

Smart Power Supply Control System

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Abstract- The system has been designed for logging ON/OFF automatically an electrical equipment multiple number of times. The number of logging sessions depends upon the program burnt into the microcontroller used. As the circuit is fully automatic, manual work required to switch any equipment ON/OFF is not required. To keep track of the time and to switch ON/OFF equipment accordingly, a real time clock (RTC) has been placed in the circuit. As every machine is designed to reduce the human effort, similarly our Smart Power Supply Control System will also diminish the manual work required to operate any equipment. A microcontroller of 8051 series has been interfaced to real time clock (RTC). Once a real time is entered, an electromagnetic switch so called relay will turn the equipment ON/OFF as per the program. Microcontroller 8051 is the heart of the system as it is one that gives command to the relay to do the work accordingly. The function of entering the multiple session time (ON/OFF) has been performed by a matrix keypad and the function of displaying that time has been performed by 7-Segment display used in the circuit.

Index Terms- Smart Systems; Automation; Real time Clock; AT89S52.

1. INTRODUCTION

Smart power supply control system is a reliable circuit that takes over the manual task of switch ON/OFF the electrical devices with respect to time. It uses real time clock (RTC) interfaced to a microcontroller of 8051 families. While the set time equals to the real time, then microcontroller gives command to the corresponding relay to turn ON the load and then another command to switch OFF as per the program. Multiple ON/OFF time entry is the biggest advantage with this paper. A matrix keypad helps entering the time. A 7-segment display is interfaced to the microcontroller to display time. Further the idea can be enhanced by interfacing a GSM modem to the existing project so that the complete control of the load can be done by sending an SMS to the control unit.

2. MICROCONTROLLER AT89S52

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory [1]. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-

flexible and cost-effective solution to many embedded control applications.

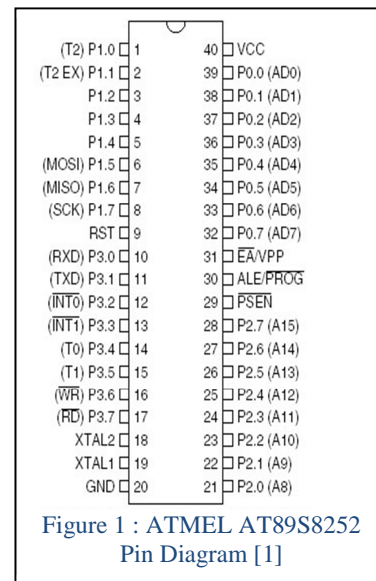


Figure 1 : ATMEL AT89S8252 Pin Diagram [1]

2.1. Features (AT89S52)-

8K Bytes of In-System Programmable (ISP) Flash Memory, Endurance: 10,000 Write/Erase Cycles, 4.0V to 5.5V Operating Range, Fully Static Operation: 0 Hz to 33 MHz, 256 x 8-bit Internal RAM, and 32 Programmable I/O Lines [1].

3. SEVEN SEGMENT DISPLAY

The illustration to the right shows the basic layout of the segments in a seven-segment display. The segments themselves are identified with lower-case letters "a" through "g," with segment "a" at the top and then counting clockwise. Segment "g" is the center bar. Most seven-segment digits also include a decimal point ("dp"), and some also include an extra triangle to turn the decimal point into a comma. This improves readability of large numbers on a calculator, for example. The decimal point is shown here on the right, but some display units put it on the left, or have a decimal point on each side.

In addition, most displays are actually slanted a bit, making them look as if they were in italics. This arrangement allows us to turn one digit upside down and place it next to another, so that the two decimal points look like a colon between the two digits. The technique is commonly used in LED clock displays.

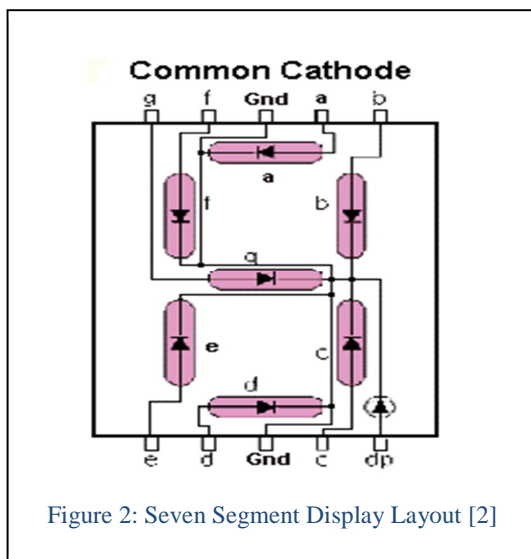


Figure 2: Seven Segment Display Layout [2]

