FAN SPEED SENSING AND CONTROL

Submitted by: Group 16

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User Requirements & Technical Specifications

This system senses the speed at which the fan is rotating and adjusts the speed, based on the user input. The user can select five different speeds of the fan. The current speed should be sensed and the control mechanism should gradually increase the speed to the desired speed.

The Technical Specifications are as follows

- The fan motor operates on AC voltage supply of 220V,50Hz
- The fan is a ceiling fan with 3 blades, 48 inches radius
- The speeds are set as follows : 1- 300rpm, 2- 360 rpm, 3-420rpm, 4- 480 rpm, 5- 540 rpm
- The max error is 20 rpm(though this reduces over time)

Assumptions & Justifications

Justification

1. As the value to be displayed is only between 1 and 5 there is only a need for one seven segment displays.
2. We are attaching 3 neodymium magnets (1 on each blade) to the fan. This ensures higher accuracy

Assumptions

1. Maximum time setting for auto mode is 5 hrs.

Components used with justification wherever required

- 8086,8254
- 8284(2 units)
- Hall Effect Sensor-A3144 (Manual Attached) – 3 Nos.
  A Hall effect sensor is a device that is used to measure the magnitude of a magnetic field. Its output voltage is directly proportional to the magnetic field strength through it. Here we use it as a magnet detector, which gives an high output pulse whenever it detects a magnet. We have attached a magnet on each blade of the fan. The sensor detects the magnet gives an high output pulse. We count the no. of high output pulse in a sec, which gives us three times the RPS which when multiplied by 20 gives us the speed (in RPM) of the fan. For example, if the sensor gives 6 high output pulses, Speed=20*6=120 rpm .

Pin Configuration:

No:	Pin Name	Description
1	+5V (Vcc)	Used to power the hall sensor, typically +5V is used
2	Ground	Connect to the ground of the circuit
3	Output	This pin goes high, if magnet detected. Output voltage is equal to Operating voltage.

- DAC 0808 – 8 bit digital to analog convertor. It offers high resolution of 0.04V – Manual Attached
- LF351 – Operation Amplifier used to convert current output of DAC to a voltage output-Manual Attached
- Common Anode Seven Segment Display – 2 Nos. As 2 digits are to be displayed
- 7447 – BCD to Common Anode 7 – Segment converter -as values will be only numeric values
- 8255 – Interface DAC , 7447, keypad, and 8254 with 8086
- 8254 – to generate interrupt every one second for control mechanism and to shut down the system in Auto mode.
- 8259 – Interrupts controller. Handles the interrupts from both timers. Interrupt from Timer 1 (auto mode) given more priority as it is giving the signal to shut down the system.
- 2732 – 4 nos. Smallest ROM chip available(in Proteus) is 4K and as we need to have even and odd bank and ROM is required at reset address which is at $FFFF0_H$ and 00000_H - where there is the IVT
- 6116 – 2 nos. Smallest RAM chip available is 2 K and we need odd and even bank. We need RAM for stack and temporary storage of data.
- LS 138 – 2 decoders
- LS 373, LS 245, LS 244 and required gates,resistors and capacitors.
- Motor- SCM590EC(Oriental Motors)- Single Phase 220VAC Motor, Can be run at variable speeds, ranging from 90 to 1600 rpm. Manual attached
- Motor Speed Controller-DSCD90EC- Used in External Speed Remote Setting- In which speed can be controlled using an external DC voltage from 0 to 10 volts. Manual Attached
- Neodynium Magnets(3 nos)

Address Map

Memory Map

ROM1: 00000-01FFF

RAM: 02000-02FFF

ROM2:FE000-FFFFF.

I/O Map

We use memory mapped IO.(fixed addressing)

