Journal of Engineering and Applied Sciences 13 (15): 6220-6224, 2018
ISSN: 1816-949X

Design and Implementation of Micro Controller Propeller Displays

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Abstract: The propeller display is a special type of circular LED display. By using of some mechanical assembly help, hardware requirement, LED count and later the total cost is reduced to very economic price. Additionally, repairing and maintenance of the display is so, easy that any technician or engineer can maintain it. The overall implementation of the synchronizing can be done through software. Propeller display which designed in this project, made using the 40-pin 16f 877A series microcontroller, using space multiplexing concept. The propeller display is mechanically scanned and shows the characters digitally and the greatest idea of this display is its crystal clear display. It's includes only eight bright LEDs which are show the display through rotation. To build this display, it's need for a small 40 pin microcontroller, LEDs and a position encoder. Propeller display can display the messages which will require anenormous 525 LEDs. Minimization of hardware and cost is achieved here.

Key words: Displayer, LED, assembly, propeller, mechanically, microcontroller

INTRODUCTION

The essential and really creative fact of propeller displays is depended on the positive after-images phenomenon which is also, called "persistence of vision". It's the standard of generating a wide display perception through a narrower but it's seem to move display element physically (this technology meritsto be a modernsense for the item "spatial multiplexing"). The combination of an exotic display method with an abnormal display device represents a fun way in this project. It changes the column of LEDs by a nixie tube (Bellan, 2015). Propeller is a word related to a rotating circular object. Because this project requires spinning the whole circuit assembly, therefore, some prime mover must be connected to it. In this research LEDs are used for demonstrating the symbols and characters on its assembly, so, it's called as 'Propeller Led Clock'. This is the phenomenon which is associated with human eye vision capability by which an after image is assumed to persevere for around 1/25th of a second. Therefore, if someone is recognizing the images at a ratio of 25 images per second then they seem to be continuous. Red circle is a good example of this feature, the observation happened when any one spin the fire cracker or incense stick in circle. This project was begun with a straight forward concept which is regularly faced in our everyday life which is vision continuance. A common example is a television in which picture is re-scanned each 25 times, so, it's seem persistent. Additionally, if brighten objects was rotated in a circle quickly, it appears a persistent circle. The modification of this idea, 7 LEDs can be turned in a circle, displaying 7 concentric circles. A steady display pattern can be shown if these LEDs are altered at accurate periods. Present systems using POV concept but for showing each pixel, separate LED is employed. Even for small sized displays there is a needfor a very large number of LEDs. Using the type of a propeller display decreased LED count, so, it, can be reduced to minimum, so, even 7 LEDs can act as over 525 LEDs. Various applications used propeller display as which need to large displays and information systems and require a cost effective solutions such as railway station information displays, bus stands and many more places (Manihar *et al*., 2012; John *et al*., 2014).

Literature review: Bob blick invented the first propeller clock to generate the display on a cylindrical surface; It rotated a single column of LEDs along a horizontal circle (a similar method is employed for "Window wiper" clocks like the fantasying message clock) (John *et al*., 2014). Computer clock real helps the time clock to track the current time for this reason Abhijeet Chincholkar and colleagues used the automatic switching just like an analog to digital switching conversion of display which implemented by using an infrared remote control. Different properties like a selecting function and time setting play

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role in this project to be more useful (Abhijeet *et al*., 2015). Bajpai *et al*. (2015) have introduced a project using a special type LED displays, i.e., propeller display on show a numerous information. On the other side, they have put a 40 pin microcontroller attached to a 16 bright LEDs display to show the expression as VIT STC ETC.ENGG. The part of synchronizausing software (Keil compiler and C language) (Bajpai *et al*., 2015).

MATERIALS AND METHODS

Any propeller display can build from: microcontroller board, LEDs, motor and power supply. Figure 1 shows the block diagram of the propeller display. Figure 1 is the descriptions of all design included elements.

Architecture of propeller display: This project used seven RGB (Red Green Blue) LEDs to display the text. To form a circular frame, one word red LED is used whereas one yellow LED is employed to make numbers in the analog clock. Figure 2 and 3 show the architecture and electronic design of propeller display.

