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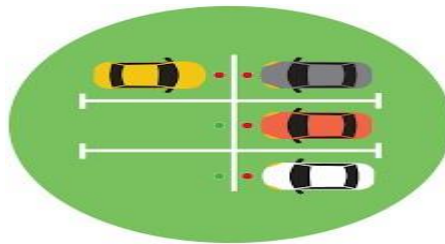**CONTINUOUS ASSESSMENT COURSE - CASE STUDY**

COURSE CODE: CS308

COURSE TITLE: COMPUTER VISION

LECTURER NAME: ALI ABUBAKAR

INSTRUCTIONS TO CANDIDATES

ANSWER ALL QUESTIONS

CASE STUDY
THE KUMASI SMART PAID-PARKING-SYSTEM

Parking is an integral part of trip making by any means of transport. In most urbanized cities worldwide, increasing car ownership and utilization, high land values in central business areas, and inadequate parking supply have compounded the parking situation. Business owners and residential dwellers compete with shoppers and patrons of businesses for available spaces to park their vehicles at on-street locations where on-street parking is free.

The Adum paid parking system was established in June 2006 to reduce congestion by reducing parking duration and increasing turnover. The area where the scheme is operational has a concentration of shops, restaurants, banks, and offices, which can best be described as a pedestrian-open mall. There are 1200 on-street stalls and three

(3) streets sites with a total capacity of 1400; The Prempeh Assembly Hall (capacity of 200 vehicles) and Kumasi Metropolitan Assembly (KMA) Central Car Parks (1200) are very remote from the central business districts. The scheme has reduced the number of illegal and wrongful parking in Adum. As of now, shoppers perceive it is easier to find parking at Adum nearer to one's destination.

Nevertheless, the parking system exists with many operational challenges. For instance, according to Adams et al. (2020), whenever a driver enters the parking lot, the first thing that they do is to look for some sign or ask the operator who has navigated and find out whether the parking lot is fully occupied, partly occupied, or vacant. It is usually challenging to identify an empty parking space in real-time. This causes ineffective use of parking divisions and traffic jams around the entrance of the parking lot. Therefore, offering drivers relevant information about the parking lot while entering the parking lot becomes an important issue. He stated that some parking divisions sometimes remain unoccupied even when the total occupancy is high, but the operators mostly claim the space is full and, thus, deny drivers entry. This has significantly reduced the net revenue of the company.

Again, he stated that parking is a real challenge for inexperienced drivers, especially when parking lots get congested. To handle such problems, the institution mainly employs several staff who direct, control, and execute all the activities in the lot. However, this approach is not always cost-effective and is not optimal (Adams, 2020). Also, some sensors, such as infrared, camera, ultrasonic, RADAR, etc., are used to observe obstacles when parking is too expensive for the company (Adams, 2020). These have motivated the administration to build and implement a real-time Optimal automatic parking system that is much more reliable, efficient, and cost-effective.

Therefore, as the senior traffic and parking lots system designer, the company has offered you this contract to develop a robust parking slot detection automated system based on image processing techniques that can capture and process the image to find empty parking slots.

REQUIRED:

Part 1: Due in Week 9

1. Formulate a detailed layout of the design problem facing the Kumasi Paid Parking System and propose a framework consisting of computer vision techniques to mark each of one them. **AP[10 marks]**

2. Based on the design problems outlined in (1), deduce a comprehensive list of opportunities and objectives of such a smart parking system. **AP[10 marks]**

3. With an aid of a flow diagram, briefly discuss the key computer vision algorithms (image processing) that are required at each phase of the design strategy. **AP[15 marks]**

4. Review various data (images and videos) acquisition mechanisms and consequently mark the most optimal technique for proper analysis, maximize accuracy and obtain realistic results for the smart parking system. Briefly discuss the acquisition process. **AP[20 marks]**

5. Image degradation is mostly inevitable in the image acquisition process. Discuss the types of degradation in your acquired images. If there is noise in the images, briefly describe the nature of the noise and suggest appropriate filters(functions) to denoise them. **CR[20 marks]**

[Total: 75 Marks]

Part 2: Due in Week 16

1. To ensure a smooth operation of this intelligent system, it must be properly initialized, briefly discuss your process of initialization. **AP[10 marks]**

2. Object/video detection is key to the building of this smart model. The detection technique must consist of sub-tasks such as counting the number of cars parked, finding the relative size of the parking space, or finding the relative distance between the parked cars. Discuss the various computer vision algorithms that are required to handle such **AP[15 marks]** tasks.

3. In building a video detection system for your model, it is required to capture the coordinates of the moving cars and highlight the cars in the video. There are multiple techniques to solve this problem. Briefly discuss and justify the method of your choice. **CR[10 marks]**

4. Separation of parked cars and empty spaces(background) essential is an important concept in image processing to be used in this smart system. Using the Gray-scale image equation Gray=0.229*R +0.587*G+0.11*B, briefly discuss how you will threshold your images and display the output. **EV[20 marks]**

5. Mostly, after thresholding an image, there will be some unnecessary fragments in the image, examine the technique you will use to address such issue. **AP[15 marks]**

6. Validate the modeling strategy using the system information obtained from the set of interviews. Your model should display two outputs after the execution of the codes.

    I. Output 1: Observation of the Whole parking area.

II. Output 2: Observation of each lane in the parking **AP[30 marks]**
     area and the vacant lane.

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[Total: 100 Marks]

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NOTE: You may work in Python/MATLAB environment. All codes and images must be zipped and uploaded on LEMAS

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END OF QUESTION PAPER

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References

Richter & Zambang MAB Adams, Charles Anum & Opoku-Boahen. Parking management in metropolitan cities in west Africa case study of the Kumasi paid parking scheme, Ghana. Int. J. Eng. Sci, 3(6):01–08, 2020