CIRCUIT BREAKER USING PASSWORD

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1. ABSTRACT:

Nowadays, electrical accidents to the line man are increasing, while repairing the electrical lines due to the lack of communication between the electrical substation and maintenance staff. This project gives a solution to this problem to ensure line man safety. In this proposed system the control (ON/OFF) of the electrical lines lies with line man. This project is arranged in such a way that maintenance staff or line man has to enter the password to ON/OFF the electrical line. Now if there is any fault in electrical line then line man will switch off the power supply to the line by entering password and comfortably repair the electrical line, and after coming to the substation line man switch on the supply to the particular line by entering the password.

Keywords: *Circuit Breaker Communication, substation*

2. INTRODUCTION:

In order to avoid such accidents, the circuit breaker can be so designed such that only authorized person can operate it with a password. Here, there is also a provision of changing the password. The system is fully controlled by the 8 bit microcontroller of 8051 family. The password is stored in an EEPROM, interfaced to the microcontroller and the password can be changed any time unlike a fixed one burnt permanently on to the microcontroller. A keypad is used to enter the password and a relay to open or close circuit breaker, which is indicated by a lamp. Any wrong attempt to open the breaker (by entering the wrong password) an alert will be actuated, indicated by another lamp.

The main component in the circuit is 8051 microcontroller. In this project 4×3 keypad is used to enter the password. The password which is entered is compared with the predefined password. If entered password is correct then the corresponding electrical line is turned ON or OFF. In this project a separate password is provided to each electrical line. Activation and deactivation of the line (circuit breaker) is indicated by the load.

LCD data pins are connected to PORT2 and control pins RS, RW, EN pins are connected P3.5, P3.6 and P3.7 respectively. Here LCD is used to display the information. Keypad is connected to PORT1 of the controller. Using this keypad we need to enter the password. Lamps are connected to P0.0, P3.1, P3.2 and P3.3 through the relays. These are used to indicate circuit breaker state. AC load should be connected to *COM* and *NO* (Normally open) pins. 5V relays are used to drive the AC loads.
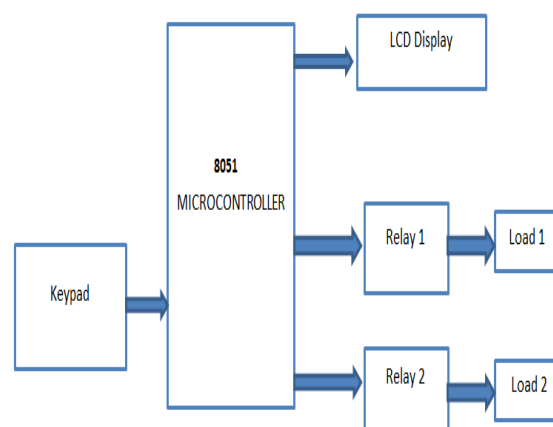
3 BLOCK DIAGRAM:

Figure 3.1 Block Diagram

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3.1 8051 MICROCONTROLLER

It is 8-bit microcontroller, means MC 8051 can Read, Write and Process 8 bit data. This is mostly used microcontroller in the robotics, home appliances like mp3 player, washing machines, electronic iron and industries. [3]

