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Perception As It Applies to Artificial Intelligence

Curtis M. Kularski

Fayetteville State University

ABSTRACT

This paper explores the Cognitive Psychology concept of Perception, as it applies to the field of Artificial Intelligence. Humans and computers see things in very distinct ways. There are parallels drawn between a computer's processor and a human's brain, but the two are not equivalent. Perception for a human is a native, organic process, but for an artificial intelligence, it is a much more involved process. There are a lot of similarities, including matching of facial patterns to identify a person and measuring of pitch and pattern in a voice to determine spoken words. The fundamental differences between organic intelligence and artificial intelligence are how the raw input is used and how it is stored.

Perception As It Applies to Artificial Intelligence

Artificial intelligence and natural intelligence are as similar and as different as their names imply when viewed and analyzed from the perspective of perception. The common comparison between the human brain and the processing ability of a computer seems very natural, but there are tasks that are best suited to one or the other. Computers have the ability to record information and then recall it in vivid detail later, whereas a natural intelligence has great difficulty with that type of task. On the other hand, computers are limited in their ability to recognize and comprehend the information that has been recorded, but a human would be able to recognize their sensory information very quickly. Perception is the ability to be aware and understand sensory information (Oxford, 2009). The primary concern when approaching artificial intelligence with this definition is the question "Can an artificial intelligence understand?". The question has been approached by many researchers; either as a direct topic or as a side effect or an attempt to make computers (or robots) act more human.

On May 19, 2007 a report entitled "The Robots With A Sense of Self" written by Dr. Celeste Biever was published in *New Scientist*. The report summarized work that was done by Kevin Gold with a humanoid robot named Nico as well as work done by Cynthia Breazeal with her fury robot, Leonardo. Mr. Gold sought to determine if it was possible to teach the robot the skill of self recognition in a mirror. The feat was accomplished and Nico became the first self-aware robot. To make the task possible, Mr. Gold installed motion sensors into the robot's anatomy and wrote various learning algorithms to allow the robot to match what was being "seen" through its four cameras to the motion that its arms were performing. After a 4 minute training exercise, Nico was able to correctly distinguish its own movement from the movement

of Mr. Gold. Leonardo was built at MIT and was given more abilities than its Yale counterpart. Leonardo was taught not how to match motion to an image for reference, but how to recognize faces, using a more complicated facial recognition application. Leonardo is capable of understanding his own perspective as well as those of other individuals, a trait with which even humans sometimes have difficulty. Both robots were used for the purpose of determining how infants are able to develop self-awareness and how they form the ability to catalog their surroundings and have a situational awareness. Between the two studies Dr. Biever was able to determine that the mirror test is not a valid way to determine self-awareness or to test for the comprehension of sensory stimuli. The two robots were the only subjects involved in the research. They were selected for their abilities to see and attempt to comprehend their surroundings. It was concluded that robots present a unique way to study human psychological development and that it is possible to give a robot the ability to match a pattern in images to test for the presence of itself in the images. These conclusions do not match the goal of reaching self-aware artificial intelligence.

Giving robots the ability to simulate some of the traits that humans have does not give them the ability to perceive, only the ability to mimic human behavior, and only by being given abilities by their programmers and being placed into specialized situations that are well suited for the robot's tasks by its researcher.

There are other ways, not involving a sense of self, where artificial intelligence is give the ability to have perception, usually as a way to study the way that humans perceive. One such study was conducted to investigate the use of the natural input memory (NIM) model. "Modeling Recognition Memory Using the Similarity Structure of Natural Input" by Joyca P. W. Lacroix,

Jaap M. J. Murre, Eric O. Postma, and H. Jaap van den Herik was published on August 5, 2005 in *Cognitive Science*. The researchers sought to determine how human subjects recognize and differentiate similar objects, for the purpose of this study, images of male human faces were used. The researchers had a goal of simulating and being able to predict the memorability of faces and test the newly developed NIM model. No humans were used in the study, only the information that is known from other works about how humans see, perceive, record, and recall visual stimuli. Computers attached to optical recognition devices were used to analyze pictures by breaking them down into units identified as "feature vectors". The selection of the feature vectors is based on "biologically informed" algorithms, which is similar to the way fingerprints are analyzed and recorded. The "biologically informed" algorithms are based on the known way that humans have eye fixations during facial recognition.

