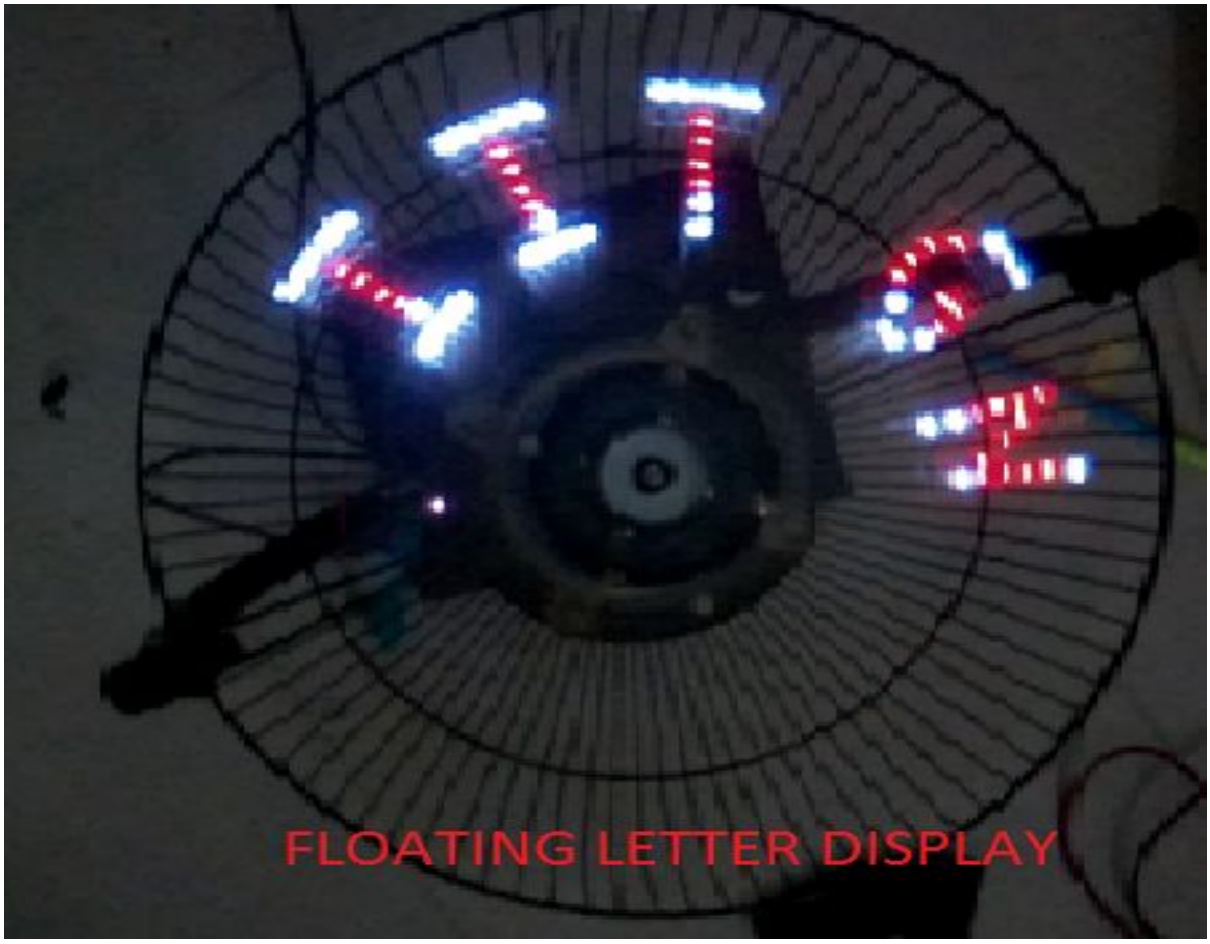
FLOATING LETTER DISPLAY

IIT Gandhinagar
Indian Institute of Technology Gandhinagar

SRIP - 2017



Advisor:
Professor Manish Jain

By: Abhinav Narayan Harish

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Abstract:

The project is a floating letter display that has the capability of displaying enriched digital content on a rotating physical medium. The output can be adjusted as per a text input by the user on the keyboard. Currently our project has the capability of displaying alphanumeric characters that are entered.

