ELECTRONICS CLUB SUMMER PROJECT

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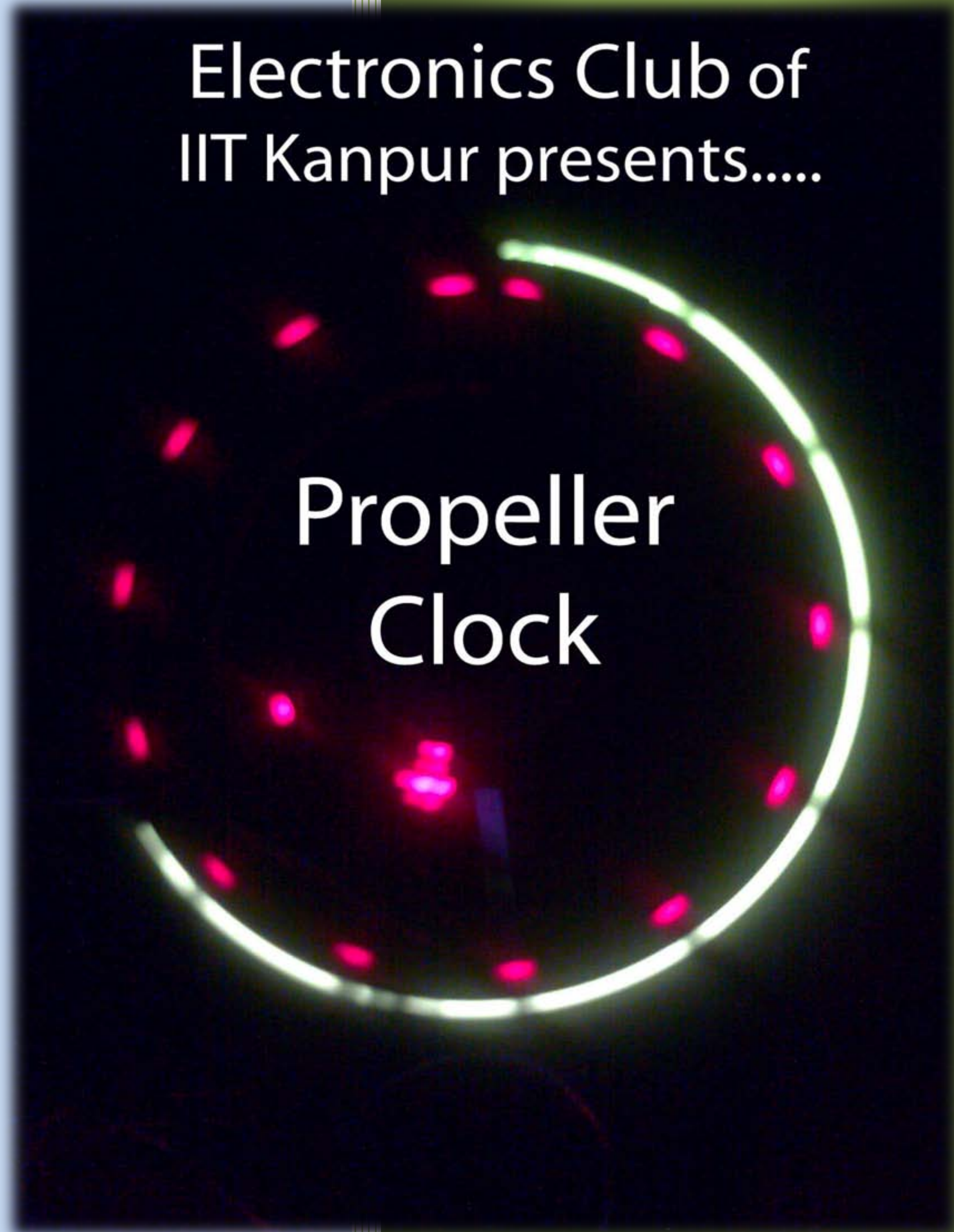
PRANAY SHARMA

Propeller Clock

Persistence of Vision

PROJECT MENTOR:

ARPIT NEMA



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INTRODUCTION

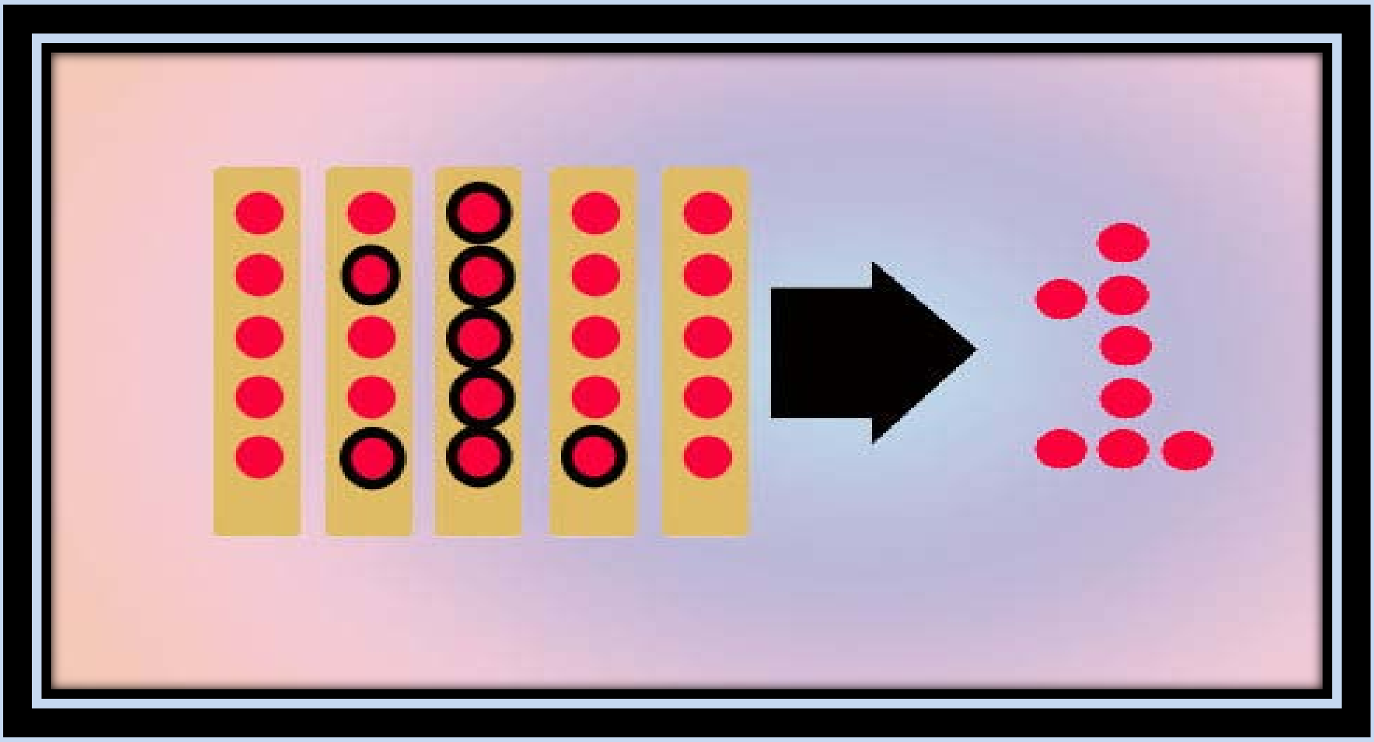
The propeller clock is a linear array of light emitting diodes, rotating at a high angular velocity to generate a circular screen.

Now by synchronising these light emitting diodes, and keeping in mind the concepts of persistence of vision and limit of resolution, we can display a clock.

Persistence of vision:

"What we see is a blend of what we are viewing and what we viewed a fraction of a second before"

For example, if '1' has to be displayed, then the series of lighting up of diodes would be like following:



