MICROPROCESSOR RELAY FOR PROTECTION OF ELECTRICAL SYSTEMS

V.LALITH KUMAR, IV-EEE

S.T.I.C, GARIVIDI, VZM DT.

INTRODUCTION:

Modern power systems have a high degree of reliability. Power system design together with proper operation and maintenance practices, decreases the probability of electrical failure but cannot exclude them completely. Hence a power system requires a real time embedded system, which operates within strict time deadlines. According to the type of electrical faults real time operations can be differentiated. In the first case, abnormal conditions like overloading of electrical equipment it is not always necessary to have quick operation of protective relaying. For such conditions slow real time operations are suitable. In the second case, electrical failures like short circuit fault causes excessive heating and damage of the equipment. So, this effect can be decreased by reducing the fault period, hence high speed real time operation is very desirable.

MODELING OF MICROPROCESSOR BASED RELAY:

Microprocessor based relay can also be referred to as numeric relays or Programmable relays. These relays are extensively used in industries. The main advantage of using this relay is its capability of replacing all specific purpose relays by a single microprocessor based relay can be used for protection against various faults like over current, over voltage, thermal overload etc by just modifying the program.

Relay Driver Interface circuit:

This 8085 kit based interface circuit controls 64 relays. The 8085 kit has 8255 programmable peripheral interface IC, whose ports have been extended via suitable connectors. The 8255 have been configured for mode'0' operation. Ports A, B and C of 8255 are configured as output ports using control word 80hex.

The various outputs of 8255 after buffering by 74LS244 are used as follows:

PA0: Connected to pin 13 of IC 74LS259 for relay switching (Logic1 for 'on' and logic0 for 'off')
PB0, PB1, PB2: As address for IC 74259 to select up to eight different relay numbers.
PC0, PC1, PC2: As address for IC 74138 to select up to eight different IC 74259.

The interface circuit comprises of 1-of-8 demultiplexer IC74138, octal buffer / driver IC74244 and IC74259 (configured here as 8 bit addressable latch). The supply for these IC's is taken from the 8085 kit itself. For relays, an external 12V supply is used.

Octal buffer IC 74244 has open collector outputs. It is used as a buffer for outputs from 8255.The relay on/off information available PA0 pin of port A is used as data input at pin 13 of IC 74259.The three bits PB0 through PB2 are used as 3-bit address for IC 74259.

IC 74259 is used here in 8-bit addressable latch mode. In this mode the data at its pin 13 corresponds to the data for the selected output (1='on' 0='off'). The remaining outputs are not effected and stay in their previous state, so the other relays controlled by these pins are not affected. The 3-bit data at PC0 through PC2 are used as a 3-bit address for 1-0f-8 multiplexer IC 74138.The output at pin 15 is used as chip select line for IC 74259.Similarly, it is possible to connect the remaining seven outputs as chip select lines for other seven 74259 ICs. So a total of 64 relays can be controlled. The relays are controlled via relay driver transistors 2N2222.If the input voltage to the base is low, the transistor remains turned off, while logic 1 output activates the relay. A diode in parallel with the relay coil protects the transistor from the high voltage induced in the relay coil during its turn-off period. When the 8085 program for relay selection is executed in the kit, the display shows 'code'. Enter the code (1 for switching on of relay and 0 for switching it off) and press 'next'. Now the display shows 'num'. Enter the relay number (from 00 to 64 can be used if all ICs and relays are in place) and press 'next'. The corresponding relay will be activated, with the relay number also displayed in the kit. For addressing peripheral devices the I/O mapped address scheme is employed in the kit. The ckt diagram is shown in fig 1.

Feedback circuit for over voltage protection:

The feedback interface circuit as shown in figure2 is used to sense over voltages and send corresponding signals as inputs to the microprocessor. It comprises of a diode bridge (800V, 6A). A capacitor (1000uf, 63V) which is used to filter D.C output, a comparator IC LM 393.External +5V supply is given to thin IC. Two such circuits are used

for over voltage protection of two loads. The load used is a resistive load (24V A.C bulb). The feedback is taken from the input. The feedback A.C voltage is given to the diode bridge, which rectifies the variable A.C voltage to the variable D.C voltage. This variable is filtered using a capacitor of rating 1000uf; 63v.A 670W resistor is used across the capacitor for fast discharging of the variable D.C voltage. The rectified D.C output is dropped to the required value using a variable resistor (10kW). A comparator LM 393 is used to compare the variable D.C voltage with a reference voltage. If the variable D.C voltage exceeds the reference voltage the output goes high else it remains in the low state. The feedback circuit connected to the second load works in the same manner. Now, the outputs of both the comparators are given as inputs to 74138 IC. The outputs of this IC are given as inputs to the microprocessor through 8255 programmable peripheral interface IC.

