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Propeller Clock using Arduino Nano Micro-controller

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Abstract: ***Once John Lubbock rightfully propounded, "What we see depends mainly on what we look for". Perfection is a just a illusion whereas Perception is the real vision. This "illusion" is based on inertia of human eye. Propeller clock is a special kind of circular LED display. It is making use of POV, a scientific phenomena termed as 'Persistence of Vision', which means that if something appears in the same spot consistently, at least 50-60 times per second, our brains think that it's permanently there when it is not. The term 'Persistence of Vision display' or 'POV display' has been used for LED display devices that compose images by displaying one spatial portion at a time in rapid succession (for example, one column of pixels every few milliseconds). A two-dimensional POV display is often accomplished by means of rapidly moving a single row of LEDs along a linear or circular path. The effect is that the image is perceived as a whole by the viewer as long as the entire path is completed during the visual persistence time of the human eye. A further effect is often to give the illusion of the image floating in mid-air. This implementation will be a coordination of electrical, electronics and mechanical engineering.***
Keywords: Persistence of Vision, Arduino Nano, Micro-controller, Led's, Propeller, POV

I. INTRODUCTION

Propeller is a term associated with a circular rotating object. As this implementation needs to rotate whole circuit assembly, there must be some prime mover attached to it, hence the term 'Propeller'. The core phenomenon on which the entire project is based is the Persistence of vision. Persistence of vision is the phenomenon pertaining to the human eye by which an after image is thought to persist for approximately one twenty-fifth of a second on the retina. The way this phenomenon works is based on the belief that human perception of motion (brain centered) is the result of persistence of vision (eye centered). Any motion that we see around us is the direct implication of persistence of vision phenomenon at work. In the past, it was scientifically proven that a frame rate of less than 16 frames per second caused the mind to see dashing images. People still identify motion at rates as low as ten frames per second or slower. The flicker caused by the shutter of a film projector is distracting below the 16-frame threshold. In drawn animation, moving characters are often shot "on twos", that is to say, one drawing is shown for every two frames of film (which usually runs at 24 frames per second), meaning there are only 12 drawings per second. Even though the image update rate is low, the fluidity is satisfactory for most subjects. However, when a character is required to perform a quick movement, it is usually necessary to revert to animating "on ones", as "twos" are too slow to convey the motion adequately. By modifying this basic idea, 19 LEDs can be rotated in a circle, showing 19 concentric circles. But if these LEDs are switched at precise intervals, a steady display pattern can be shown. Existing systems do employ POV principle, but for displaying each pixel, individual LED is used. This results in a huge number of LEDs even for small sized displays. By using a propeller type display, LED count can be kept to a bare minimum. Even 7 LEDs can perform a task of over 525LEDs. Power consumption and the count of Led usage are reduced.Thus, formulating an idea of a Eco-friendly display.

II. BLOCK DIAGRAM AND IMPLEMENTATION

The propeller display consists of following blocks, as shown in the block diagram.

A. Interrupter Module
B. Micro-controller (Arduino Nano)
C. LED module
D. DC motor
E. DC power supply

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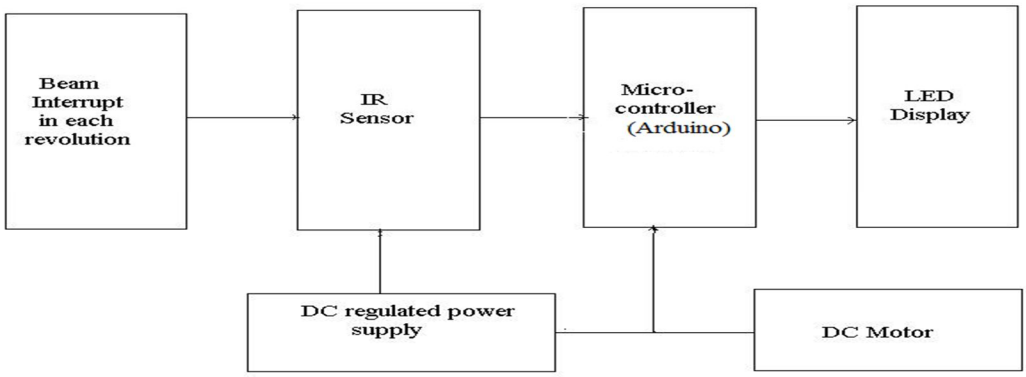

