

Dancing Milk
Feet wet project
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Image Intent:

The purpose of this image is to show the movement of sound waves through a liquid and the propagation of sound waves. By placing a bowl of milk with drops of food coloring on the subwoofer of a stereo playing music, it appears that the dye in the milk is dancing to the music. This was originally attempted using water, but this did not provide as dramatic of an effect as the use of milk with food coloring so milk was used instead. The image is taken using video and audio, so the connection between the movement of the liquid and the sound is apparent. "Heartless" by Kanye West was the chosen music because it is a song that has a very steady heavy beat.

Flow Apparatus:

The apparatus for creating the flow is fairly simple. Milk is placed in a clear plastic dish with a radius of 7". This bowl is placed on a black sheet of paper which is directly placed on top of the subwoofer for a Panasonic model SA-HT75 sound system. With Kanye West's "Heartless" playing at full volume on the sound system, waves propagate through the milk causing movement of the particles and spreading the dye through the milk. Sound moves through fluids as a compression wave. Varying frequencies cause the different pitches perceived by the ear. These different frequencies are visualized in the fluid flow by noting the different rates at which waves are created in the milk. Sound moves through different mediums at different rates. A widely accepted value of the speed of sound through air is 340m/s. Through a liquid, the speed of sound varies according to the bulk modulus of the material and the density of the material using the relationship $c_{\text{fluid}} = \sqrt{K/\rho}$, where c is the speed of the sound wave, K is the bulk modulus and ρ is the density of milk¹. Assuming that the density of milk is similar to that of water, it is safe to assume that the sound waves will travel through the milk at a speed of about 1500 m/s. This does not mean that the particles in the milk will move at this same rate because the sound wave is moving through the milk.

Visualization Technique:

The flow is created in a clear bowl containing 3.75 cups of 2% low-fat milk at an approximate temperature of 45° F. Four droplets of blue, water based food coloring are added at opposing sides of the bowl to show how the particles are moving on the surface of the milk due to the disturbance caused by the sound waves traveling through the fluid. A black background is created providing a deep contrast with the white color of the milk. The lighting is provided with a 60 W soft white light bulb 24" above the surface of the fluid.

Photographic Technique:

The video of the flow is taken using a JVC Everio memory camcorder (MODEL: GZ-MS100U). The zoom is set to a point such that the vertical field of view is 12.5" and the horizontal field of view is 6.5". The lens used is 1:18 \varnothing 30.5 Kinoca Minolta Lens 35x zoom at a zoom level of 1.2. The camera uses removable SD memory media for data storage. The video is taken at a rate of 24 frames per second. The video resolution is 720x480 pixels. The lens of the camera is placed at a horizontal distance of 8" from the center of the milk air interface and a vertical distance of 12". This makes a total distance of 13.8". Please see figure one.

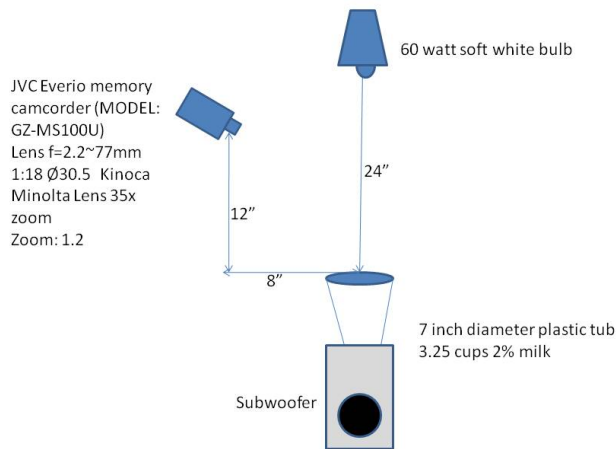


figure 1

Future Work:

In many ways this image does fulfill its purpose. The different frequencies of bass notes are clearly visible through the motion of the die in the milk. For future use a video camera with a better resolution should be used and better lighting so the ripples on the surface of the fluid are more clearly visible. Another improvement would be a better way of capturing the sound. The microphone on the camera doesn't do a good job of capturing the bass and it detracts from the overall presentation. Overall this image is a success. It is impossible to see sound waves propagating because they are simply changes in local pressure within a fluid, but it is interesting to see the way it still causes the fluid to move around.

ⁱ Everest, F. (2001). *The Master Handbook of Acoustics*. New York: McGraw-Hill