INTERNSHIP PROJECT(s) REPORT

Report submitted to L.J University

For showcasing the Accomplishments of Multiple Projects during Internship at CCL, IIT-Gandhinagar

By

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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to **Lok Jagruti University** and **Centre for Creative Learning(CCL), IIT Gandhinagar** for providing me with the opportunity to participate in the internship program as **Engineering Intern** for CCL, IIT Gandhinagar. These Internship Projects have been a valuable learning experience, and I am grateful for the support and guidance I received throughout my internship period at CCL Gandhinagar.

I would like to especially thank **Jay Thakkar (IIT Kharagpur), Mr.Nikharv Shah (IIT Gn, 2023)** and **Mr.Shashwat Jain (IIT Gn, 2023)**, the project supervisors, for their guidance and support. Their expertise and encouragement were instrumental in helping me complete the projects successfully.

I am also grateful to the staff of CCL Gandhinagar for their cooperation and assistance. Their willingness to share their knowledge and expertise was essential to the success of the projects. Without their help the projects would not be completed. Finally thanks to all persons who directly or indirectly supported us in making the projects.

ABSTRACT

During my tenure at CCL, IIT Gandhinagar, we led the development of numerous engineering prototypes showcasing expertise in mechatronics, digital electronics, and Programming.

This abstract summarizes three engineering projects undertaken during the internship period at CCL, IIT-Gandhinagar. The primary objective of these projects was to develop engineering prototypes aimed at providing hands-on experience to engineering students, bridging the gap between theoretical knowledge and practical application in the field of engineering.

1. **Digital Clock W/O Microcontroller:**

   The digital clock project utilized a combination of digital electronics components, including a common cathode seven-segment LED display, oscillator circuits, and frequency divider ICs. An oscillator circuit generated the Pulse signal, which was then divided into seconds using frequency divider IC and then cascaded to minutes and hours.

2. **Ammeter Clock:**

   The ammeter clock project integrated three analog ammeters to display time. Arduino microcontrollers interfaced with the ammeters, controlling needle positions via pulse-width modulation (PWM). Arduino code employed PWM to generate analog signals reflecting time values. Each ammeter is connected to a PWM pin, with code dynamically adjusting duty cycles for accuracy. Resistors calibrated ammeters for precise time measurement.

3. **Counter Circuit:**

   The counter circuit employed push buttons for incrementing the count. Each button press triggered an increment in the count, visually displayed on the output. To enable double-digit counting, a cascading arrangement of displays was utilized. Push buttons facilitated user input for minute and hour settings, suitable for alarm functions in a digital clock project.

4. Hollow Clock:

The Hollow clock is a desk clock crafted from Arduino components And 3D-Printed parts.Its innovative design features a transparent Frame, revealing the inner mechanisms.Powered via USB, it Utilizes a stepper motor for precise time display.geared movements Within the circular layout dynamically indicates the current time.

5. O-clock:

The O-clock utilizes arduino components and incorporates 3D-Printed parts for its construction. Additionally, we've integrated a rotary encoder to facilitate mode changes. Moreover, the Inclusion of 2 buttons allows for easy time setting.Powered via usb and adapter. The clock can be programmed using an arduino nano

6. Contributed Assistance:

I Contributed to various collaborative projects, assisting my Colleagues in creating a 2-sided rubik's cube portrait,bindi art and Laser cutting. Additionally, I aided in crafting a sticky notes portrait.

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1. Digital Clock W/O Micro-controller

Introduction

Digital clocks have become ubiquitous in modern society, serving as essential timekeeping devices in various applications ranging from household appliances to industrial systems. In the context of engineering education and practical skill development, the design and construction of digital clocks represent an invaluable opportunity for students to apply theoretical knowledge to real-world projects.

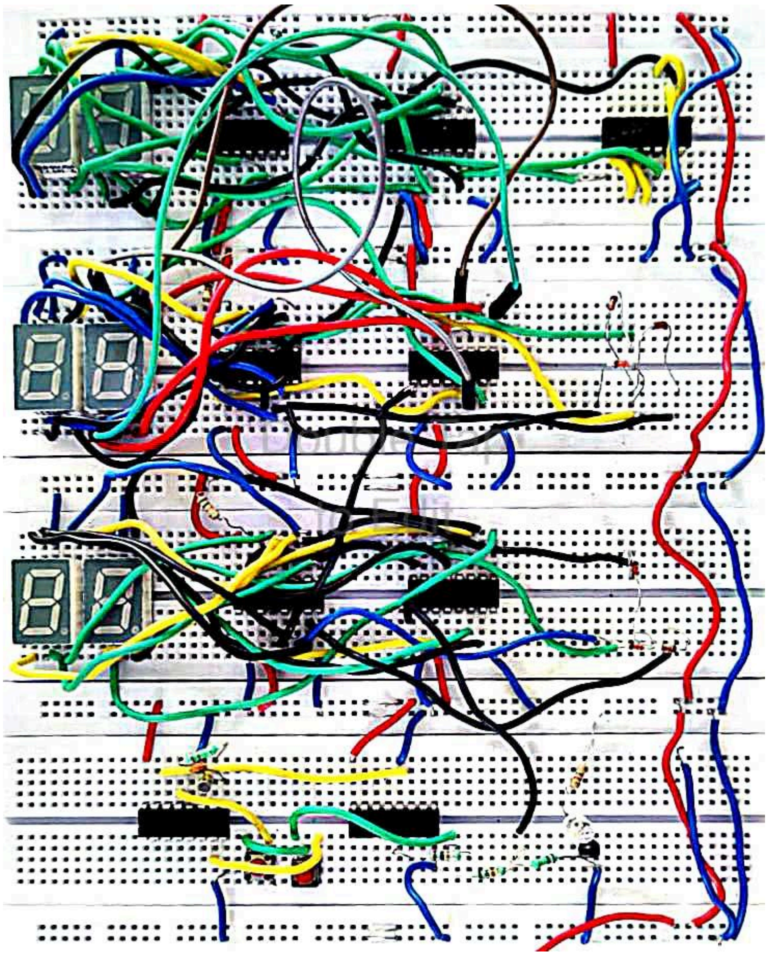
The objective of the digital clock project undertaken during the internship period was to design and construct a functional digital clock using fundamental digital electronics principles. The project aimed to demonstrate the feasibility of creating a digital timekeeping device without relying on microcontroller systems, emphasizing hands-on learning and practical skill development.

Within the scope of this project, the digital clock was envisioned to incorporate basic digital electronics components such as counters, logic gates, and display units. The design prioritized simplicity and efficiency, leveraging these components to achieve accurate timekeeping functionality while minimizing complexity.

The significance of the digital clock project lies in its educational value and practical applications. By engaging in the design and implementation process, we gained valuable insights into digital electronics design, circuitry, and timekeeping mechanisms.

Furthermore, the project provided a platform for exploring the integration of theoretical concepts with practical engineering solutions, fostering a deeper understanding of electronics principles and their real-world applications.

This introduction provides a foundation for the subsequent sections of the report, which will delve into the methodology, results, analysis, and conclusions of the digital clock project. Through detailed exploration and reflection, this report aims to showcase the process and outcomes of the digital clock project, highlighting its relevance and significance in the context of engineering education and practical skill development.



Circuit-Breakdown

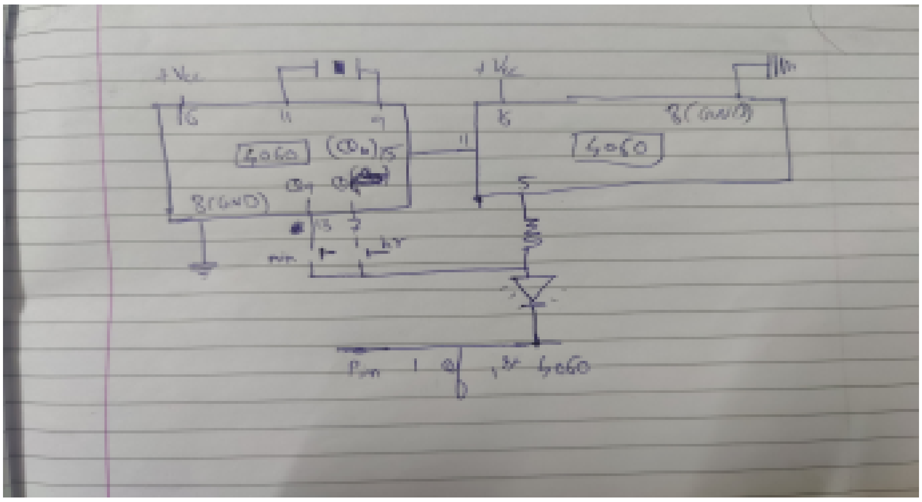
The circuit design of the digital clock primarily consists of four key components:

1. **Pulse Generation**: Responsible for generating the clock pulses of frequency 1Hz that regulate the timing of the digital clock.
2. **Mod 60 Circuit (Second)**: Receives the incoming clock pulses and displays into seconds, ensuring accurate timekeeping up to 60 seconds before resetting.
3. **Mod 60 Circuit (Minute)**: Similar to the second Mod 60 circuit, but used for tracking minutes.