Testing of relay for two loads:

Probable conditions for occurrence of fault:

Legend: N-normal operation.

F -fault.

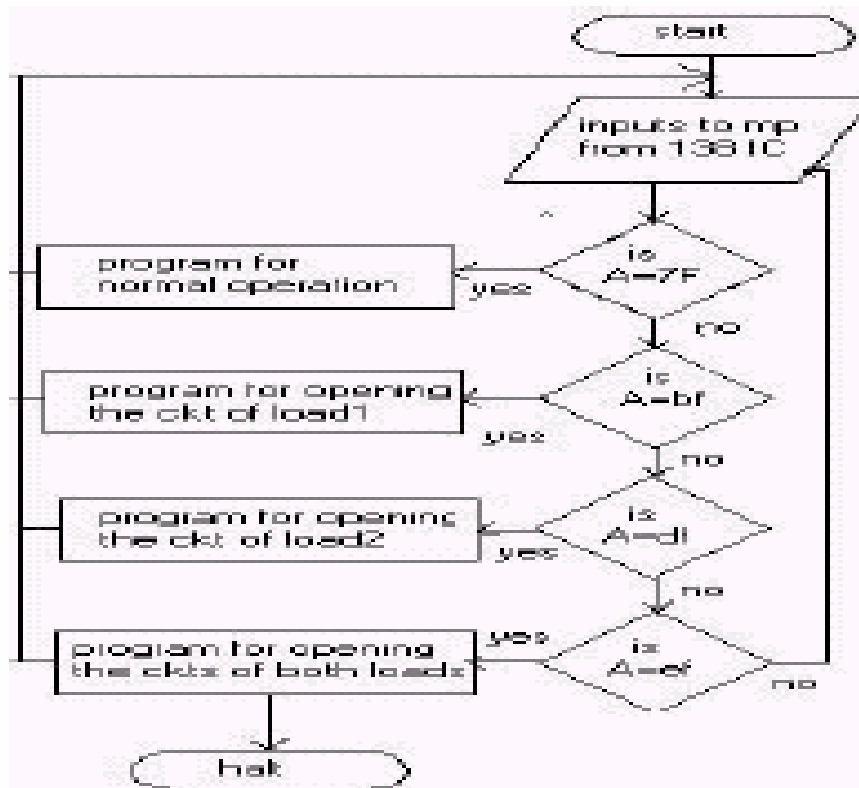| LOAD 1	LOAD 2
N	N
N	F
F	N
F	F

This relay works for all above conditions in any sequence for any number of times. To test the functionality of the relay an over voltage fault was created using an autotransformer. The inputs of the 74138 IC (from the comparator LM 393) and the outputs of this IC are shown in the following table. These outputs act as inputs to the microprocessor. The microprocessor produces the corresponding output to the relay driver circuit, which in turn disconnects the load from the source.

INPUT			OUTPUT								He
0	0	0	0	1	1	1	1	1	1	1	7F
0	1	0	1	0	1	1	1	1	1	1	bF
1	0	0	1	1	0	1	1	1	1	1	dF
1	1	0	1	1	1	0	1	1	1	1	ef

FLOWCHARTS:

Instantaneous tripping:

The logic for the instantaneous tripping is shown by the flowchart.

Time delay tripping:

    Delay calculations:

        The time delay in the loop TL with 3.072 MHz clock frequency is calculated as TL=(T*loop T -states*N10).
Where TL = time delay in the loop. T = system clock period. N10 = equivalent decimal numbers of the hexadecimal count loaded in the delay register. TL = 21 T-states T (clock period)*count. Time delay for 100 ms: 100mS = 21*.325*10e-6*count. Count = 393C(Hex).

