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Persistence of Vision Control Using Arduino

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Abstract

This paper mainly highlight on the POV (Persistence of Vision) technology. In current era in which energy is the main factor in designing all the applications, maximum and efficient use of the energy is very significant. To overcome the drawback of old processor we have decided to implement the same display a new and advanced microprocessor, the Arduino duemilanove. This platform brings with it newer coding and a different understanding of peripherals. Arduino interface boards provide us with a low-cost, easy-to use technology to create the project. We also aim to build the newer display to work with modern forms of interfaces. To accomplish this, we will be interfacing the display with an Android device. This project can be implemented with help of any Android Smartphone/tablet running Android 4.0+.

Keywords: POV, Arduino, Android, AT Mega 328, USB Interfacing, Piranha LED.

1. Introduction

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 afterimage is thought to persist for approximately one twenty-fifth of a second on the retina. The way this phenomenon of persistence of vision 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. The belief was debunked in 1912 by Wertheimer [1] but persists in many citations in many classic and modern film-theory texts. [2][3][4]. Persistence of vision is still the accepted term for this phenomenon in the realm of cinema history and theory. Blinks POV is a reprogrammable LED kit that uses persistence of vision to create the illusion of text or a small picture floating in the air. In the past, it was scientifically proven that a frame rate of less than 16 frames per second caused the mind to seen flashing images. People still identify motion at rates as low as ten frames per second or slower (as in a flipbook). 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.

The phenomenon of POV is evident in a number of events like for e.g.: When we rotate a fire cracker stick at high speed, we observe a continuous circle being formed as shown in fig. 1.

Figure 1: Demonstration of POV effect

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 as shown in fig.1.

A 3 dimensional POV display is often constructed using a 2D grid of LEDs which is swept or rotated through a volume. POV display devices can be used in combination with long camera exposures to produce light.

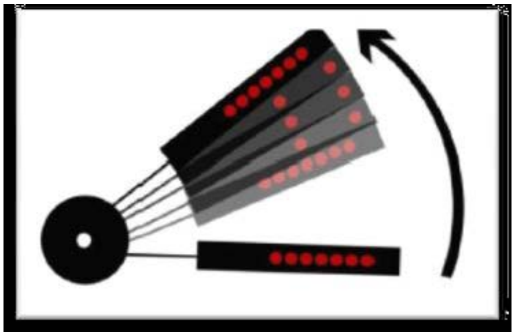

Figure 2: POV effect demonstrations

2. Body (subtopics being addressed)

A Display Based on 8051 Microcontroller

2.1 Existing Implementation and Modification

We have already implemented a POV display based on 8051 microcontroller. The display used an 8051 based AT89C2051 microcontroller chip that was used to control the switching of 8 red colored LEDs as shown in Fig 3

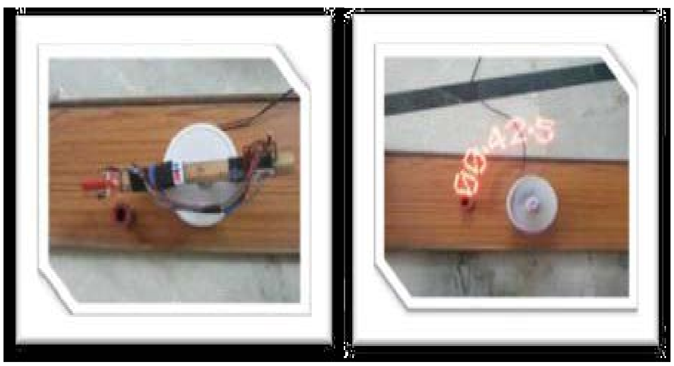

Figure 3: POV display based on 8051 microcontroller

3. The Arduino Development Board and Android Operating System

3.1 Ardino Development Borad Details

The search for a new microcontroller started with the main factor as speed of operation. We looked into different kinds of microcontrollers that are available in today‘s markets. It is during this search that we came across a totally new generation of controllers that were ready interfaced and armed with loads of basic features. Such controllers are called development boards. Due to the stunning features of such boards, we started searching a development board that suited our purpose. Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. They can either be powered through the USB connection from the computer or from a 9V battery. They can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently. Making the display on this entirely new platform requires that we write entirely new code for it.

Many microcontroller boards use separate programming hardware to get programs into the microcontroller. With Arduino, it‘s all contained on the board itself. We finally rested upon the Arduino series of development boards. We finalized on the Duemilanove 328 version of the development board due to its easy availability in local markets as shown in fig. 3.1

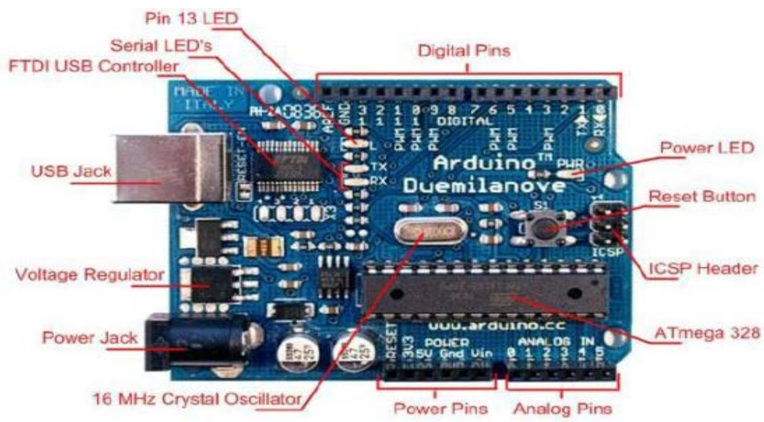

Figure 4: Arduino Duemilanove board

Table 1: Arduino Duemilanove Technical specification

Microcontroller	**AT mega328**
Operating Voltage	5V
Input Voltage	7-12 V
Input Voltage (limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
Flash Memory	32 KB of which 2 KB used by boot loader
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 Hz