4. **Mod 12 Circuit (Hour)**: Tracks hours in a 12-hour format.

1. Pulse Generation

The pulse generation circuit utilizes an oscillator with a frequency of 32.768 kHz. Two 4060 frequency divider ICs divide this frequency to 1 Hz, enabling counting every second. The 1 Hz output is used to drive an LED, resulting in a blink every second. Additionally, this 1 Hz output is sent to the Mod 60 circuit for seconds, as detailed in subsequent sections.

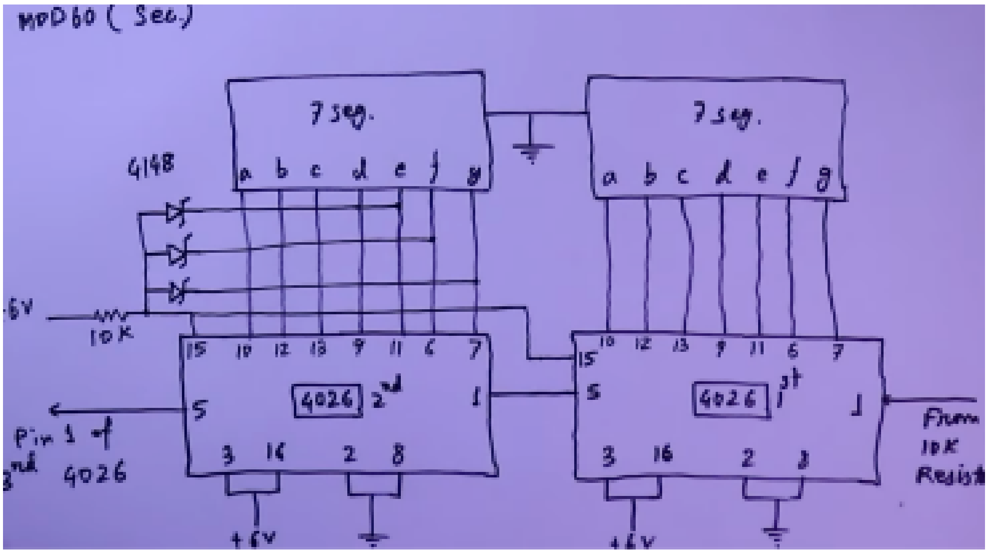


We divide the frequency by using pin 15(Q10) and pin 5(Q5) which equals Q15 and it means, it divides the frequency by 2^15 and since 32.768Khz is perfect 2^15 it ends up becoming 1Hz. Also we have added minute and hour button in which we have shorted the circuit when the buttons are pressed to higher frequency for minute and even higher frequency for hour than 1hz output, so that the time increments very fast when the buttons are pressed, allowing to set time

2. Mod 60 Circuit (Second)

The Mod 60 circuit receives a 1 Hz pulse from the pulse generation circuit and interfaces with 4026 ICs, which act as driver ICs for the common cathode displays. With each pulse received (i.e., every second), the Mod 60 circuit increments the time displayed on both segments of the display, allowing for accurate timekeeping up to 60 seconds before resetting.

To reset at 60 seconds, an AND gate is created using three diodes. The other end of each diode is connected to pins 6 (f), 7 (g), and 11 (e) of the second display segment, checking if the second display segment indicates '6'. When the display reaches '60', all three diodes send a high signal to pin 15 (reset) of both 4026 ICs, resetting the count to '00' for the next minute cycle



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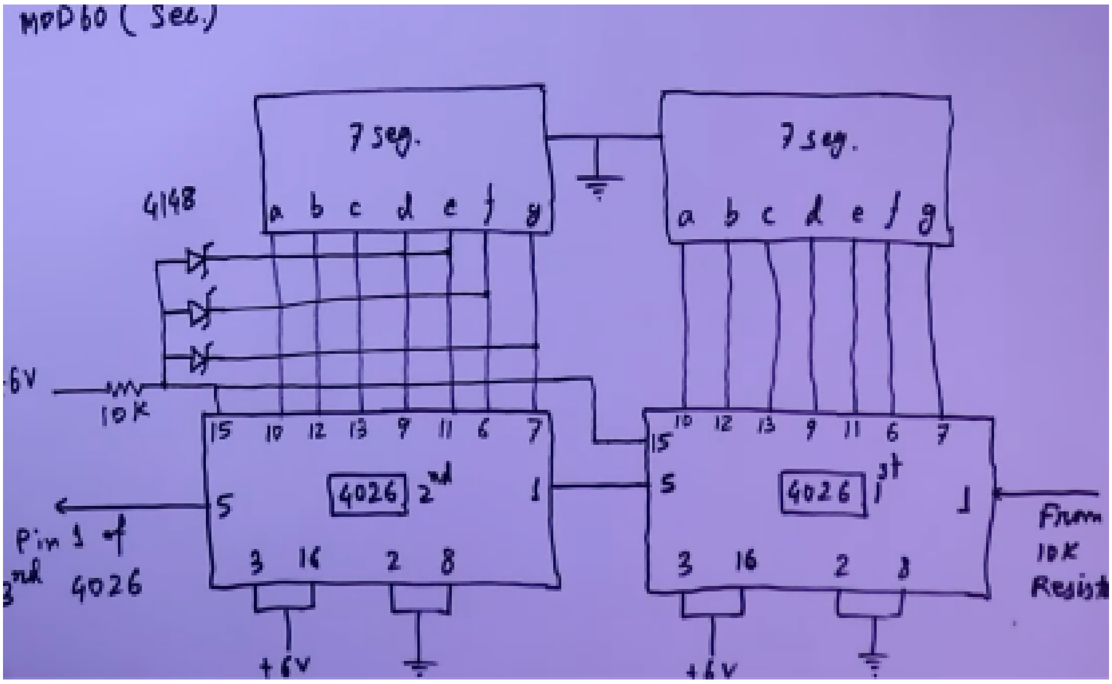
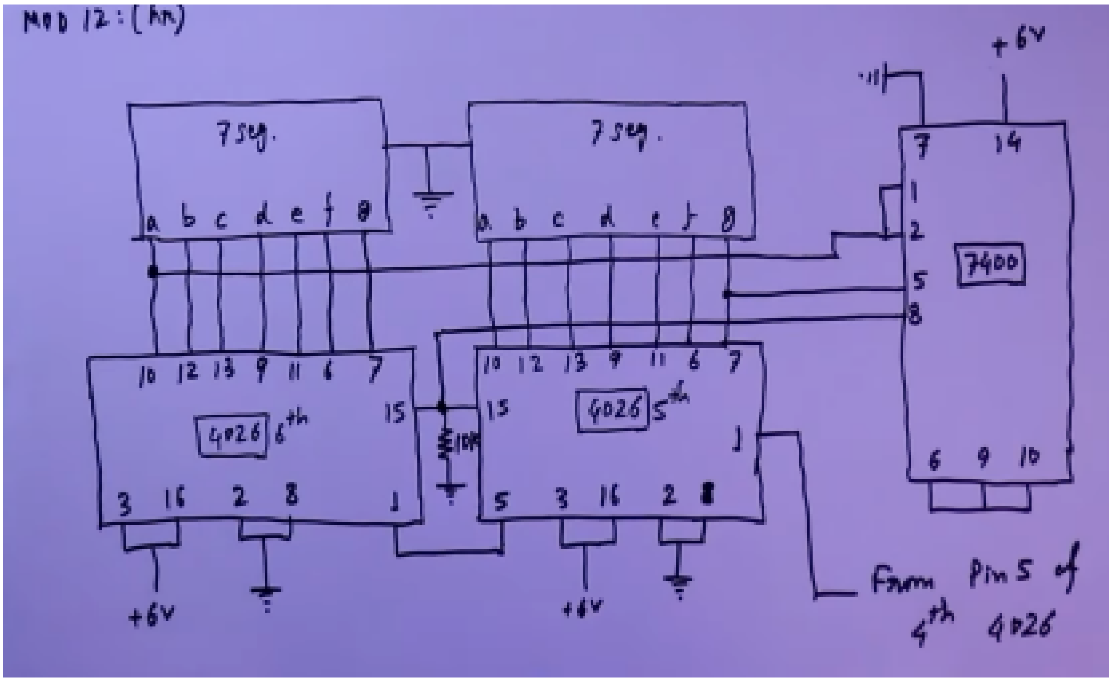
3. Mod 60 Circuit (Minute)

The second Mod 60 circuit functions similarly to the first Mod 60 circuit for seconds. It receives the output from pin 5 (carry) of the previous Mod 60 circuit at its pin 1, allowing it to increment once every 60 seconds. Additionally, all six 4026 ICs are connected in cascade mode to enable seamless counting across seconds, minutes and hours



4. Mod 12 Circuit (Hour)

The Mod 12 circuit receives its input from the minutes Mod 60 circuit, which is cascaded into its 4026 ICs. This setup enables the Mod 12 circuit to accurately track hours, incrementing once every 60 minutes. Additionally, to ensure seamless operation and handle the transition at 12 hours, a NAND gate IC 7400 is integrated into the circuit. This NAND gate monitors the output of the seven-segment displays, checking if '12' is displayed. If the display indicates '12', the NAND gate outputs a high signal, which is then applied to pin 15 (reset) of both 4026 ICs, initiating the reset process.