Related videos on 'Persistence of vision':

http://www.youtube.com/watch?v=oPkeku_BMGo

http://www.youtube.com/watch?v=-6JnAxTXApw

Limit of Resolution

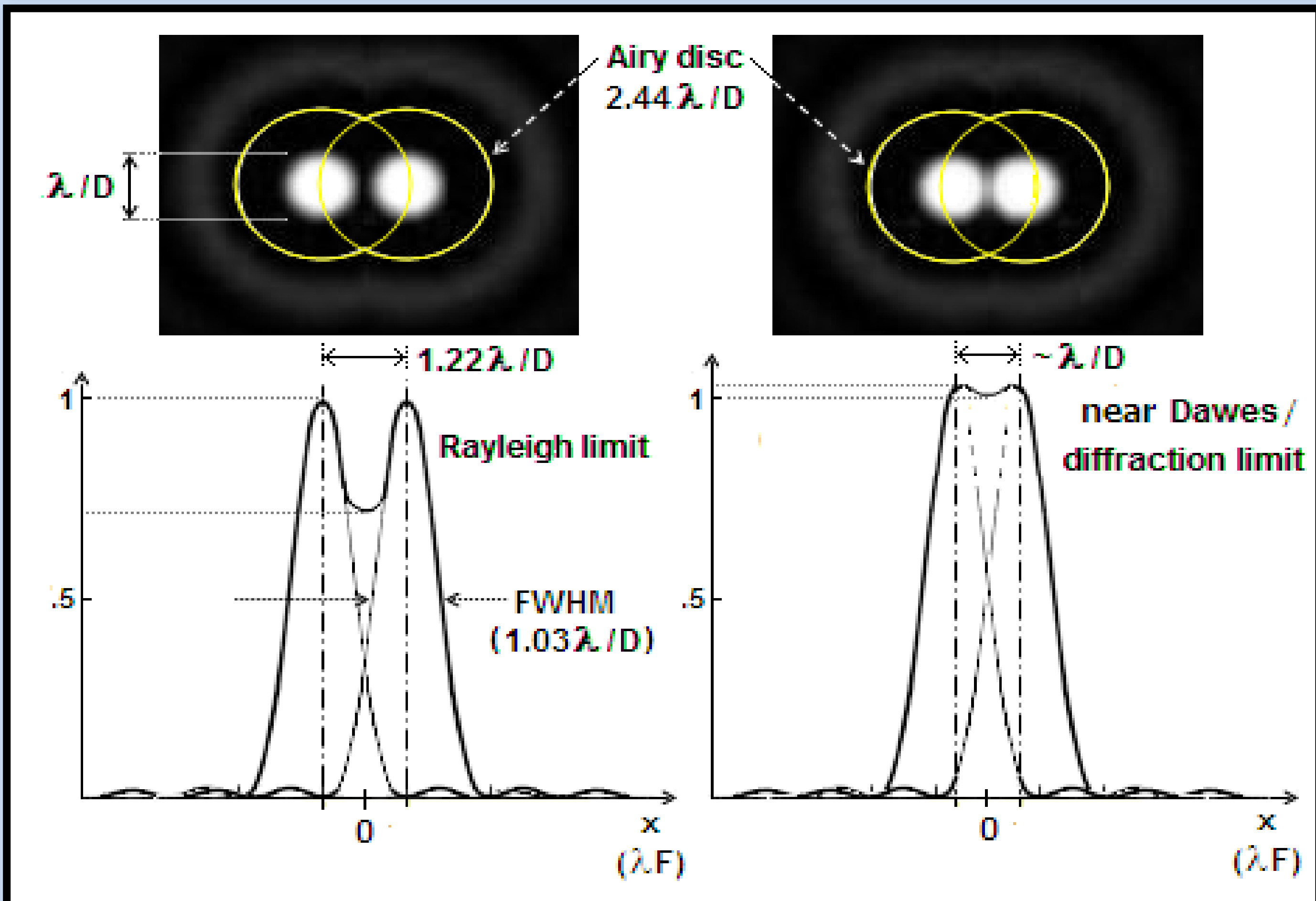
Applied Diffraction:Limit of resolution

The ability of a lens to resolve detail is usually determined by the quality of the lens but is ultimately limited by diffraction. Light coming from a point in the object diffracts through the lens aperture such that it forms a diffraction pattern in the image which has a central spot and surrounding bright rings, separated by dark nulls; this pattern is known as an Airy pattern, and the central bright lobe as an Airy disk. The angular radius of the Airy disk (measured from the center to the first null) is given by

sin(theta)= 1.22 {lambda}/{D}

where
theta is the angular resolution,
lambda is the wavelength of light,
and D is the diameter of the lens aperture.