8255: 00H to 07H

8254(1): 08H-0FH

8253(2): 10H-17H

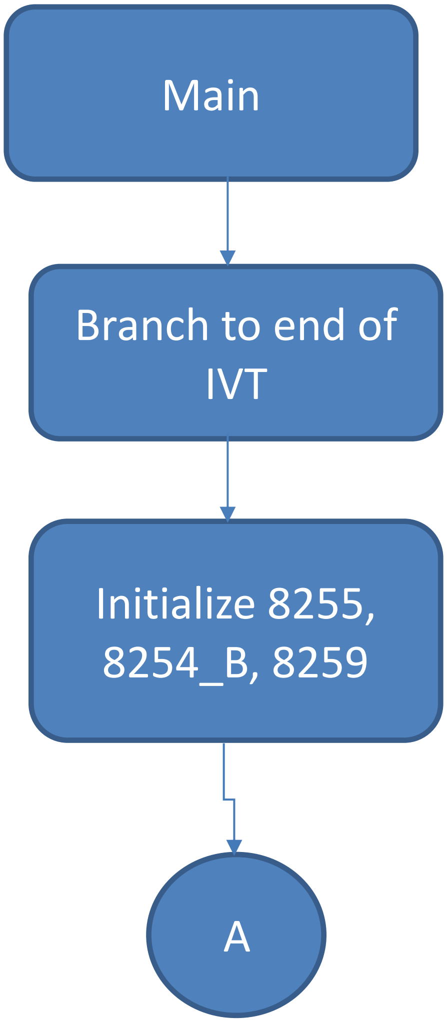
8259: 18H-1AH

Design

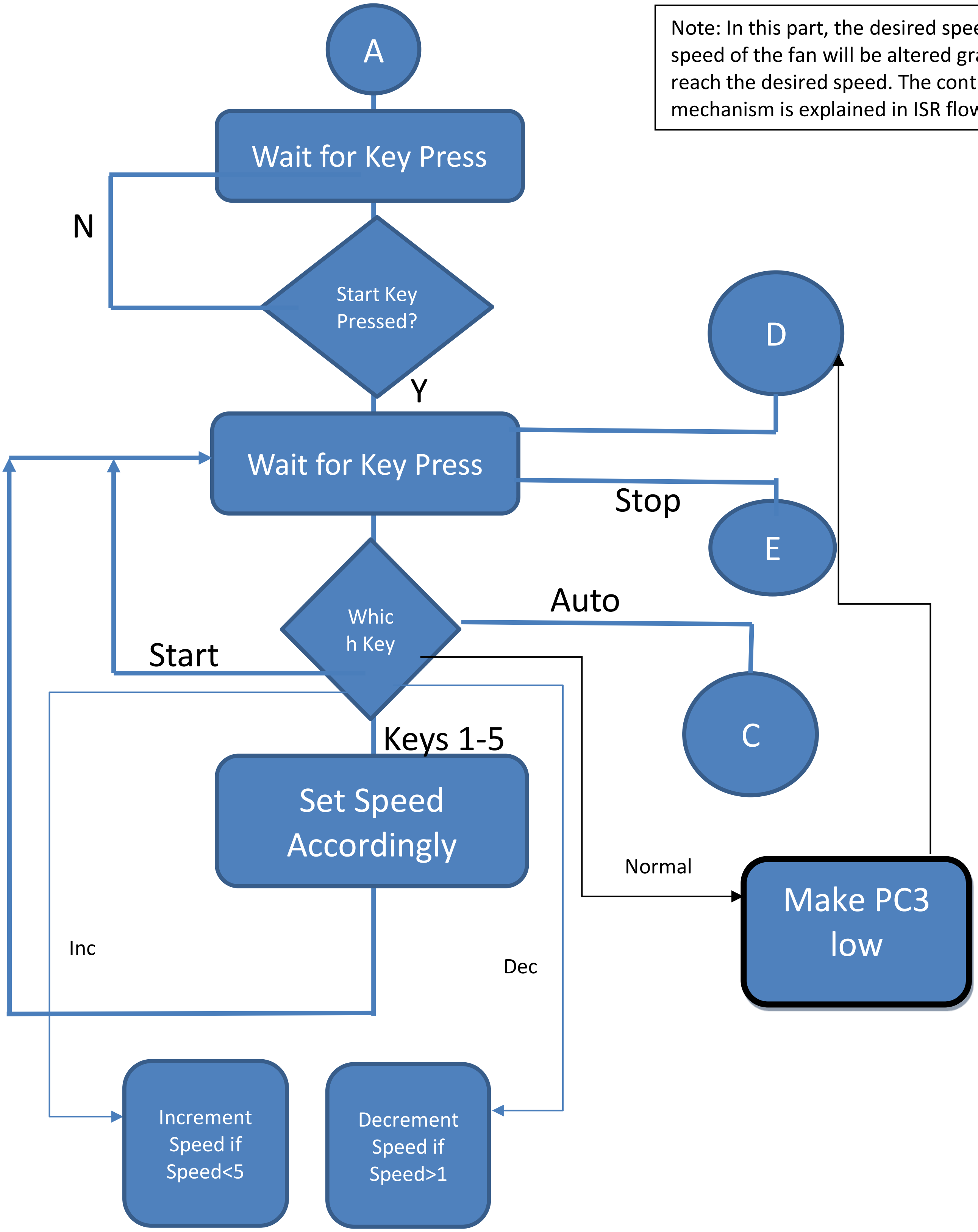
Complete design shown with proper labelling (design attached)