Project Details

The project was executed at Creative Learning Initiative (CLI) premises(Block 6-346). The available environment at CLI facilitated the development of the project. This section will provide details of the hardware and software components used, project execution steps with related timelines, challenges faced and project output.

Hardware and Software components

The following hardware components were used as part of the project

Hardware Components

Hardware Component	Description
PCB	It is a circuit board that provides a mechanical support for connecting electrical components
Photodiodes	It is a device that converts light to electrical current or voltage
IR LED	It is an LED that produces infrared light

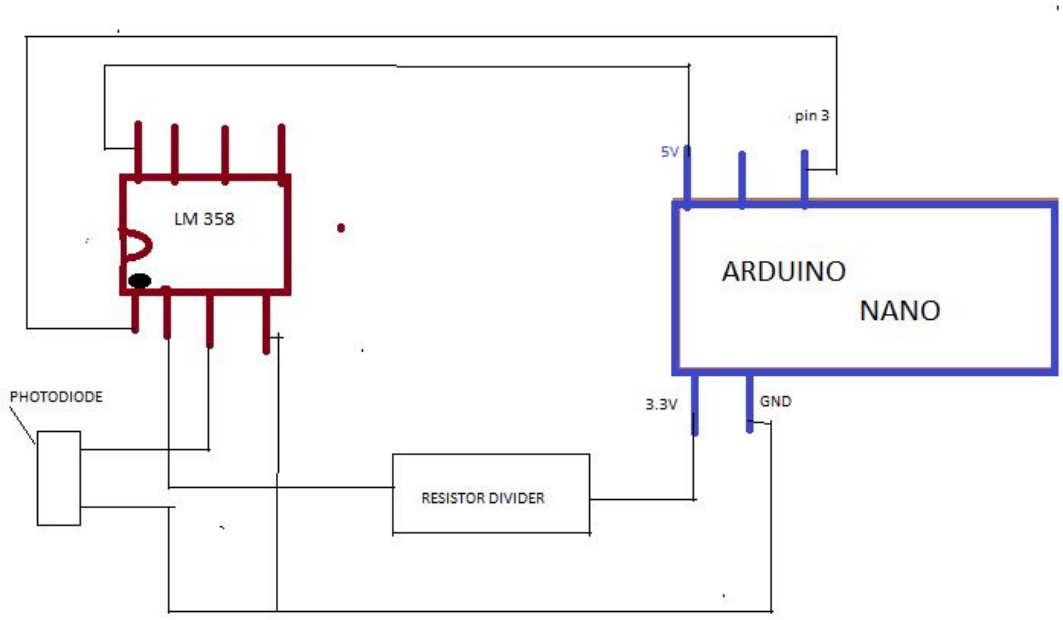
LED	A diode that produces visible light on supplying forward voltage
Arduino Nano	A small-sized microcontroller produces by Arduino.
Resistor (10K and 100K)	They are used to create a resistor divider network to produce 0.3V
OPAMP IC LM 358	A low power consuming OPAMP. Requires 5V supply voltage.

Software Environment

The software environment used for this project involved Arduino IDE 1.8.2 with C/C++ programming.

The Circuit Diagram

The following figure illustrates the circuit used for the project.



Note:IC LM 358 uses less power compared to the traditional IC's.

Project Execution Steps

The project was completed with an elapsed time of seven weeks. The following were the key steps executed as part of the project.

Project Step	Description
Understanding the problem statement	Brainstorming sessions with Mr Manish Jain discussing the project and the challenges that would be involved in making this project.
Ice cream stick Model	Use of an Ice-cream stick with 4-LED's, attached to a DC motor shaft.
Building the Tachometer	Preparing a device capable of measuring the rpm of a rotating object. For this part we used a photodiode to sense and an Infra- Red LED to produce infrared radiation. When the fan blade blocked the path of the IR LED this is sensed by the Arduino interrupt pin. The time difference between the two interrupts helps us measure the rpm of the fan. $rpm = 60/time_{diff}$
Constructing the PCB	By soldering the LED's and the OPAMP to the PCB board
Mounting the System	The PCB was mounted onto a table fan by a copper wire winding.
Writing the Code	Starting with a hard-code for fixed combination of letters and numbers, we progressed to a general user input of letters and numbers, where programme itself checks what it has to display and displays it.
Modes of Display	Efficient code needs to be written for various modes. 1. Static String 2. Rotating String 3. Bouncing String 4. Rotating with a Window 5. Large String

Challenges faced

As a team we had to face lots of challenges. We are listing some of the key ones we faced in the table below.

