Propeller LED Display Using Embedded System

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Abstract: This project comprises of circular display of a string of LEDs. Using a high speed motor and some mechanical assembly, LED string mounted on a printed circuit board are duly interfaced to a microcontroller. An appropriate program while executed drives a pair of single line LEDs in space multiplexing mode. This displays some message and or a clock timing taking advantage of persistence of vision of human eye. Without the single line of LEDs in space multiplexing mode if one would have to display a message, number of LEDs as high as around 525 would have been used. Here the project uses only 8 LEDs. Thus material count, hardware requirement, brings the overall cost to very affordable price. The synchronizing is being implemented through software.

Keywords: microcontroller, led's, space multiplexing, motor, hardware. Etc.

I.INTRODUCTION

Propeller is a term connected with a rotating object: motor or pump, and is used in this project. Propeller rotates a set of light-emitting diodes for displaying numbers, characters and symbols in a rotating manner that's the reason why it is termed as a Propeller LED Display.

The rotating LED displays can be cylindrical or disc shaped. The cylindrical displays are capable of displaying texts and digits, and the disc-shaped displays are capable of displaying analog clock. A Propeller display is a mechanically-scanned device that displays its characters in a digital format.

This project is designed to display a message by using virtual LEDs. In this project, we are using a set of LEDs instead of bulk of LEDs because these are connected in multiplexing mode. This working of LED Display involves three circuits, viz. motor driver circuit, wireless power-transfer circuit and propeller-display circuits.

In a motor-driver circuit, the power from the AC mains is stepped down to a range by a step down transformer. Because it is a DC motor, the AC voltage is converted into DC using a bridge-rectifier circuit, and then it is regulated to a motor voltage.
Supplying power to moving objects is not a simple task, therefore, in this project, a wireless -power transmission is to used supply the power to the control circuit, which is a moving object. For transferring the power wirelessly to some distance, the supply frequency must be increased to a certain extent.

Propeller is a term associated with circular rotating objects.Conventional methods of displaying images are mainly using LCD display and dot-matrix where a huge number of LED's and power processors are used to create the display. The main idea of this project is to use minimum number of LED's and components to create a virtual display with minimum power consumption. For the purpose of displaying a set of LED's have been used, hence the name Propeller LED display. The main advantage of propeller display as compared to the LED matrix board is its lower power consumption. The first propeller clock was created by Bob Blick, where a single array of LED's was used to produce the display. Propeller clock uses extremely small LED's for displaying the typescript and symbols on its assembly in an appropriate way. The main mechanism behind virtual display is the phenomenon of Persistence of vision (POV). The phenomenon is related to vision capability of human eye by which an after image is thought to persist for approximately 1/25th of a second. So, if someone is observing theimages at a rate of 25 images per second, then they appear to be continuous. Existing systems do employ POV principle, but for displaying each pixel, individual LED is used [1]. This results in a huge number of LEDs even for small sized displays. By using a propeller type display, LED count can be kept minimum. The LED's are attached to a rotating board. They turn ON and OFF at very definite and precise time intervals. All we can see are the lighted dots from the LED's making a readable display that seems to float [2]. In the project an array of LED's, microcontroller and infrared receiver are placed on the board and are rotated by a motor at a very high rpm. The prototyping board itself is used as the propeller to minimize the weight and parts used for the propeller LED display.Applications can find their way into cost effective solutions for large public displays,information systems. It candirectly replace Railway station information displays,bus stands and many more places.

Embedded System:

Embedded system is a computer system designed to perform one or few dedicated functions often with real time computing constraints. It is embedded as a part of a complete device often including hardware and mechanical parts. By contrast a PC (personal computer) is designed to be flexible and to meet wide range of end user needs, embedded systems control many devices in common use today.

Embedded systems are controlled by one or more processing cores that are typically microcontrollers or digital signal processors (DSP). the key characteristic, however, is to handle a particular task. For example, air traffic control system maybe usefully viewed as an embedded system, even though they involve mainframe computers and dedicated national and regional networks between airports and radar sites.