4. POWER SUPPLY

The circuit uses standard power supply comprising of a step-down transformer from 230 V to 12 V and 4 diodes forming a bridge rectifier that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 470 μ F to 1000 μ F. The filtered dc being unregulated, IC LM7805 is used to get 5 V DC constant at its pin no 3 irrespective of input DC varying from 7 V to 15 V. The input dc shall be varying in the event of input ac at 230 volts' section varies from 160 V to 270 V in the ratio of the transformer primary voltage V_1 to secondary voltage V_2 governed by the formula

$$V_1/V_2=N_1/N_2.$$

As N_1/N_2 i.e. no. of turns in the primary to the no. of turns in the secondary remains unchanged V_2 is directly proportional to V_1 . Thus if the transformer delivers 12 V at 220 V input it will give 8.72 V at 160 V. Similarly, at 270 V it will give 14.72 V. Thus the dc voltage at the input of the regulator changes from about 8 V to 15 V because of A.C voltage variation from 160 V to 270 V the regulator output will remain constant at 5 V.

The regulated 5 V DC is further filtered by a small electrolytic capacitor of 10 μ F for any noise so generated by the circuit. One LED is connected of this 5 V point in series with a current limiting resistor of 330 Ω to the ground i.e., negative voltage to indicate 5 V power supply availability. The unregulated 12 V point is used for other applications as and when required.

5. RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts.

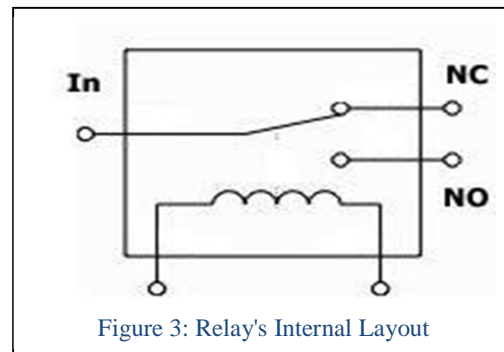
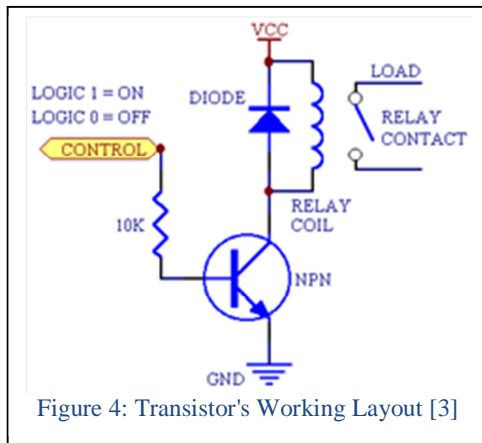


Figure 3: Relay's Internal Layout

6. TRANSISTOR

An NPN transistor is "on" when its base is pulled high relative to the emitter. The arrow in the NPN transistor symbol is on the emitter leg and points in the direction of the conventional current flow when the device is in forward active mode. Whenever base is high, then current starts flowing through base and emitter and after that only current will pass from collector to emitter [3].



7. CONNECTIONS TO 8051

ATMEL series of 8051 family of micro controllers need certain standard connections. The actual number of the Microcontroller could be “89C51”, “89C52”, “89S51”, “89S52”, and as regards to 20 pin configuration a number of “89C2051”. The 4 set of I/O ports are used based on the project requirement. Every microcontroller requires a timing reference for its internal program execution therefore an oscillator needs to be functional with a desired frequency to obtain the timing reference as $t = 1/f$.

A crystal ranging from 2 to 20 MHz is required to be used at its pin number 18 and 19 for the internal oscillator. It may be noted here the crystal is not to be understood as crystal oscillator. It is just a crystal, while connected to the appropriate pin of the microcontroller it results in oscillator function inside the microcontroller. Typically, 11.0592 MHz crystal is used in general for most of the circuits using 8051 series microcontroller. Two small value ceramic capacitors of 33pF each is used.

