

COMPUTER SCIENCE TRIPOS Part IA – 2024 – Paper 3

4 Introduction to Graphics (rkm38)

Your task is to design a rendering pipeline for a next-generation augmented reality headset.

- (a) Explain how you could improve the quality of rendering given the following hardware limitations. Keep your answers short, up to 100 words.
- (i) The high refresh rate display will be controlled by 6 instead of 8 bits for each colour channel. [3 marks]
 - (ii) The display resolution will be 1024×1024 , resulting in a relatively large pixel size when magnified by the lens of the headset [4 marks]
 - (iii) The headset is equipped with an optical see-through display in which the light from the environment is mixed (in an additive manner) with the light from the display. The headset has a sensor that can measure the overall amount of environment luminance reaching the display. [5 marks]
- (b) The tracking sensors provide the position of the estimated centre of the left eye, e_L , in the units of millimetres and the view direction, \hat{v} , both in the world coordinates. The distance between the two eyes in millimetres is d_{IOD} . The headset uses a right-handed coordinate system, and the up vector is $u = [0 \ 1 \ 0]$. Derive view matrices for the left and the right eye cameras. Illustrate your answer with a diagram. [8 marks]