3D Augmented Reality Capture and Display System

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ABSTRACT

- Augmented Reality (AR) is one of the emerging techniques due to the nature of three-dimensional vision being more involving and interactive for any individual. In this technique, the object made virtually or digitally is superimposed on the real-world objects or equipment in order to enhance the real world by adding virtual elements in it.
- In this project, we propose a low-cost integrated 3D augmented reality system made by the locally available components with the features of both 3D image capture and Multiview 3D display. The proposed system allows creation of environment of an observer/user that can help to view and analyze any real object/person standing at the remote place. The display sub-system provides three different views of the scene/object including front stereo-3D view and two side-views. A semi-reflective mirror based optical setup is developed to provide the notion of see-through display to demonstrate AR. On the other hand, the capture subsystem consists of four-camera capturing the front stereo-views and two side-views. The capture and display modules placed at two different physical locations are further connected through internet.

AIM & OBJECTIVES

- The aim of the project is to capture the object or person from different directions in 3D and transmit the data through internet to the Augmented Reality Display system in real time.
- The objective are given below:
  1. Design and develop a stereoscopic and multi-view image capture setup.
  2. Design the optical setup of the system using geometric optics.
  3. Develop the AR display system using the designed optical setup.
  4. Develop a content capture and processing pipeline using python, OpenCV library.
  5. Develop an internet-based link between display and capture modules of the system.
  6. Demonstrate the real-time capture and display of real objects using the developed prototype system.