Use of Nand gate to Detect '12'

The NAND gate checks if '12' is displayed by receiving inputs from the 'a' pin of the first seven-segment display (10th place) and the 'g' segment of the second seven-segment display (unit place).

Both inputs to the first NAND gate consist of the 'a' signal. If 'a' is off (low), indicating '1' in the 10th place, the first NAND gate outputs '1'. The output of the first NAND gate and the 'g' signal are fed into the second NAND gate. Simultaneously, if 'g' is high, indicating '2' in the unit place, both inputs to the second NAND gate result in' high', leading to an output of low. Consequently, the output of the second NAND gate(which is low) is given to both the inputs of 3rd NAND gate which triggers a high output from the third NAND gate, which is then applied to reset both seven-segment displays

Challenges

Intermittent Connections: Loose connections on the breadboard can be difficult to troubleshoot and may lead to inconsistent operation of the circuit.

Component Faults: If a single component is faulty, it can affect the entire circuit's functionality, requiring extensive testing and replacement of individual components.

Complex Troubleshooting: Identifying the root cause of issues can be time-consuming, especially when multiple components are involved, leading to exhaustive troubleshooting processes.

Human Errors: Mistakes such as giving input to the wrong pin or incorrect wiring can introduce errors into the circuit, prolonging the time required to debug and rectify issues.

Integration Challenges: Integrating different modules and circuits seamlessly can be challenging, requiring careful planning and coordination to ensure compatibility and functionality.

2. Ammeter Clock

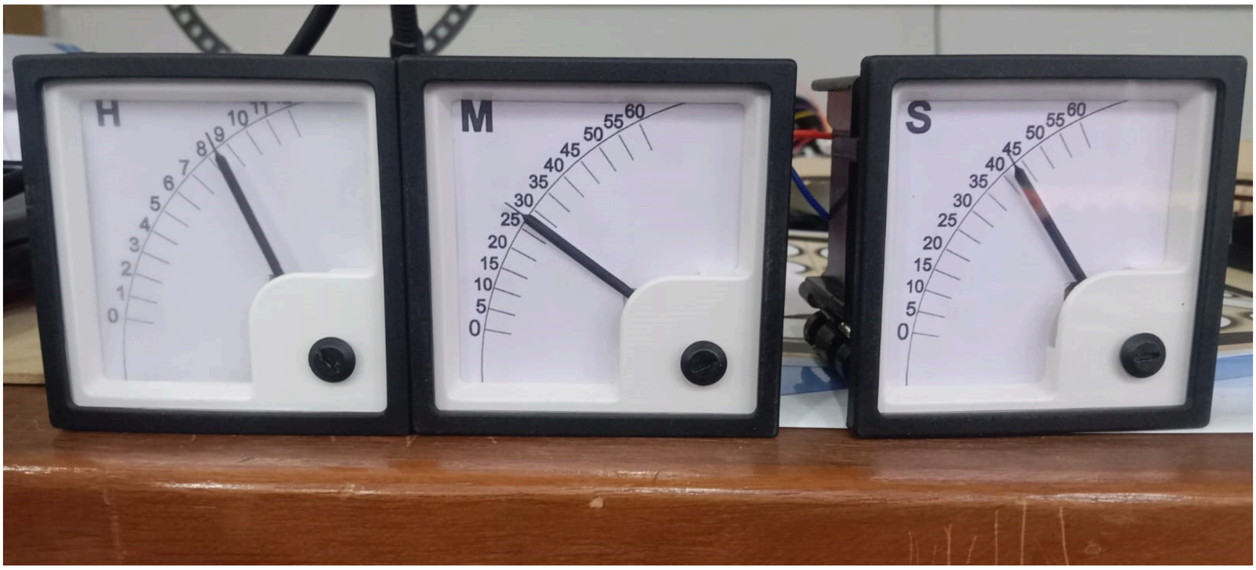
Introduction

The Ammeter Clock project represents a fascinating exploration into the intersection of traditional timekeeping mechanisms and modern digital technology. Unlike conventional clocks, which rely on numerical displays or analog dials to convey time, the Ammeter Clock presents time through the dynamic movement of ammeter needles. This unique approach not only offers a visually captivating display but also serves as a testament to the versatility and creativity inherent in electronics design.

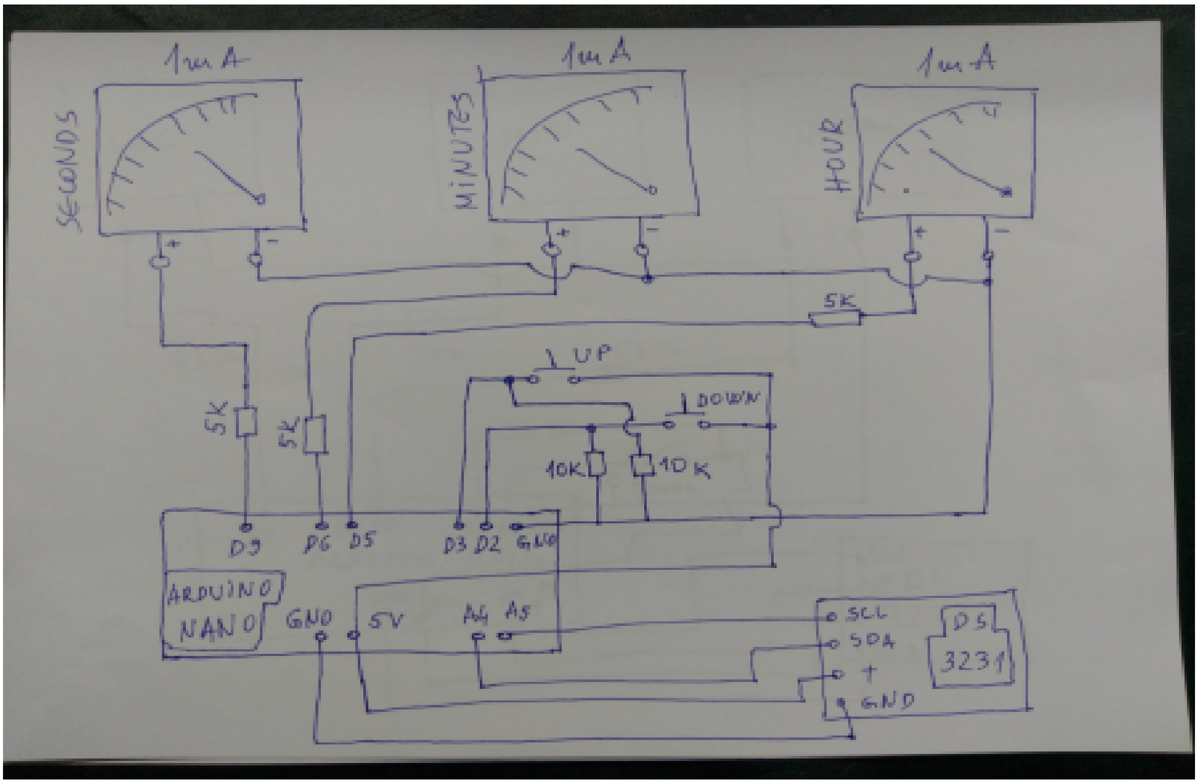
At its core, the Ammeter Clock project embodies the fusion of analog instrumentation with digital control systems. By harnessing the principles of current measurement, the project transforms ordinary ammeters into precise timekeeping instruments. Each ammeter, designated to track seconds, minutes, and hours, represents a distinctive facet of the overall timekeeping mechanism, culminating in a cohesive and visually striking display of time.

