Seismometer Report

In today's world of highly advanced technology a lot of noise is generated which is affecting our lifestyle. A part of this is infrasonic frequencies which is produced due to seismic activity, construction work, vehicles, and other natural and human activities. This range of frequencies is left unnoticed and therefore to be explored. A seismometer can be used to study this frequency distribution. This device detects seismic motion, which is in the infrasonic range. The present available seismometers are costly, complex therefore cannot be easily constructed by a common person. Raspberry Shake is one such instrument but not affordable to everyone.

Here we propose a seismometer that is low cost and easy to construct, that can be used to detect this infrasonic frequency noise in our vicinity. The device is made from three main parts which are an **optical mouse, PVC pipes,** and an **Arduino UNO.**

The device has a flimsy microscope constructed in PVC pipe which is a cantilever. This microscope helps magnify the minute vibrations that are present. It is done by using a ball lens, light source, and an optical mouse as a detector. All of which is mounted on the cantilever. A scratched transparent plastic slide is placed in between the lens and the light source to generate the speckled pattern. This plastic slide is kept stationary with reference to the cantilever. The motion captured by the cantilever causes a change in the image falling on the detector which is recorded as a seismic digital signal by the Arduino.

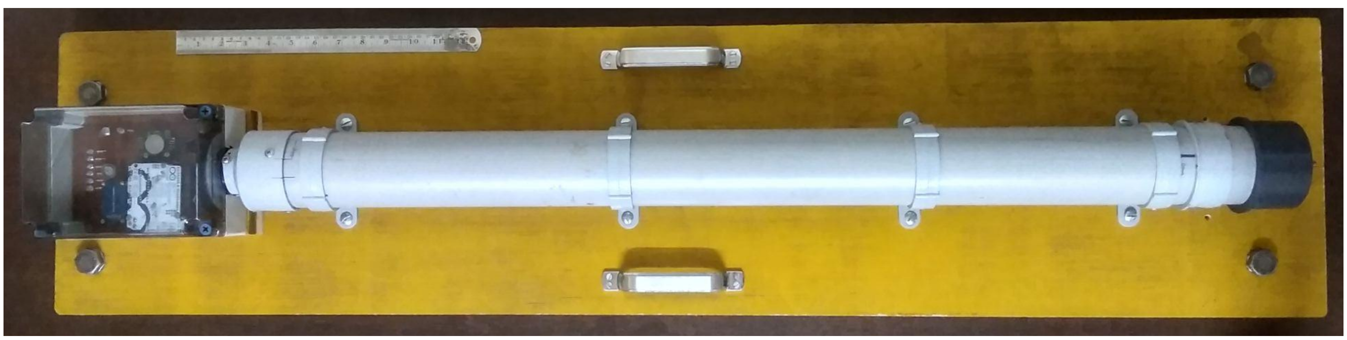

Figure 1a: The optical mouse-based seismometer. The pipe holds the cantilever and the box contains the circuit. The device is mounted on a wooden platform with adjustable height.

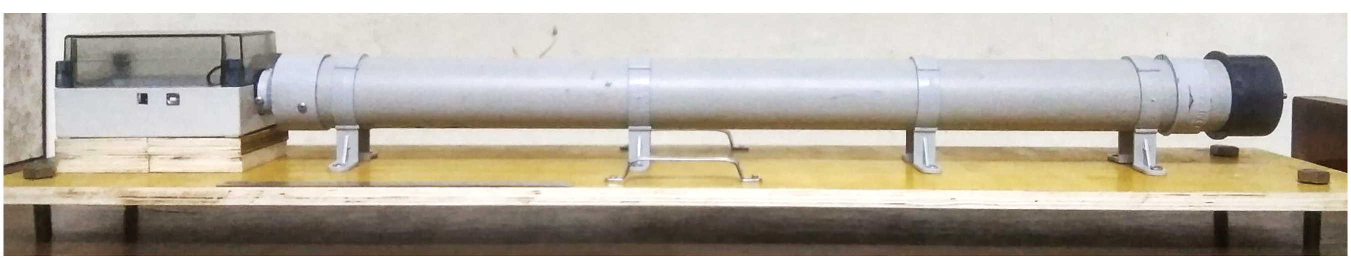

Figure 1b: Side view of the device

The device can be constructed by referring to the following procedure.

