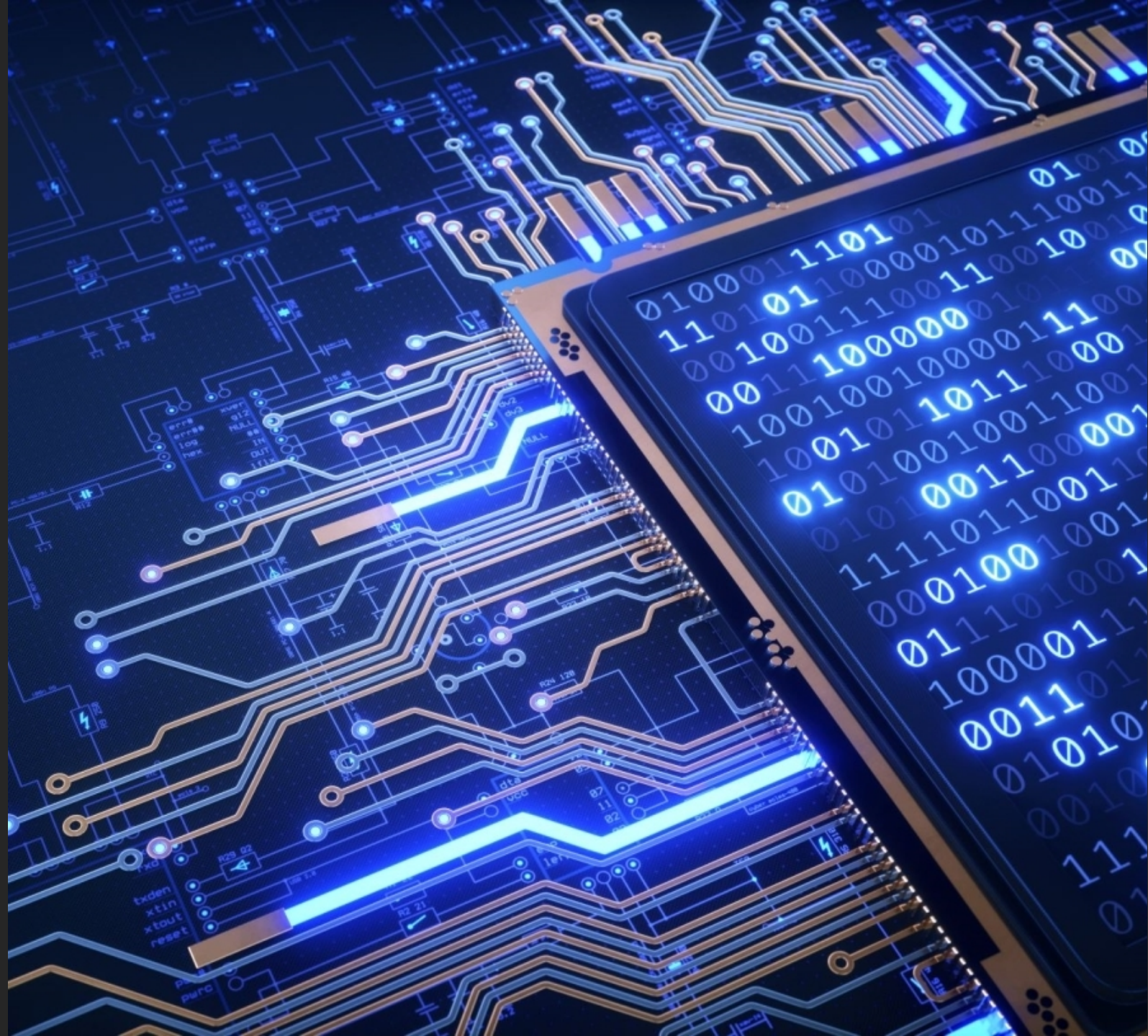
ADAPTIVE BRIGHTNESS IN AUGMENTED REALITY

CONTRAST ADJUSTMENT BETWEEN FOREGROUND VIRTUAL CONTENT AND BACKGROUND SCENE



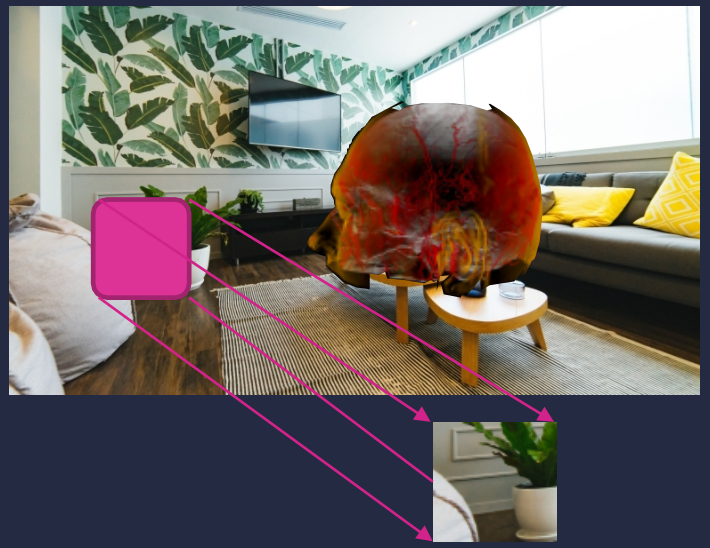
ABSTRACT

- This thesis will explore of enhancing visibility in Augmented Reality in terms of visibility based on light Intensity of colour format of background video stream attached to the camera
- Objective is to estimate the brightness in the video frame texture and modify the brightness of augmented object with the help of average brightness presented in real world scene in Augmented environment
- Implementation is divided into two parts : Illuminance extraction using HSV colour format to capture average amount of light in a environment , and estimate the global brightness of augmented model using colour model conversions to set according to video frame light distribution

GLOBAL BRIGHTNESS V/S LOCAL BRIGHTNESS

- Global brightness means considering the brightness of the entire real world scene background and evaluates the brightness of the virtual content in augmented environment
- Local brightness means considering only selected part in the texture based on user interest to determine the brightness of the virtual content

Global Brightness



Local Brightness

OVERALL AIM

- Brightness modulation of augmented objects in augmented environment to achieve good visibility in the scene.