What sets the Ammeter Clock project apart is its reliance on coding and microcontroller technology to orchestrate the synchronized movement of the ammeter needles. Utilizing an Arduino Nano microcontroller, the project leverages the power of embedded programming to translate time data into precise analog signals. Through the implementation of pulse-width modulation (PWM)
techniques, the Arduino Nano intricately controls the position and intensity of each ammeter needle, resulting in a seamless and accurate representation of time.

Beyond its technical intricacies, the Ammeter Clock project embodies the spirit of innovation and experimentation inherent in engineering pursuits. By challenging conventional notions of timekeeping and exploring unconventional display mechanisms, the project encourages creativity and exploration in the realm of electronics design. Moreover, the project serves as a testament to the adaptability of electronic components, showcasing their potential to transcend their traditional roles and serve novel purposes.



Circuit/Implementation/Working



Circuit diagram of Ammeter clock

As we can see in the above Circuit diagram, that we have mainly used the following components in following manner

Three Ammeters (0-1 milliamps range): These serve as the primary display elements for tracking seconds, minutes, and hours.

5k Resistors: These resistors are used for current limiting and calibration purposes, ensuring accurate measurements and safe operation of the ammeters.

Two Push Buttons: These buttons are used for user input, allowing for functions such as Time incrementing and Time decrementing

Arduino Nano: The Arduino Nano serves as the central processing unit of the clock, controlling the operation of the ammeters, reading user inputs, and interfacing with external components.

Real-Time Module: This module provides accurate timekeeping functionality by synchronizing with an external time source, such as a quartz crystal oscillator or atomic clock signal. It ensures that the clock maintains accurate time even in the absence of external power or internet connectivity.

Coding

Code Description: Ammeter Clock Arduino Nano

The Arduino Nano code provided facilitates the functionality of the Ammeter Clock project, which utilizes three ammeters to display seconds, minutes, and hours. Below is a brief overview of the code structure and its key components:

Libraries and Initialization:

- The code begins by including necessary libraries such as DS3231 for real-time clock functionality and Wire for I2C communication.
- Pins are defined for push buttons (up and down), ammeters (left, right, and seconds), and the real-time clock (RTC).

Setup Function:

- The setup function initializes serial communication, the real-time clock, and pin modes.
- Test signals are sent to the ammeters on startup to ensure

functionality.

Loop Function:

- Inside the loop function, a delay is introduced to control the Frequency of clock updates and sensitivity of button inputs.
- The real-time clock's time data is retrieved and stored in variables for hours, minutes, and seconds.
- Button inputs are detected to adjust the time by incrementing or decrementing minutes and hours.
- PWM signals are generated using the analogWrite function to drive the ammeters, mapping time values to pulse widths for smooth needle movement.

Mapping Functions:

- Two mapping functions (mapping_hour_pwm and mapping_time_pwm) are defined to convert time values to appropriate PWM values for ammeter control.

Description of PWM:

- Pulse width modulation (PWM) is utilized to control the position and intensity of the ammeter needles. PWM signals are generated to drive the ammeters, simulating analog-like control over the display of time.

Conclusion:

- The code demonstrates the integration of real-time clock functionality with analog ammeters using Arduino Nano, enabling the creation of a unique and functional Ammeter Clock.

PWM(Pulse Width Modulation)

Pulse width modulation (PWM) is a technique used to control the average power delivered to a load by varying the width of pulses in a regular pulse train. In the Ammeter Clock project, PWM is utilized to control the position and intensity of the ammeter needles, thereby achieving precise analog-like control over the display of time.

In the Arduino code, analogWrite() function is used to generate PWM signals to drive the ammeter meters. The analogWrite() function takes two arguments: the pin number and the duty cycle. The duty cycle represents the percentage of time the signal is ON within each PWM period. By adjusting the duty cycle, the average power delivered to the load (in this case, the ammeter meters) can be controlled, allowing for smooth and continuous movement of the ammeter needles to indicate the passage of time.

In essence, PWM enables the Arduino Nano to simulate analog signals, providing a means to control analog devices such as the ammeter meters with digital precision.

Challenges

Soldering Skills Development: Soldering was a skill that required learning, and initial attempts often resulted in poorly soldered joints. This led to unreliable connections and intermittent operation of the clock.

Risk of Short Circuits: During soldering, wires occasionally overlapped or came into contact with adjacent soldered components, leading to short circuits. These shorts caused unexpected behavior in the clock's output and required meticulous troubleshooting to identify and rectify.

Insulation Issues: To prevent short circuits, insulation was necessary after soldering. However, applying insulation tape sometimes proved challenging, and improper insulation could lead to further shorting or unreliable connections.

Solder Joint Reliability: Despite efforts to create secure solder joints, some connections were prone to breaking or becoming loose over time. This resulted in intermittent operation of the clock and necessitated periodic maintenance to ensure consistent performance.

Unfamiliarity with Arduino Features: Initially, there was limited knowledge about advanced features of the Arduino platform, such as pulse width modulation (PWM). Learning to leverage these features effectively was essential for achieving precise control over the ammeter needles and optimizing the clock's performance.

Overcoming these challenges required patience, perseverance, and a willingness to learn new skills. Through experimentation, research, and hands-on experience, the construction and optimization of the Ammeter Clock gradually became a rewarding and educational journey.

3. Counter Circuit

INTRODUCTION

The Counter Circuit project represents an innovative approach to manual counting, leveraging digital display technology to create a versatile and user-friendly counting device. Featuring four displays divided into two halves, the Counter Circuit offers intuitive operation and precise counting capabilities for a wide range of applications.

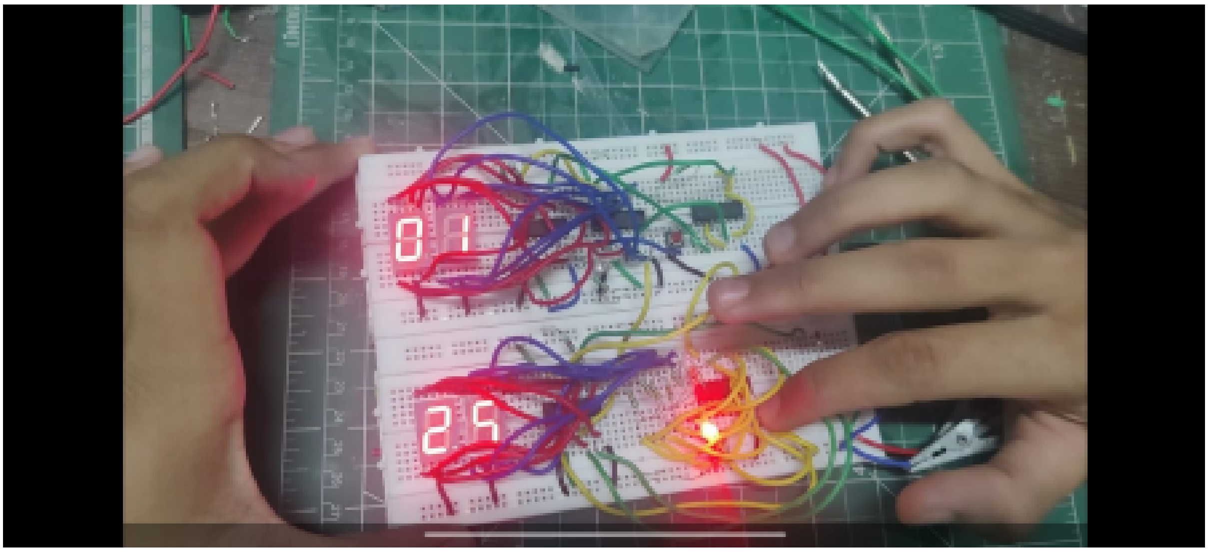
At its core, the Counter Circuit comprises two distinct counters, each equipped with a pair of common cathode seven-segment displays arranged in cascade mode. Positioned in the bottom and top halves of the circuit, these counters provide convenient and accessible interfaces for users to track and manipulate counts with ease.

A distinguishing feature of the Counter Circuit is its manual counting mechanism, facilitated by strategically placed buttons in each half of the counter. Pressing the button in the bottom half increments the corresponding counter by one, updating the display to reflect the new count. The bottom counter is reset to zero when it reaches 60, ensuring continuous and accurate counting for extended periods.

Similarly, pressing the button in the top half initiates an increment operation for the respective counter, enabling seamless counting across both halves of the circuit. The top counter, designed for shorter duration counting tasks, is reset to zero when it reaches 12, providing a convenient way to track smaller increments of time or items.