Following is the list of components used to construct the device:

1. 40mm diameter PVC pipe of length 1.3m
2. 75mm diameter PVC pipe of length 1.0m
3. Two 75mm diameter cap
4. A 40mm diameter cap
5. 40mm to 75mm PVC coupler
6. Four 75mm PVC pipe holder
7. 3cm x 3cm copper plate of 5mm thickness
8. M5 Brass screw and nut
9. M3 and M2 screws and nuts

The device has the following electrical components:

1. Optical Mouse
2. Arduino UNO
3. Arduino USB host shield
4. Arduino based MicroSD card reader
5. Arduino based RTC
6. LEDs
7. 2.200 Ohms resistors
8. Wires and PCB board

Procedure

The main functional part of the device is a cantilever that has an optical mouse mounted on its fixed end. It is made from a 40mm diameter PVC pipe of length 1.3m. The pipe is rigidly fixed inside the 40mm-75mm PVC coupler as shown in **figure 2 and 3**.

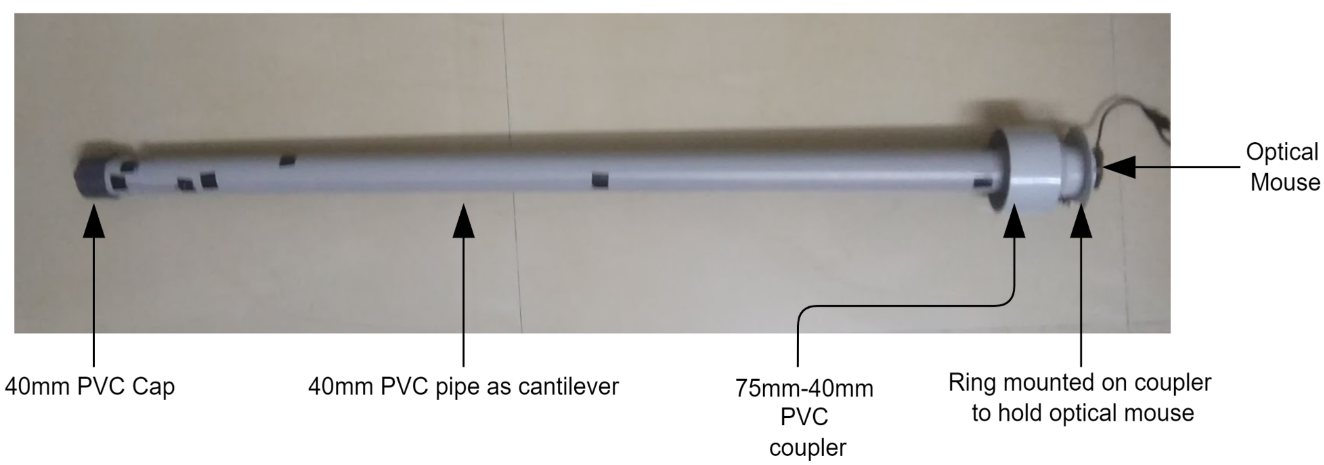

Figure 2: The 40mm diameter PVC pipe used as a cantilever. The figure shows the components used for its construction.

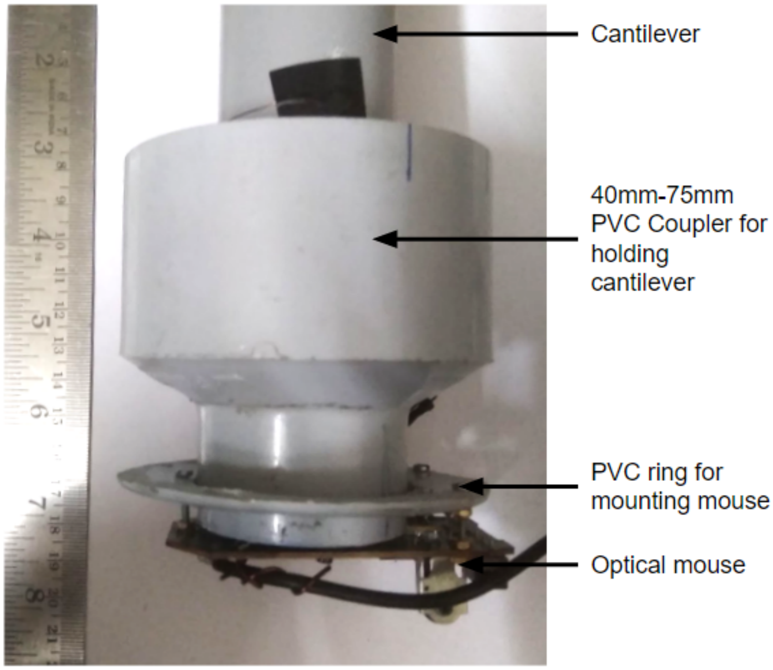

Figure 3: The 40mm diameter PVC pipe used as a cantilever. The figure shows the components used for its construction.

