Propeller Based Display System

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ABSTRACT

Propeller Based Display System is a system which displays messages using LED with the help of microcontroller. The microcontroller we used for this project is PIC16F877A .There is no user input for the display system, but the user can change the messages using a RF remote control which is linked wirelessly to a RF module connected with the microcontroller. The code is written in C language using MPLAB. The circuit is mounted on the mechanical structure, which is then mounted on the motor, so when the motor rotates the circuit displays a message programmed in microcontroller using LEDs. The messages are stored in microcontroller and can be changed using the remote control. This unique idea of message display is very eye catching and can be used in auto industry, advertisement and toys etc.

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Signed
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Nomenclature

2D	2-Dimensional
3D	3-Dimensional
AC	Alternate Current
ADC	Analog to Digital convertor
ASCII	American Standard Code for Information Interchange
CPU	Central processing unit
DC	Direct Current
EEPROM	Electrical Erasable Programmable Read Only Memory
GCC	GNU Complier Construction
GND	Ground
I/O	Input Output
IC	Integrated Circuit
IDE	Integrated Development Environment
ISR	Interrupt Service Routine
LCD	Liquid Crystal Display
LED	light emitting diode
MCLR	Master clear
PCB	Printed Circuit Board

PIC	Programmable Interface Controller
POV	persistence of vision
RAM	Random Access Memory
RF	Radio Frequency
RGB	Red Green Blue
ROM	Read only memory
RPM	Revolution per minute
SPICE	Software Process Improvement and Capability Determination
Spoke	Arm of the mechanical structure
VSM	Virtual System Modeling

Chapter 1

INTRODUCTION

1.1 Introduction

A propeller is a mechanical structure which is mounted on a motor having an arm of fixed length which gives rotation due to the motor. The speed of the propeller is based on the output of the motor. This project is based on persistence of vision. The Persistence of vision is the phenomenon of the eye by which an afterimage is thought to persist for approximately one twenty-fifth of a second on the retina. A simple microcontroller blinks eight LEDs on and off so that when waved through the air, an image or message appears to float in front of the viewer.

1.2 Previous Work

Different People worked on the same concept with different design and implementation There design varied in many aspects such as speed of the motor, the counter balance weight which they used to balance the electronic circuit board. The mechanical platform on which work was done was on Hard disk platters, AC sewing machines, and bicycle tires. The limitation to their design was the mechanical arm length and RPM. Having a large arm means longer message could be displayed but having more flickering. Having a small arm means smaller message could be displayed but having less flickering. So a mechanical arm of medium length was required. The motor RPM should be more in able for the character to be displayed. Previously different people worked with quad LED's instead of having single LED strip. Varying the size of the LED strip they displayed bigger message, image. Using RGB LED's image was displayed in colors, using different microcontrollers such as Atmel 89S51, HS290 microcontrollers. Run

time analog clock was shown on hard disk plates. There design varied in mechanical platform such as steel and wooden platform to support the upper electronic assembly. For display purposes some people used vertical LED strip as well as horizontal strip for propeller Display. These ideas had been used for various purposes in industries. Some used this concept in advertisement as a replacement of Scrolling text sign boards used at traffic signals, others used it as Mini POV in toy industry, for the message to be displayed in limited space. Mini POV is a small device which is available in the market for the message to be displayed in small area. Some people used different amount of LEDs in there project, which depends what you want to display for image large amount of LEDs at least 16 LEDs is required. The Propeller concept is mainly used in aeronautical industry, toys, advertisements, analog digital clock.

1.3 Motivation

The main inspiration of this project came from the automotive industry. While doing research for final year project, a very interesting website was encountered which sell car rims by the name of PIMPSTAR RIMS. The main eye catching product of this company was LED display car rims. The idea the company used was a LED strip on spoke of the rims, so when the car moves the strip of LEDs display a message or an image. With the PimpStar built-in full color LED lights, microprocessor and wireless modem, it can display virtually any image, including text, graphics, logos, and even digital photos. The software included allows creating custom images and sending them to each wheel individually or all wheels at the same time while driving. Pre-loaded six images can be displayed for each rim and program them to change automatically at the time intervals you select. The tag price that company quoted for the rims was too expensive (i.e. $19,500). This idea inspired on doing research regarding its concept behind this product. After doing a lot of research that how it was done, the basic concept was to develop a prototype based on rotation able to display an image or a message on lower scale, so it could be cost efficient and consumes low power, which could also be used commercially for advertisements and also to make a product like this company PimpStar that would be less costly and easily available for local customers.

Figure 1.1: LEDs based car rims [16]

1.4 Limitaion of Idea

The main limitation of this idea is that it is 2D based display system for images and message that we cannot use for 3D images or messages. The collection of images and messages is limited because it depends on the memory of the microcontroller. The whole idea is dependent on the power source which is also limited and has to be changed after some time. Another limitation of this idea is that the images that are supposed to be displayed have to be resized so that it would be properly displayed on the limited area of the rim.