Fig 1 : Proposed Block Diagram

1) *Interrupter Module:* Interrupter module is the sensor module, consisting of a Hall Sensor . In order to know when the system should restart displaying the current image or message on the propeller clock, we need a known reference point called home point. A hall sensor is placed in the vicinity to the revolution of the PCB. When the PCB passes the point of the sensor's psoition, a signal is sent to the Arduino Nano indicating the exact current position of the PCB.
2) *Microcontroller (Arduino Nano):* Arduino Nano is a single-board microcontroller, which is used to make the application of interactive objects or environments more accessible. It is an open source physical computing platform and a development environment for writing software for the board. It can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs.
3) *LED Module:* LED module consisting of 19 bright LED is fixed in another side of the arm of our project. These LEDs are connected with each of the port pin of microcontroller, with a series current limiting resistor of 2.2k ohm and 270 ohm.
4) *DC Motor:* Repeated scanning of the display is must for continuous vision. This task is achieved using circular rotation of the whole circuit assembly. So, we need to use a Dc motor for the revolution of the circuit.
5) *DC Power Supply:* For microcontroller, as well as the DC motor, a regulated DC power supply is required. We have to provide +5V to the Arduino Nano, while +12V to the motor.

III.MECHANICAL ASSEMBLY

Mechanical assembly plays a pivotal role in proper functioning of this assembly. The display is scanned each time, by rotating the whole assembly in a circular path. Fig 2 shows a reliable way to implement this assembly. A challenge here is to provide continous power supply to the Arduino Nano which is encountering continous circular rotation. A battery is installed onto the PCB to evade the negative consequences of the rotation, and to provide uninterrupted power supply.

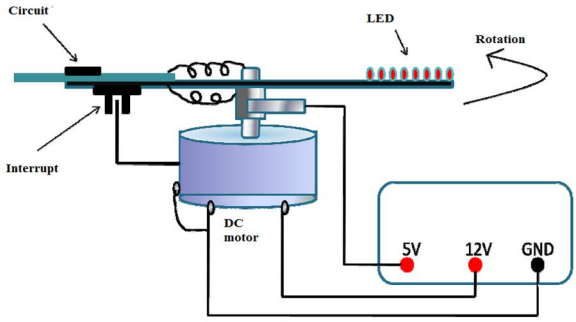

Fig 2: A mechanical assembly of the propeller clock circuit

Most critical objective was to accomplish pristine balance and overall good mechanical strength. We designed a case in which motor is fixed permanently and PCB is fixed on it with the help of nut and bolts to avoid wobbling. To balance the weight we placed battery on one side of PCB and whole circuit on other side.