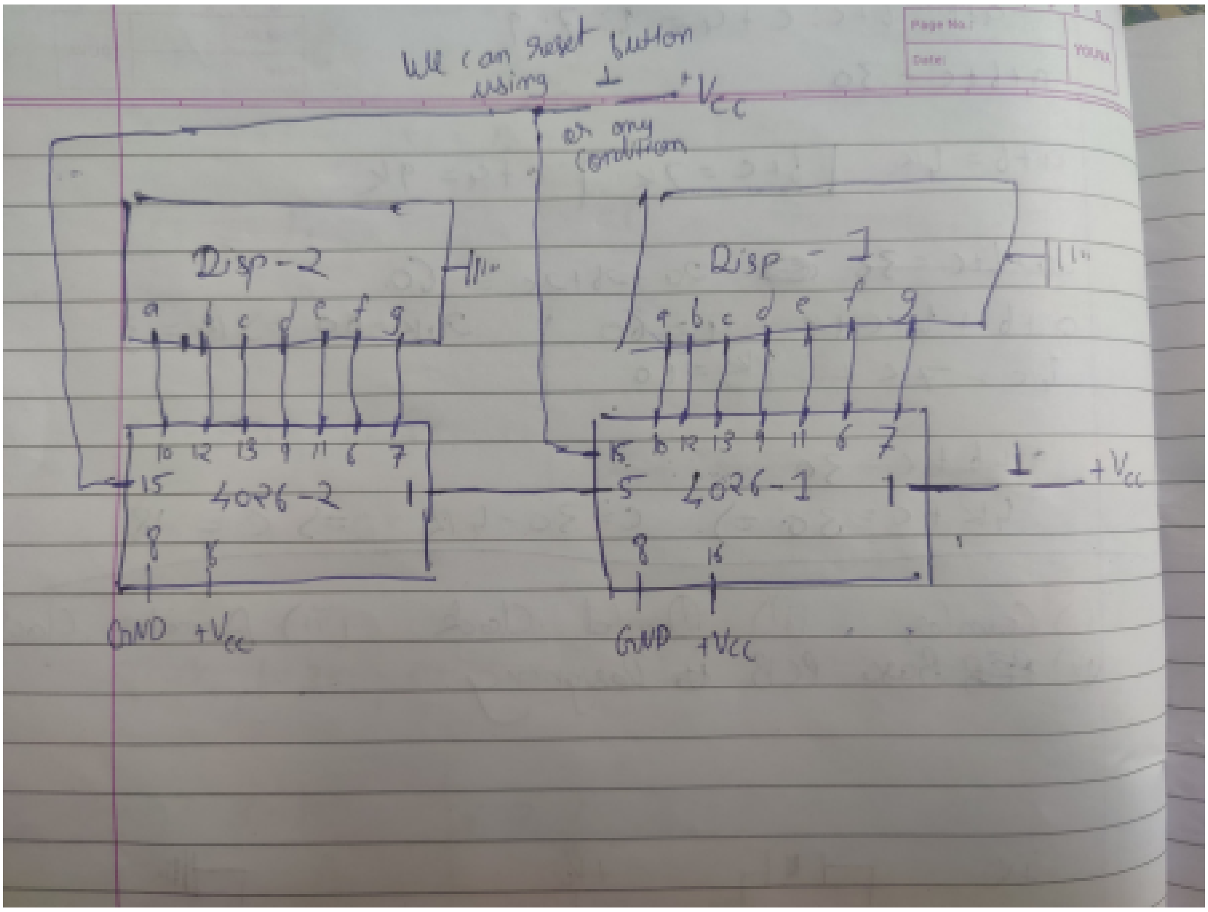
Unlike traditional counting devices that rely on automatic pulses or external stimuli, the Counter Circuit empowers users to exercise direct control over the counting process, enhancing versatility and interactivity. Whether used for inventory management, production monitoring, or educational purposes, the Counter Circuit offers a practical and adaptable solution for a variety of counting tasks.

In summary, the Counter Circuit project exemplifies the fusion of digital display technology with manual counting functionality, providing a user-friendly and customizable platform for accurate counting operations. As we delve deeper into the intricacies of the Counter Circuit design and operation, we uncover a wealth of opportunities for innovation and application in diverse fields of endeavor.



CIRCUIT/IMPLEMENTATION

Below is the basic circuit of a simple 2 digit counter. However the counter that we have made consists of more components, like 4 displays, conditional gates to reset at particular values, leds that blink at every increment etc



The Counter Circuit is designed to accurately track and display counts using digital display technology and manual input mechanisms. At its core, the counter circuit comprises two distinct

counters, each utilizing a pair of 4026 ICs in cascade mode to drive common cathode seven-segment displays.

In the bottom half of the counter, two 4026 ICs are connected in cascade mode, allowing for seamless counting of two-digit numbers. Each time a low-to-high transition is detected, typically initiated by pressing a push button, the cascade-connected ICs increment the count displayed on the bottom counter by one. This manual input mechanism sets the Counter Circuit apart from a traditional clock, where counting is typically driven by an oscillator generating pulses.

A unique feature of the bottom counter is its reset functionality, implemented using an AND gate formed by three diodes. When the count reaches 60, the AND gate triggers a reset signal, resetting the bottom counter to zero. This reset mechanism adds versatility to the counter circuit, allowing for customization of the reset value to suit specific counting requirements.

Similarly, the top half of the counter is constructed using the same principles, with two 4026 ICs in cascade mode driving a pair of seven-segment displays. However, the reset threshold for the top counter is set at 12, providing a convenient way to track smaller increments of time or items.

To provide visual feedback of counting events, LEDs are connected in series with the push buttons in both the bottom and top halves of the counter. When a push button is pressed and a pulse is received, the corresponding LED lights up, indicating successful counting activity.

In summary, the Counter Circuit offers a versatile and user-friendly solution for manual counting tasks, leveraging digital display technology and manual input mechanisms to provide accurate count tracking. The combination of cascade-connected 4026 ICs, reset functionality, and visual feedback LEDs makes the Counter Circuit a valuable tool for a wide range of counting applications.

Also, the values 60 and 12 are taken here as we were thinking of making an alarm module, wherein the user can input time through this type of counter.

Challenges

Similar to the challenges in the above 2 projects.

4. Hollow Clock

Introduction

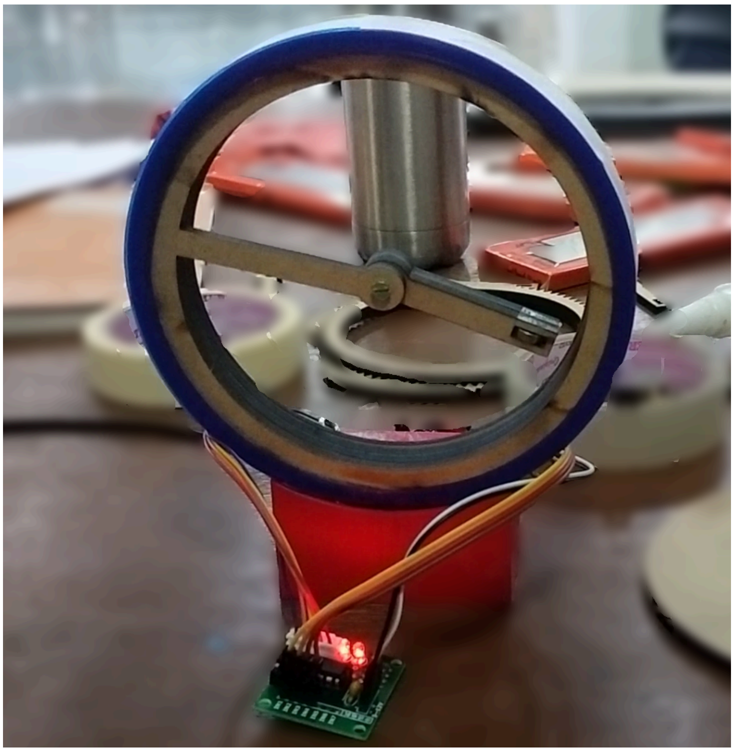
The Hollow Clock, an embodiment of craftsmanship and technological prowess, emerges as a mesmerizing creation fashioned from an Arduino board, 3D-printed parts, a stepper motor, and assorted electronic components. Its purposeful design beckons placement on a desk, its hollowed-out frame offering a captivating portal into the inner machinations of timekeeping.

Powered by a USB supply or adapter, this ingenious timepiece employs programmed geared movements arranged within its circular frame to elegantly display the passage of time. Each rotation serves as a testament to the precision engineering and meticulous calibration required to achieve seamless timekeeping. Engaging in its construction offers hands-on experience, enriching enthusiasts with practical knowledge in electronics, programming, and mechanical design.