Two adjacent points in the object give rise to two diffraction patterns. If the angular separation of the two points is significantly less than the Airy disk angular radius, then the two points cannot be resolved in the image, but if their angular separation is much greater than this, distinct images of the two points are formed and they can therefore be resolved.

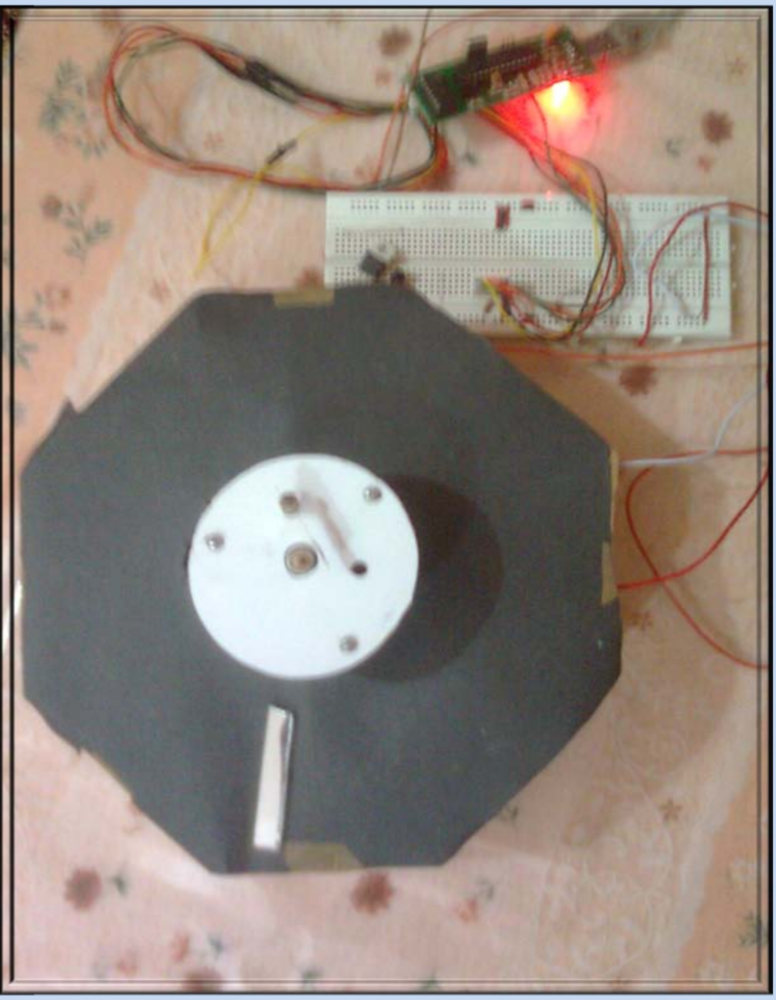


PARTS

Basically, it has 2 units:

1. Rotating circuit board
2. DC motor with power supply unit

Rotating board and DC motor with power supply unit:

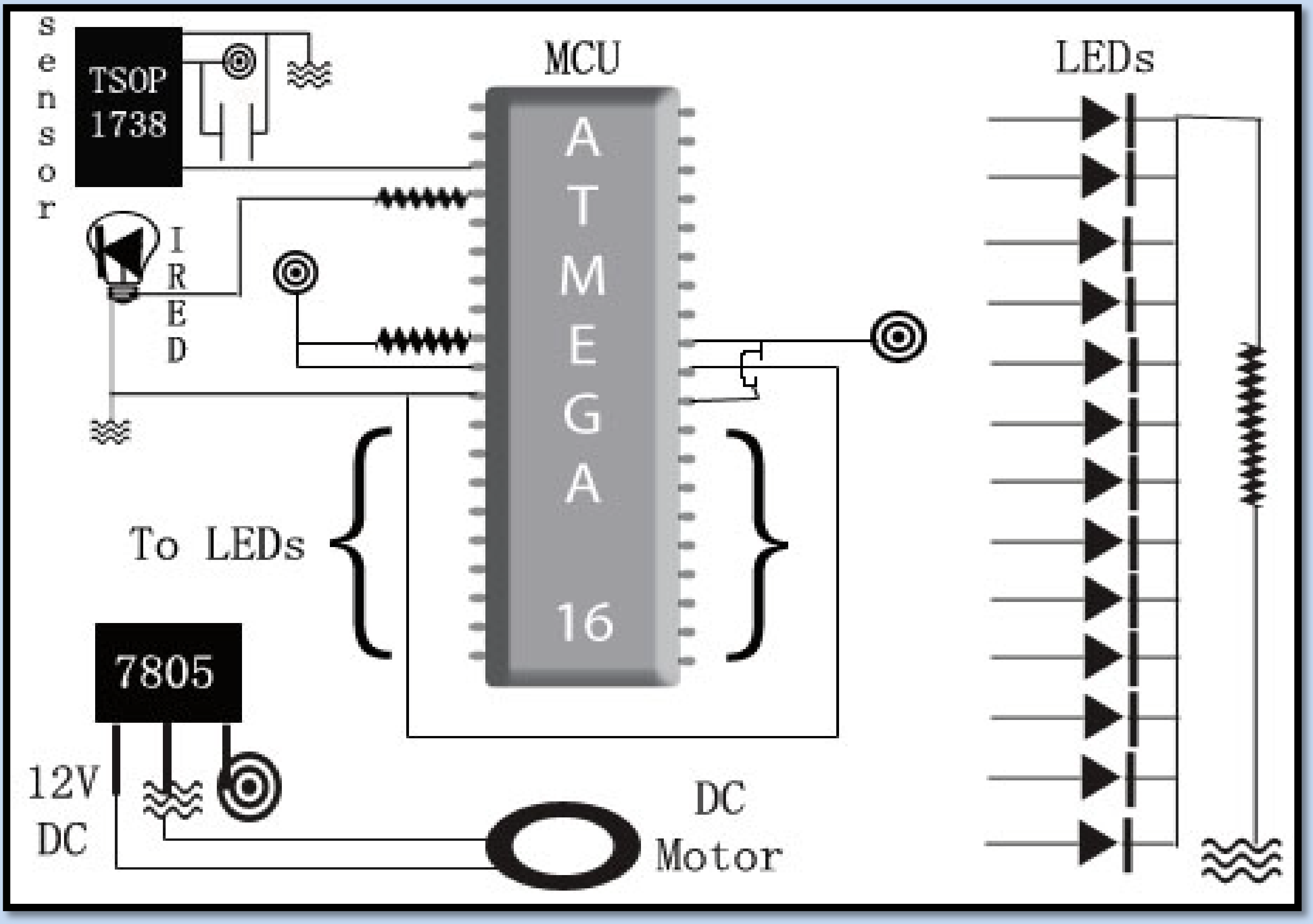


The rotating board has several primary parts. It includes 1 microcontroller 'ATMEGA16', 19 LEDs, 2 capacitors of 2200 µF each, 1 infrared LED, 1 TSOP1738 sensor, 1 rheostat of 10kΩ, resistances of 220Ω and 5kΩ, insulated copper wires and connecting wires.

The power supply unit is actually a slip ring as 1 electrode and a contact wire attached to motor shaft as the other electrode. It has 7805 IC for 12V and 5V regulation to motor and board respectively. There is a small piece of mirror to act as a trigger point of remote sensing.

CIRCUIT

The following is a schematic diagram of the circuit of the propeller clock:



The motor rotates at a quasi-constant angular velocity (about 1000 rpm). The MCU generates a 38kHz pulse for the IRLED which the mirror reflects once every rotation and is sensed by TSOP sensor to trigger an external interrupt which counts the number of microseconds elapsed between 2 successive triggers, thereby getting the instantaneous time period of the rotation. Now depending on what has to be displayed, the LEDs are synchronised. An internal clock keeps the record of time in hours, minutes, and seconds format for display. For full code, contact us.

MAKING

The biggest problem was the making of the hardware setup as the whole system had to be a light weight, evenly balanced and yet a strong one. Even slight variation of centre of mass from the axle resulted in large scale wobbling of the system.

For board, we used the high quality blank circuit board. It had an outlining equipotential surface which we used as the common ground. For the purpose of making it light and compact, we used insulated copper wires. The LEDs were mounted on a female port after being chiselled from their edges to form a close packing.