1.5 Aim of Project

The aim of the project is to come with a project which could be used commercially in the field of advertisement. These days the most prominent ways of advertising are through bill boards and LED scrolling sign boards, in our point of view the problem with bill boards is that only one message or picture can be displayed at a time not to mention the cumbersome task of printing those ads and pasting them on the bill boards. For LED scrolling sign board the text doesn't hold long enough when the viewer is in motion, as the message is not clearly visible because it scrolls quickly. Furthermore it should be cost effective and easy to maintain and require less power to operate. This project can show various messages which are already programmed in the microcontroller and can be changed by the user on runtime using a remote control.

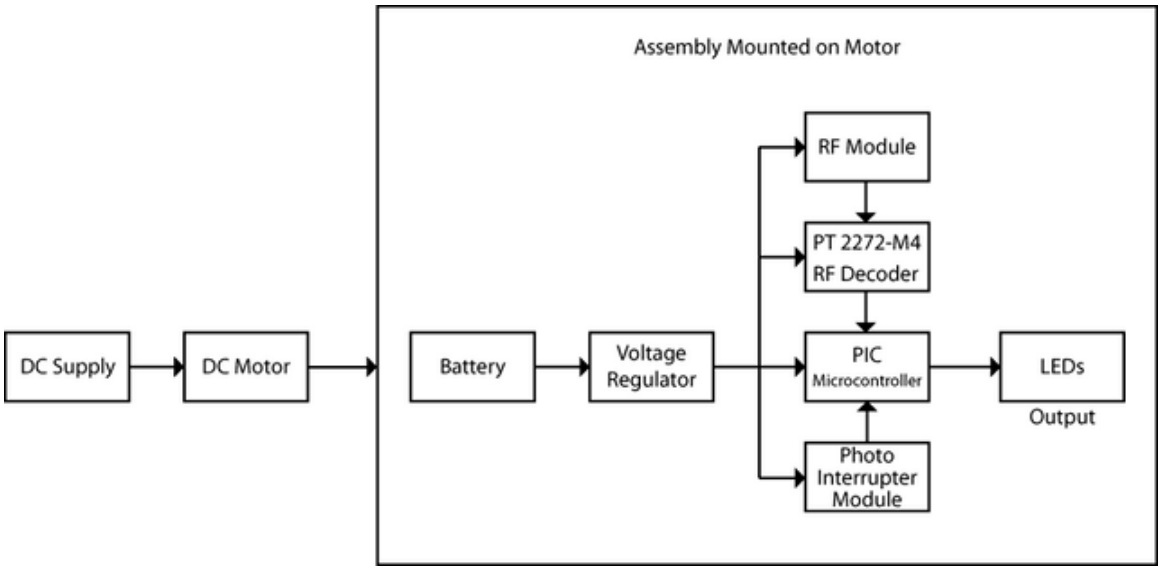

Figure 1.2: Block diagram of propeller based display system

Chapter 2

PROPELLER DISPLAY CONCEPT AND PROPERTIES

2.1 Concept

The main concept behind this project is persistence of vision, which is which an after-image is thought to persist for approximately one twenty-fifth of a second on the retina. In other words vision is not as simple as light passing through a lens, since the brain has to make sense of the visual data the eye provides and construct a coherent picture of reality. A class of display device described as "POV" is one that composes an image by displaying one spatial portion at a time in rapid succession (for example, one column of pixels every few milliseconds). A 2-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. A 3-dimensional POV display is often constructed using a 2D grid of LEDs which is swept or rotated through a volume. [15]

2.2 Display Requirements

In able to see the text message on propeller, following things were required for the propeller to display such as

- 5V,12V Power Supplies

- 12V motor
- MPLAB for programming
- Proteus for designing the PCB and schematics
- WINPIC800 for programming the microcontroller
- PIC16F877A trainer
- Multi meter
- PC or a Laptop
- Oscilloscope
- Soldering Iron / Solder
- PCB and schematics drawing tool
- Microsoft Word Latex for documentation
- Consumable Material (LED's, resistors, microcontroller, terminal blocks...)

2.3 LED blinking Frame Rate Calculation

As it is known that the frame rate of television is 100hz. The more the frame rate less would be the flickering on the propeller.

$(FrameRate) f = 25Hz$
$(Radius) r = 0.1956m$
$(Circumferenceofcircle) u = 2 * \pi * r = 1.23m$
$(BlinkingspeedofLEDs) v = f * u * 3600 = 110.7km/h$

This shows the blinking frame rate of the LEDs from one LED column to another column. In order to solve the weight and to counter balance the problem, calculations of the LED strip, LED to LED distance, width of the rotating arm, PCB length were calculated and measured.