- Contrast balance between virtual object and real world scene to maintain good visibility through out the video stream.
- Contrast balance based average brightness in real world being captured by camera to define the brightness of virtual model
- It is assumed the background video which can be either played by prebuilt or live video stream from webcam as augmented environment.
- Comparing the brightness of virtual object and real world objects(video frame texture) frame by frame and maintaining the good ratio to ensure good conspicuous.
- Volume Dataset to blend in the real world(Indirect Volume Rendering)

MOTIVATION

- Generally, Handheld devices are most likely to capture bright and dim areas of the scene due to freedom of rotation
- It is good to maintain the contrast ratio between real world and virtual object for virtual object saliency .
- Easy colour conversion makes this task simple and easy whereas other techniques include bit complicated like acquiring the input from camera sensors and much more.

EXPOSURE V/S BRIGHTNESS

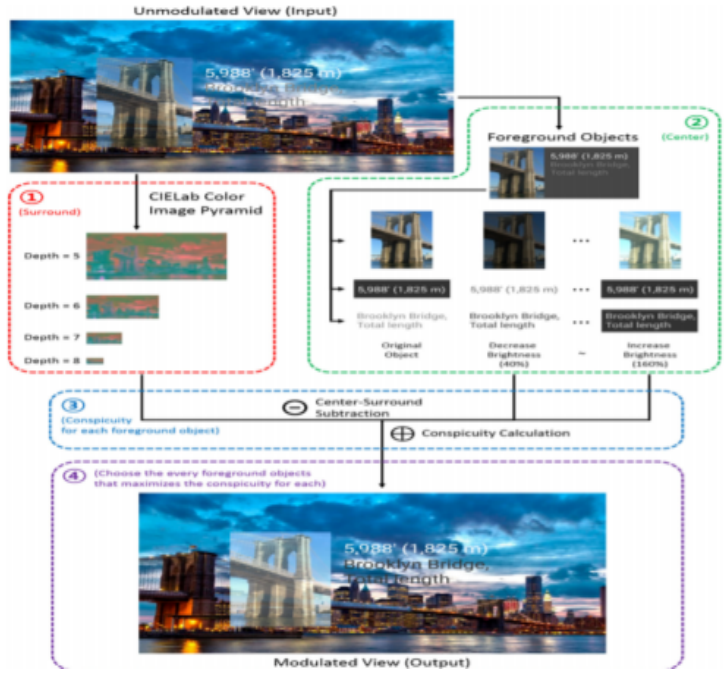
- Exposure – Amount of light falling per unit area on sensor and it is determined by scene illuminance.(photons strike the sensor and produces electrons).
- If camera captures not enough light then it is called underexposure otherwise it is called overexposure.