Since the embedded system is dedicated to a specific task, design engineers can optimize it to reduce the size and cost of the product and increase reliability and performance, some embedded systems are mass produced, benefiting from economies of scale.

In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. For example, handheld computers share some with embedded systems such as the operating systems and microprocessors which power them, but they allow different applications to be loaded and peripherals to be connected. Moreover, even systems which don't expose programmability as a primary feature generally need to support software updates. On a continuum from "general purpose" to "embedded", large application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a few dedicated functions", and is thus appropriate to call "embedded".

II.METHODOLOGY

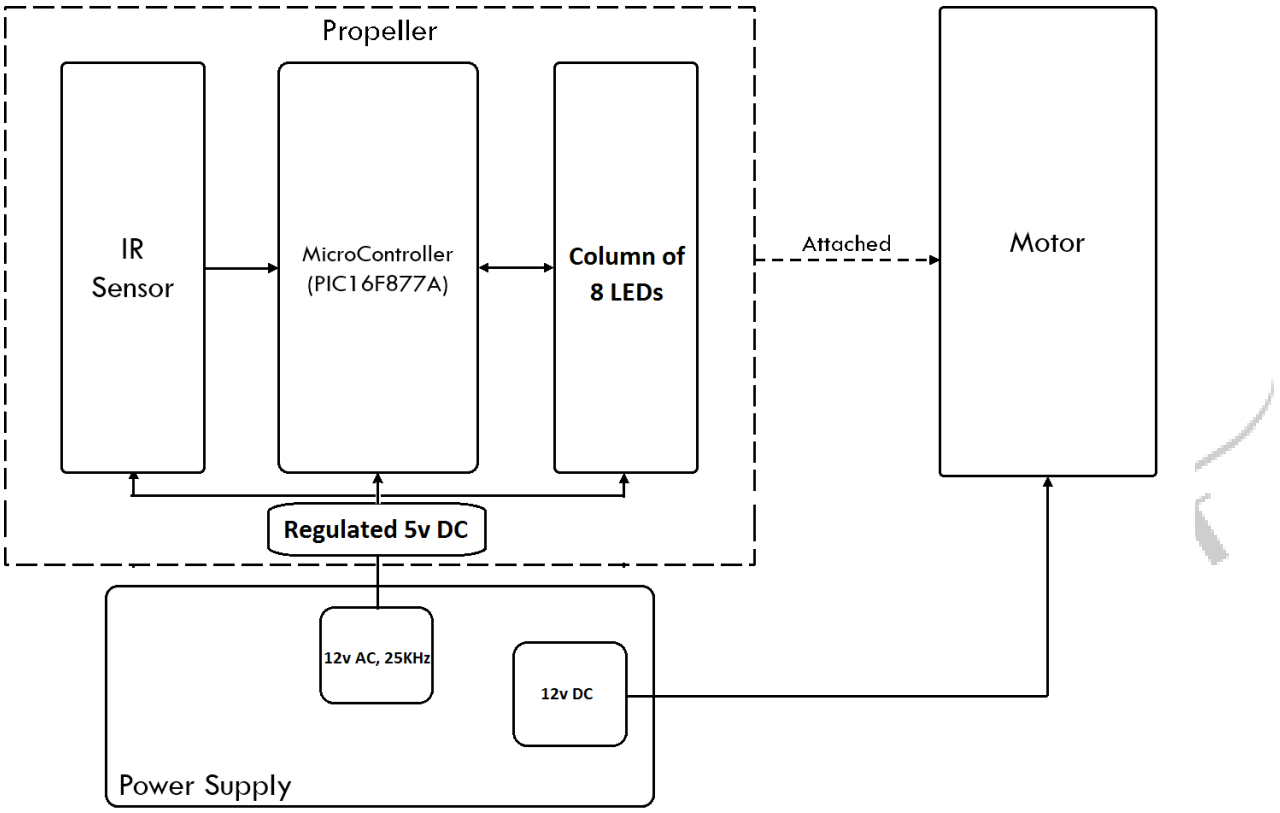

Figure 2.1: Block Diagram Of Propeller Display

Block Diagram Description:

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

Microcontroller:

This project is based around the microcontroller PIC16F877A. This is a 40 pin IC packaged in DIP package. 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 appropriate RPM

Led:

LED module consisting of 8 bright LEDs is fixed in another side of the arm of our propeller. These LEDs are connected with each of the port pin of microcontroller, with a series current limiting resistor of 47ohms.

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 motoras the prime mover.

Interrupter:

Interrupter is our IR sensor. Output of the module is LOW, if interrupt occurs, otherwise it remains HIGH. It consists of IR LED and Photodiode. When light emitted by the IR LED is blocked because of some completely opaque object, logic level of the photo diode changes. This change in the logic level can be sensed by the microcontroller. And this signal is taken as a reference point for the alignment of message.

Mechanical assembly:

Mechanical assembly plays a vital role in proper functioning of this project. The display is scanned each time, by rotating the whole assembly in a circular path.Here, one major challenge was how to bring +5V supply to the spinning circuit. So to achieve this the frequency is increased to 25KHz by using electronic transformer and power is wirelessly transferred to the propeller.

Dc power supply

Power supply block is such that it gives two different voltages. One from the normal transformer i.e., 12 volts DC for the motor and other from electronic transformer i.e., 12v AC with increased frequency of 25KHz which is regulated to 5v DC later on the propeller.

III.SCHEMATIC DESCRIPTION:

The upper part of the above circuit section is the powering the motor from normal ac supply after getting converted to DC (on the right) and to the controller through wireless power transfer from the secondary of the HF coil (on the left) . The HF transformer used develops about 25 KHz at 12 volts at its secondary to feed to the primary of the HF coil.

The circuit at the bottom left is the sensing section that develops a high to low pulse at the collector of Q1 on every rotation of the pcb. The IR LED light gets reflected on to the reverse biased photo diode that conducts to drive the Q1 to conduction. The reflection takes place from a white patch below the PCB. The pulse so developed is fed to the microcontroller Pin 33 to refresh the propeller set of LEDs on each rotation as per the program.

After being rectified & regulated the DC is used to power the rotating PCB on which the microcontroller isplaced. The above section is the controller section with 8BLUE LEDs those display the text that is programmed while rotating at a speed. Though there are only a small number of leds, the virtual text display appears because of persistence of vision of human eye.

