Spinning LED Display

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Purpose of the Project

Demonstrate Proficiency with precision timing, the HCS12 microcontroller, and mechanical interfacing

Design and interface a system that has a stator and rotor

Reproduce a modern method of displaying data
Background Information

- Platform gives form and support
- LED’s turn on and off for a set period of time
- Motor rotates the platform faster than your eye “refresh rate”
  - Higher RPM increases the resolution
  - Faster blinks increase the sharpness of the image
- Turning specific LED’s on at precise timings provide the message

http://hackedgadgets.com/2010/05/03/rotating-led-globe/
Physical Construction

- 16 LED’s on 2 vertical panels
- 1 300 RPM DC motor
- HCS12 Nanocore module standalone
- 9V battery supply
- LED driver with constant current sink
  (We used MAX6969ANG)
Letter Patterns

- 38 Supported characters
- A-Z, 0-9, :, .
- 5x8 pixels each
- Write each column one at a time to display with time delay in between
- LED’s correspond to vertical resolution
- Timing between displayed LED columns determines horizontal spacing
- All patterns stored in #definitions in C-code
Display Timing

- By utilizing each LED panel we effectively double the framerate compared to motor rotation speed (2*300rpm -> 10Hz theoretical)

- Matching programmed half rotation time (T_hrot) results in stable image

- Variations in half rotation timing cause characters to “spin” around display
Display Timing cont.

Writing data to LED panels:

- Utilizes SPI interface

- Uses MAX6969 LED Driver

- Provides 16 current sinks. 8 used for each panel

- This functionality encapsulated in DriveLED() function
Pseudocode of Program

Main Program

- Configure DDRT and DDRM
- Initialize SPI

loop forever
  print string to display
end

Printing Character

- write 1st column corr. to char
- delay T_b
- write 2nd column corr. to char
- delay T_b
- ...
- delay T_b
- write 5th column corr. to char
- delay T_b
- delay T_b
Pseudocode cont.

Printing a string

```plaintext
define printChar
  for each char in string
    print char to one panel on display
  end
delay (half rotation time) = (elapsed string time)
define printChar2
  for each char in string
    print char to other panel on display
  end
delay (half rotation time) = (elapsed string time)
```

- Utilize free running counter to keep track of elapsed time to display message on 1st panel
- Subtract elapsed time from half rotation time to determine when to display message again on 2nd panel
void driveLED(unsigned int data) {
  PTT = PTT & 0xFE; //Sets PT0 (LE) to low
  putcharSPI((char)(data >> 8));
  putcharSPI((char)(data & 0x00FF));
  PTT = PTT | 0x01; //Sets PT0 (LE) to high
  PTT = PTT & 0xFE; //Sets PT0 (LE) to low
}

void driveLED(unsigned int data) {
  PTT = PTT & 0xFE; //Sets PT0 (LE) to low
  putcharSPI((char)(data >> 8));
  putcharSPI((char)(data & 0x00FF));
  PTT = PTT | 0x01; //Sets PT0 (LE) to high
  PTT = PTT & 0xFE; //Sets PT0 (LE) to low
}

switch(type) {
  case(0):
    driveLED((unsigned int)(_A0));
    DelayuSec(t);
    driveLED((unsigned int)(_A1));
    DelayuSec(t);
    driveLED((unsigned int)(_A2));
    DelayuSec(t);
    driveLED((unsigned int)(_A3));
    DelayuSec(t);
    driveLED((unsigned int)(_A4));
    DelayuSec(t);
    driveLED(0x0000);
    DelayuSec(t);
    break;
  ...
  ...
  ...

  printStrLED("HELLO");
Current Results

- Can display characters
- Currently limited to 4 characters (more in advanced version)
  - Due to half rotation delay calculation, 4 characters fit comfortably in a semicircle on our display

NOTE: Image continuous with eyes. Video camera caused disruption due to rolling shutter.
Difficulties Encountered

- Brightness of the LEDs and visibility of project in general
- Nanocore module failure during one test (unsure of cause)
- Power supply for the motor (stall current of about 2A. Start of .7 A)
- Noisy Power supply DC voltage (fluctuations cause different RPMs)
  - Coupling Capacitor solution
- Weight Constraints
  - Wobbling
  - Possible loss of RPM
Questions?