RELATED WORKS

- **Real-Time adjustment of contrast saliency for improved information visibility in mobile augmented reality.(*Euijai Ahn et al.,2018*)**
  - ❖ Image saliency analysis technique

- **Scene-Adaptive High Dynamic Range Display for Low Latency Augmented Reality.(*Peter Lincoln et al.,2017*),**
  - ❖ Dynamically adjust the brightness

- **RealTime Estimation of Illumination Direction for Augmented Reality.(Ibrahim Arief)**
  - ❖ Shape and intensity of shadow



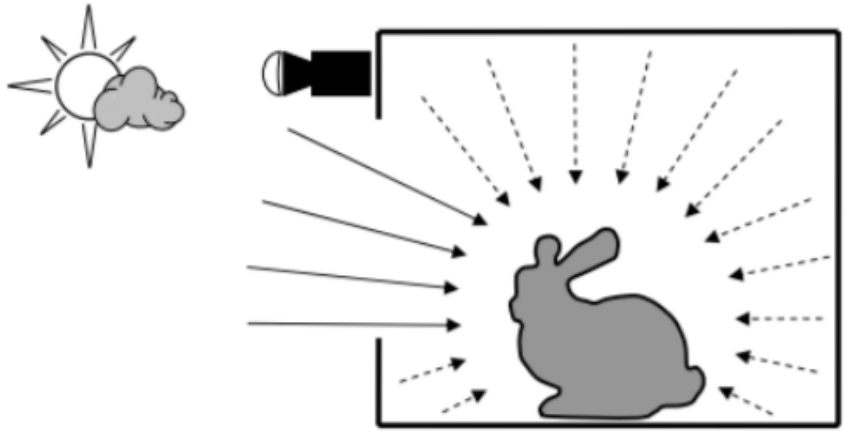
RELATED WORKS

- **Illumination Reconstruction for Augmented Reality,(Daniel Cullen)**
  - Fish eye camera model to change virtual model lighting effects

- **Modifying virtual object display properties to increase power performance of augmented reality devices**
  - proven various properties especially brightness will increase power performance

- **Adaptive Display of Virtual Content for Improving Usability and Safety in Mixed and Augmented Reality. (*Jason orlosky*)**
  - Proposed use of dynamic content display and field of view tehniques for safety and usability issues.

- **AUGMENTED REALITY IN MOBILE DEVICES.(*Sneha kasetty Sudarshan*)**
  - Proposed various problems associated with brightnesss especially in mobile devices



RELATED WORKS

- **Visibility-based blending for real-time applications.(Taiki Fukiage et al.,2014),**
  - Blending parameter is set based on subjective metric of visibility adaptively optimized so that virtual object saliency constant in any background texture at targeted level.

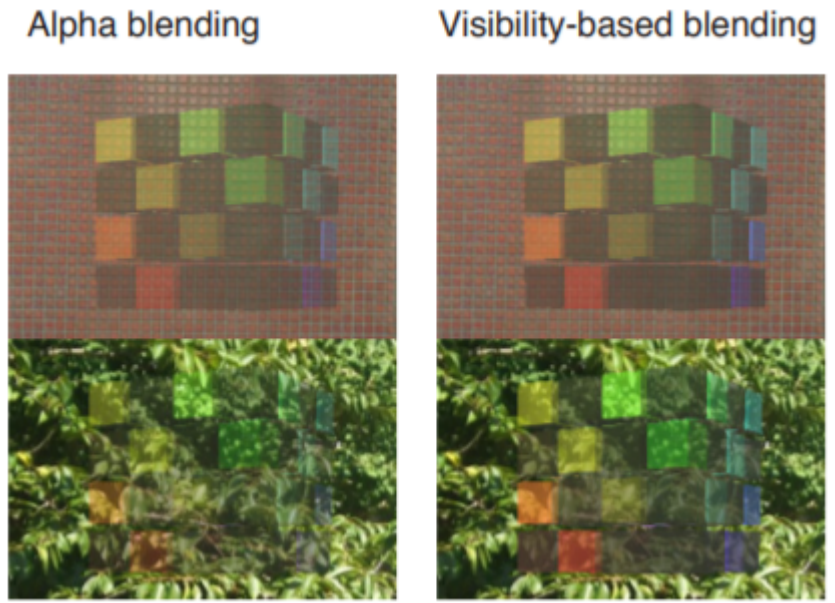
- **See-through near-eye display glasses including an auto-brightness control for the display brightness based on the brightness in the environment**
  - Eye piece with internal processor