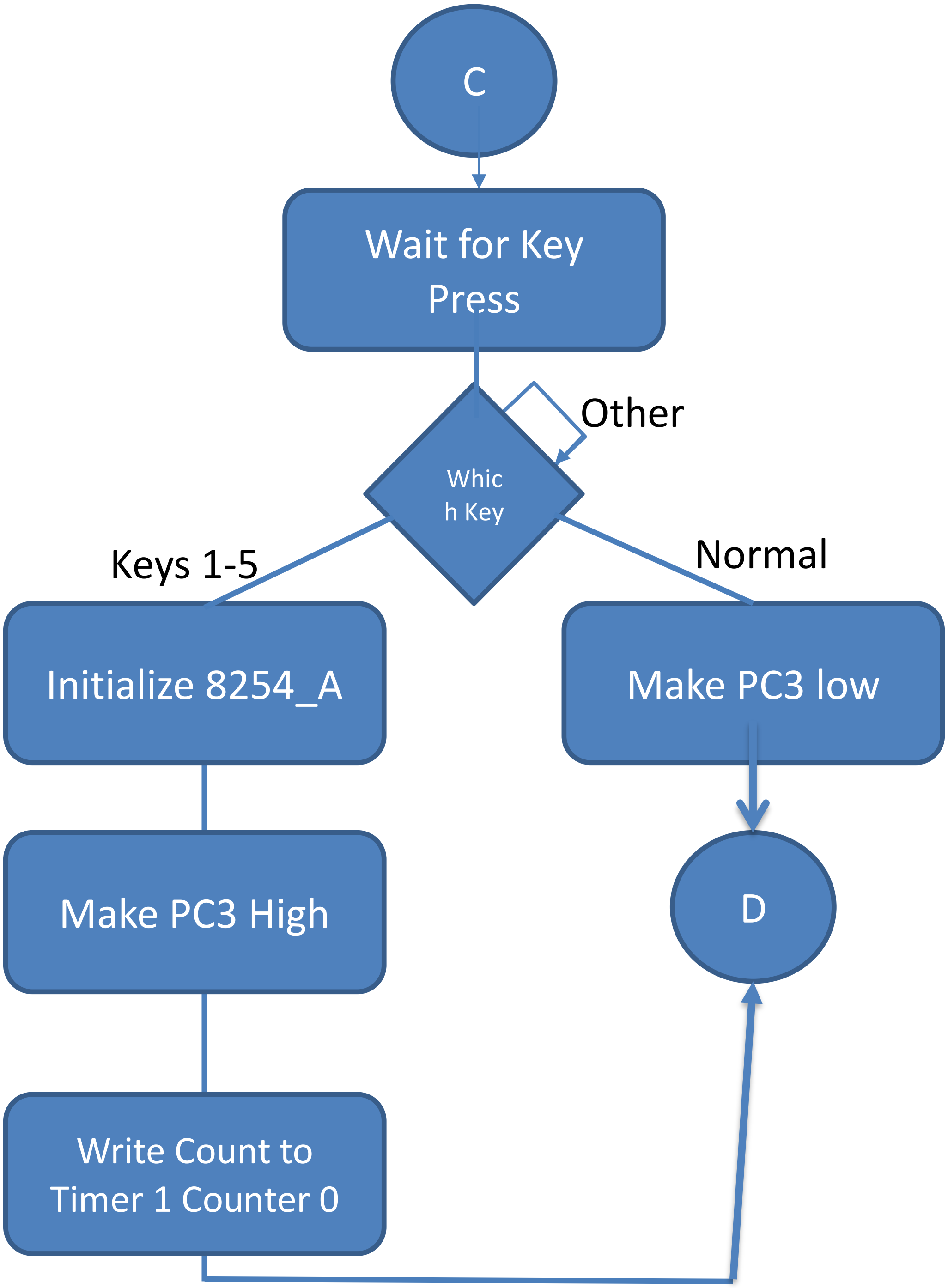
Flow Chart

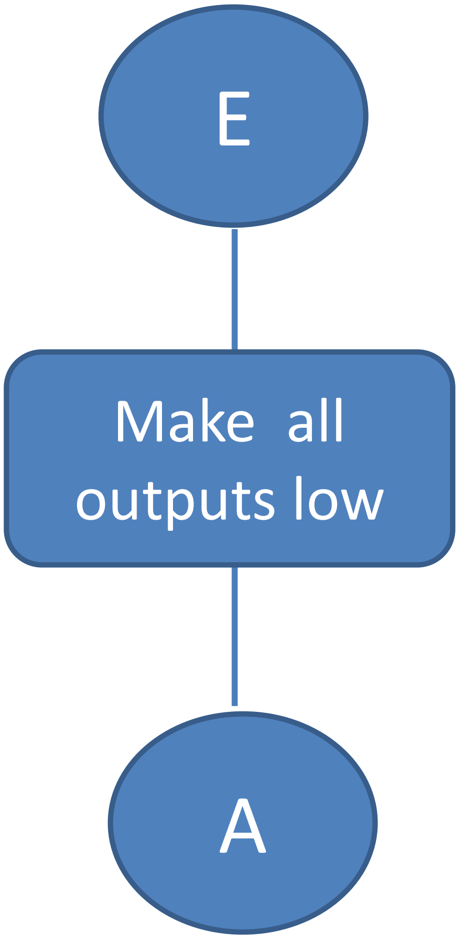
Main Program



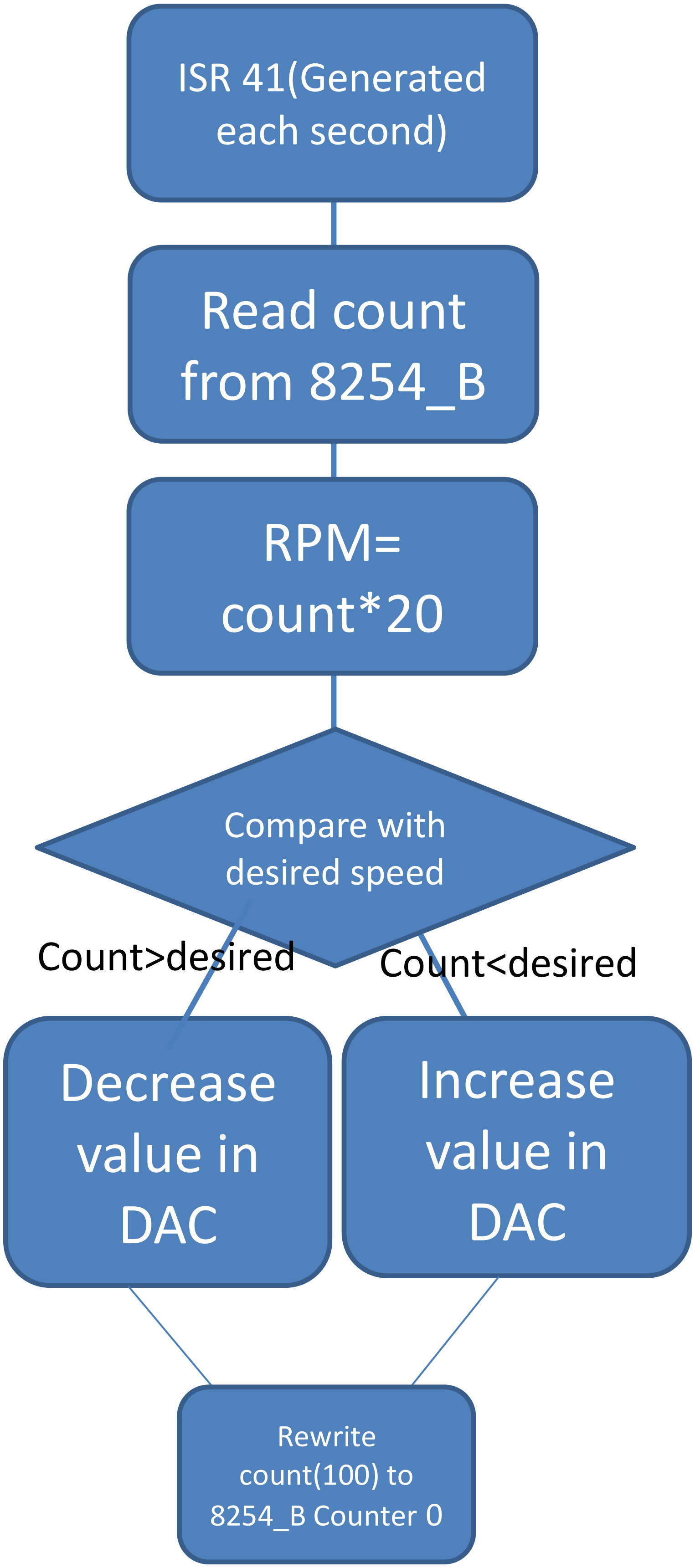
Note: In this part, the desired speed is set. The speed of the fan will be altered gradually till we reach the desired speed. The control mechanism is explained in ISR flowchart



