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Low Cost Propeller LED Display

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Abstract: This paper explains the project which is a special kind of circular LED display. The Propeller Display is a linear array of light emitting diodes, rotating at a high angular velocity to generate a circular screen. With the help some mechanical assembly, LED count, hardware requirement, and hence overall cost is cut to very affordable price. Also, maintenance and repairing of the display is easy. All the synchronizing can be implemented through software. This project uses the principle of Persistence of Vision. The propeller display is mechanically scanned and displays the characters and symbols. It can be used anywhere and everywhere and the most amazing fact is its crystal clear display.

Keywords: Propeller; LEDs; circular display; persistence of vision, microcontroller.

1 INTRODUCTION

Propeller display is a linear array of LEDs, rotating at high angular velocity to generate a circular screen. This “illusion” is based on inertia of human eye. The basic rule of Propeller Display is a linear array of light emitting diodes which rotate at a high angular velocity to generate a circular screen. Persistence of vision phenomenon is related to vision capability of human eye by which an after image is thought persistent. This project also uses the principle of Space Multiplexing. In this project we rotate a set of LEDs for displaying characters, numbers and symbols in a rotating manner, which will require a whopping 525 LEDs. This propeller display is a mechanically scanned and displays the characters in digital format. This display consists of just 8 bright LEDs which are rotated to show the crystal clear display. This display can show the messages too. This small sized IC is used, mainly because of its reduced weight. This improves the performance of the display, because reduced weight gives advantage of increased RPM. So hardware and cost minimization is achieved. The maintenance and display of this project may be very simple. All the synchronizing can be implemented through software. This project

requires to rotate whole circuit assembly. So, there must be some prime mover for its rotation. That’s why the term ‘Propeller’ is used. To display the characters and symbols on its assembly the project uses the bright light emitting diodes. It is made using the 20-pin 8051 series microcontroller.

2 WORKING PRINCIPLE

This display consists of just 8 bright LEDs which are rotated to show the display. For building this project, requirement is just a microcontroller, dc motor, interrupter module and LEDs. The basic principle behind propeller LED display is “persistence of vision”. This is the phenomenon which is related to vision capability of human eye by which an after image is thought persist for approximately 1/25th of a second. So if someone is observing the image at a rate of 25 images per second then they appear to be continuous. The propeller display is a linear array of light emitting diodes, rotating at a high angular velocity to generate a circular screen. A television is a common example; in which image is re-scanned every 25 times, thereby appear continuous. Further, a glowing objects if rotated in a circle at fast speed, it shows a continuous circle. By modifying this

basic idea, 8 LEDs can be rotated in a circle, showing 8 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.

3 METHODOLOGY

3.1 Block Diagram

In this section, we will emphasize on detailed overview of each of the block shown in above block diagram. In every description of the block respective schematics and working principle is explained. The propeller display consists of following blocks, as shown in the block diagram.

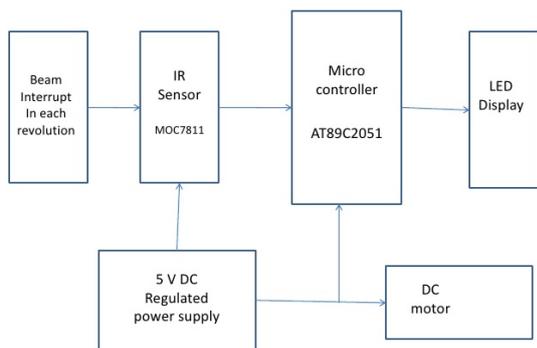


Fig. 1. Block diagram.

3.1.1 Microcontroller (AT89S51): This project is based around the microcontroller AT89S51. The AT89S51 is a low-power, high-performance CMOS 8-bit microcontroller with 4K bytes of In-System Programmable Flash memory. This small sized IC is used, mainly because of its reduced weight. This improves the performance of the display, because reduced weight gives advantage of increased rounds per minute (RPM).

3.1.2 Led Module: LED module consisting of 8 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 330 ohm. LED module is used to displaying the characters and symbols.

3.1.3 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 used a DC motor as the prime mover.

3.1.4 Interrupter Module: This module is our sensor module, consisting of the IR LED and a phototransistor. 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 phototransistor and an IR LED are used to determine that reference point. The IR LED, which is stationary, is fixed on the base of rotating assembly. When the IR rays sent by the IR LED falls on the photo diode, which is placed on the rotating pcb, it will generate a low pulse on the interrupt pin of microcontroller which results in the generation of desired pattern.