This coupler is then fixed on the 75mm diameter PVC pipe of 1m length (**figure 4**). The outer pipe provides support to the cantilever for its oscillation allowing the cantilever's other end to freely oscillate under external vibrations. The free end of the cantilever had cut sections as shown in **figure 5**. These cut sections allowed the fixing of a ball lens in the diametric plane of the pipe. Additional sections were cut for the axial movement of the transparent plastic slide (**figure 5)**. This helped to adjust the distance between the lens and the plastic slide generating a clear speckled image on the sensor.

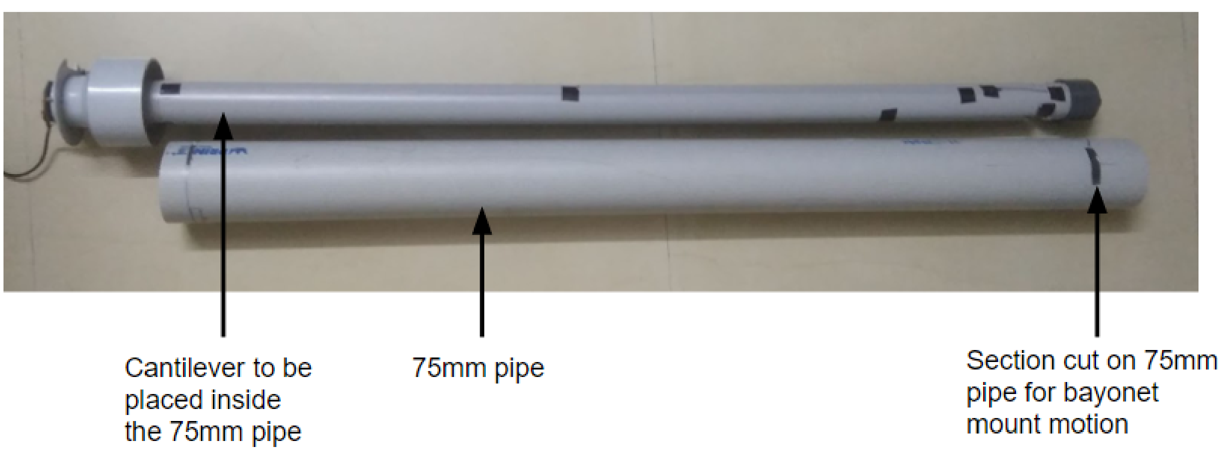

Figure 4: The 40mm diameter PVC pipe used as a cantilever with its outer body

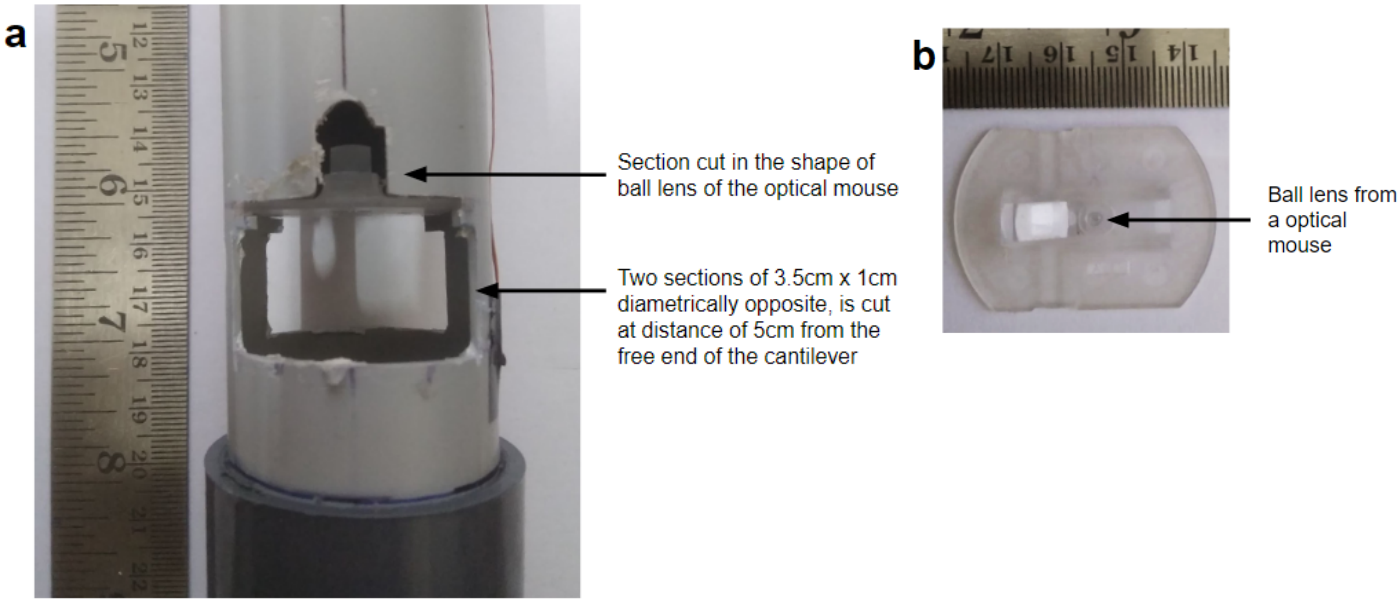

Figure 5: Free end of the cantilever. (a) Cut sections at the free end of the cantilever. (b) Ball lens