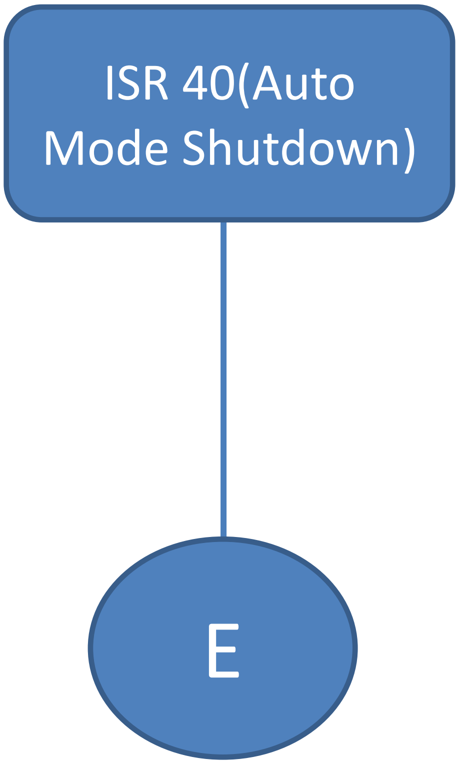

C
Wait for Key Press
Other
Whic
h Key
Keys 1-5
Normal
Initialize 8254_A
Make PC3 low
Make PC3 High
D
Write Count to Timer 1 Counter 0


E
Make all outputs low
A

Flow Chart-ISR



Note: The change in value of DAC is as follows: 1/40*(desired speed-current speed)


ISR 40(Auto Mode Shutdown)
E

Variations in Proteus with Justification

1. As hall sensors and magnets are unavailable in Proteus , we have omitted them from our Proteus design. The hall sensors give a pulse like output. We cannot use a pulse generator either as that would cause the control mechanism to fail. For ex, if the clock generator has a frequency 15Hz, it would be interpreted as 300 rpm. The processor would interpret the fan to be at 300 rpm even if actual value is different.
2. Without hall sensors, we cannot sense the speed, thus , value in DAC has been hardcoded for each speed setting. Timer 2 is not needed anymore, and it is omitted.
3. Single phase induction motor is unavailable in Proteus- we use a DC motor instead.
4. Using 8253 – as 8254 not available in Proteus.
5. Clock is at 2 MHz as the clock generated for 8086 requires a long rise and fall time of clock.
   Thus, 10Khz clock provided to timer , as the 2.5 Mhz we were providing originally is above the maximum limit.
6. As 8259 does not work in proteus, we have connected the interrupt from the timer directly to INTR. As we are using INTR, vector no needs to be provided on data lines. We accomplish this using 2 tri state buffers(74244) which are enabled when INTA goes low.
7. In auto mode, system will shut down in n*5 seconds instead of n hours.

Firmware

Implemented using emu8086 attached.

List of Attachments

1. Complete Hardware Real World Design – onpaperdesign.pdf
2. Manuals
   a. DAC 0808
   b. LF351
   c. A3144
   d. Motor and Motor Speed Controller
3. Proteus File – design.dsn
4. EMU8086 ASM File(code for on paper design) – proj.asm
5. EMU8086 ASM File(code for proteus design)-sim.asm
6. Binary File after assembly – sim.bin