After recording the feature vectors of multiple natural images, the computer creates a similarity matrix between all of the features, giving each a weight based on the number of occurrences of similar features. In the next phase, the recall phase, the computer is given new images, compares them to the feature exemplars that have already been collected and attempts to asses how memorable each of the new images is expected to be (if seen by a human). The identification of images that should appear familiar is performed by summing the similar feature vectors. This approach allows for the identification of a previously known person, even if some traits of that person may have changed, such as the absence or presence of glasses or even a difference in expression state (smiling vs. frowning). For the purpose of this study, the concept of attention from the NIM model was ignored, allowing for all similarity traits to be weighted equally. This study was conducted in parallel with a human version of the study, conducted by a different group of researchers attempting to learn more about the same topic. Both groups used

the same set of images. At the conclusion of the computer based study, it was determined that using the NIM model, there is a high correlation between the results of the humans and of the computers.

The study presents an interesting concept of being able to simulate human traits with a machine, but with this study, there is no true intelligence on the part of the computer, nor was it intended to be. The goal of the study was to construct an imaging system that would compare facial features and be able to determine similarities between them, for a greater understanding of how humans handle visual stimuli. The study accomplished its objective and helped validate a new model of human perception with the aid of artificial intelligence.

Another study, which shows the importance of perception in artificial intelligence is "Face Hallucination: Theory and Practice" by Ce Liu and William T. Freeman that was published in February 2007 in the *International Journal for Computer Vision*. The article focuses on the usefulness of computer hallucination, an advanced form of simulation. The article describes an experimental software developed by the researchers for the purpose of creating high resolution images from low resolution images. The high resolution images would be the equivalent of seeing someone in natural light at a conversational distance, whereas the low resolution version would be more like seeing someone at a much longer distance. It is relatively easy for the human brain to identify another human face from a distance because of the identification of certain features that are familiar. In this experiment the computers were given low resolution images of human faces, as well as low resolution images of some facial features. The computers were tasked with assembling a high resolution image from the original low resolution image by using the high resolution features to assemble (or hallucinate) the face. The

experiment was successful and the computer was able to generate high resolution images that were a close match to a high resolution version of the original input low resolution image.

References

Biever, C. (2007, May 19). The robots with a sense of self. *New Scientist,* 194(2604), 30-31. Retrieved February 7, 2009, from Academic Search Premier via EbscoHost.

Hang, R., Ding, X., & Liu, H. (2007, September). Discriminative Training Based Quadratic Classifier For Handwritten Character Recognition. *International Journal of Pattern Recognition and Artificial Intelligence*, 21(6), 1035-1046. Retrieved January 30, 2009, from Academic Search Premier via EbscoHost.

Lacroix, J, Murre, O, Postma, H. J. van den Herik. (2006, August). Modeling Recognition Memory Using the Similarity Structure of Natural Input. Cognitive Psychology (30), 121-145. Retrieved February 7, 2009 from Academic Search Premier via EbscoHost.

Liu, C., Shum, H., & Freeman, W. (2007, October). Face Hallucination: Theory and Practice. *International Journal of Computer Vision*, 75(1), 115-134. Retrieved February 7, 2009 from Academic Search Premier via EbscoHost.

Oxford English Dictionary. Entry for "perception". Retrieved March 12, 2009 from http://www.oed.com/.

Reynolds, J., Zacks, J., & Braver, T. (2007, July). A Computational Model of Event Segmentation From Perceptual Prediction. *Cognitive Science*, 31(4), 613-643. Retrieved February 7, 2009 from Academic Search Premier via EbscoHost..

Rucci, M., Bullock, D., & Santini, F. (2007, October). Integrating robotics and neuroscience: brains for robots, bodies for brains. *Advanced Robotics*, 21(10), 1115-1129. Retrieved February 7, 2009 from Academic Search Premier via EbscoHost.