- **Adaptive Display of Virtual Content for Improving Usability and Safety in Mixed and Augmented Reality. (Jason orlosky)**

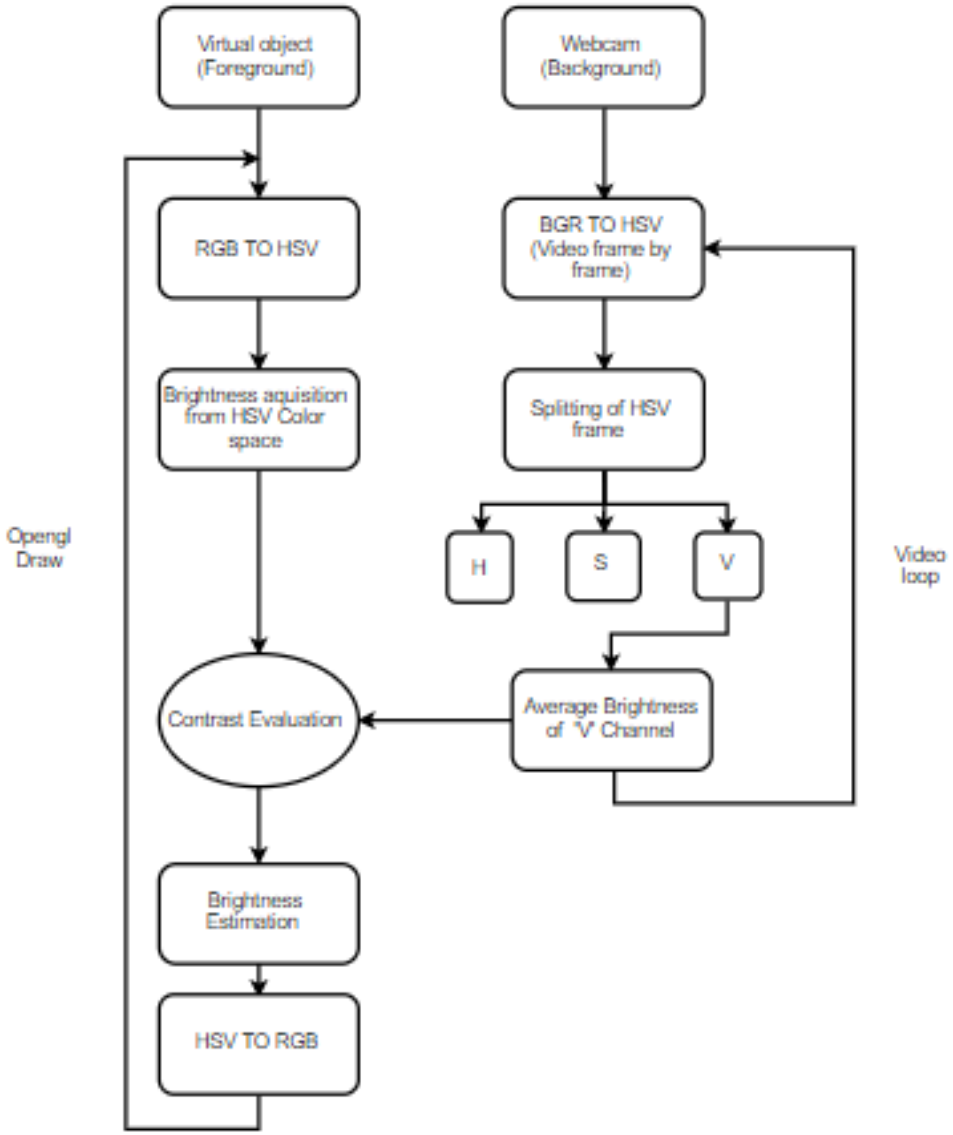
  Proposed use of dynamic content display and field of view tehniques for safety and usability issues.

