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Level 3 Digital Technologies and Hangarau Matihiko

Common Assessment Task, 2019

91908 Analyse an area of computer science

Credits: Three

INSTRUCTIONS

Follow the instructions and answer the questions below to analyse an area of computer science.

You should aim to produce between 800 and 1500 words.

Only work directly keyed by you into your computer or device may be used in your assessment response.

You may not use hard-copy or online course resources, or notes of any type, to complete this assessment.

By saving your work at the end of this assessment session, you are verifying this work is your own. NZQA may digitally sample your work to test authenticity.

Save your work using the filename format:
four digit schoolcode-yourNSN-91908.pdf. For example, 0001-123456789-91908.pdf

Your supervisor will tell you your school code and where to save this file.

Please use a nine-digit NSN with no leading zero.

The filename must be written in the document header.

Please check the filename is correct before saving.

Choose ONE of the following areas of computer science:

- complexity and tractability
- computer vision
- big data
- computer graphics
- formal languages
- network communication protocols.

Follow the instructions and answer the questions below to write a report that critically analyses an area of computer science.

QUESTION ONE

Explain some of the key aspects of the computer science area.

The area I have chosen for this assessment task is computer vision. Computer vision is a term used to describe how computers see and sense the world around them and then perform actions based on their interpretation of their surroundings. Digital devices such as smartphones have cameras and other sensors that can react to the world around them. This is known as computer vision. It is an area that is growing rapidly, as more and more devices are connected to the "Internet of things" and tasks such as facial recognition for security purposes. It also has medical uses, where images such as MRI scans are read by a computer to look for tumours or other forms of cancer. It can also be used in food manufacturing and processing to check for any imperfections or foreign objects in food before it is made available for sale. It is also used in self-driving car technology to detect the distance between a car and other objects.

Achievement
The candidate explains key aspects.

QUESTION TWO

Explain the relevant algorithms or other mechanisms behind the area.

Facial recognition works by scanning someone's face in a crowd, extracting the face from the rest of the scene, and comparing it to a database of stored images. In order for this software to work, it must know how to tell the difference between a basic face and the rest of the background. Facial-recognition software is based on the ability to recognise a face and then measure the various features of the face.

Every face has specific features such as peaks and valleys. Facial-recognition software measures these points or nodes. The average face has nearly 100 of these nodes, such as the nose, the width between the eyes, the shape of someone's jaw, or the depth of their eye sockets.

The computer programme scans a face, noting all these points, and creates a numeric code called a face print. This is then saved to a database. Later, when a person's face is scanned, the nodes in the scan can be compared with a database. This could be used to allow access to a particular building or to allow you to unlock your cellphone.

3D facial recognition is the most accurate way of recognising someone's face, as it uses distinctive features of the face, such as the curves of the eye socket, nose, and chin, to identify the subject. With 2D facial recognition, these features can be obscured by poor lighting.

As 3D scanning uses depth and an axis of measurement that is not affected by lighting, 3D facial recognition can even be used in poor light and also can recognise faces at angles of up to 90 degrees away from the camera.

Achievement
The candidate gives an explanation of some of the mechanisms of facial recognition.

QUESTION THREE

Choose ONE of the following three options to answer:

How is the area used?

OR

How is the area implemented?

OR

How does it occur?

How is the area used?

The concept is used in a number of ways. My phone, for example, uses facial recognition to secure the home screen. When I bought my phone, I could add this feature to the security, along with a passcode and fingerprint scanning. I just need to stare at the screen while the phone's scanner develops a map of my face. This is now entered into the phone's security database and I can now unlock my phone's lock screen just by looking at it. When I look at the phone, it performs a scan of my face, converts my facial features into numeric codes and then compares that to the stored codes within the phone's security database to check if the person looking at the phone is me or someone else with access to my phone. Once it detects a match, the phone will unlock.

A key area where computer vision is used is in the automobile industry. For a number of years now, cars have used sensors to detect when an object could come into contact with a car that is reversing. At first, cars used distance sensors to warn a driver they were getting too close to an object and could hit it. This was extended to reversing cameras, which show the driver a few of the areas they are reversing into and, again, provide a warning if they are about to hit something. This has been enhanced further to provide some cars with an "autopilot" option. This uses a range of sensors and cameras that constantly feed data into the car's computer system to ensure it stays on the road at a safe distance from other cars, and does not hit any other objects, moving or stationary.

Achievement
The candidate gives an explanation of how the concept is used.

QUESTION FOUR

What are the key problems or issues related to the area and how have these been, or could they be, addressed?

One of the key problems with facial-recognition scanning was that initially it was performed using 2D scanning. This meant the distances on the Z axis were not included. This meant when faces were scanned in low light, or on an angle, the computer did not record the correct numeric faceprint. This problem was solved by the introduction of 3D scanning, which gives greater depth and enables scanning of facial features, such as cheekbone structure, that can be identified in low light and on an angle from the camera's viewpoint. Features such as cheekbone structure do not change naturally over time, so this has increased the accuracy of the scans.

Achievement
The candidate gives an explanation of key problems.

QUESTION FIVE

How do the the technical capabilities and limitations of the area relate to humans?

One of the key issues with computer vision is the ability to make judgments. At present, the software can read shapes and assess distances, but in the case of a self-driving car or vehicle on autopilot, how could the car differentiate between a person and a lamppost? If the car is forced to turn off the road to miss another car on the other side of the road, would it be able to avoid humans on the footpath. How could the car decide what to do?

Merit
Explains relationship to humans.

QUESTION SIX

Compare and contrast different perspectives on the area.

One area where computer vision is used is in the food industry. Produce from farms is scanned to ensure it meets standards, which are largely based on shape and appearance. Supermarkets request this to ensure all their produce looks similar and so will all be sold. However, others claim this can lead to wastage, as perfectly good apples or bananas, for example, are rejected simply because they do not meet a specified shape, as determined by a supermarket.

With regards to facial recognition, it is common at most airports around the world to have your face scanned and added to an international database. This can be useful when travelling, as if you have a smart passport, you can walk straight through the smart gate at the airport. Others view this as a breach of privacy. How does anyone know which databases their face is on and when they are being scanned?

Merit
Comparison of different perspectives.

QUESTION SEVEN

What conclusions can you draw about the area?

The area of computer vision can provide many ways to make our lives safer. This includes facial recognition to provide better security at airports and character recognition to help travellers translate signs in foreign countries.

Like any new technology, there are upsides and downsides. With computers constantly scanning and storing information about people's whereabouts, who protects that data?

How can people be sure it is secure? With regards to computer vision used in cars, there is a great deal at stake. If the car's computer reads data inaccurately, this could have fatal consequences.

Excellence
Candidate draws conclusions about the area.