Question 2

Candidate Number: 59069

Visual Intelligence - CS3VI18

2.

a) L.G. Roberts in 1965 published a landmark thesis on the recognition of unspecified polyhedral objects, now recognised as the forerunner to modern computer vision research into 3D geometric-based object recognition. Describe the main steps in Robert's approach to recognition. (4 marks)

Robert's took it upon himself to complete the task of recognition of unspecified polyhedral objects, his approach consisted of 4 crucial stages. The first of which was image analysis; for this Roberts used a digital image taken from a high quality photograph. Roberts image analysis method operated on a mostly isotropic functionality with the aim of picking out edges using what is now known as the Roberts operator.

After the initial image analysis phase; the next stage was to find the edges and the lines. By using the Roberts operator, Roberts could reduce most points where grey levels hardly change to near zero values, while emphasizing all the edges giving a clear discontinuity between the two values. Robert also performed analysis on squares of groups of pixels currently in a four by four manner if these four pixels were aligned this could be used to to infer that this was part of a line fragment which could be extended creating longer lines and giving a more accurate estimate of a line's position and orientation.

The third step in Roberts' process was to match the Unknown polyhedron's edges to corresponding prototypes. The edges are traced until a vertex is reached, when the edge creating the largest angle is followed and labelled. This process is then repeated.

The final step occurred in the event of a complex object which did not correlate with one of the prototyped shapes. In this situation, assimilations will be made with a set of predefined rules in an attempt to derive the model's identity through deductive reasoning.

b) Behavioural analysis, as part of a visual surveillance system, is an important application of computer Vision. Explain how behaviour analysis may be applied for the task of anomaly detection in maritime surveillance. You may assume the input to the process is a set of vessels' (boats') detection and their trajectories (tracks). (6 marks)

Anomaly detection in maritime surveillance is a prime example of how behaviour analysis may be used in conjunction with computer Vision. Maritime surveillance presents a circumstance in which a visual intelligence model may be used to monitor the surroundings and interactions with the environment, this would likely be through the combination of cameras, sensors and other information passed to the model, all of which would contribute to confirm the information which the visual intelligence entity is perceiving. One opportunity in which a system like this may be utilised would be if the model was given a set of vessels detection and their suspected route, the model would then be able to cross reference them and compare them with the perceived trajectories alerting the controller if any errors or misinformation, such as a offcourse ship or an inbound collision could occur. Behavioral Analysis and pattern recognition can also be implemented as part of a visual surveillance system in order to track any suspicious activities or unusual behaviours. A behavioural analysis methodology could also be used to account for the minor, consistent changes that would otherwise be extremely prevalent, an example of this could be the perceived change in location due to the waves and the motion instigated by the constantly moving.

c) "Artificial vision has often been described as one of the key remaining challenges to be solved before machines can act intelligently. Recent developments in deep learning have enabled impressive gains in machine Vision - giving a sense that the problem of vision is getting closer to being solved." Discuss this statement including examples where appropriate to support your views. (10 marks)

Due to the extreme ever-advancing nature of the technology industry and the burst of enthusiasm leading the way through the multiple different fields. It is without doubt that as a society we are closer to the solution of artificial vision than we have ever been before. There are still many key obstructions in the way before a fully complete solution to the issues at hand are settled.

Artificial Vision is still currently overwhelmed with small challenges preventing it from exponentially making its way into the public household. Some of these challenges are:

- Scarcity - The systems are still hard to come across
- Price - if by some miracle you find an effective Artificial vision model, it will be very expensive.
- Resources: Artificial vision is extremely resource intensive, to develop, manufacture and maintain,
- Still not consistently effective or reliable enough to be implemented unsupervised in critical situations.
- Extremely high development and maintenance costs, and time requirements.
- Technology is evolving at a faster rate than the hardware can keep up.
- Fear, Uncertainty and doubt of the general public introducing a stigma around this technology suppressing the ability to get this integrated with the public.

- General use cases are lacking.

One very basic example of a parallel to this, would be the attempted mass integration of the Kinect camera system into the XBOX gaming console. This seemed like a strong idea and a great way to introduce the public to this style of software on a small scale in terms of complexity but a large scale in terms of outreach. This idea was eventually discontinued in 2017. [1]

Artificial intelligence is a growing field with many implementations taking the form of systems encapsulating artificial vision functionalities, this could be facilities throughout many major areas of the working world. With more and more resources becoming available, materials becoming cheaper, society becoming more accepting of technology and applications and use cases presenting themselves more each day.

[1] https://finance.yahoo.com/news/downfall-kinect-why-microsoft-gave-183900710.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAANqdqtHMPJ-uO4-ixoMsglaTlylhcCauPFjqEfFHGjLfk4cQJnUHHNP0JH5RK3lkXHrY2pSsh30kp2Vkad7UgT4-yJ4EKaMEgUnGEk1A6ehGAXc4XXkZlcQXX2K4Kw6cUtr66qJCsnsUV80bpi5WVs3IvU4i6E7MIkfnfXiaoqYq