- **AUGMENTED REALITY IN MOBILE DEVICES.(Sneha kasetty Sudarshan)**

  Proposed various problems associated with brightnesss especially in mobile devices



REAL TIME ADAPTIVE BRIGHTNESS



COLOUR MODELS

- It is a method by which we can specify, create and visualize the colour
- OpenGL uses RGB format where as OpenCV uses BGR format
- It consists of both chromatic and illuminance information
- To quantify brightness, Those formats are converted to HSV colour format

$$H = \begin{cases} 60° \times \left(\frac{G'-B'}{\Delta} mod 6\right) & , Cmax = R' \\ 60° \times \left(\frac{B'-R'}{\Delta} + 2\right) & , Cmax = G' \\ 60° \times \left(\frac{R'-G'}{\Delta} + 4\right) & , Cmax = B' \end{cases}$$

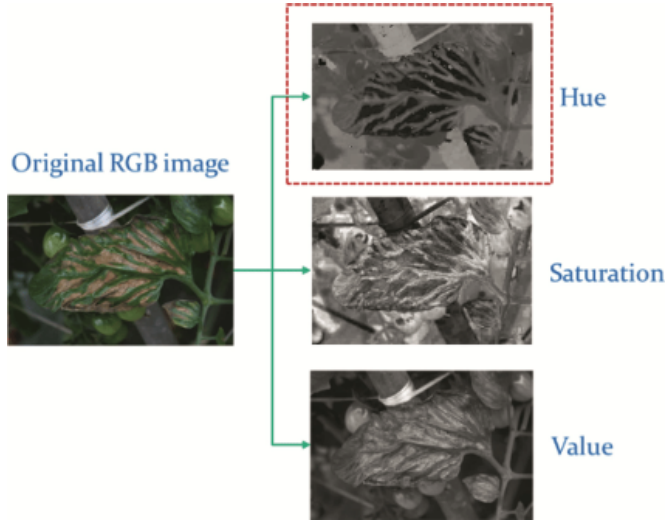
Saturation calculation:

$$S = \begin{cases} 0 & , C_{max} = 0 \\ \frac{\Delta}{C_{max}} & , C_{max} \neq 0 \end{cases}$$

Value calculation: V = Cmax

BRIGHTNESS EXTRACTION

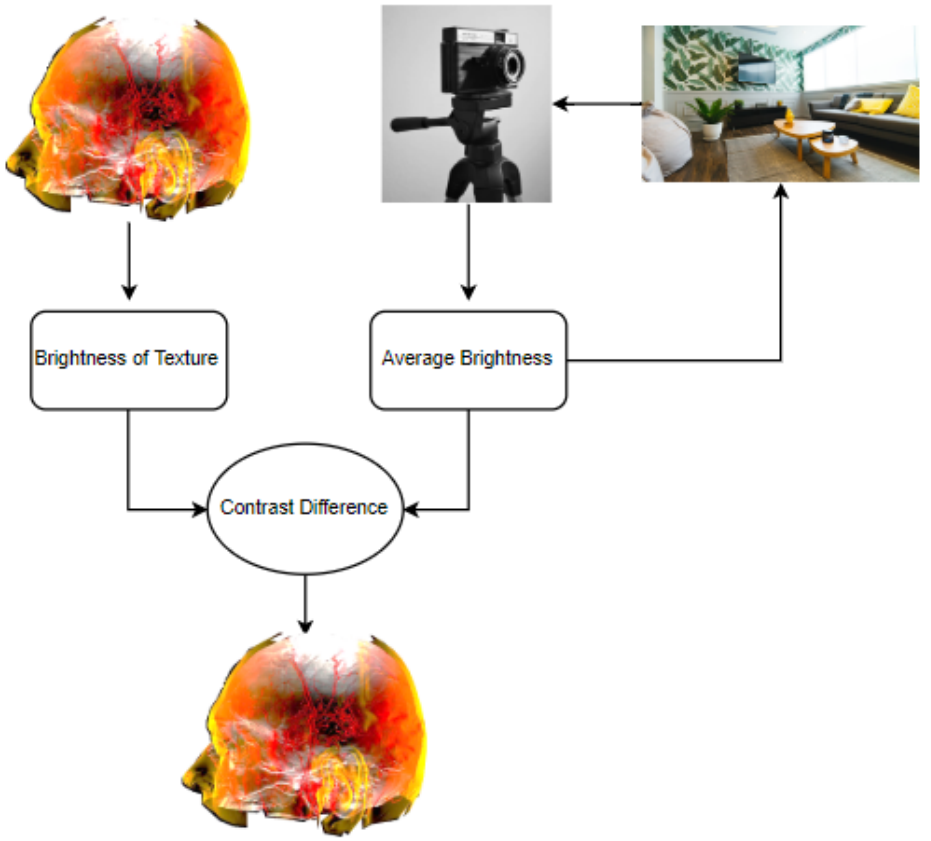
- Brightness will be stored in ‘VALUE’ channel in HSV format
- Splitting up converted frame in a video
- Calculating histogram of third channel and there by taking average value to get average brightness in the frame
- This brightness will be compared with brightness of virtual model for contrast adjustment