4. Implementation & Configuration of Different Modules

Implementing the project hardware requires construction of different modules that will then be put together to create the final outcome. The project hardware is divided into 3 main modules:

(i) LED module

(ii) The Arduino board

(iii) Motor mechanical assembly & Motor Speed control module

Out of these, not much work is needed to be done on the Arduino board as it comes already mounted on a circuit. The only work required to be done to get the board running is to provide a 7-12 V supply at the supply pin provided on the board. An alternate way of providing power is by connecting the USB plug of the board to a computer (or even a Smartphone via an OTG cable!).

The other modules however require specialized making as no pre-made circuit is available in the market.

4.1 LED Module

The LED module consists of 8 RGB LEDs connected in a vertical column and provided with a pull-up resistor for each of the 8 LEDs. The LEDs can be quite expensive when bought from a regular component supplier. You can get a better deal on eBay. When buying them, make sure they are common anode (the positive connections of each of the three LEDs connected together) and that the pin connections are the same. It is always worth checking the LEDs data sheet. LEDs with a diffuse lens produce a better effect than those with a clear lens. Although such a module using simple single colored LEDS is readily available in the market, the use of 4 legged RGB LEDs impose new design requirements and complex soldering work because of 4 closely spaced legs of the LEDs. As mentioned earlier, the LEDs used for this project are 5mm piranha RGB LEDs. The actual picture of the LED is given in fig5.

Figure 5: Piranha RGB LED

4.2 The Arduino Board

The free ends of the pull-up resistors are connected to ribbon wires in pairs or 2, i.e. a ribbon of 6 wires used for 2 LEDs. A 6 wire ribbon scheme is chosen so as to make it easy for the wires to be plugged into the I/O ports of the Arduino. The Arduino has 3 sets of 6 I/O ports and so we can easily connect the 3 ribbon lines coming out from the LED module. The ends of the ribbon wires should be soldered to 6 pin male connectors so that they can be easily inserted in the female connectors that are already provided on the Arduino board as shown in fig 6

Figure 6: Male connectors at wire ends

4.3 Motor Speed Control Module & Mechanical Assembly

We need to be able to control the speed of the motor, because it must match the speed at which the LEDs switch from displaying one column to the next. There is no sensor to automatically synchronize the LEDs with the spinning motor. Although such controllers are readily available in the market, we decided to make our own to make the task more challenging and informative. The motor controller uses the 555 timer IC as the primary timing device.

At this point of time we have all the modules necessary, we now need to assemble them on a flat stable base which can be then mounted on the motor shaft and rotated. We have used a wooden sheet having dimensions: Width - 2.5 inch, Length - 7 inch, Thickness – 0.4 inch. The Led module is attached in a vertical manner to the narrower dimension of the mounting piece as shown in fig7. The Arduino board is mounted on the face of the wooden piece and is held together in place with the help of 2 nails pierced through the holes provided in the board by the manufacturers. The battery assembly required to power the board is put at the center of the piece to provide balance. The final assembly of the complete project can be seen in fig7

Figure 7: Final assembly of mounting piece

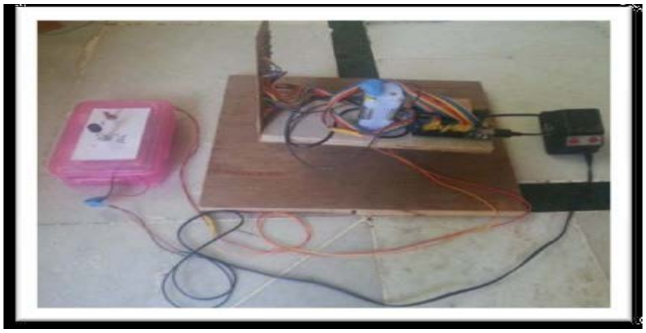

Figure 8: POV project Hardware

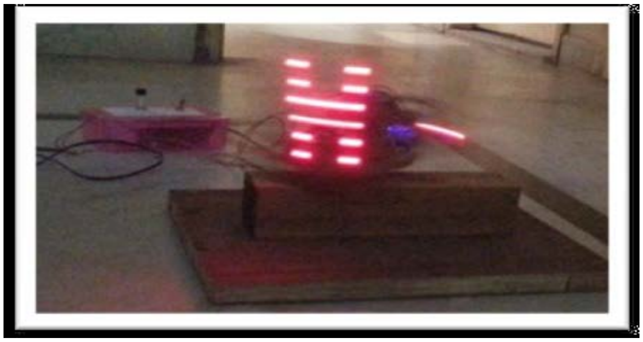

Figure 9: POV Display

5. Conclusions

The conventional LED displays used in advertisements and information display uses an individual matrix of LEDs for each character. For example in a display using 8X4 Led matrix for a single character, 10X8X4 LEDs would be required to display a word consisting of 10 characters, increasing the circuit complexity. Our circuit uses a low power Arduino Duemilanove board, with 7 multicolor LEDs and a low power motor. This technology saves power monumentally. The display is configurable to show any pattern in any color through an Android device that dictates its output as shown in fig

9. The display is extremely attractive to look at and gives a sense of being a transparent display. By using a motor of higher RPM, one can achieve more clarity in the display.

6. References

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