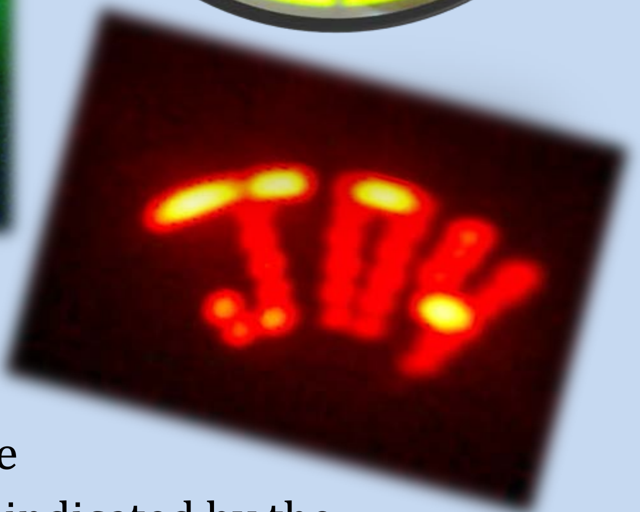
The problem of power transfer was overcome by making our own slip ring by riveting a circular conductor around the axis. A piece of razor blade was used as brush. A nut was fixed centrally which had the contact wire passing internally through a pen refill acting as shaft of the propeller.

A rheostat was used to adjust the range of the infrared so that it could distinguish a black background from a mirror. Instead of attaching a resistance to each of the LEDs, a common resistor was used.

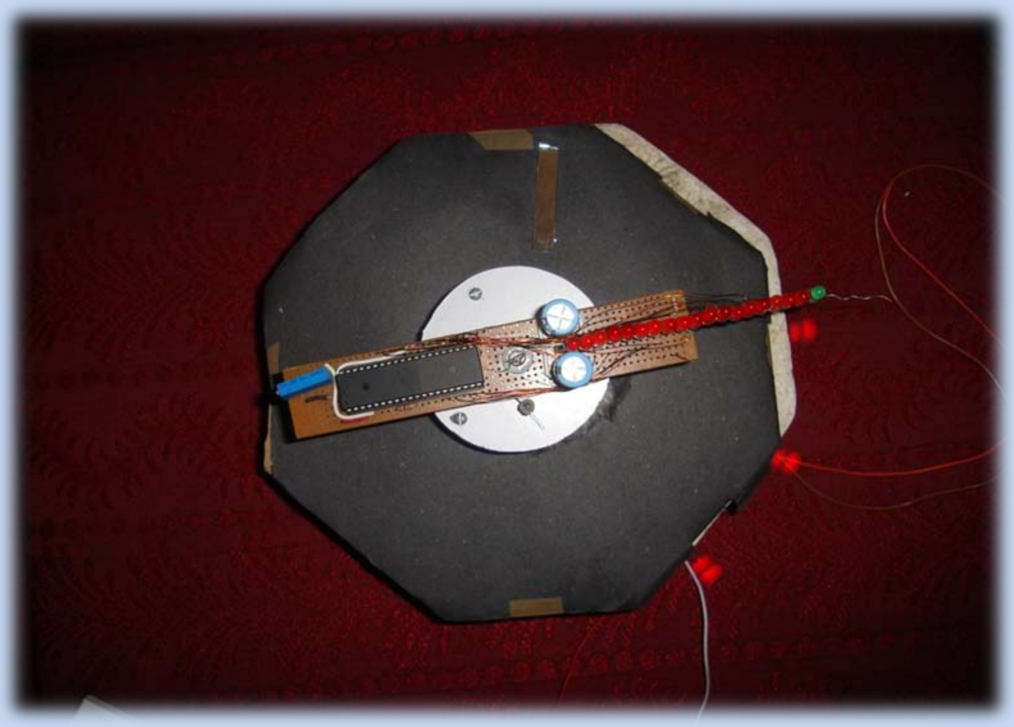
Programming the microcontroller was not simple either. A lot of experiments were done to get proper display of characters (extended version of our clock). We had some soldering practice when we made our own programmer for the project.