Beyond its utilitarian function, the Hollow Clock stands as a unique and fascinating project that transcends mere functionality to become a work of art. Its blend of form and function transforms the mundane task of timekeeping into an aesthetic experience, appealing to electronics enthusiasts, artists, and gadget lovers alike. As builders immerse themselves in this endeavor, they embark on a journey of exploration into the realms of creativity and technology.

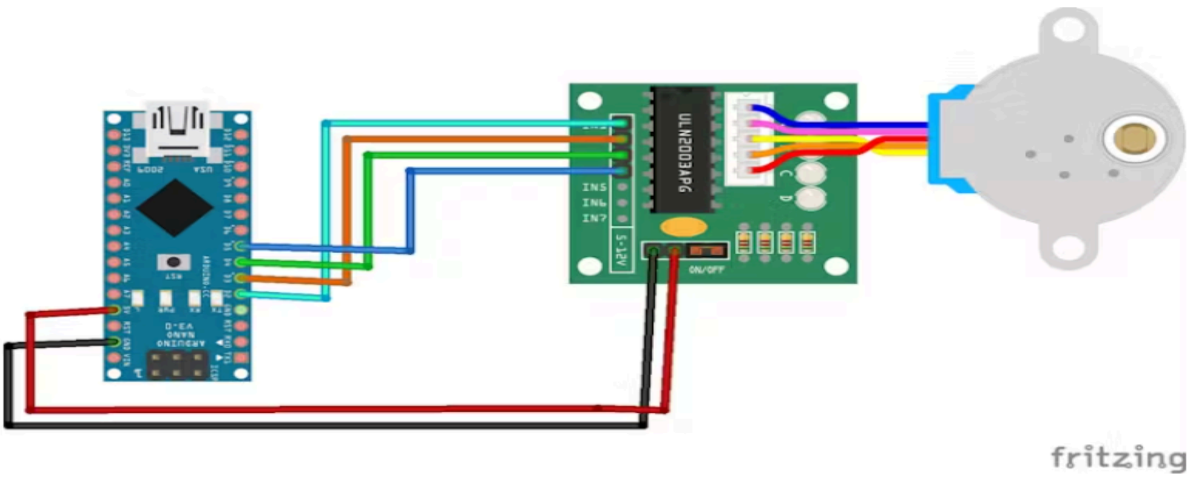
Moreover, the construction of the Arduino Hollow Clock provides a tangible opportunity for enthusiasts to apply theoretical knowledge to real-world applications. Through hands-on experience, individuals gain invaluable insights into electronics, programming, and mechanical design. This type of project not only bridges the gap between theory and practice but also fosters a deeper appreciation for the complexities of modern timekeeping devices.

In essence, the Hollow Clock symbolizes more than just the passage of time; it represents a fusion of artistry and innovation, inviting enthusiasts to embark on a transformative journey of self-discovery and skill development. With each meticulously calibrated gear and precisely programmed movement, individuals craft not just a functional timepiece but also a testament to human ingenuity and creativity.



HOLLOW CLOCK

CIRCUIT DIAGRAM:-



Challenges:

Unfamiliarity with stepper motor: Initially, there was limited knowledge about the complexities of the stepper motor, presenting a significant hurdle in the Hollow Clock project. Grappling with unfamiliar concepts such as steps and torque, builders embarked on a journey of exploration and discovery. Despite initial uncertainty, diligent research and hands-on experimentation eventually led to a deeper understanding and mastery of motor control. Through perseverance and determination, the once unfamiliar stepper motor became a valuable asset in the construction of the clock.

Laser cutting: I encountered difficulties in accurately cutting the hole for the hour hand due to my initial unfamiliarity with the process. As a newcomer, understanding the intricacies of laser cutting proved daunting.

Despite these challenges, the journey of building the Hollow Clock was a rewarding one, offering invaluable lessons in problem-solving and perseverance. Each obstacle encountered served as an opportunity for growth, pushing the boundaries of creativity and innovation.In the end, overcoming these challenges imbued the project with a sense of accomplishment and imbued the Hollow Clock with a deeper significance

5. O-clock

Introduction

The O-clock, a masterpiece of contemporary engineering, epitomizes the seamless integration of technology and design. With its core components including the Arduino Nano, RTC module, rotary encoder, push buttons, and LED strip, this timepiece stands as a testament to innovation and craftsmanship. Powered by a versatile USB or adapter supply, the O-clock is poised to grace any space with its mesmerizing glow and precise timekeeping capabilities.

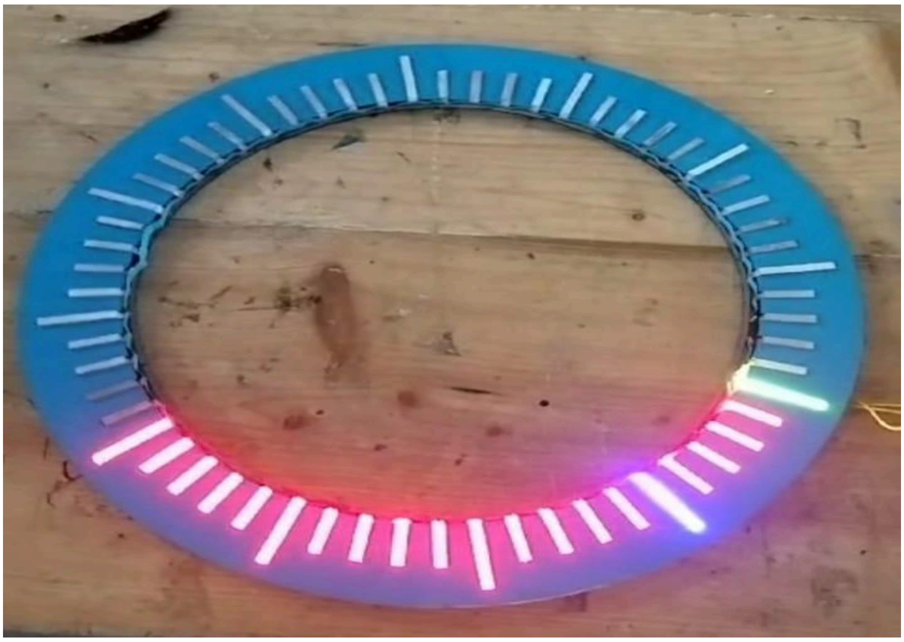
At its essence, the O-clock represents a hands-on exploration into the realms of electronics and programming. Utilizing the Arduino Nano as its foundation, enthusiasts embark on a journey of discovery, honing their skills in circuitry design and code implementation. The inclusion of a RTC module ensures accuracy in timekeeping, while the rotary encoder and push buttons offer intuitive user interaction, transforming time adjustment into a seamless experience.

Central to the allure of the O-clock is the utilization of acrylic pieces to enhance the luminosity of its LED strip. This innovative approach not only imbues the clock with a captivating glow but also underscores the versatility of materials in modern design. As builders engage in the assembly process, they gain a tactile understanding of the interplay between form and function, solidifying their grasp of design principles.

Beyond its technical sophistication, the O-clock serves as a symbol of ingenuity and imagination. Each meticulously chosen and assembled component reflects a commitment to excellence and a passion for innovation. Whether gracing a workspace or illuminating a living area, the O-clock stands as a testament to the limitless possibilities at the intersection of art and technology.

