

# Pepper's Cone: An Inexpensive Do-It-Yourself 3D Display

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## 1 Problem Statement

With the advancement of sophisticated algorithms for Augmented Reality, there is a growing need to evolve to high-end displays. The concept of having Holographic displays have always intrigued AR researchers as it can easily blend with the real world. Our project aims to build a 3D display that can be assembled using simple easy-to-arrange items, and can provide a 360 degree rotational view of a 3D object without using any expensive head-mounted glass.

## 2 Key Idea and Challenges Involved

The way this works is that the image of the 3D object is rendered on the tablet display which lies underneath the conic reflector. The reflection of the rendered 3D object is seen by the observer who looks directly at the reflector. This setup creates an illusion that the object is floating inside the conic reflector. There are two primary challenges involved in this idea.

- Due to the shape of the conic reflector, the image appears distorted to the observer. So, it is necessary to pre-distort the image so as to show a perspective correct image. This requires us to learn a distortion map using calibration technique.
- The shape of the conic reflector results in vertical parallax, as the left and right eye perceives different image of the object. In order to make sure that the vertical parallax is within limits, it's necessary to account for the shape of the conic reflector so as to maximize the field of view.

## 3 Result Summary

The result of this project work is a nice easy-to-use 3D display which can render a 3D shape and allows us to see the object along all 360 degree rotation angles.



Figure 1: A tiger rendered on the 3D display.

## 4 Implementation

The authors have a Unity implementation which we failed to compile and run. It is written for an iPad and probably a specific version of OSX.

Because it is not very technically challenging, we set out to do our own implementation using WebVR. It is now in a dormant state of development, because Mozilla is focussing on WebXR, a universal framework for AR, VR, MR, and whatever you may want X to be.

WebVR is primarily used to query the mobile device for rotation data and WebGL coupled with Three.js is used to render the distorted mesh.