Operational instructions: The first thing to do isputtinga 5 V DC as a power supply to the motor then operatingit, it will turn and at the end the turning, a steady state will satisfied and those seven LEDs will become an image. However, it does not likea picture but the speed forms it to appear like a picture, same as it happens in cartoon films. Button 1 is employed for the assembly of "seconds", button 2 for "minutes" and "hour" assembly. Button 4 for the beginning of the clock. Use button 3 to switch between digital and analog mode.

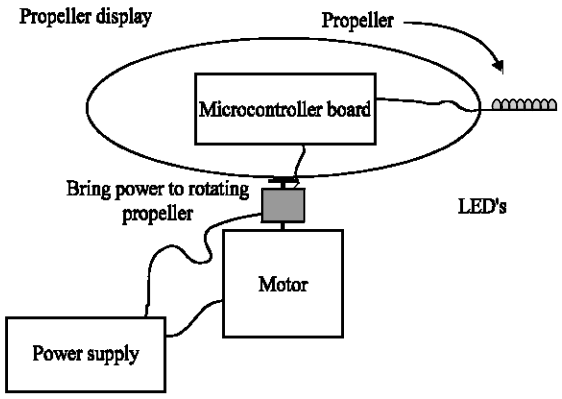

Fig. 1: System block diagram

Simulation software and tools: Some of software's and simulators are employed such as Multisim 11, Edsim simulator and Micro-vision Keil. Edsim simulator is employed to implement the simulation of assembly code, so, primary the program checked in Edsim and checked all the registers values like accumulator and so on. In Multism11 schematic of the display was designed whereas the Micro-vision Keil software was usefulin converting the assembly code to HEX file and in uploading the program from the user to programmer. ATMEL series programmer was used which allow for user to program various ATMELs Ics and AVR too (Hamirani *et al*., 2012).

Flip the floppy: The most important thing to address before designing the propeller display is the kind of administration that will offer the rotary motion. The other of mechanical design parts depends on this choice. As an indifferent computer scrap collector (more specifically all electronic scrap), a little browsing alongthe used boxes solving this issue. The holy grail was a forgotten 5.25 floppy drive which be placed at the lowest of a box with a few other drives, so, it's can be used toachieve the propeller display by bindingthe floppy motor to a rectangular circuit board and rising a sideview of nixie tube standing on one end of the board facing outward. That unit www.circuitcellar.com CIRCUIT CELLAR ® satisfied the required aim. At the beginning, the drive size

