Project Documentation

Project Title: RGB POV Display
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Basic aim:

Our project's aim is to display a colored image utilizing persistence of vision ability of human eye.

Motivation

Every day we see a new display technology emerging around us. Also we came across one of the electronic clubs previous project (POV GLOBE) and decided to make an extended version of the same, which will be colored POV display instead of monochromatic display.

Theory

Persistence of Vision is the ability of the eye to retain the impression of an image for a short time after the image has disappeared. This ability can be used to create an illusion of images/characters floating in the air, by rapidly flashing a column of LEDs while moving the display in air. So to display a colored image we need to do the following:

1. Design a circuitry to control the flashing of LEDs in a LED column.
2. Program the circuit to flash in an appropriate pattern.
3. Synchronize the flashing with the motion of the display.

RGB LED's:

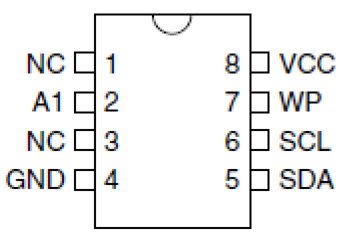
RGB led's are four legged leds .The longest one is common cathode . Other three are for red , green and blue respectively .To display a combination of two colour say red and green ,we need give 5V to red and green led and 0V to blue led .

Each led has different power consumption so to have equal intensity display of all leds we need to provide combination of resistances (and transistors if current rating of leds is high) which can be calculated by referring their datasheets. Only then we will obtain complete white colour.Other technical details can be obtained from its datasheet.

EEPROM:

EEPROM stands for Electrically Erasable Programmable Read-Only Memory.
Data stored in an EEPROM chip is permanent, at least until the user decides to erase and replace the information it contains. Furthermore, the data stored in an EEPROM chip is not lost even when power is turned off.
There are many kinds of EEPROM available like
SPI based EEPROM's, parallel interface EEPROMS, I2C based etc.

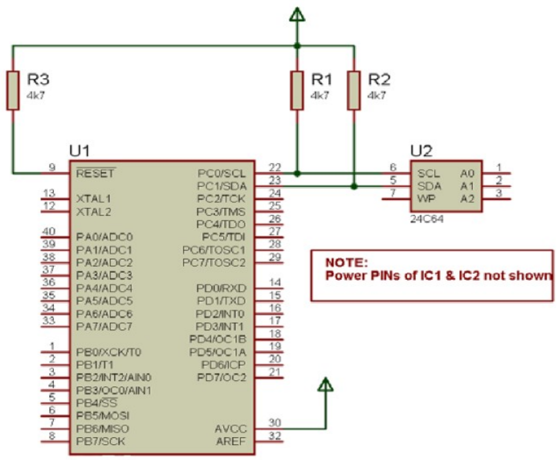
24C1024, an I2c based EEPROM



It is organized as 131,072 words of 8 bits each.

Instead of writing I2C protocol we used 24c64 libraries easily available in net and programmed in AVRGCC compiler.
If you are not using A1 (i.e. using single EEPROM) it is better to keep it ground.
It is better to keep WP ground. And in the programming side there should be some delay (_delay_loop_2(0) * 100) between two successive write operation . We used

Myutils library .SCL, SDA pin of EEPROM must be pulled high through high resistance like 47K.