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IV. CIRCUIT IMPLEMENTATION

A. *Schematic Diagram: (Arduino Nano Pin Diagram)*

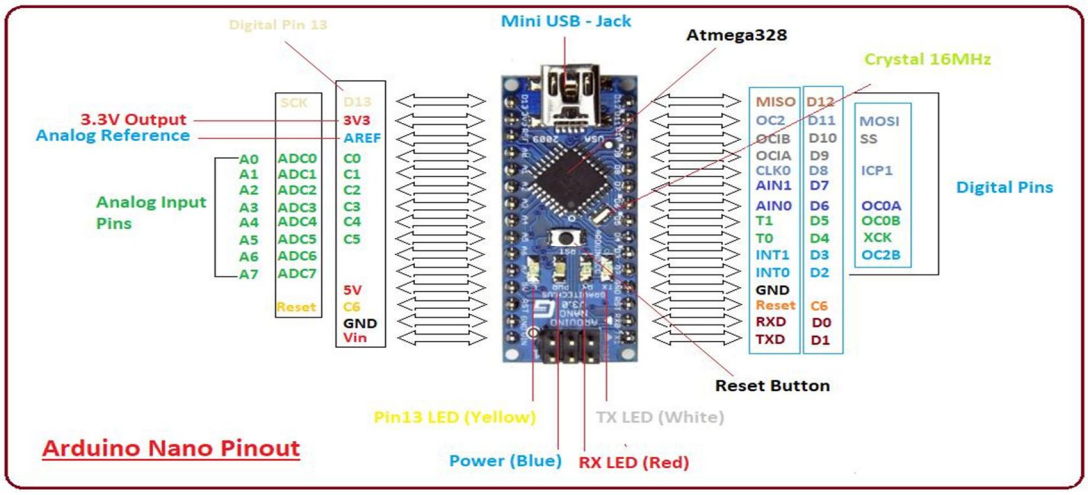

Fig 4: The Pin Diagram of Arduino Nano Micro-Controller

B. *Arduino Nano Pin Functions*

Pin Category	Pin Name	Details
Power	**Vin, 3.3V, 5V, GND**	**Vin:** Input voltage **5V:** Regulated power supply used to power microcontroller and other components on the board. **3.3V:** 3.3V supply generated by on-board voltage regulator. **GND:** Ground pins.
Reset	**Reset**	Resets the microcontroller.
Analog Pins	**A0 – A7**	Used to measure analog voltage in the range of 0-5V
Input/Output Pins	**Digital Pins D0 - D13**	Can be used as input or output pins. 0V (low) and 5V (high)
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	**13**	To turn on the inbuilt LED.
IIC	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	**AREF**	To provide reference voltage for input voltage.
Serial	Rx, **Tx**	Used to receive and transmit TTL serial data.

Fig 5 : Functions of Arduino Nano Pins

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C. Circuit Diagram

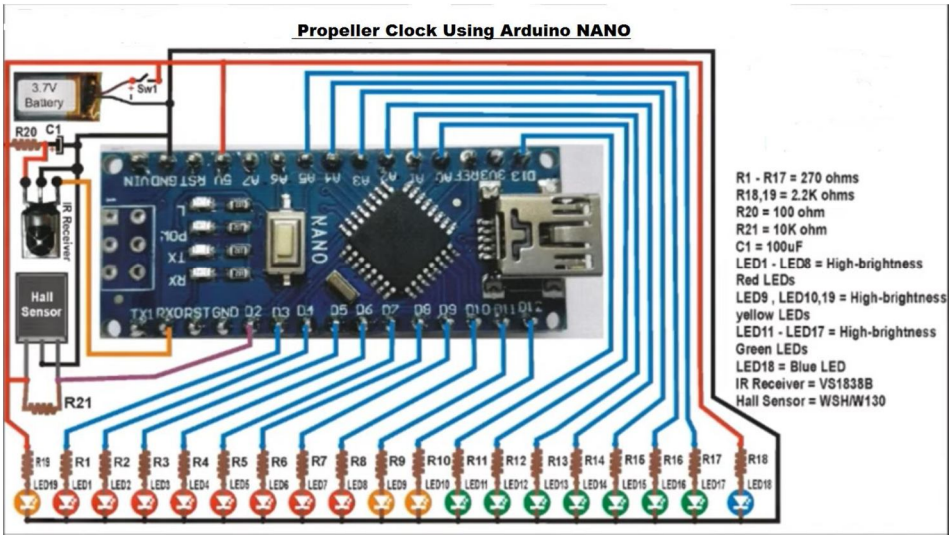

Fig 6 : Connections and Circuit implementation over Arduino Nano Micro-controller

V. RESULT

Overall, with the help of a hall sensor the exact position of wheel, on which whole circuit is mounted, is obtained and is given as a interrupt to the circuit through which the program progresses. DC Motor used in this implementation is 12 V dc motor which is tested by using digital multi-meter. Arrangement is made so that the sensing circuit gives high to low pulse for each completion of revolution. Power supply module was designed to provide 5V DC power supply necessary to drive the circuit . Thus the Circuit implementation is done and the analog clock is hence obtained.

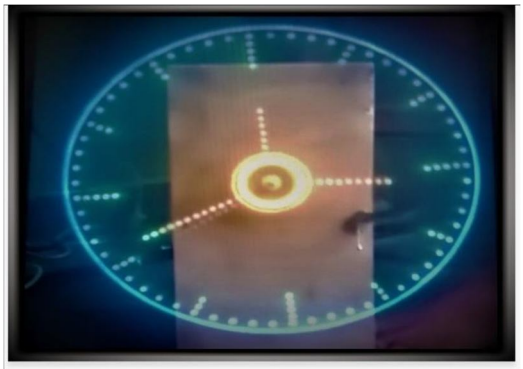

Fig 7 : A Persistence of vision display, displaying a clock.