- 4 KB on chip program memory.
- 128 bytes on chip data memory (RAM).
- 128 user defined software flags.
- 8-bit data bus
- 16-bit address bus
- 32 general purpose registers each of 8 bits
- 16 bit timers (usually 2, but may have more, or less).
- 3 internal and 2 external interrupts.
- Bit as well as byte addressable RAM area of 16 bytes.
- Four 8-bit ports, (short models have two 8-bit ports).
- 16-bit program counter and data pointer.
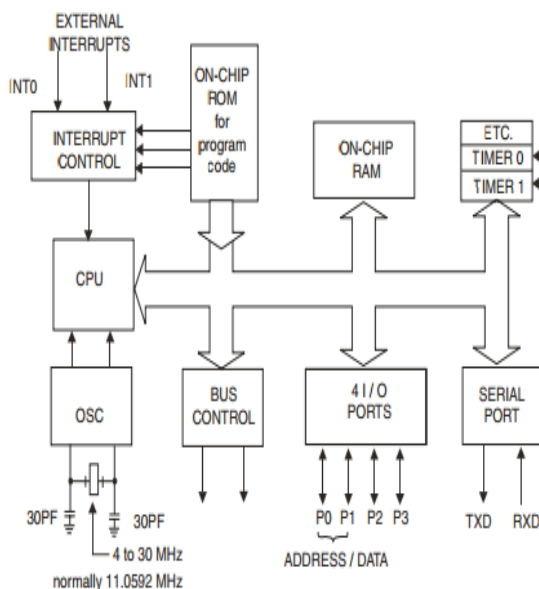- 1 Microsecond instruction cycle with 12 MHz Crystal

Figure 3.2 Block diagram of 8051 Microcontroller

3.1.1 PIN CONFIGURATION:

The description of each pin is given as follows [5]

- • VCC → 5V supply
- • VSS → GND
- • XTAL2/XTALI are for oscillator input
- • Port 0 – 32 to 39 – AD0/AD7 and P0.0 to P0.7
- • Port 1 – 1 to 8 – P1.0 to P1.7
- • Port 2 – 21 to 28 – P2.0 to P2.7 and A8 to A15
- • Port 3 – 10 to 17 – P3.0 to P3.7
- • P 3.0 – RXD – Serial data input – SBUF
- • P 3.1 – TXD – Serial data output – SBUF
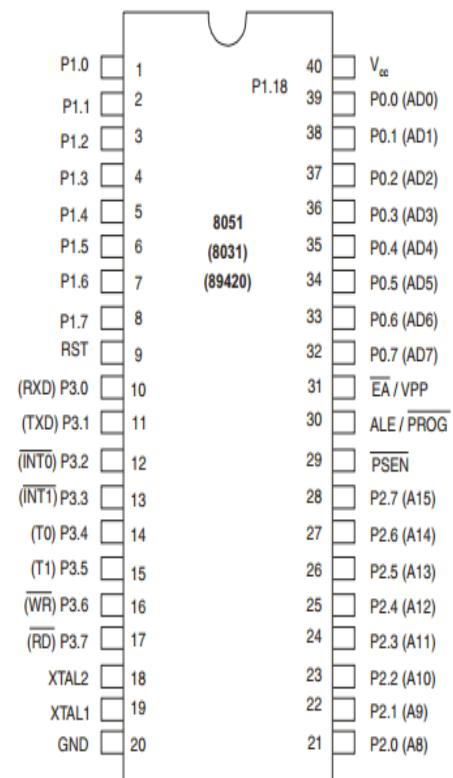- • P 3.2 – INT0 – External interrupt 0 – TCON 0.1

Figure 3.3 Pin configuration

- • P 3.3 – INT1 – External interrupt 1 – TCON 0.3
- • P 3.4 – T0 – External timer 0 input – TMOD

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- • P 3.5 – T1 – External timer 1 input – TMOD
- • P 3.6 – WR – External memory write cycle – Active LOW
- • P 3.7 – RD – External memory read cycle – Active LOW
- • RST – for Restarting 8051
- • ALE – Address latch enable 1 – Address on AD 0 to AD 7 0 – Data on AD 0 to AD 7
- • PSEN – Program store enable
- For describing pin diagram and pin configuration of 8051, we are taking into consideration a 40 pin DIP (Dual inline package). Now let's go through pin configuration in detail.