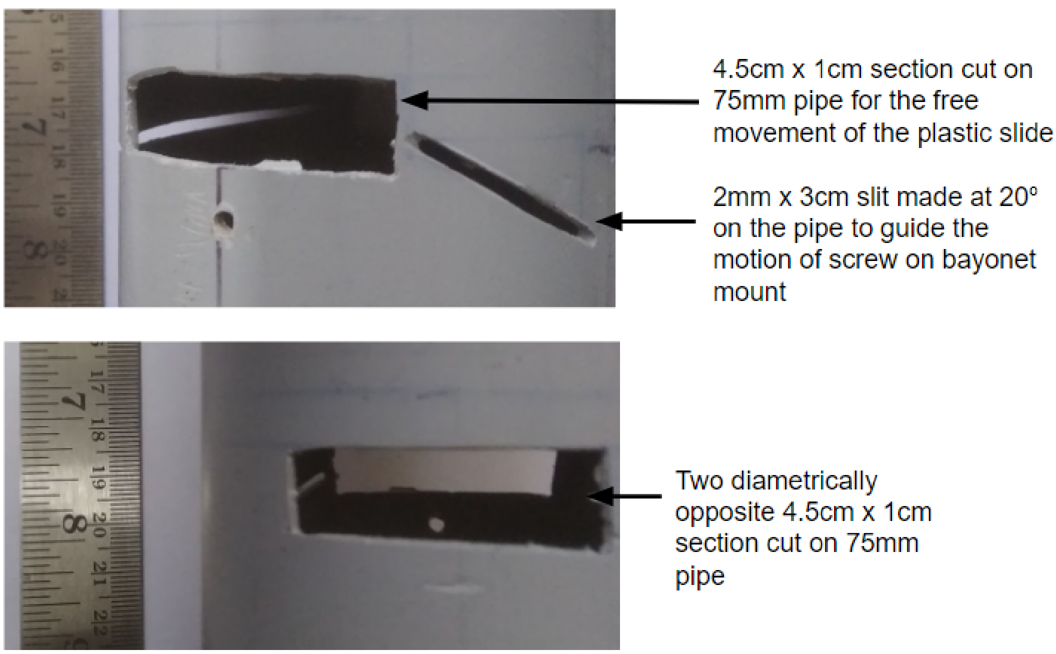

Figure 6: Sections and slits made for the bayonet mount. The rotational motion of the mount is converted to axial motion, therefore, mediating precise control over the positioning of the plastic slide.

The motion of the slide is controlled by the bayonet mount fixed on the outer 75mm diameter pipe (**Figure 6**) and a slider (discussed further). A 40mm diameter PVC cap is attached to the free end of the cantilever. Inside the cap, a LASER is mounted coaxially to the pipe. The light from the LASER first falls on the plastic slide following to it, the ball lens, and finally on the sensor. Four rare-earth magnets were mounted using M-Seal to the outer side of the 40mm PVC cap (**Figure 7-9**). This is the complete construction of the cantilever which acts as a flimsy microscope.

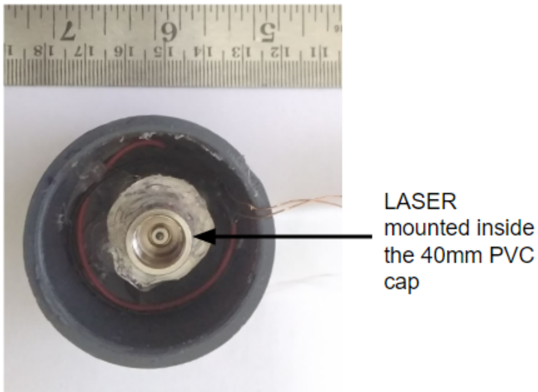

Figure 7: Mounting of LASER
the 40mm PVC cap.

