Using Movement to Calculate the Distance to Objects

**Abstract.** This paper proposes that the well-known “following moon” phenomena can be used to calculate the distance to an object given that we know how far the image capturing device has moved along with any measurements that can be taken from the image.

Introduction

The goal that I want to achieve, and the reason for me writing this paper, is that I want to create a device that can convert an image stream into sound. The audience that this is targeted at are blind or partially sighted people though it also would not hurt if someone tried it for fun.

There are of course legal, moral and ethical concerns for this product for example will I be responsible for any injury that befalls someone while using it, what if the machine has long term effects on hearing, is it okay to allow people to use it?

The following Moon Phenomena

The following moon phenomena is something almost everyone has experienced when walking outside; if you look up at the moon while walking it appears to be following you rather than moving backwards and away like the objects closer to you.

A more down to earth example of this is something that you may have experienced, when you were on a train and looking out of the window. When it first sets off you are usually in an area with a lot of houses and fences and bushes close by that all seem to blur out, but after a while when you get out into the countryside the fields you see appear to be moving slowly.

The following equation describes what the phenomena.

Where is a constant of proportionality to be calculated experimentally.

Notice the RHS of the equation becomes very small if the distance the object we are looking at is far away, so it looks like the object is moving less compared to closer objects. Hence giving the elution that distant objects are following you.

How will the device work?

Since I have only recently began to think about this seriously, I am not sure if what I describe will be possible. The device will work in 4 parts:

* Calculate distance moved by the observer.
* Convert the distance moved by points in the image and store this data in an array.
* Use the data to calculate the actual distance to the points.
* Convert the distances into sound.

When I sum it up like that it does not seem particularly daunting. But, sure enough, there is a lot more to consider.

Converting Observed motion to the Distance to the Object

This part of the project is going to be the toughest – for now I can only rearrange the following moon (FM) equation.

Even though the above equation would not be a terrible for a proof of concept, I doubt any client would be interested to buy a product that only works when they do the crab dance (reference to how this only works when you move perpendicular to the direction you are facing).

I am currently working on trying to improve the formula so that I can take in all sorts of motion measurements and use them to calculate the distance to an object.

The Focus Constant

Only major pitfall that people fall into when they try to use the (FM) equation is that the constant appears to change when the focus of the camera changes. The easiest solution to this is, of course, turn off auto-focus – this seemed like a copout to me, but I doubt it would have had a massive effect on the end audio quality.

Also, I do not know how the constant changes in response to different image magnifications either so that might need looking into.

Converting Distance to Sound

I am not familiar with how sound is stored in a computer, but I am fairly certain that it was not intended to ever be displayed as an image. When I was first thinking this up a few years back I had intended for there to be an entire headset with lots of speakers that could be triggered individually and calibrated. Of course, the helmet would cover your entire head so it would be difficult to see but considering the target audience that does not seem like much of an issue. I hear there are similar types of helmet available for gaming and I will have to look into it.

If that does turn out not to be possible, we will just have to settle with compressing the data down into a left half and a right half which can be outputted through a headset.

Graphical User Interphase

I have no problems with creating a GUI for this though it would be unnecessary as the device is targeted at people who cannot see. I was hoping the app would start working the moment it opened and would stop once you clicked the home button.