RESULTS:

        This paper presents two modules. The first module consisted of the design, fabrication and testing of the relay driver interface circuit and also the development of program for control of 64 relays. At the end of each phase, it was necessary to obtain switching of relays depending upon the input conditions given, i.e. 00 for relay turn-off, 01 for turn- on of the relay and the corresponding relay number. The first module has been designed, fabricated and tested for the above output. The second module consisted of the design, fabrication and testing of the feedback circuit, which was connected to the relay driver interface circuit and the development of program for over voltage protection. At the end of this phase it was necessary to disconnect any of the loads instantaneously if the voltage exceeds the predetermined value. The second module has been designed, fabricated and tested for the above output. The output is also verified for time delay tripping.
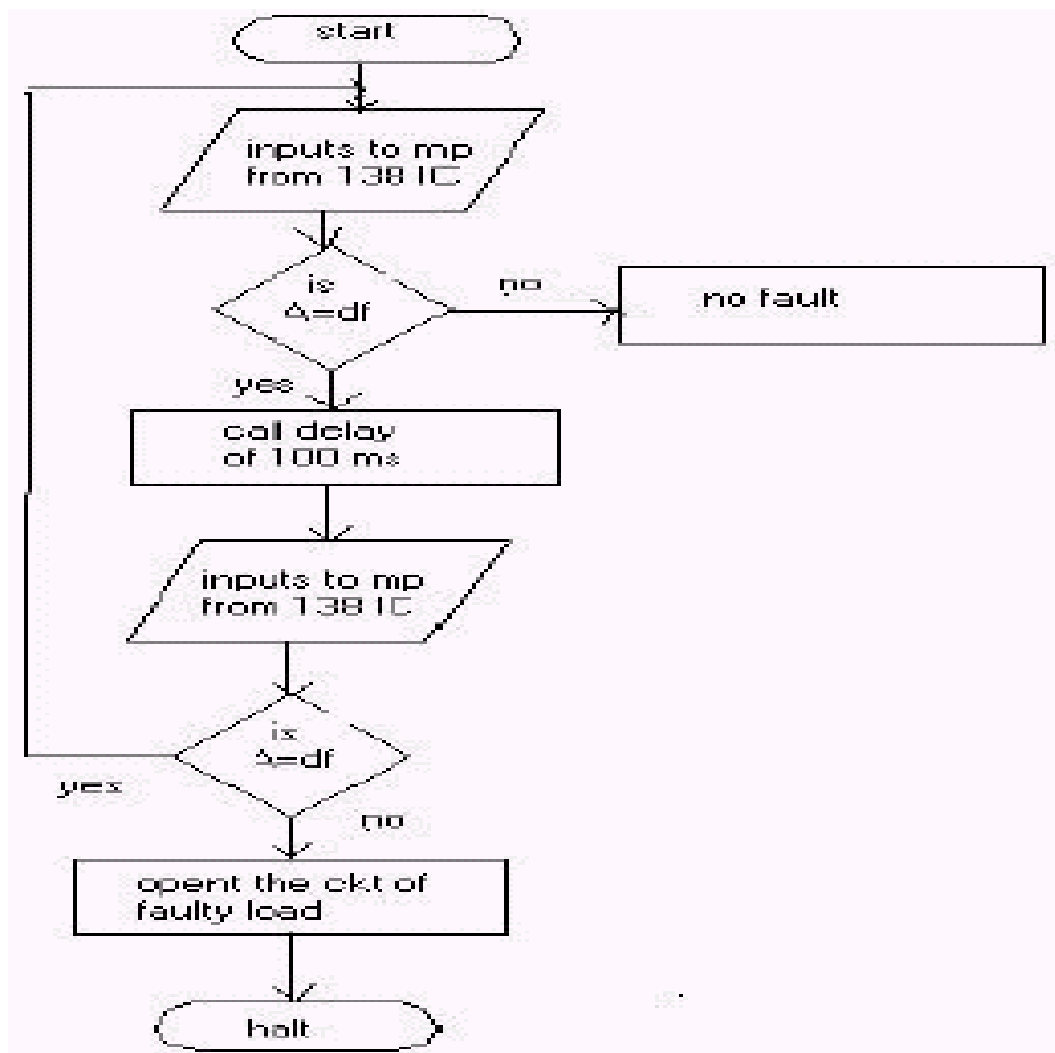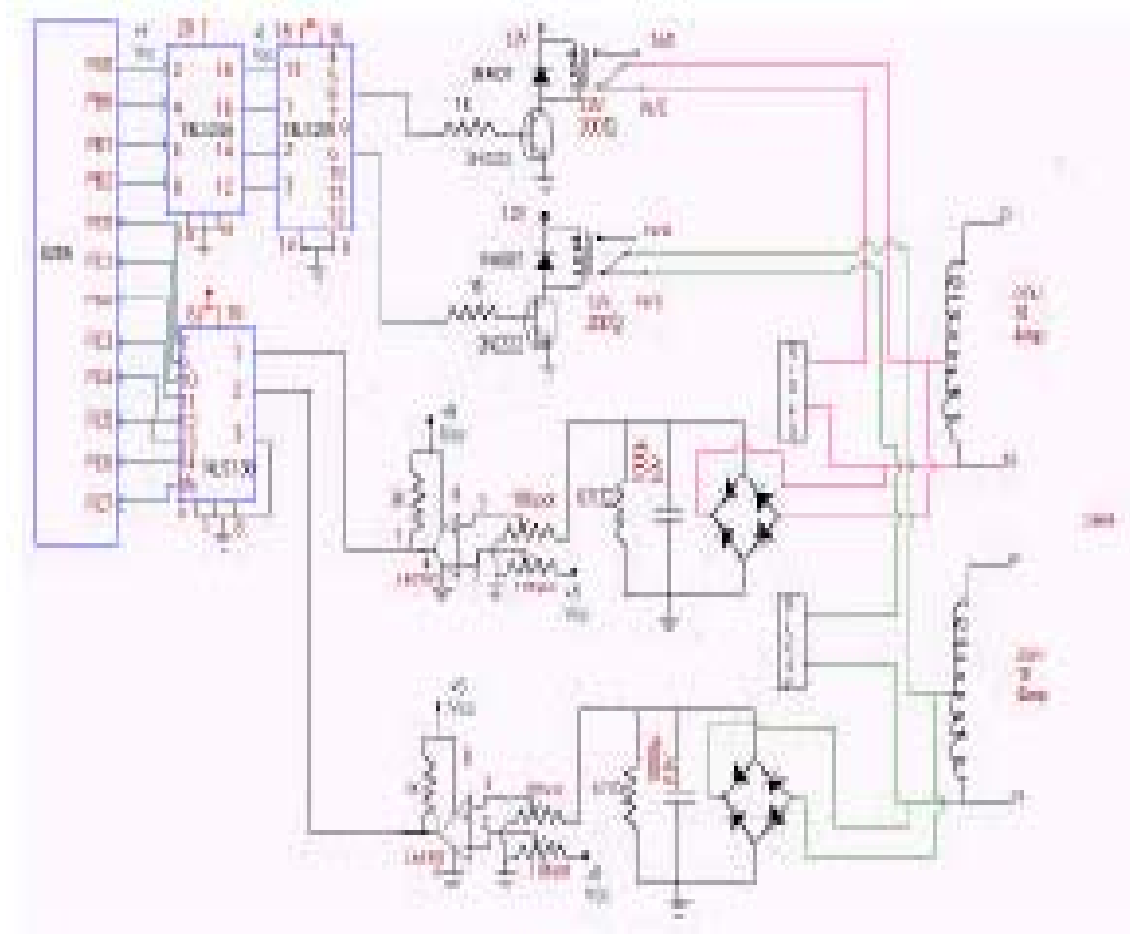
FIGURE 1:

FIGURE 2:

CONCLUSION:

The first module was constructed and tested for control of 64 relays. This module was interfaced with 8085 microprocessor and the program was executed successfully. The second module that contained the feedback circuit in addition to relay driver interface circuit was also fabricated and tested. The relays were successfully operated for over voltages. There is a lot of scope for further development of this module. The above circuit can be used for sensing various faults by changing the logic of the program accordingly.

REFERENCES:

1.Microprocessor architecture, programming and applications, by Ramesh. S. Gaonkar; new age international publishers, 2nd Edition
2.Microprocessor programming and interfacing, Doughlas V. Hall, TMH publications.
3.Advanced Microprocessors and peripherals, A.K.Ray, K.M.Bhurchandi TMH publications.