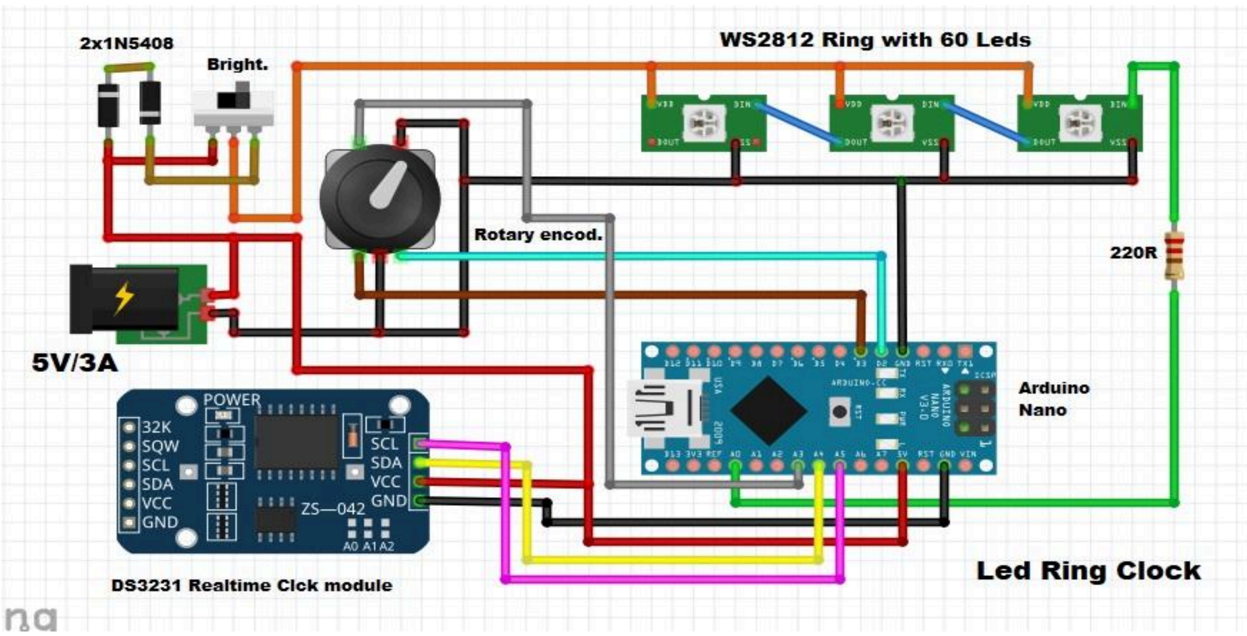
In conclusion, the O-clock transcends its role as a mere timekeeping device; it represents a journey of exploration and creativity. Through the integration of advanced components and hands-on experience, enthusiasts are empowered to push the boundaries of what is possible, transforming ordinary moments into extraordinary experiences. With its mesmerizing glow and elegant design, the O-clock illuminates the path towards a future where innovation knows no bounds.

O-clock(3D-Printed version)



O-clock(mdf version)

CIRCUIT DIAGRAM:



Challenges:

Rotary Encoder: Rotary encoder was new for me, then understanding the wiring and programming posed initial challenges. Debouncing the encoder signals for accurate mode changes required careful timing and debounce algorithms. Mapping encoder rotations to specific modes proved tricky as I navigated pulse counting and mode selection logic. Troubleshooting hardware or software conflicts related to the encoder added to the complexity, demanding patience and perseverance to resolve. Despite the hurdles, mastering the rotary encoder proved rewarding, enhancing my understanding of electronics and programming in clock projects.

Soldering Skills Development: Soldering was a skill that required learning, and initial attempts often resulted in poorly soldered joints. This led to unreliable connections and intermittent operation of the clock.

Risk of Short Circuits: During soldering, wires occasionally overlapped or came into contact with adjacent soldered components, leading to short circuits. These shorts caused unexpected behavior in the clock's output and required meticulous troubleshooting to identify and rectify.

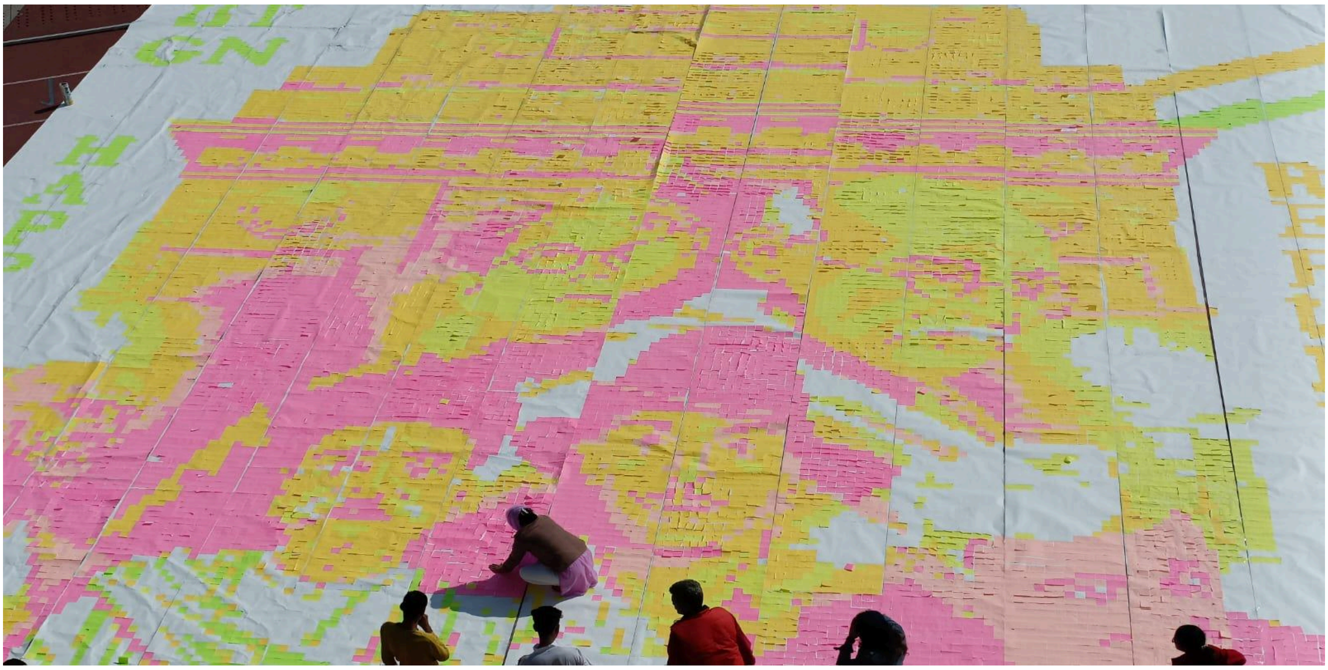
Insulation Issues: To prevent short circuits, insulation was necessary after soldering. However, applying insulation tape sometimes proved challenging, and improper insulation could lead to further shorting or unreliable connections.

Navigating the challenges of rotary encoder integration and soldering skills development in clock projects required patience and perseverance. Overcoming initial hurdles in wiring, programming, and debouncing encoder signals proved crucial for achieving accurate mode changes. Additionally, mastering soldering techniques was essential to address issues such as unreliable connections and short circuits. Despite the complexity, these challenges ultimately enriched my understanding of electronics and programming, paving the way for more successful clock projects in the future.