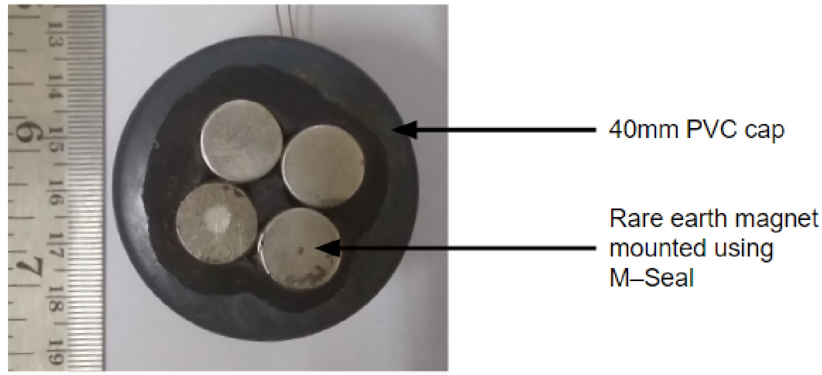

Figure 8: Magnet attachment to the outer side of Inside the 40mm PVC cap.

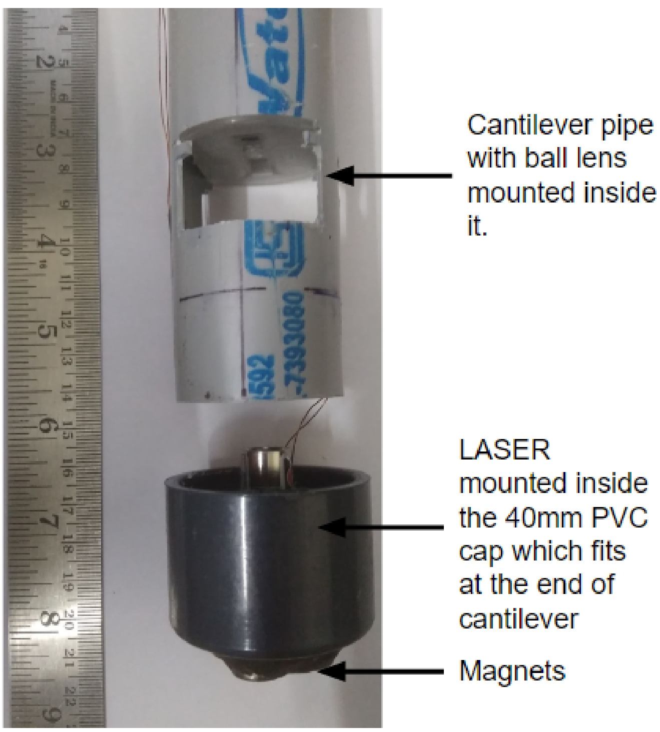

Figure 9: Complete assembly of the free end of the cantilever.

The optical mouse sensor fixed on the rigid side of the cantilever was mounted on a cut-out ring from the closed-end of a 75mm diameter PVC cap. The ring had an inner diameter of 46mm. This could easily press fit over the coupler (**figure 10**).

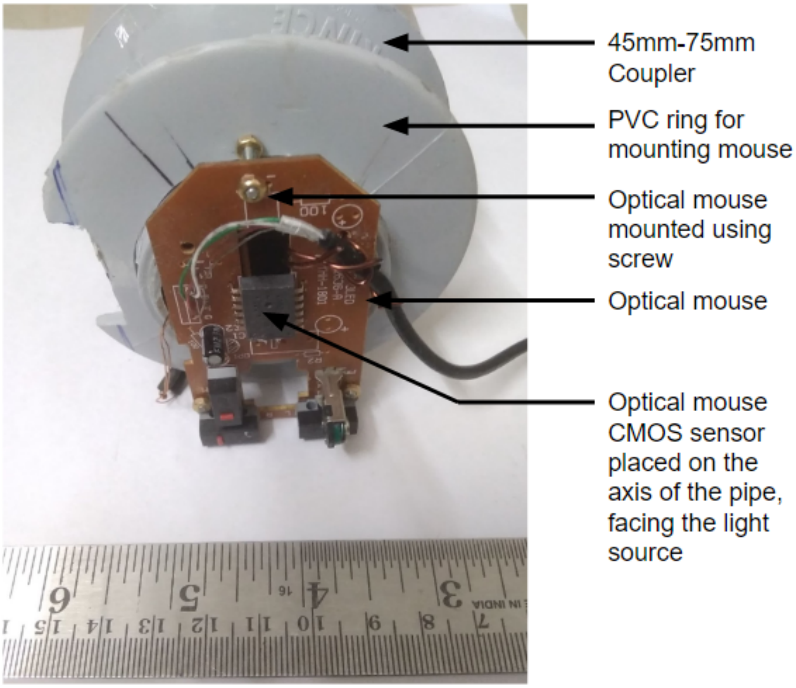

Figure 10: Attachment of the mouse on the coupler.