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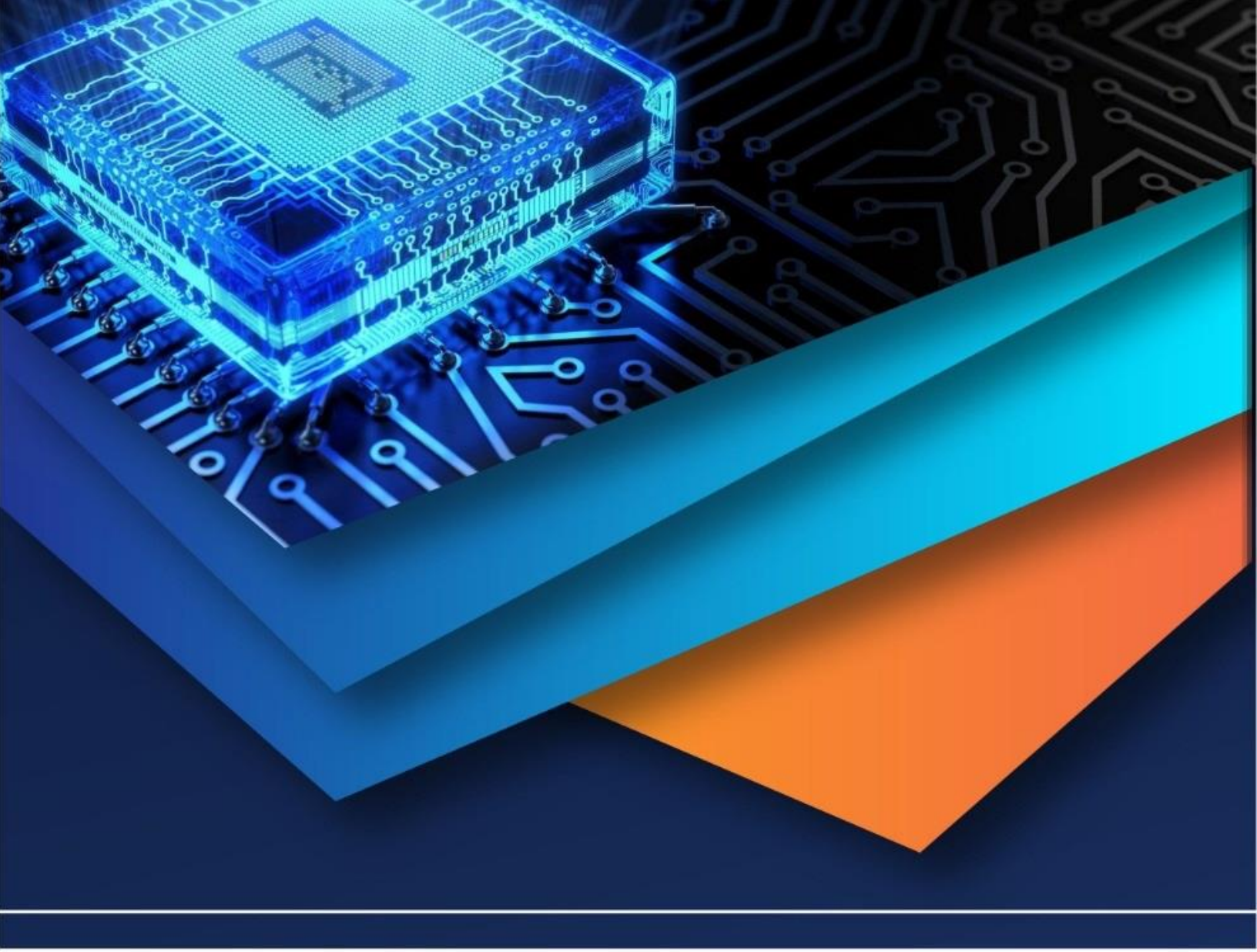

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