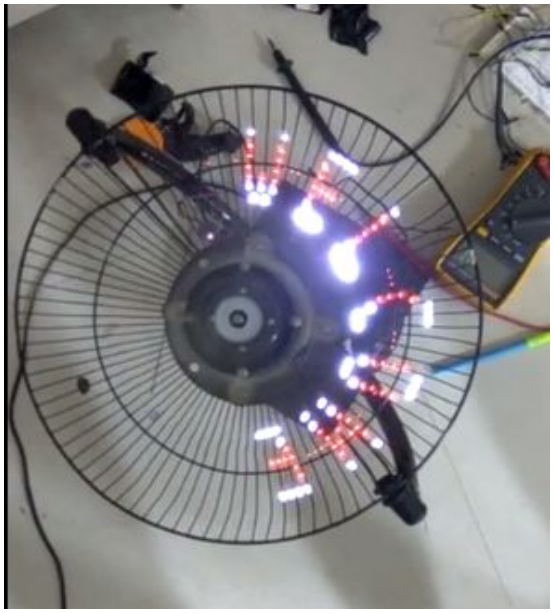
Challenge	Description	How it was resolved
Winding Problem	The wires connected to the LED's from an external source wound over each other as the motor rotated.	Placing the arduino, the battery on the rotating system to resolve winding issue
Soldering	There was an issue of shorting of the wires due to poor soldering and complicated nature of the circuit	We used shorter wires and stuck them to the PCB to reduce chances of short circuit .Soldering was done nicely and neatly
Centrifugal Force	Since the fan was running at 1200 rpm(approx.) we experienced this force.On installing the arduino and the battery on the fan itself we got an unstable and unsafe system.	We used the very traditional method of winding the pcb board on the fan to prevent the pcb from flying off. Winding distributed the centrifugal force on the copper wire wound and prevented our pcb board from flying.
Flickering of the Output	The output that appeared on the display was flickering rapidly.	This was solved by increasing the accuracy of the rpm value by using microsecond, instead of, millisecond accuracy
Writing Efficient Code in	Memory is Nano is	Fans spin at 20 Hz or

C	16K. Program needs to be written in C. Program has to be efficient so that it doesn't take much time to execute.	50ms. So we need to execute all our ISR routine in that time. This requires using most efficient methods in C to do all the processing to find out the letter of string, and where to start printing and how much delay in each cycle of Fan.
Accuracy near the IR-LED	Delays in Arduino get reset as soon as the fan crosses over IR LED or in other words completes one rotation	All our delays need to fit in that window of 1 revolution. We cannot go more. So we need to have very precise computation of the RPM so that we can have a minimal display hole near the IR LED.

Project output and results

The project output is illustrated through some screenshots that highlight the achieved objectives. We also have uploaded a video version of the project and its output on youtube (see link :)
https://www.youtube.com/watch?v=JkVEA1qSac8


FLOATING LETTER DISPLAY



Conclusions and Next Steps

The section baselines what was achieved as part of the project. It also enumerates the key next steps to take the project to the next level and also the future directions.

In our two months at CLI we were able to complete our floating letter display project a demonstrable level. During this time,we faced many challenges. However, we learnt a lot by overcoming these challenges.

Theoretically, we learnt more about Arduino, microcontrollers, electronic components such as IR LED's, photodiodes and Operational Amplifiers. However majority of our learnings were philosophical. Doing things at a practical project level for the first time, we were able to appreciate the prevailing gap between ideas and implementation. The true value of an idea is brought out by implementing it. All the good things in life never come easy, hard-work is required to translate ideas into reality.

Looking forward, we plan to continue this project in the upcoming semester. Many changes need to be made to bring this project to a practical, user-friendly stage. We plan to improve the system by replacing the Arduino with a Raspberry Pi and introducing Bluetooth to enable wireless communication. This product has many potential applications in ceiling fans in schools and colleges, or as a luxury commodity for displaying desired data.

In conclusion, It was a truly enriching experience and we are looking forward to continuing it in the next semester.