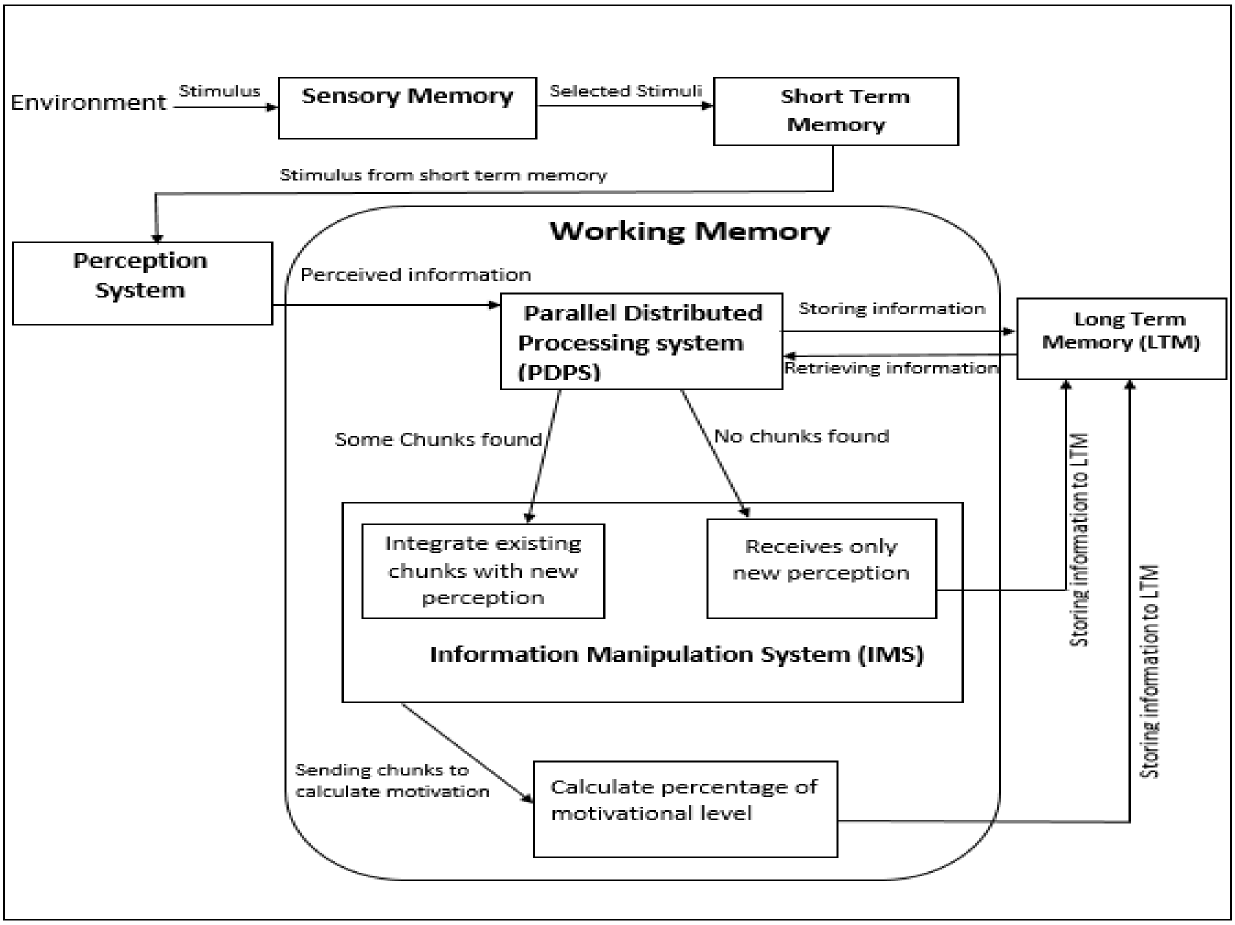


**Figure 1.**Cognitive Architecture for Motivational Learning

In **figure 1** the architecture of the proposed system is shown. Complete description of this architecture is described in multiple algorithms.

**Get new perception from Perception system**
**Get Chunks Related to new Perception from LTM**
**If chunks are not null**
**Send Chunks and new perception to IMS**

**Else**
**Send new perception IMS**

**Algorithm 2.** Perception System Mechanism

In **Algorithm 2** shows that perception system generate a new perception of stimuli received from the short term memory. Parallel distributed processing system (PDPS) receives the new perception generated and search chunks related to this perception in long term memory and send to information manipulation system (IMS) for further processing.

**Get chunks from PDPS**
**If Chunks contain new perception and old one**
**Integrate new chunks and old related chunks**
**Send integrated chunks to LTM and motivational calculation**

**Else**
**Send chunks to LTM and motivational calculation**

**Algorithm 3.** Information Manipulation System

**Algorithm 3** shows that information manipulation system (IMS) receives input from parallel distributed processing (PDP) system. If along new perception related chunks are also received, IMS integrates new perception with those chunks and sends to long term memory and for motivational level calculation otherwise only new perception is sent further.

**Get chunks from IMS**
**If Chunks Are Integrated**
**Get Motivational Percentage of old chunks from LTM**
**Calculate motivational percentage of new chunk**
**Add new motivational percentage with LTM percentage**
**Else**
**Calculate motivational percentage of new chunks**
**Store motivational percentage to LTM**

**Algorithm 4.** Motivational Manipulating System

In **Algorithm 4** the procedure of motivational level calculation is shown. Percentage of motivational level is calculated from the chunks received from information manipulations system. At the end, long term memory stores the chunks. In this way this architecture helps robot to get stimulus, perceive and manipulate the information and finally store it.

## 4. Conclusion and Future Work

In this paper, robot learning technique is described using motivational feelings factor and a cognitive learning framework. This system provides an efficient way for robots to learn from environment without human interruption directly, instead using an indirect way of learning about the feelings of human and interpret them accordingly. Using motivational level concept can help robots to gain knowledge about environment continuously. In future this mechanism of learning can be refined through introducing more factors with the motivational factor like interest level which will eventually increase the capacity of robot learning and this will lead towards a new way for making robot-human interaction easier and comfortable for both of them.

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