My goal is to build a 360-degree view periscope with no image disorientation, maximum comfort and minimum observer space requirement.

First Step- I wanted to create a 360-degree periscope so I can see in all directions without moving my body. I hypothesized that if I create a periscope where the top mirror rotates but the bottom mirror stays fixed, I can achieve this goal. I created such a periscope, but to my dismay, I found that the image gets disoriented when I rotate the top mirror of the periscope.

Second Step- I had to understand the relationship between the rotation of the top mirror and the tilt of the image. I hypothesized that in a rotating top periscope, the image tilts by the same degree as the degree of rotation of the top mirror of the periscope and the image tilts in the same direction as the direction of rotation of the top mirror of the periscope. My first experiment proved all my hypothesis as correct.

Third Step- Armed with the knowledge gained through my experiment above, I ventured to find a way where I can cancel the disorientation of images in a rotating top mirror periscope. I focused my research to find if someone had already created a rotating top periscope. I found a patent from Rudolph Gundlach, but it was difficult to understand. I, then, refocused my research on findings ways to cancel the disorientation of the image through an optical device. That is where I came to know about the use of dove prisms to rotate an image. I did detailed research on dove prism and hypothesized that I can use a dove prism to fix the disorientation of the image, the dove prism needs to rotated by X/2 degrees to fix a tilt of X degrees of the image, the dove prism needs to rotated in a direction opposite to the direction of the rotation of the top mirror of the periscope. My second experiment proved that all my hypotheses, except one, were correct. The dove prism had to be tilted in the same direction as the rotation of the top mirror to cancel the disorientation.

Fourth Step- My second experiment had a limitation. I had used a pencil as a reference image. When I used a different reference image, I found out that the image orientation was fixed but the image was mirror image of the original image. I hypothesized that I can use a second fixed dove prism at 90-degree orientation between the bottom mirror of the periscope and the rotating dove prism, to fix the mirror image. I repeated my second experiment with this new arrangement and my hypothesis was proved correct.

Fifth Step- This periscope has couple of limitations. For my periscope to see in all directions, I must turn the top mirror, note its orientation and then turn the dove prism by half of that. This can be time consuming and difficult. I would like to build a mechanical control through which I can control the orientation of the top mirror and the dove prism, together through a single control. The periscope is bulky, heavy and fragile. I would like to change my periscope so that it is light weight, compact and strong. I hypothesized that I can use gears and PVC pipes to achieve the goals above. After going through multiple design changes and failures, I was able to create a successful design and build a periscope that met the design criteria of Fifth step. I performed various experiments and successfully verified that the periscope achieved its design goals.

Next Steps and Applications –It would be nice to add image magnification, compass direction and further reduce the size and weight of the periscope for better handling. My periscope can make the life of sailors and soldiers in submarines and armored vehicles much more comfortable. It will free up precious space in submarines and armored vehicles because of no observer movements.

Materials – PVC pipes, Birch plywood for Gears, Bearings, Wooden planks, Wooden cylindrical bars, PVC union Joints, PVC couplers, Hand Saw, Protractor, Mirrors, Dove Prism, Glu gun, PVC Elbow joints