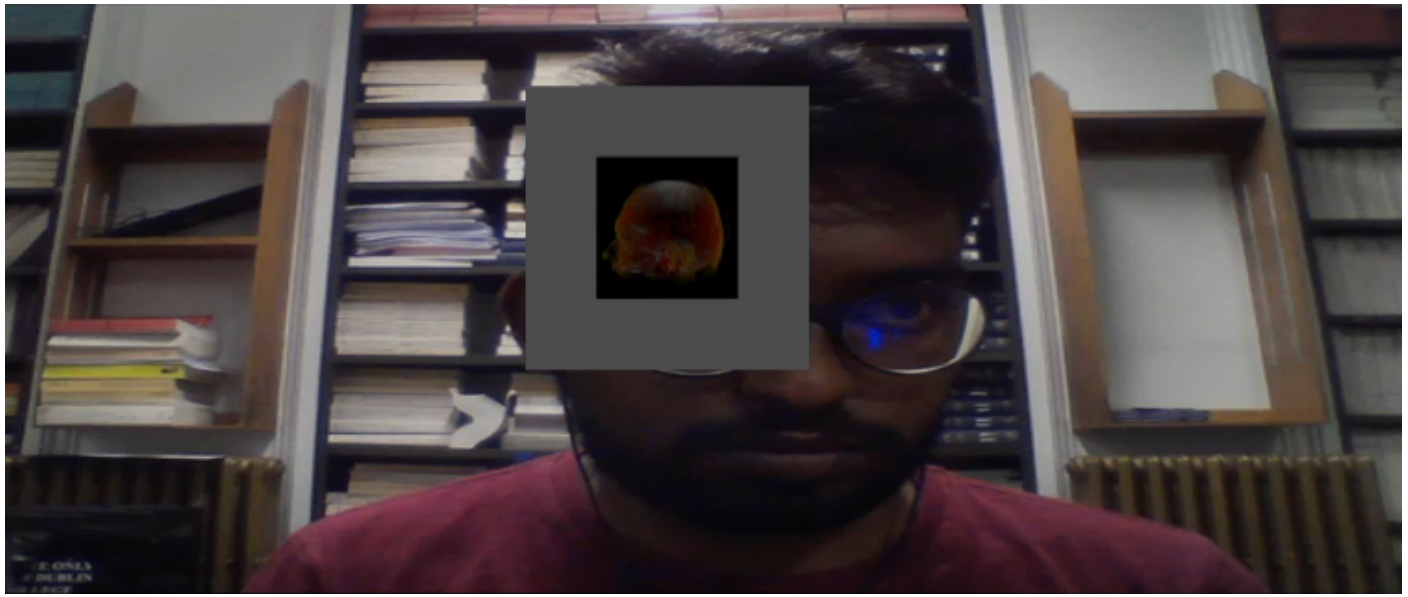
CONTRAST ADJUSTMENT

- Average brightness which is calculated will be considered in order to the brightness of the virtual world.
- Brightness of the real world and virtual content taken into consideration.
- Brightness of virtual model increases when brightness of real world more than virtual model brightness

CONTRAST ADJUSTMENT



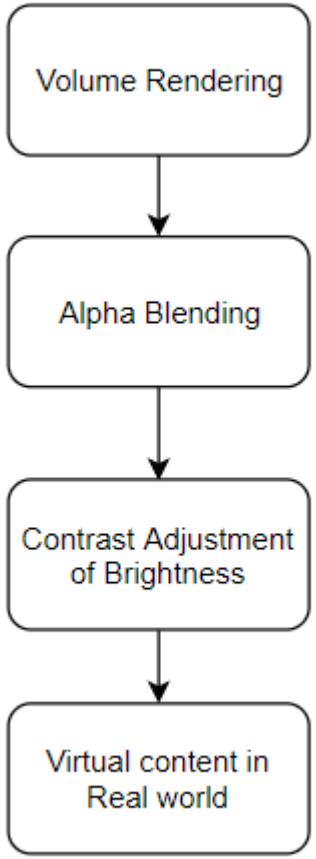
RESULTS



CONCLUSIONS

- Goal: Adaptive Brightness based on light intensity presented in background camera texture
- Adaptive brightness is working with different scenes
- Future works: Implementation of local brightness and blending of volume data set in the real world scene

INITIAL PLAN



- Started implementation of volume rendering but it leads to difficulty and challenges lack of documentation for OpenGL ES.
- Implemented Augmented Reality App to deploy