3.1.5 DC Power Supply: For microcontroller, as well as for the DC motor, a regulated DC power supply is required. We have to provide +5V supply to the microcontroller, dc motor and to interrupter circuit by using voltage regulator (LM7805CV).

4 CIRCUIT DIAGRAM

The figure shows the complete circuit diagram of the project. We have used 12 volt, 2400 rpm dc motor, but we are giving 5 volt supply to it to reduce the speed of dc motor to stabilize the circuit. Current limiting resistors of 330 ohm are used in series with LEDs. Interrupter Module used to determine the reference point, is connected to the 12th interrupt pin of the microcontroller.

5 SOFTWARE DESCRIPTION

Basically the microcontroller is a device that cannot act on its own. It is a device that can be tailored to perform a specific function. Timing of LEDs turning on and off is controlled by microcontroller through program written in assembly language.

KEIL: The software is written in “ASSEMBLY” language and compiled using KEIL (micro vision).

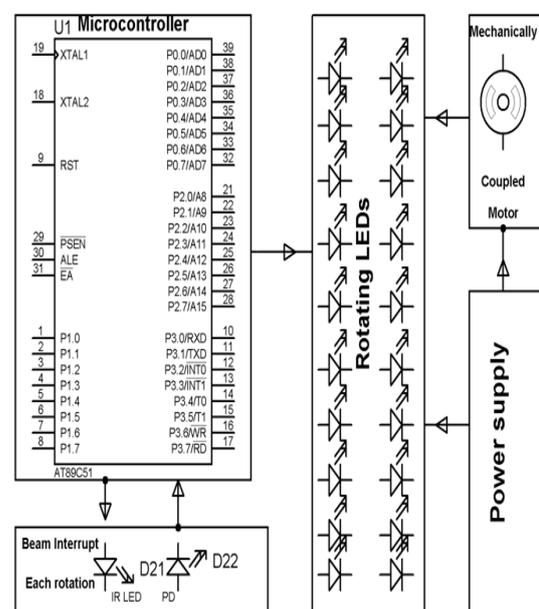


Fig. 2. Circuit diagram.

The source program is converted into hex code by the compiler. Burn this hex code into AT89S51 microcontroller.

EAGLE SCHEMATIC: Eagle (Easily Applicable Graphical Layout Editor) PCB design software to design an electronic schematic and lay out a printed circuit board (PCB). Eagle is a PCB design software package consisting of a schematics editor, a PCB editor and an auto router module.

6 RESULTS

This Project Propeller LED Display is first tested and then successfully implemented. The programming of microcontroller AT89S51 used in the project is done in Assembly language which is converted to HEX Code by KEIL software. Interrupter Circuit is used in this project to stabilize the image. All the passive elements are tested by multimeter. And all other circuits are first analyzed on breadboard and then implemented on PCB.

8.1 Interrupter Module Testing

This Interrupter module testing is required for detecting exact position of wheel on which whole circuit assembly is mounted. Output voltage obtained at Pin.No.12 of AT89S51 without interrupt = 5 Volt Output voltage obtained at Pin.No.12 of AT89S51 with interrupt = 0 Volt.

8.2 Calculation of Time for One Rotation

1 minute = 1500 rotations and 1 second = $(1500 \div 60) = 25$ rotations Therefore 1 rotation = $(1 \div 16.67) = 40$ milliseconds. So, persistence of vision can be achieved.

8.3 DC motor RPM Testing

DC Motor used in this project is 12 V dc motor which is tested by using digital contact-less tachometer. Arrangement was made so that the sensing circuit gives high to low pulse for each completion of revolution. By measuring the time difference between two successive pulses RPS can be calculated which further provide RPM value, as

shown below: Power supply given to DC Motor = 5 V Time interval between two successive pulses as seen on CRO = 41.46 ms RPS = $1 / (41.46 \text{ ms}) = 24.11 = 24$ and RPM = $24 \times 60 = 1440$.

7 CONCLUSION

This project and implementation using bright light emitting diodes is for displaying the characters and symbols on its assembly. That's why this project and implementation is named as 'PROPELLER DISPLAY'. By using a propeller type display, LED count can be kept to a bare minimum. Even 8 LEDs can perform a task of over 525 LEDs. Applications can find their way into cost effective solutions for large public displays, information systems. It can directly replace Railway Station Information Displays, Bus Stands, Air Ports and many more important places.

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