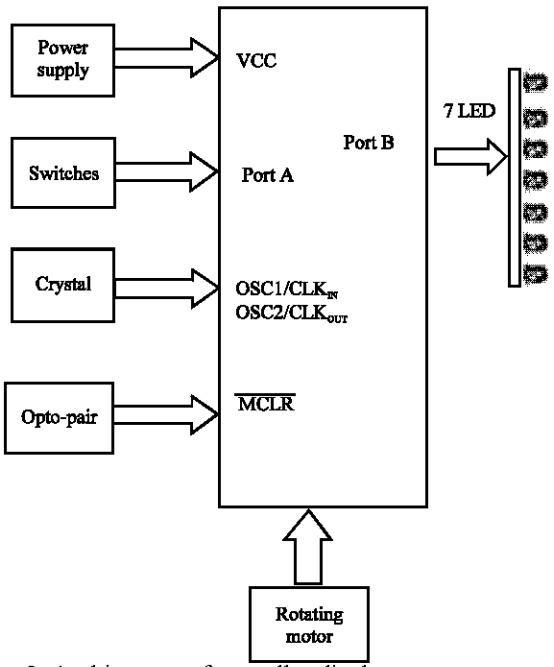

Fig. 2: Architecture of propeller display

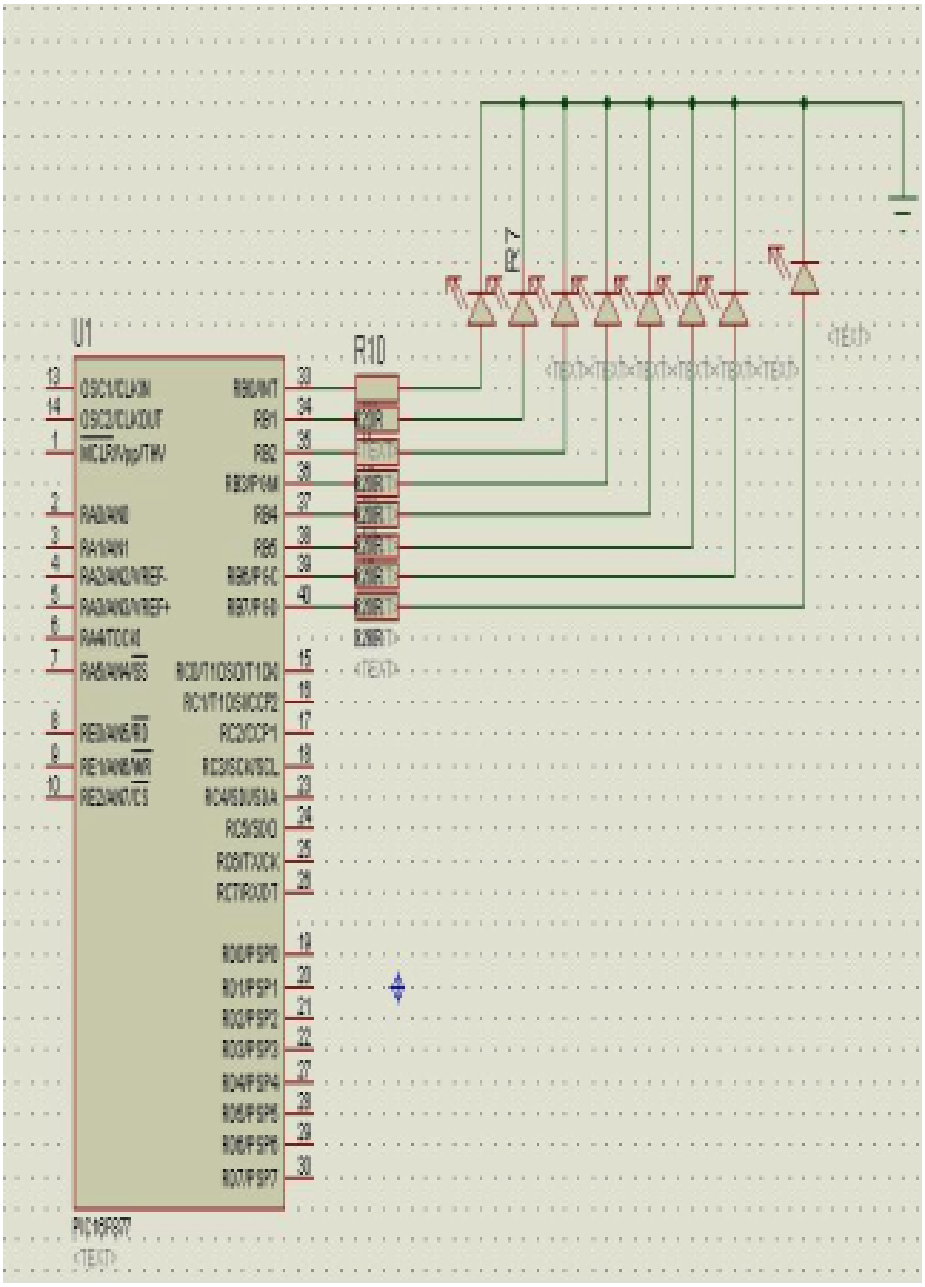

Fig. 3: Electronic design of propeller display

is reasonable, even if each point of the spinner circuit board stays within the margins of the drive which make the mechanical achievement simpler and safer.

Though, the design key is the drive's speed controlled motor which turns away at 300 or 360 rpm, basing on the SPD input signal case which received by the motor electronics. A single spinning nixie tube's data is not totally free spark (also, at the higher speed) but it's simply readable. Turning the drive reversely exposed the electronics of motor and the magnetic metal plate to be like a rotor. After disrobing all of the other drive elements, the circuit board of clock installed to this side, oppositely to the original top. The three small punctures on the plate appeared ideal to hold the mounting screws. After that, the mounting screws placed on the punctures and strained them then joined to the plate back to its original place. The clock's parts were designed on a 5"×1.75" prototyping board but it's possible that the PCB

design could implement a slimmer footprint. The component that involved high precision was the links array for the power levels between the fixed world and the spinning clock circuitry, so, the solution is the usage of the slip rings. The NTPC "slip ring" assembly contains of a 0.25 stereo headphone plug twisted vertically right in the center of the circuit board and stationary contacts put as shown in Fig. 2 and 3. With a special spray of WD-40 for greasing, this slip ring has been mixing away without a fault. The contacts can endure the small jiggle of the rotating headphone plug, required that they aren't insistent against the plug very strongly. The plug of stereo headphone has three contacts (two of which are used for power), so, there is only single power line left for any mechanical requirements to control the clock (Manihar *et al*., 2012).