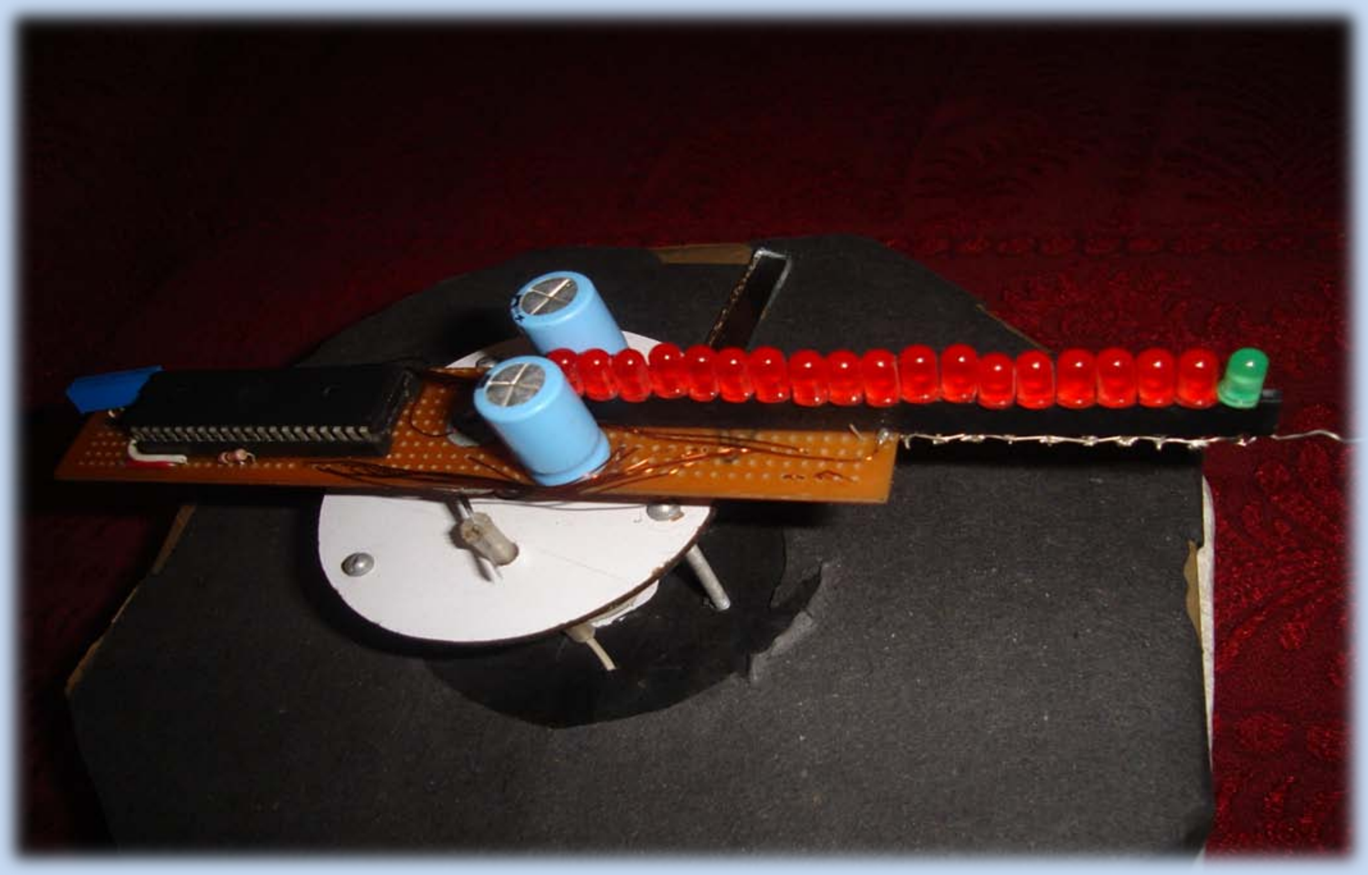
(From left : Joy and Pranay with programmer)