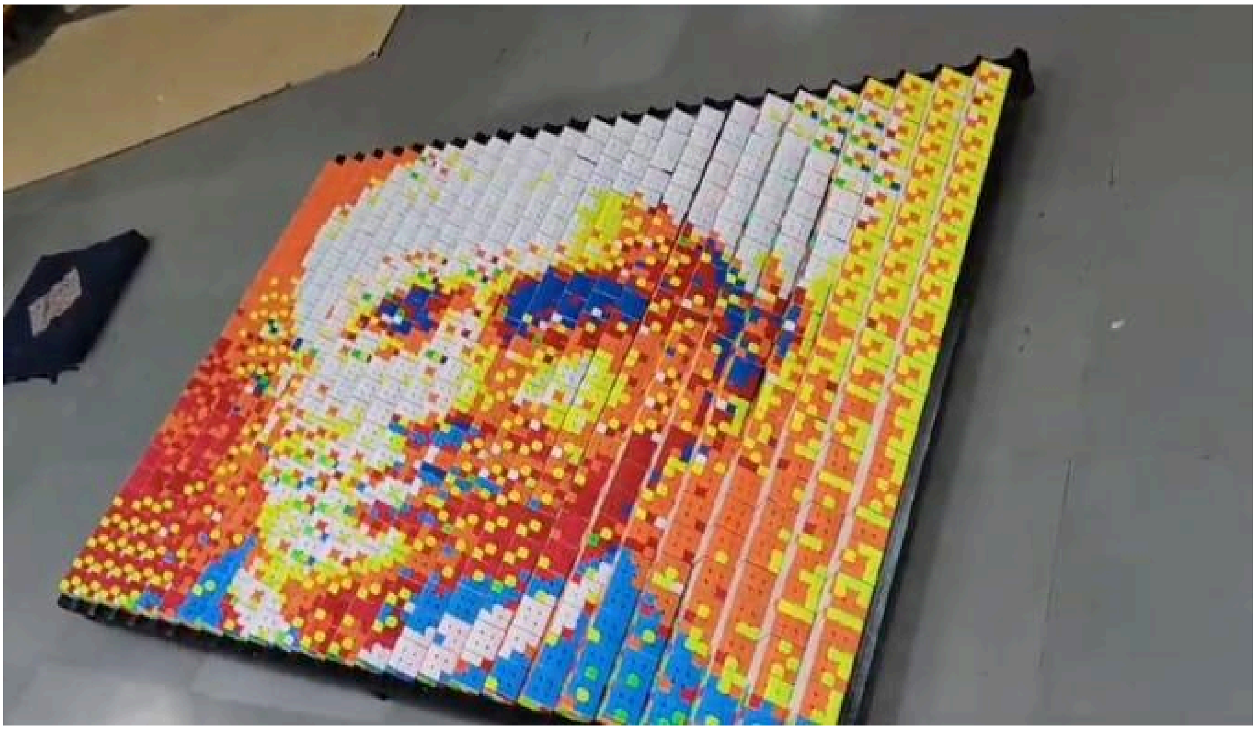
6. Contributed Assistance

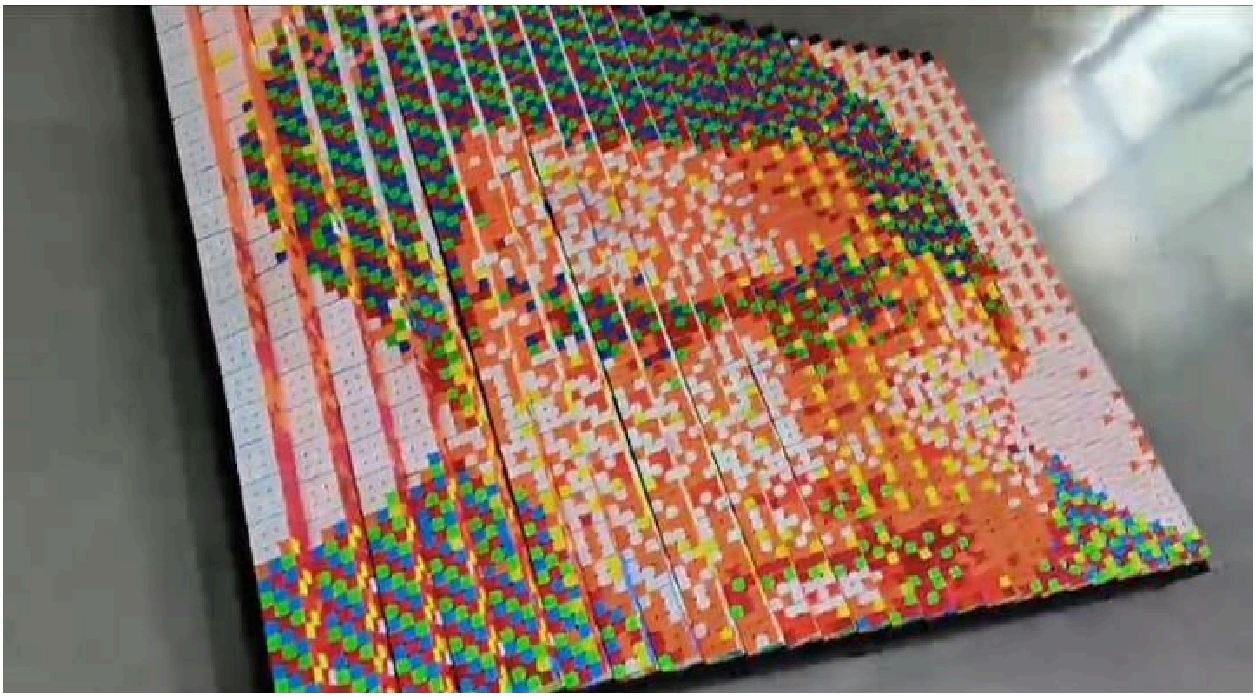
I contributed to various collaborative projects, assisting my colleagues in creating a two-sided Rubik's Cube portrait, bindi art, and laser cutting Additionally, I aided in crafting a striking sticky notes portrait.

1) Sticky Notes Portrait:- The team of CCL at IITGN achieved a world record on January 26th by creating a portrait using 25,000 sticky notes.

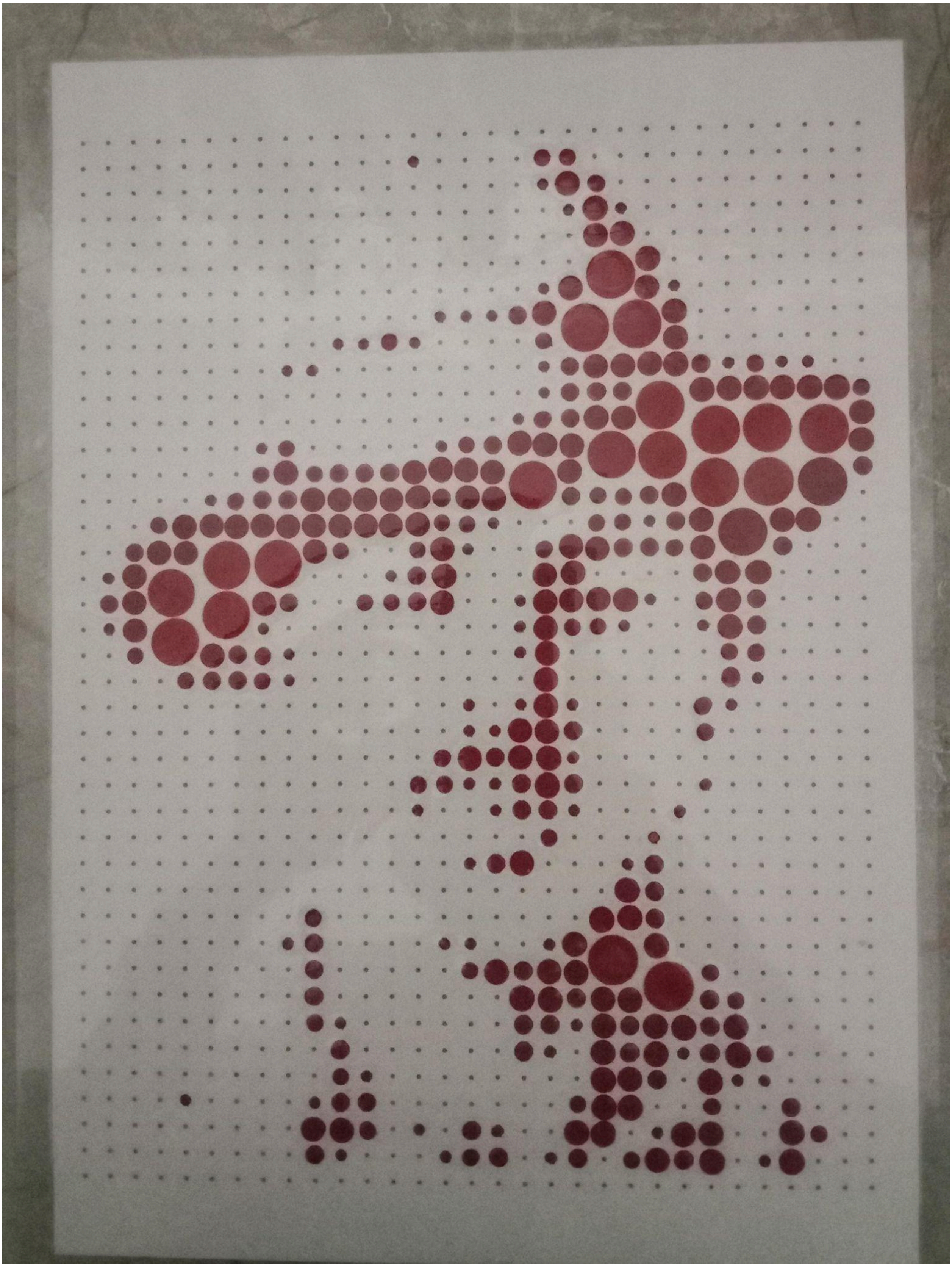


2) 2-sided rubik's cube portrait: The team of CCL at IITGN created a two-sided portrait using Rubik's Cubes**.**





3) **Bindi Art:-** I assisted in gluing the bindis (jewels) during the sessions.



7. Conclusion

These projects, completed during my internship at CCL, IIT Gandhinagar, have been instrumental in enhancing my engineering skills and knowledge. From developing a digital clock without a microcontroller to crafting an ammeter clock, hollow clock , O-clock and a versatile counter circuit, each project has provided valuable hands-on experience and insight into real-world engineering applications.

As I transition from student to professional, I am grateful for the opportunity to apply theoretical knowledge to practical projects and collaborate with industry professionals at CCL, IIT-Gandhinagar. These experiences have equipped me with the skills and confidence to tackle future challenges in the field of engineering.

I extend my sincere appreciation to CCL, IIT-Gandhinagar for their support and guidance throughout my internship journey. These projects, alongside others undertaken during this time, have been invaluable learning experiences that will undoubtedly shape my future endeavors in engineering.

8. References

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