Electronic design: The electronics of NTPC's floppy motor request 5 V and 12 V_{DC} power sources and they are placed on the stationary power boardas shown in Fig. 1. The four-way rectified and filtered power of the 9 V_{AC} adapters ranges around 11 V_{RMS} with a 1 V fluctuate enough reaching 12 V to operate the floppy's motor immaculately. The 5 V are produced with the ordinary 7805 voltage regulator. The electronics of clock are powered from this 5 V source as well. Also, this is where the input wire from SW2 is attached this switch is placed on the drive face plastic. It used to stop the motor for in-circuit permanent software promotion or test measurement uses. The nixie tube with all the electronics of clock which driving it, is mounted on the rotating board which is the main board put on the carousel. For eliminating the noise of slip ring from the power signals, capacitor C7 is employed.

The PIC16F84A microcontroller achieves all the functions of the clock, including time retaining. Inputs on port B received the environment signals. The firm ware operates on the internal cutoff resistors of the port. Port A delivers the BCD signal which is one digit and the nixie's decimal point drive using single bit. The internal circuitry of microcontroller and the external 19.6608 MHz quartz X1 was attached to form the oscillator. It's better to change the crystal by a Temperature-compensated Crystal Oscillator (TCXO) whose stability are just a few PPM and the frequency is fluctuated as this design is a clock. The output of TCXO is attached to the OSC1/CLKIN input of microcontroller andthe 74141 TTL chip is in charge of transferring the BCD encoded digit data to nixie decoded waves. Practically, the IC represents aregular active low BCDcode to 10 decoder. The important feature of the 74141 is that it's output drivers ability to tolerate high voltages displaying on the sleepy outputs. Actually, the 74141 was typically designated to turn cold cathode tubes which made the chips obsolete as possible as nixies themselves became obsolete (Bellan, 2015). There are some complementary electronic requirements can be briefed as the following:

15 V regulator: In this project, 5 V supply and a LM7805 fixed 5 V regulator are used. There is a need to number of input and output capacitors beside the regulator itself. Datasheet is used to fix the capacitors values. 1A is the maximal output current.

Moving message display: Before displaying the text, it must be transferred to a bit map and saved in an array. As the H8S/2633 has a lot of RAM, so, it used to keep the whole text as a bitmap in it. Later, the bitmap can easilyconvert periodically to the light emitting diodes that show the image column by column. The human eye set these columns together to seem as an integrated image. To transfer a string to a bit map there is a need to have a font. Each possible character is kept in the flash. As the propeller motor turns clockwise, the microcontroller has to produce the image from the right side to the left. The text appears mirrored, if the direction would be wrong.

Scrolling: The implementation of scrolling is quite easy too; using a window which conform the pixel count of one round of the propeller and is moved over the image. The LED's putted out only the pixels in this window. The window movement proportional with the displayed text movements and it seems to be scrolling.

Remarks: To get a high quality image, the LED's sparks for a short period of time when the propeller is on a place then they are off while the propeller move the LED's to then ext pixel position and they spark again. The divider did this task.

RESULTS AND DISCUSSION

The rotation speed of the LED's effects directly on the number of images can be showed in a second and this relates to the frame rate. In the modern TV, the frame rate is about 100 Hz as this rate increase, less the flickering of the image. Because of the mechanically scan of the picture on the propeller display, so, it is not easy to get high frame rates. The propeller has to be balanced, so, good to decrease vibrations as possible and keep the rotating LED's speed as high as possible.When the display radius is large, the speed will be large too and more vibrations occur.

CONCLUSION

Propeller display should assemble as lighter and more stable. The speed of propeller rotation is very important, so, if the assembly is balanced perfect with having good mechanical strength then it can reach to stability and rotate at high rpm. High quality display can obtain using bright light LEDs. An IR transmitter receiver pair should be employed to obtain a 'home' point for the propeller display. This point used to perceive the completion of one revolution and this will enhance the total efficiency of propeller display and gives a pure picture without flicker. The idea of the project was using the propeller mechanism to design a display. The text was written is very clear and use multi colors for making interest for display.

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