Question 1

# Candidate Number: 59069

## Visual Intelligence - CS3VI18

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# Section A:

## 1 a) Outline the form and function of the primary visual area (Area V1) in the human brain. (5 marks)

“V1” Is the primary visual area of the cerebral cortex and the initial stage of cortical processing of visual information. Most visual information ultimately reaching the rest of the visual Cortex is first channeled through the largest known cortical area. V1 is used to create a saliency map highlighting what is important using Visual inputs to guide shifts of attention known as gaze shifts.

in Visual information processing the area with the most well-defined anatomical boundaries, there are two primary pathways both beginning with V1 these are the ventral stream and the dorsal stream, the former of which starts with V1 before going through V2, V4 and the inferior temporal cortex; being mainly associated with form recognition, object representation and long-term memory. The dorsal stream also begins with the V1 before going through V2 then going to the dorsomedial area BN6 the medial temporal area MTV before going to the Post cereal parietal cortex this pathway is associated with motion representation of object location and control of the eyes and arms. V1 is the most studied visual area in the brain.

## b) Compare and contrast different human visual systems for detection of movement. (6 marks)

There are two predominant visual systems in place for the detection of movement in humans; these are known as 1) The image-retina system;  and 2) The eye-head system.  The first of which focuses around the idea of an image of a moving object running across the retina while the eyes hold still,  giving information on movement through sequential firing of receptors in its path.  Eyes contain various types of receptors, although virtually all of these signal changes in illumination as opposed to registering continuous steady light.

Some of these receptors will fire when any illumination is initiated, some will fire on the removal of light and some will fire on any change in light level. These are “on”, “off” and “on-off” receptors respectively. Only light receptors will signal movement and eyes are the primary detectors of movement.

The alternate system Exhibit itself when the eye is following a movie objects the image remains stationary upon the retina but still allows acknowledgement of the movement signalled from commands to move eyes.

During regular eye movements both image-retina and eye-head systems are used and they cancel each other out to give stability in the visual world. When the eye-head system is active, Signals are sent to the brain to knowledge that the eye is being moved and this in turn is used to identify movements of external objects.

## c) Considering the following statement: “Researchers have taught computers to ‘see’ visual illusions.” Discuss the implications of this statement for developing more robust artificial vision systems. Illustrate your answer with one or more suitable examples. (9 marks)

When taking into account the development of robust vision systems the implications of the statement is extremely severe. Research conducted in 2014 [1] showed that it was possible to trick a computer by using manipulated images, creating an optical illusion effect to the device, however to a human the image would just look like white noise or static. If the circumstances arose such that a computer was “Seeing” optical illusions in a similar manner to which humans would process them then this could be revolutionary in more ways than one. On one hand if visual intelligence has progressed to the extent that parallels can be drawn between the processes and vision of a human, and that which belong to a machine, then this would mean limitless opportunities for the machine learning world, and the computer science industry in general. The applications and possibilities for this concept would be unparalleled in many fields, such as product testing, health and safety testing, advertisements and publicity and many more fields based around interaction with human beings. It would offer a facility to test how a human could interpret an idea or product without even having to run the risk of putting the idea out in the public domain,

It is one idea to have computers able to ‘see’ visual illusions however the real question comes with how they would deal with this predicament, with some devices crashing, stalling, hanging and in some cases even being infiltrated. [2] This is an extremely prevalent issue in the general research community with a number of groups such as Elon Musk-founded OpenAI, who are devoting many resources to conducting research on adversarial attacks after a series of perturbed images were used to infiltrate a system

via a visual AI system. This is a situation which will likely be petrifying to many members of the public, because any tool with this much capability can have devastating effects if used with malicious intent. The benefits of a situation like this outweighs the fear of the harm that could be caused by the same technology, with the option to have the same insight that a human brain would offer, at the convenience of being able to run billions of tests on. It also allows investigation into the idiosynchronicity of the human psych.

This is also a major step in creating a life-like, humanoid Artificial Intelligence. Furthermore an AI with the same outlook and perception as a human may entitle the public to feel more relaxed and at ease amongst the machinery, moving towards a more integrated lifestyle and dynamic co-habitance creating an efficient effective environment.

## References


[1]A. Nguyen, J. Yosinski and J. Clune, "Deep Neural Networks are Easily Fooled: High Confidence Predictions for Unrecognizable Images", *arXiv.org*, 2021. [Online]. Available: https://arxiv.org/abs/1412.1897 . [Accessed: 27- Apr- 2021].

[2]"Magic AI: these are the optical illusions that trick, fool, and flummox computers", *The Verge*, 2021. [Online]. Available: https://www.theverge.com/2017/4/12/15271874/ai-adversarial-images-fooling-attacks-artificial-intelligence. [Accessed: 27- Apr- 2021].

[3]"How Human and Deep Learning Perception are Very Different", *Medium*, 2021. [Online]. Available: https://medium.com/intuitionmachine/our-minds-see-and-hear-only-what-we-imagine-dc303056171. [Accessed: 27- Apr- 2021].