The axial motion of the plastic slide was mediated by sliding the PVC slider (made from the cut out left from the cap in the previous step) over the 75mm pipe. Two diametrically opposite slits were made for the plastic slide to slide in (**figure 11**). In this slit, the plastic transparent slide made out of a Compact Disc was pushed in (**figure 12**).

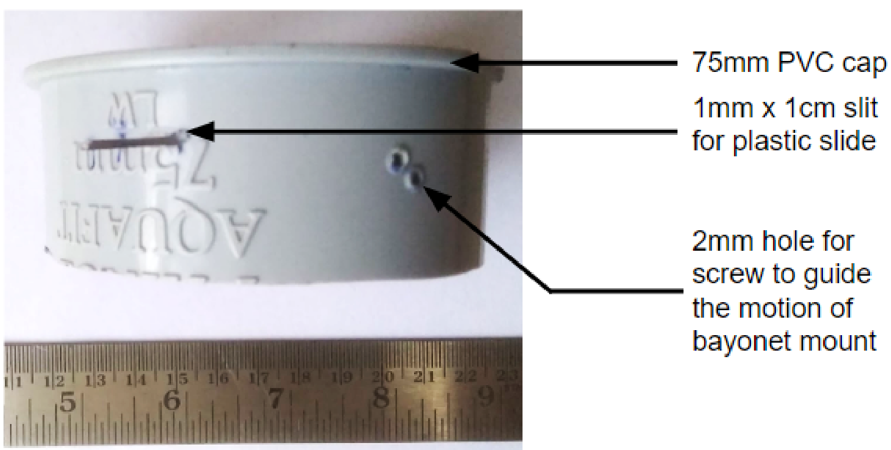

Figure 11: Slider of the bayonet mount

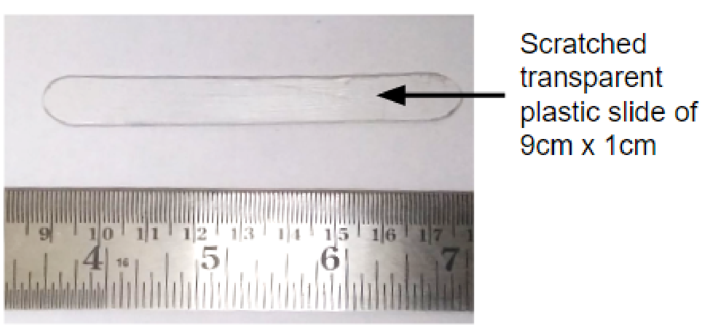

Figure 12: Transparent plastic slide

A brass plate was fixed on an adjustable screw attached in an another 75mm PVC cap. This brass plate faced the magnets which acted as a damper. This cap closed the open end of the 75mm diameter PVC pipe (**figure 13 -14**).