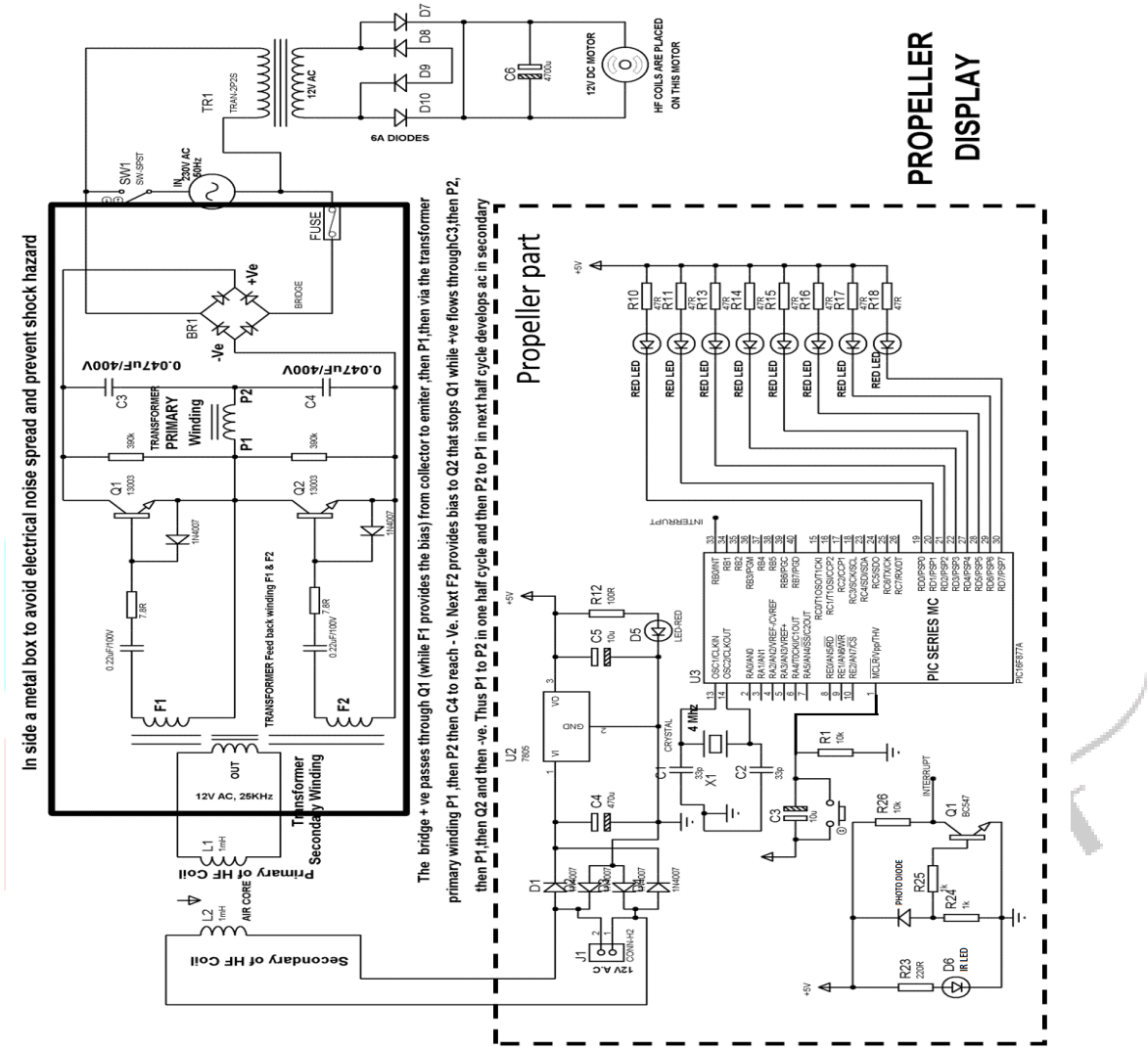

Figure 3.1: Block Diagram SCHEMATIC Diagram

Advantages

- LED count- If we use normal LED display for this project, it would take atleast 525 LEDs, by we have reduced the no. of LEDs un-comparatively to 8.
- Hardware requirement is very less and hence overall cost is cut to very affordable price.
- Maintenance and repairing of the display is so easy, that anyone having a little electronics knowledge, can take care of this.
- Low power consumption.
- If we use cylindrical type, the message can be viewed in 360 degrees from all sides.

Applications

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 and many more places.

And also

- For advertisements
- Display message on wheels

IV.CONCLUSION

In conclusion, this project really demonstrated competence combining a difficult integration of the mechanical and electrical systems to build a persistence of vision display. The propeller should be built as lighter as possible to make it more stable. It matters to a faster rotation of propeller. And if the assembly is balanced perfectly with having good mechanical strength, then it can achieve stability, and rotate at maximum RPM. This project also has so much room to explore further exciting developments and additions to the many devices with which it could interface.

This displays some message on car wheels of persistence of vision of human eye. Without the single line of LEDs in space multiplexing mode if one would have to display a message, number of LEDs as high as around 525 would have been used. Here the project uses only 8 LEDs. Thus material count, hardware requirement, brings the overall cost to very affordable price. The synchronizing is being implemented through software

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