Augmented Reality (AR) : Direct or indirect view of physical,real world whose elements are augmented by computer generated sensory data such as sound,video,graphics etc. With the help of AR, the information about the surrounding real world of the user becomes interactive and digitally manipulated.

Ex : Microsoft Hololens, Pokemon GO.

Virtual Reality (VR) : Virtual reality is a computer technology that replicates a real world environment with artificially created sensory experience which can include touch,hearing,sight and simulates a user’s physical presence to interact with the virtual world.

Ex : Google Cardboard, Oculus rift.

Depth Map : It is an image which contains information about the distance of surfaces of objects from a viewpoint(.ie camera).

At a point (x,y) in depth image I, I(x,y) is the depth of object surface at (x,y) from the camera.

We can get depth map from depth sensing cameras like Microsoft Kinect, Intel Realsense.

Working Principle of Kinect / Realsense : It consists of an RGB camera,IR emitter and IR camera.The IR emitter projects a speckle pattern of IR light which falls on objects present in view of the camera where the pattern gets distorted because of uneven surface.The IR camera sends this distorted IR pattern to the depth sensor’s processor and the processor works out the depth from the displacement of dots in the projected IR pattern.

Kinect can track the user’s skeleton.It’s large and highly varied training dataset allows the classifier to estimate body parts invariant to pose, body shape, clothing, etc. Finally we generate confidence-scored 3D proposals of several body joints by reprojecting the classification result and finding local modes.But kinect includes very high computations.

Kinect SDK : With the help of kinect SDK , we can get the depth view,RGB view ,IR view and skeleton view. And then we can further process this information.

Realsense SDK : With the help of Realsense SDK , we can get the depth view,RGB view ,IR view and skeleton view. And then we can further process this information.

Skeltrack : Seltrack is an open source library that can track upper half of the human body.It follows a simple approch without high computation. It starts by finding the extremas in a depth map. Skeltrack is easy to use in UBUNTU.

Ref for Install Skeltrack in UBUNTU : <http://webtecbasics.blogspot.in/2014/06/how-to-install-skeltrack-on-ubuntu-1110.html>

Libfreenect : Libfreenect is an open source library that can extract raw information (like RGB view, depth view) for Ubuntu. There exists a python wrapper in Libfreenect which can be used to code in Python.

Ref for Libfreenect in Ubuntu :

http://mitchtech.net/ubuntu-openkinect/

Extracting Hand Contour :

* First get depth information using Libfreenect.
* Now threshold the depth map to get region having hands (300 - 700).
* Find contours in the thresholded depth map.
* Convert the image into a binary image.
* Get the contour with maximum area.
* Again threshold the contour we get above to remove any occlusions (Like another hand behind front hand).
* This should be the first hand.
* Get the contour with second largest area.
* This should be the second hand.

Finding Extremities :

* Now draw a convex hull around the first contour and second contour separately.
* Find convex defects for the convex hull of first hand and second hand separately.
* These convex defects contain the starting and ending points of a convex defect along with the depth of defect.
* Now threshold the defect depth to get the extreme points.

Codes :

* Double\_Hand.py (For Extrimities of Two Hands)
* Double\_Hands\_Occluded.py (For Extrmities of Two Hands With Occlusion)