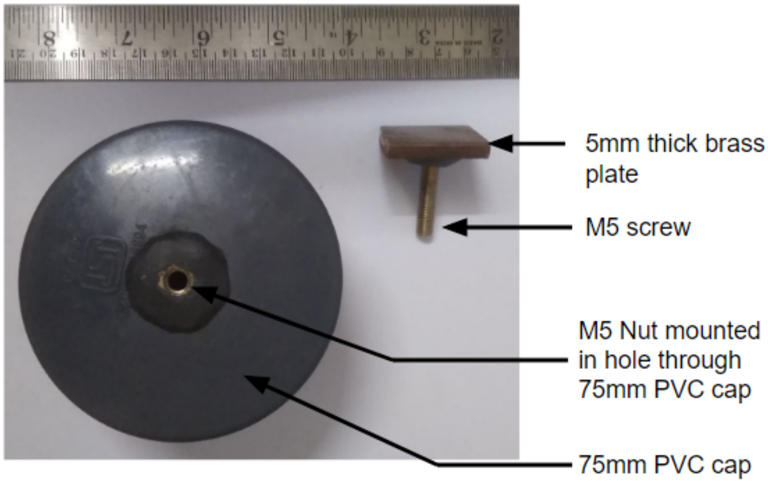

Figure 13: Assembly to attach the brass plate

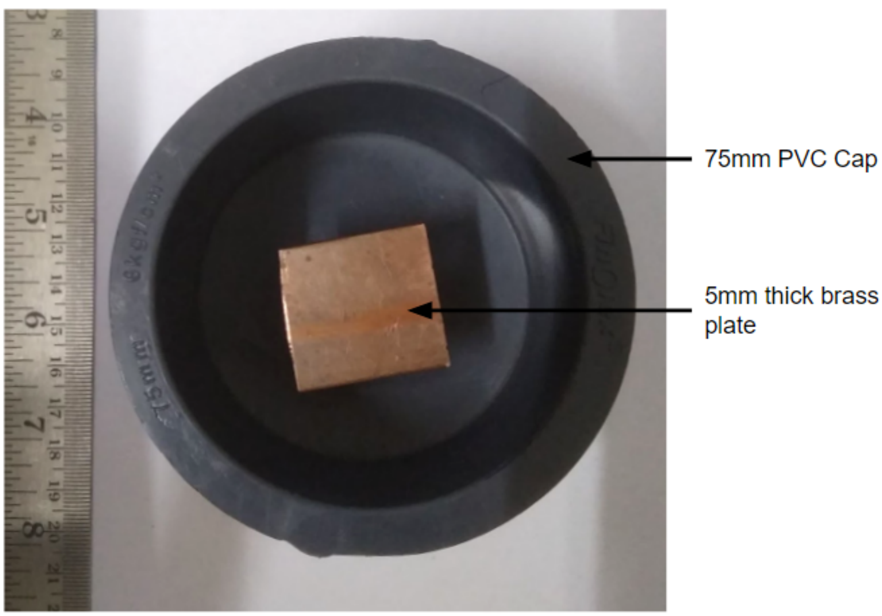

Figure 14: Adjustable attachment of the brass plate which is used as a damper

The electronics Involved

The block diagram shows the overall connection of the circuit is presented in **figure 15**. The circuit used for the working of the device is shown **figure 16** below. **FIgure 17** shows the functional circuit.
The code for running the arduino is available on **Git Hub**.

