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| **Course Name:** | **Sensors in Augmented and Virtual Reality** | **Semester:** | **IV** |
| **Date of Performance:** |  | **Batch No:** |  |
| **Faculty Name:** | **Dr. Ninad Mehendale** | **Roll No:** |  |
| **Faculty Sign & Date:** |  | **Grade/Marks:** |  |

**Experiment No: 1**

**Title: Camera Sensor Characteristics**

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| **Aim and Objective of the Experiment:** |
| To study the resolution and FPS of camera sensor in mobile phone |

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| **COs to be achieved:** |
| **CO1: Study basic sensors used in Augmented reality systems**  **CO2: Gain basic knowledge sensors in Virtual reality headsets** |

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| **Theory:** |
| This measurement is the video resolution measured in time. 24-30 fps is the normal level for good picture quality. A video with lower frame rates appear as “choppy” on screen and fail to capture fast moving objects properly. A frame is analog to a picture captures. A video is collection of pictures moving at a fast pace. The frame rate is the rate at which these images are captured. For the video playback speed to be in normal mode, it is essential that the frames are displayed in the same speed as they were taken. Higher fps means that the video is more consistant transitions from one frame to the other. At a minimum, **24 fps** is what you need for distinct frames to appear as one moving image. This is related to the speed at which our brain perceives movement. However, the higher you go from this number, the faster and smoother your display quality and viewing experience will be.  However FPS is not related to the resolution of the image or video. The resolution of the image screen or video is the number of pixels displayed. Higher the pixels, higher the resolution. In order for the picture to be displayed properly, both the screen as well as the taken image must be of a high resolution. A Brief History of Photography and the CameraCounterclockwise: plotting the average camera resolution through the years  - GSMArena.com news |

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| **Stepwise-Procedure:** |
| Install Matlab  Click picture and record video from each camera using different camera options  Run following code in Matlab:  clc  close all  clear all  I=imread("macro.jpg");  %I=imread("front cam.jpg");  %I=imread("main cam default.jpg");  %I=imread("front cam default.jpg");  imshow(I);  [m n z]=size(I);  qualityinMP=m\*n/1000000  % Video  V = "20210204\_102811.mp4"; %Video full fileName  v = VideoReader(V);  D=v.Duration;  FPS=v.FrameRate;  T =(round( D\*FPS));  H=v.Height  W=v.Width  while hasFrame(v)  frame = readFrame(v);  imshow(frame);  drawnow  end |

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| **Output Screen shots:** |
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| **Results: The results are shown as follows** |
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| **Post Lab Subjective/Objective type Questions:** |
| 1. What is difference between CCD and CMOS sensor   CCD (charge coupled device) and CMOS (complementary metal oxide semiconductor) image sensors are two different technologies for capturing images digitally. Each has unique strengths and weaknesses giving advantages in different applications. CCD sensors create high-quality, low-noise images. CMOS sensors are usually more susceptible to noise. Because each photosite on a CMOS sensor has several transistors located next to it, the light sensitivity of a CMOS chip tends to be lower, as many of the photons hit the transistors instead of the photosite. CCD sensors consume as much as 100 times more power than an equivalent CMOS sensor. CMOS sensors can be manufactured on most standard silicon production lines, so are inexpensive to produce compared to CCD sensors.   1. Define resolution and FPS   FPS stands for frames per second, while the resolution is the number of pixels displayed on a screen   1. Explain concept of HDR   In photography, HDR stands for *high dynamic range.* Dynamic range is simply the range of the lightest tones to the darkest tones within a photo. Put another way — it’s a measure of the light intensities from the highlights to the shadows.  For example, let’s take the human eye — it’s capable of a wide dynamic range, which is why we can see details in shadows as well as details in highlights at the same time. So, if the sun is setting in a valley, our eyes can see where the sun is highlighting the peaks of the valley, but our eyes can also equally appreciate the darker shadows that are cast.  However, it can be more challenging to capture the same image on camera that our eyes sees. Cameras have a shorter dynamic range, meaning they catch fewer details than our eyes.  The higher dynamic range your camera has, the closer the photo will compare to what an eye can see. This means that you’ll be able to capture more details in the shadows that might otherwise appear pure black, and you’ll be able to see details in the highlights that might otherwise be washed out with white. |

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| **Conclusion:** |
| Thus we have studied the camera sensors in mobile phone by analyzing the resolution and FPS of images and videos in MATLAB. We understood the two types of photo sensors used in cameras. CCD sensors are high resolution sensors while CMOS are low resolution but cheaper and consume lesser power. |

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| **Signature of faculty in-charge with Date:** |