HARDWARE DETAILS

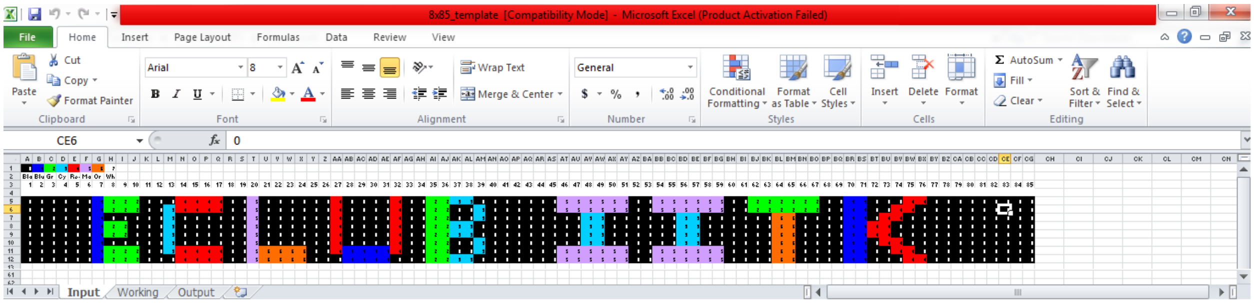
1. **ATMEGA16** – It's a general use 8-bit Microcontroller with 16 Kbytes of In-System Self-programmable Flash program memory. Since we used only 1 MCU we prepared 8 X display.

2. **High RPM motor** – We used 12 V DC motor of 1500 rpm.
To mount our setup over the motor we arranged an appropriate **coupler** for it.

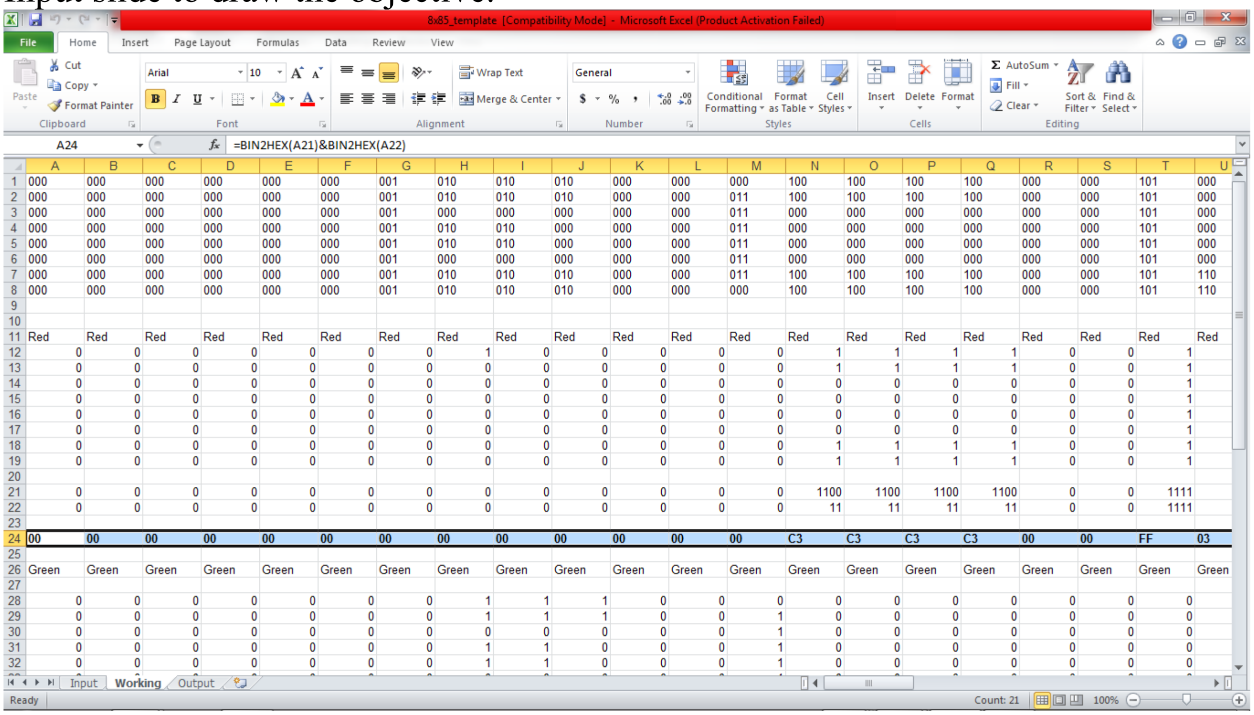
3. **Voltage regulator** – We used 7805 to convert 12V supply to 5V to make it appropriate for MCU.