7.1. Reset

Pin no 9 is provided with a reset arrangement by a combination of an electrolytic capacitor and a register forming RC time constant. At the time of switch on, the capacitor gets charged, and it behaves as a full short circuit from the positive to the pin number 9. After the capacitor gets fully charged the current stops flowing and pin number 9 goes low which is pulled down by a 10k resistor to the ground. This arrangement of reset at pin 9 going high initially and then to logic 0 i.e., low helps the program execution to start from the beginning. In absence of this the program execution could have taken place arbitrarily anywhere from the program cycle.

A pushbutton switch is connected across the capacitor so that at any given time as desired it can be pressed such that it discharges the capacitor and while released the capacitor starts charging again and then pin number 9 goes to high and then back to low, to enable the program execution from the beginning. This operation of high to low of the reset pin takes place in fraction of a second as decided by the time constant R and C.

For example: A $10\mu\text{F}$ capacitor and a $10\text{k}\Omega$ resistor would render a 100ms time to pin number 9 from logic high to low, there after the pin number 9 remains low.

7.2. External Access

Pin no 31 of 40 pin 8051 microcontroller termed as EA is required to be connected to 5V for accessing the program form the on-chip program memory. If it is connected to ground, then the controller accesses the program from external memory. However, as we are using the internal memory it is always connected to +5V.

7.3. Interconnections

The output of the power supply which is 5v is connected to the 40 pin of MC & GND is connected to its 20 pin. Pin's 1 to 6 of MC are given to 1, 3, 5, 8,10,12 pins of inverter IC 74LS04 & the output pins of the inverter IC 2,4,6,9,11,13 are given to input pins of 1,2,3,4,5,6 of relay driver IC. ULN2003A.

Pin 14 of 74LS04 and 9 of ULN2003A are given to 5v supply. Pin 7 of 74LS04 and 8 of ULN2003A are given to GND. Pin's 15 & 10 of ULN2003A are given to relay's. Pin's 11 to 14 of MC are given to Rows A, B, C, D of Matrix keypad. Pin's 15 to 17 of MC are given to 1, 2, 3 columns of keypad. Pin's 3, 4 of RTC IC DS1307 are given to 3 V battery. Pin 1, 2 of IC DS1307 are given to Crystal Oscillator 32.788KHz pins of MC. Pin's 7, 8 of IC DS1307 are given to collector of Transistor Q4 that drive's fourth seven segment display. Pin's 26 to 32 of MC are given to bare terminals of transistor's Q1 to Q4. Pin's 33 to 39 of MC are given to anodes of multiple seven segment display.

8. WORKING

The project uses one real time clock IC DS1307 i.e., interface to the MC pin 27 & 28. A matrix keypad is used for setting the time, relay ON time & OFF time. The relay is driven by pin 25 of MC through driving transistor BC547. Seven segment LEDs are parallel connected to Port 0 through driving transistors BC547 to the respective, anode of seven segment LED display as per the operation which is explained above and the operation procedures.



Figure 5: System, when real time (ex- 11:00) is entered

Enter the Current real time using keypad. Then press '#' to store the real time. After that press '*' display shows all dashes. Then enter the 1st ON time of load. After that press '*' to save the 1st ON time. Then press '*' display shows all dashes. After that enter the 1st OFF time of load. Then press '*' to save the 1st OFF time. Continue this procedure for 3 ON times & 3 OFF times. Then press '*' to get the real time.



Figure 6: System gets ON after required time interval (ex- after 1 min i.e., 11:01)

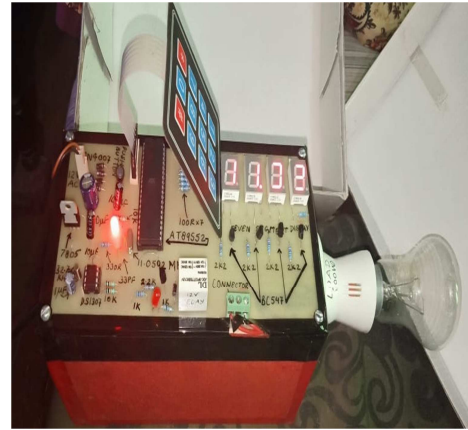


Figure 7: System gets OFF after required time interval (ex- after 1 min i.e., 11:02)

9. CONCLUSION

Present day most of the power supply operations are carried out manually. The main disadvantage of this is that one person has to be alert for this. To overcome from this, we decided to prepare the circuit which is operated automatically and thus reduce human efforts and also save electricity. Due to automatic system, the operation is reliable, provides fixed and accurate time, have fast response to disturbances, time editable facility is available and its compact in size so takes less space.

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