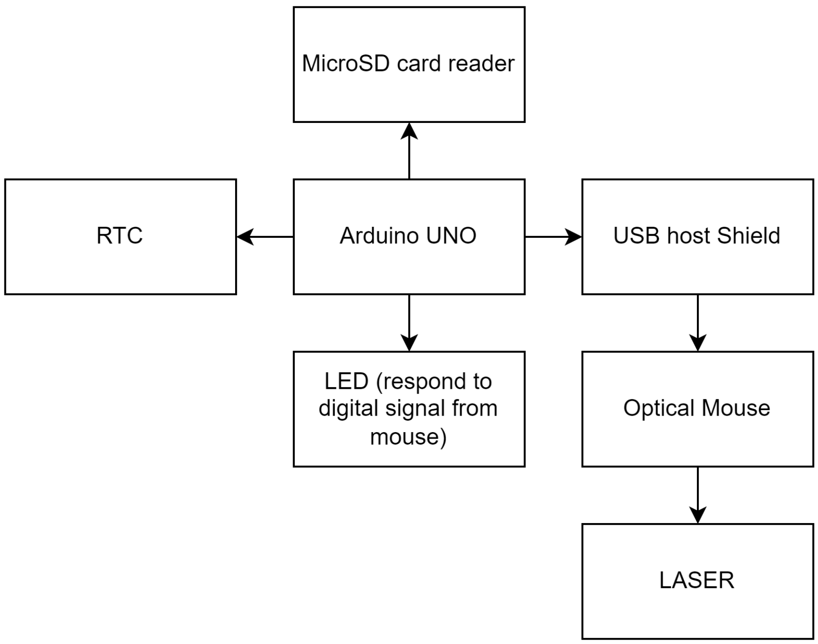

Figure 15: Block diagram of the circuit

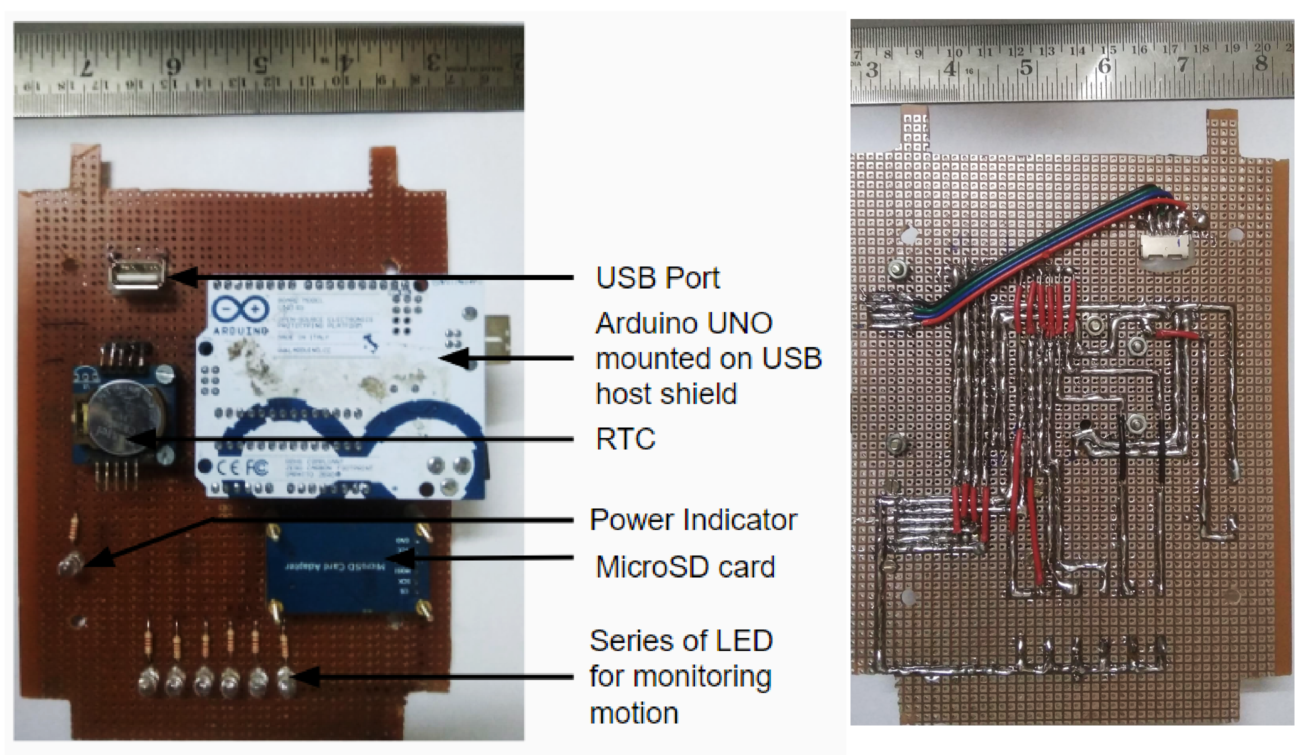

Figure 16: Electronic circuit used for the device with its upper and lower side.

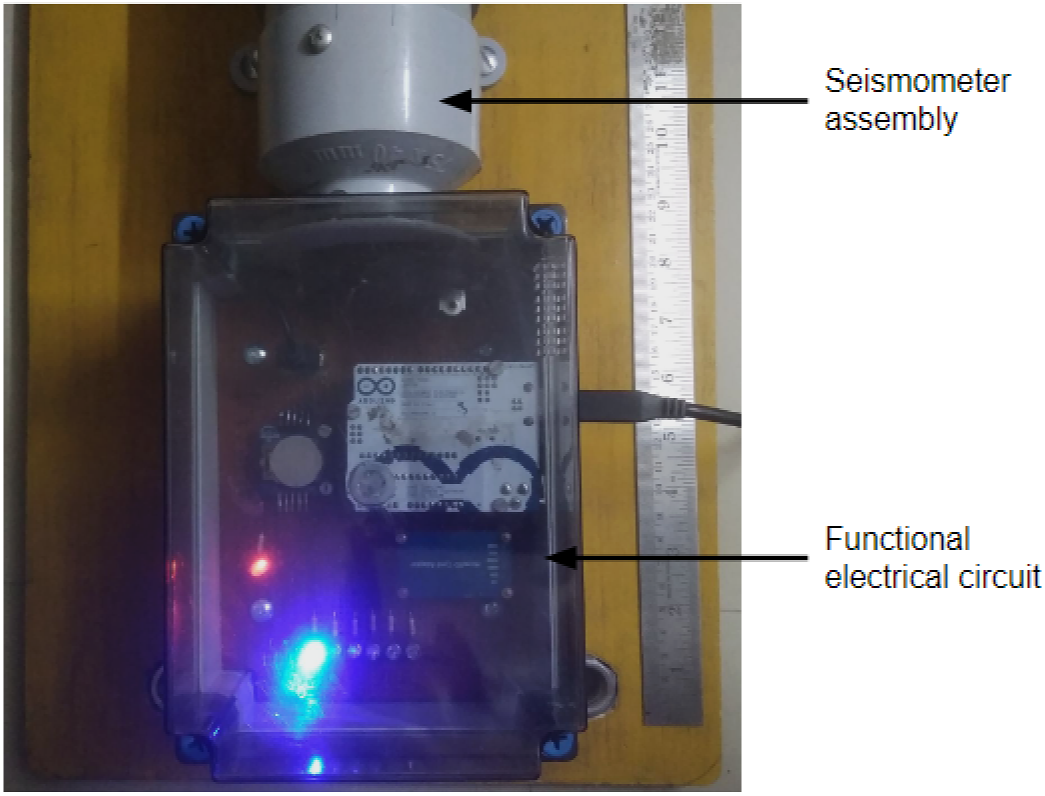

Figure 17: Functional electrical circuit. Blue light indicating the captured signal by the device.

The data obtained from the device is in the from of displacement in the *x* and *y* coordinates. A live plot of seismic activity is obtained as a result.