METHODOLOGY

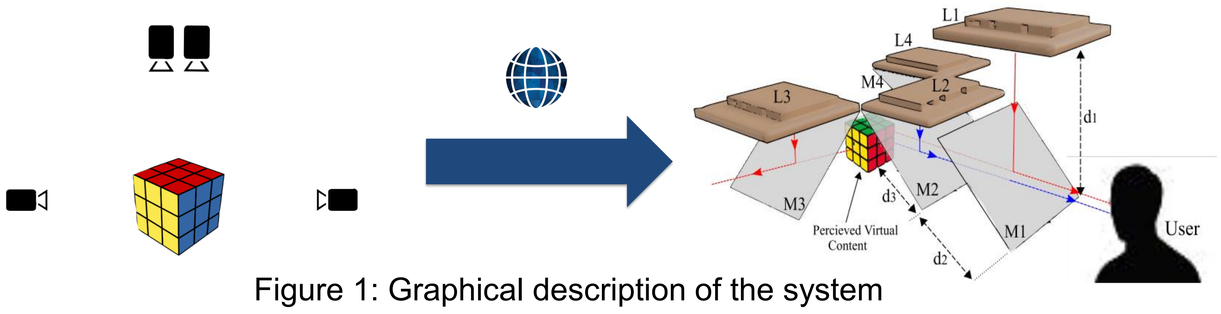

Figure 1: Graphical description of the system

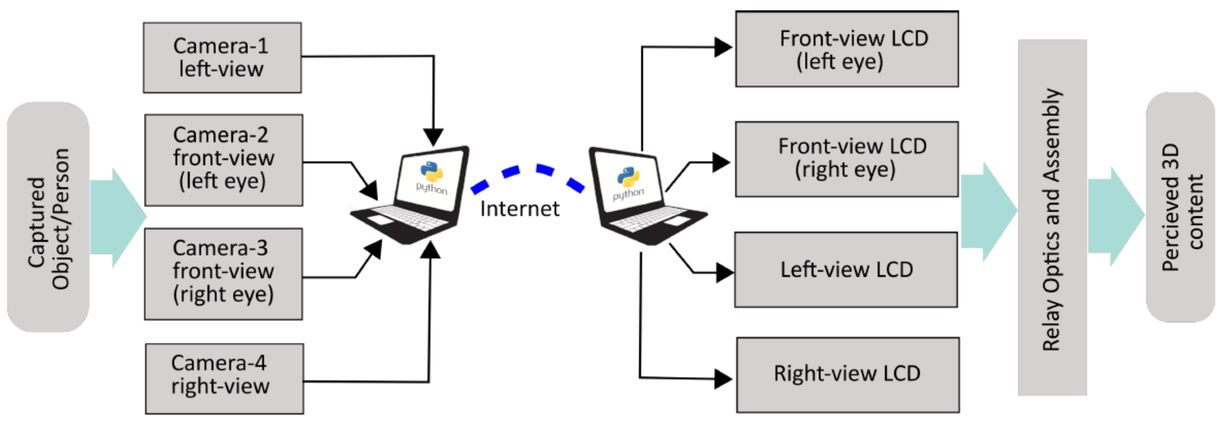

Figure 2: Block Diagram of the system

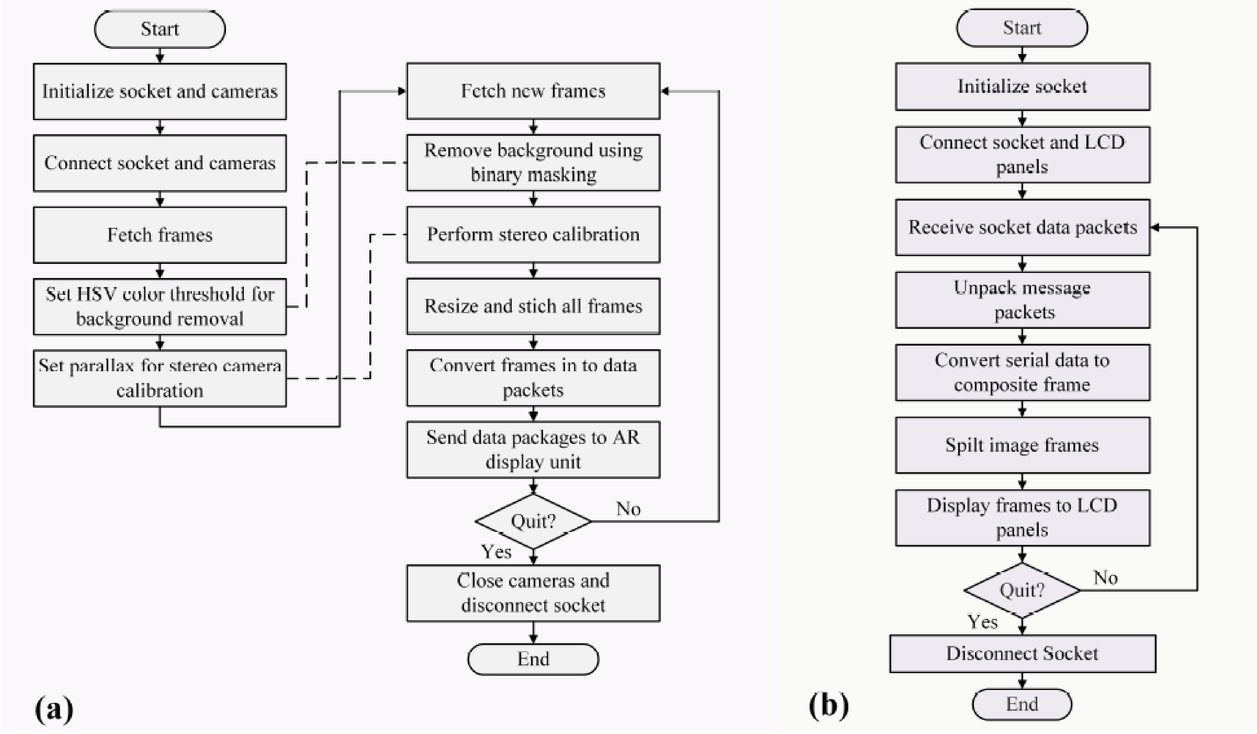

Figure 3. (a) Flowchart of the software application on capture-end, and (b) flowchart of the software application on display-end.