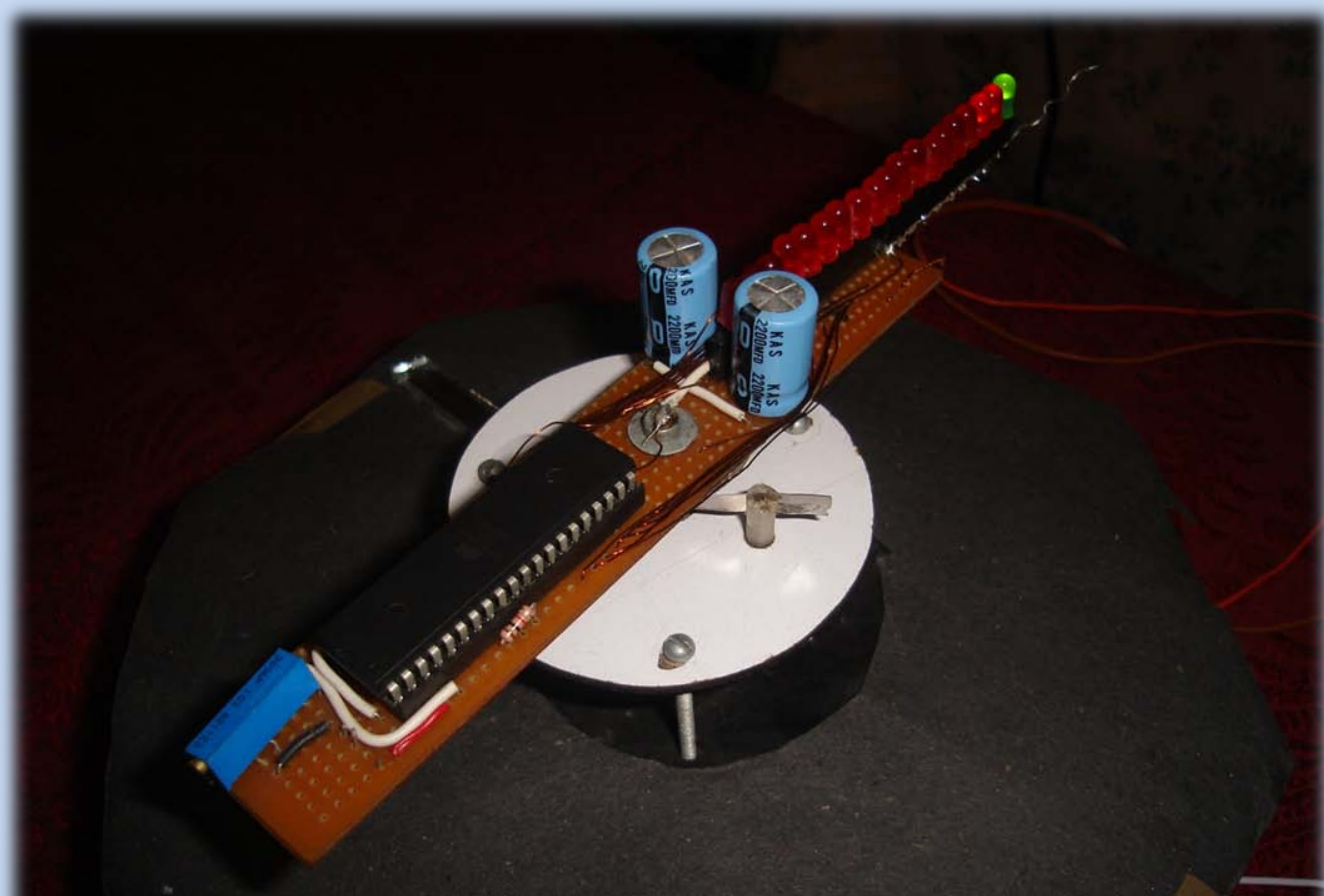
And when it worked........... ☺



In this version, the 12 dots represents the hours 1-12, pointed by a dot indicating hour. The minutes are indicated by the arrow. The seconds are indicated by the arc length of circumference. These were images in motion. Now let us look at some pictures of the clock in still....



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CONTACTS:

We are thankfull to the club for firmly supporting the idea of making a persistence of vision propeller clock. The project would have been incomplete without the support of the electronics club which was well co-ordinated by:

- Siddhartha Garg(gsid@iitk.ac.in)
- Ankit Gupta(angupta@iitk.ac.in)
- Anubhav Singla(anubhav@iitk.ac.in)

Special thanks to our project mentor

- Arpit Nema

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Regards,

Team members :

- Joy Bhattacharjee (joyb@iitk.ac.in)
- Pranay Sharma (pranays@iitk.ac.in)

Cheers............ to ‘**Electronics Club** of IIT Kanpur’