4. **TSOP-1738 & IR led** - TSOP 1738 Sensor is a digital IR Sensor. It is logic 1 (+5V) when IR below a threshold is falling on it and logic 0 (0V) when it receives IR above threshold. It does not respond to any stray IR, it only responds to IR falling on it at a pulse rate of 38 KHz.

SOFTWARE –
From any simple image (3-bit image or converted to 3-bit image) using Image processing we can get pixel values of red, blue and green and then store it in EEPROM.
But we rather used an MS-EXCEL template. In which we draw our objective and in the working slide gives us required value.



Input slide to draw the objective.



Working slide giving column by column pixel information of image.

MAKING:

If you are using ATMEGA 16 you can display at most 9 X display .We are using 8 leds to show 8 X 85 display .Red, green and blue leds are connected to port A, B(except B.2), D(and c.3) through appropriate combination of resistance . From an 8 X 85 3-bit image, value of red, green and blue pixels of each row is stored in an EEPROM in the form of an array.

For the display we need to synchronize display of image and rotation of motor. For this you need to calculate motors time period which is calculated using TSOP sensors and IR LEDS. We placed a strip on the board so that the contact between TSOP and IR led is obstructed once in a rotation. We called an external interrupt on the falling edge of output pin of TSOP.And with that we calculated time period for every rotation.

We divide that time interval by 85(to show 8 X 85 display), to get the time for which successive patterns of leds will glow and change color. So after one rotation leds will again pick same configuration and a still image will appear to us. One can do this by using delay (by first calculating speed of motor manually and accurately) or through interrupts.
Since motor speed will be changing it will be better to use an internal interrupt being called after a time-period of motor's time-period/85 and then updating led column.
If motors speed remains uniform we will obtain a still image. To show an animation we will require another interrupt to update the whole image after a time which will also depend on speed of motor. To show a good animation you are required to show at least 8 frames per second (for simple display).

PROBLEMS FACED:

1. POWER SUPPLY: Power supply to the motor and IC was a bit of problem to us. We first used carbon brushes to give ground from the inner side of motor and VCC through axle, but the carbon brushes lowered the speed of motor. We then give ground from uppers side through carbon brushes, but it doesn't make 100% contacts with motor. So finally we used separate supply for both.

2. BALANCING YOUR SETUP: It's a crucial problem since your setup will be running at high speed. So wobbling of setup will give distorted image. Your setup must be horizontal and center of mass of setup must be at the point about which setup is rotating. To resolve this we added weight through M-seal to the poor side.

3. IR detection at high speed: To call the interrupt at high speed, TSOP wasn't detecting IR rays. To resolve this you use transistors to increase current through IR led and variacs to increase sensitivity of TSOP.

CONCLUSION AND FUTURE ASPECT

Our project can display any image of height at most 9 and width around 90 (for good display) in the POV setup. Our project is basically showing 2-D figure from 1-D array of leds .
1. Using multiple microcontrollers we can view POV of large sizes.
2. LED controllers can be used to change intensity of leds and showing HD images.
3. Rotating a 2-D array of led setup, cool 3-D views can be made

which can be viewed from all the directions.

UTILITY:

It can be used in advertising and marketing campaign.

REFERENCES:

Google
Datasheets
http://www.instructables.com/
Download 8 X 85 excel template from:
http://www.bradsprojects.com/8x85_pov_files/8x85_template.xls

ACKNOWLEDGEMENT:

The project wouldn't have been possible without the support of the our project mentor
Shadab Alam
And electronics club:
Rishabh Maheshwari
Ganesh Pitchiah
Rajat Arora
for their support and ideas which helped us to finish the summer project.

Special thanks to robotics club for hardware and other suggestions.

Cheers..........to 'Electronics Club of IIT Kanpur'