EXPERIMENTAL SETUP

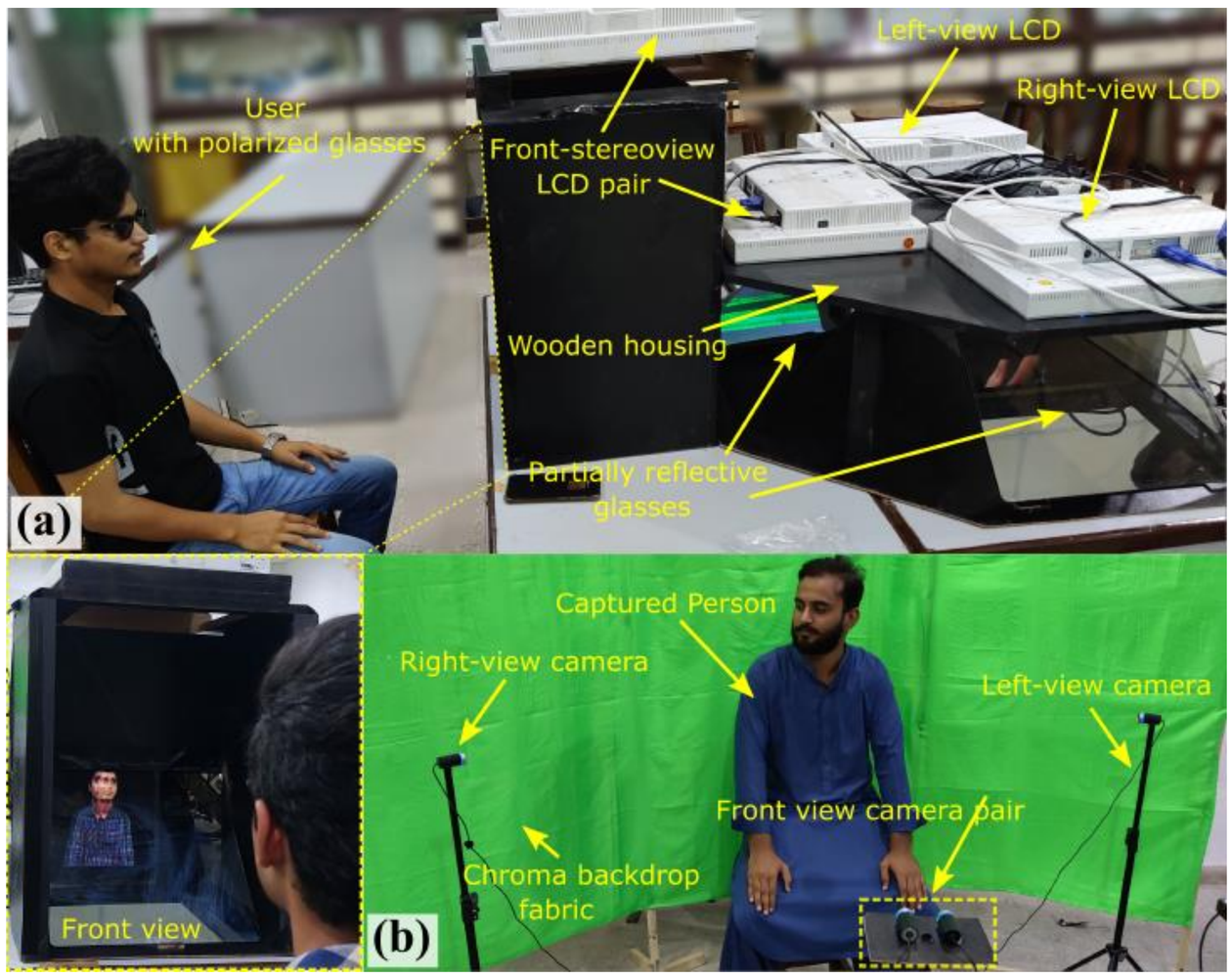

Figure 4. (a) Developed experimental prototype of the display showing the user viewing the display from front end and,
(b) shows the 3D image capture setup capturing the person from three directions.

DISPLAY RESULTS

Different display parameters were tested for our 3D AR display system. The reflection of light towards the viewer was found to be 54.6% while 35.1% of the light passed through the semi-reflective mirror and the remaining 10.3% of light was lost. The stereo crosstalk was negligible (less than 5%) in 3D front view. The frame rates were good at lower resolutions of the transmitted frame but decreased as the resolution increased. The viewing angle was stable at ±20° from the center of the display.

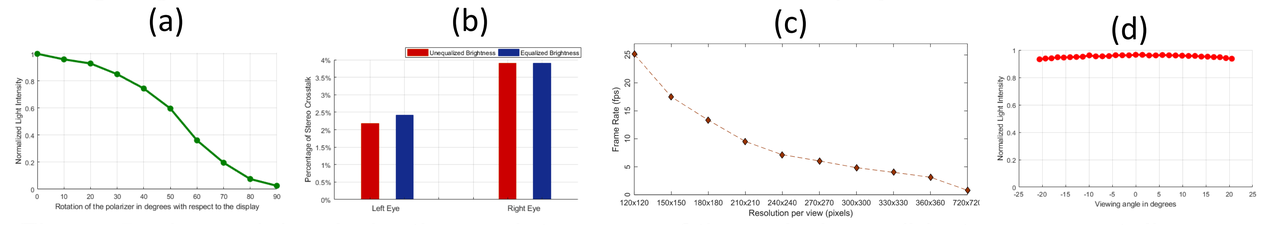

Figure 5: shows (a) polarization maintenance of the polarizer , (b) stereo crosstalk ,
(c) Average framerate per resolution , (d) viewing angle of the display

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