Projection Warping on Non-flat Surfaces (PWNS)

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Projection techniques are very similar to artists. Both take time and perseverance and both can be annoying to deal with if they do not turn out right. Projection Warping on Non-flat Surfaces (PWNS) is another step in trying a new form of projection. It’s not unlike the way an artist would try a new technique. However, there are challenges in trying to achieve something as specific as a baseline for innovative development in projection. Our approach was executed by taking a simple surfaced object and displaying an image onto it. But the question still remains; can we distort the image so it looks smooth and crisp on the surface of a non-flat object?

Presenting information in a subtle way is important when integrating it as part of our lives. Immersive environments seek to integrate a person into a new environment to achieve a more natural method of data presentation. The presence of an object in our natural environment is more subtle and easier to adapt into our lives. This being the case, providing data seamlessly is becoming a bigger challenge given the quantity and specificity of data that we go through day by day. We decided to experiment using a sphere as an object to project onto it is simple enough of an object to assess the implications and their difficulties.

The specific elements taken into consideration for the project were design and construction of the structural set-up and manual calibration of digitally projected images. Included in these two elements are the use of projector, the surface to project onto and its size, the color and texture of that surface, the size of the structure provided the distances to the surface, and the calibration of the projection. These are all discussed separately and their methods, advantages and challenges that each presents.

**Design and Construction**

The first task was assembling the hardware; it started with projectors and their features. Different projectors’ ratio varies the focus of an image onto a rounded surface of an object, in our case a sphere, and creates different degrees of distortion onto its surface. For this reason regular and short throw projector variations were tested to select the most convenient. Short throws were considered first with the possibility of a compact design. However, the pixel stretching was too significant. In other words details were lost over the curvature of the ball. Regular throw projectors were selected as they have the most even focus across the surface and enough surface cover to meet expectations, without distorting the pixels beyond recognition.

After assembling the hardware, our next task was to select the sphere with the best surface for projection. The surface is important because the texture has implications for the way the image will be presented. Naturally uneven images are presented in an inwards manner, as if walking into them. For example, the corners of a room or the distortion in a book open for reading. In this situation this is opposed, when considering an object’s surface that becomes outward contour and therefore become challenging in a perspective notion. The distortion caused by the surface was corrected manually with a warping and blending application developed in another project also VisU program of UKY.

**Manual Calibration**

The second element of the project was the manual calibration for the image projection. For a seamless uniform projection across the surface manual calibration is necessary, as a result a person would be able to move around the setup and see the details of the image without noticing stretch points or unfocused surroundings. An error margin had to be taken into consideration because there is no way to predict the correct placement distortion of specific pixel(s), for this reason it is not part of the topics under research.

The technique used was to identify straight lines. This became an asset for development. The round shape of our object eliminates discrepancies in rough turns. This results in curved lines which are manually manipulated to align properly onto the surface. Grid patterns were used to even the image projection on stretched areas for alignment and scale. It gives us the benefit of having near symmetric disproportion as well as avoiding having blind spot from a single perspective. This refers to locations on an object that have steep angles and therefor create shadows on the surface that otherwise may have been covered.

**Summary**

With much effort we were able to create a stationary model of a object projection display and make the images pretty clear and smooth on the surface of a 13’ diameter ball. Our research shows that flat painted surface works perfectly without relying on texture. The various hardware settings we were able to try were a helpful reference to what we wanted to accomplish in terms on quality and size. I personally had a great experience working with the tools acquired and created during this process. There is still more that could turn out from this given the time needed to accomplish new goal.

**Future Work**

There are many things this project might lead to but I have a few ideas of my own which I will mention. A very large scale edition of the sphere setup could be created with an all-around view. Special content that provide application usage and other interactive features that do not obstruct the free movement of the user could be developed. Finally a globally functional set-up for projector that works with multiple objects would take this project to a new level of usability.