Table 2.1: Mounted Circuit Board Specifications

Specifications	Dimensions
Diameter of the rotating arm	14.5 inch
Width of the rotating arm	4.7 inch
LED to LED	0.4 inch
LED strip	1.9 inch
Center to LEDs	5.8 inch
PCB length	8.5 inch
PCB width	3 inch
Center to Photo Interupter	6.5 inch

Chapter 3

DESIGN AND IMPLEMENTATION

3.1 Hardware

This section explains the hardware required for the completion of the project. It includes the general overview of the hardware which was required in the project. [1]

3.1.1 Motor

Table 3.1: Motor Specifications

Motor	Specification
Type of Motor	DC
Rating (Operating Voltage)	12V
Operating Current	1 A (No load)
RPM	2200 rpm(No load)
Diameter	4.2 inches(outer)

3.1.2 Platform Design

The platform which was used in this project should be strong and stable enough to support the overall assembly which consists of motor and electronic circuit part. Changes were made in the initial design to overcome the problems that were faced during the completion of the project, which would be explained.

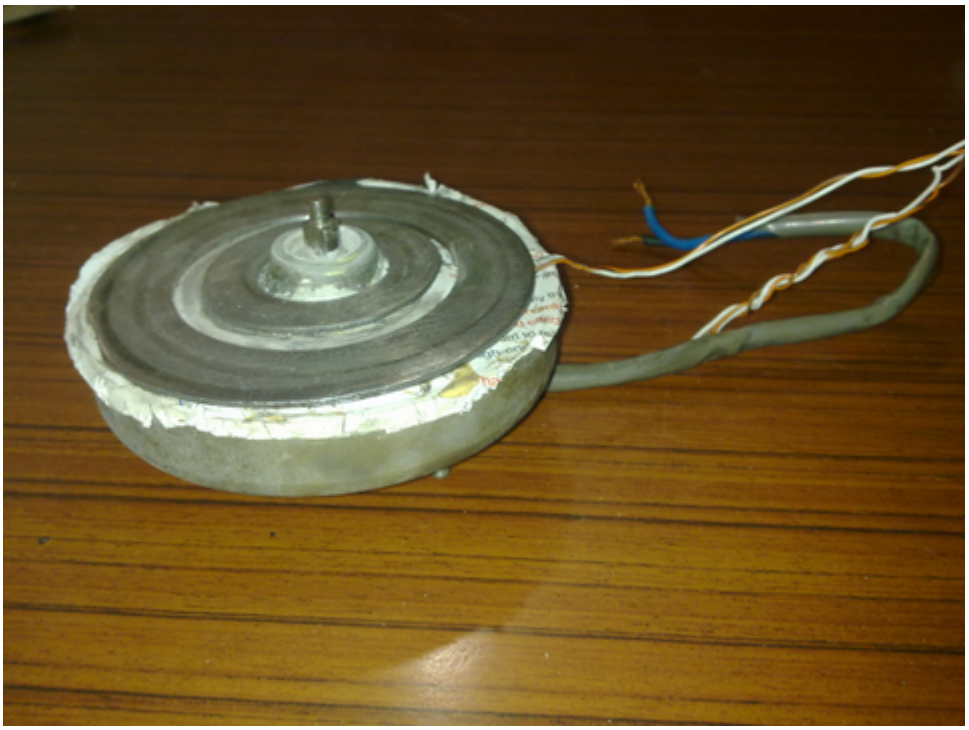

Figure 3.1: Motor

3.1.2.1 Old Design

Initial platform was made of plywood board having a rectangular structure. That was feasible enough to hold the motor assembly. Holes were made at the backside of the board so the wirings and the circuit board wirings would pass through the side of the board. A hole was made at the center of the plywood board so that the motor can be fixed. Specifications for this design are given below.

Table 3.2: Previous Board Specification

Previous board	Specification
Height	1.5 inches
Length	18 inches
Width	8 inches
Motor hole diameter (Inner)	2.25 inches

The problems which were faced in first design, that with constant rotation of the motor, the plywood platform structure was de shaped and became unstable. As a result when the motor starts running the board starts vibrating and the platform itself start moving. Another problem which was faced that as the structure was rectangular but

Figure 3.2: Old platform design

when the PCB was made of the electronic part, the length of the assembly mounted on the motor became greater than the width of the plywood platform which was against the safety of the user.

3.1.3 Mounted Upper Assembly Design

It is a design which holds all the power supply and electronic circuitry that have to be mounted on the motor while rotating. Some of the designs which were made during the project are discussed below.

3.1.3.1 Previous Design

This design was based on wooden platform having a hole at the center for the motor shaft. This platform rotates with the motor and it holds all the circuit and components which were required for the power supply. It consisted of a counter weight on the other side of the electronic circuit board, which was screwed into the wooden platform.