- **Pin-40:** Named as Vcc is the main power source. Usually its +5V DC.
- You may note some pins are designated with two signals (shown in brackets).
- **Pins 32-39:** Known as Port 0 (P0.0 to P0.7) – In addition to serving as I/O port, lower order address and data bus signals are multiplexed with this port (to serve the purpose of external memory interfacing). This is a bi directional I/O port (the only one in 8051) and external pull up resistors are required to function this port as I/O.
- **Pin-31:-** ALE aka Address Latch Enable is used to demultiplex the address-data signal of port 0 (for external memory interfacing.) 2 ALE pulses are available for each machine cycle.
- **Pin-30:-** EA/ External Access input is used to enable or disallow external memory interfacing. If there is no external memory requirement, this pin is pulled high by connecting it to Vcc.
- **Pin- 29:-** PSEN or Program Store Enable is used to read signal from external program memory.
- **Pins- 21-28:-** Known as Port 2 (P 2.0 to P 2.7) – in addition to serving as I/O port, higher order address bus signals

are multiplexed with this quasi bi directional port.

- **Pin 20:-** Named as Vss – it represents ground (0 V) connection.
- **Pins 18 and 19:-** Used for interfacing an external crystal to provide system clock.
- **Pins 10 – 17:-** Known as Port 3. This port also serves some other functions like interrupts, timer input, control signals for external memory interfacing RD and WR, serial communication signals RxD and TxD etc. This is a quasi bi directional port with internal pull up.
- **Pin 9:-** As explained before RESET pin is used to set the 8051 microcontroller to its initial values, while the microcontroller is working or at the initial start of application. The RESET pin must be set high for 2 machine cycles.
- **Pins 1 – 8:-** Known as Port 1. Unlike other ports, this port does not serve any other functions. Port 1 is an internally pulled up, quasi bi directional I/O port.

3.2 POWER SUPPLY

A power supply is a device which delivers an exact voltage to another device as per its needs. There are many power supplies available today in the market like regulated, unregulated, variable etc, and the decision to pick the correct one depends entirely on what device you are trying to operate with the power supply. Power supplies, often called power adapters, or simply adapters, are available in various voltages, with varying current capacities, which is nothing but the maximum capacity of a power supply to deliver current to a load (Load is the device you are trying to supply power to).

3.2.1 Requirements
1. Copper wires, with at least 1A current carrying capacity for AC mains
2. Step Down Transformer
3. 1N4007 Silica Diodes (×4)

4. 1000µF Capacitor
5. 10µF Capacitor
6. Voltage regulator (78XX) (XX is the output voltage reqd. I'll explain this concept later)
7. Soldering iron
8. Solder
9. General Purpose PCB
10. Adapter jack (to provide the output voltage to a device with a particular socket)
11. 2 Pin plug

3.2.2 Transformers

Transformers are devices which step down a relatively higher AC input Voltage into a lower AC output voltage. To find the input and output terminals of a transformer is very tricky. Refer to the following illustration or the internet to understand where what is. [4]
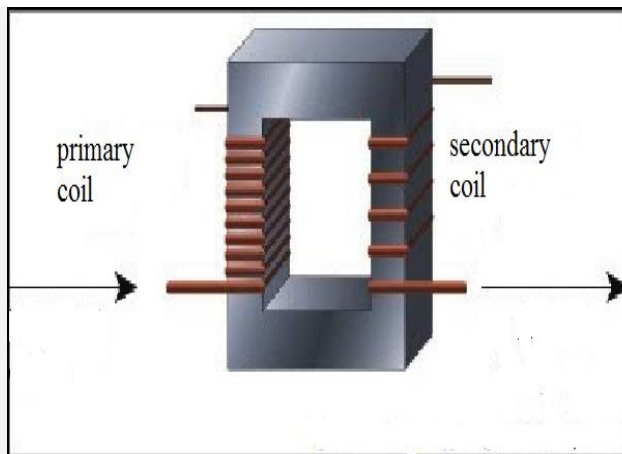

Fig 3.4: I/O Terminals of a Transformer

Basically, there are two sides in a transformer where the coil winding inside the transformer ends. Both ends have two wires each (unless you are using a center-tapped transformer for full wave rectification). On the transformer, one side will have three terminals and the other will have two. The one with the three terminals is the stepped down output of the transformer, and the one with the two terminals is where the input voltage is to be provided [10].

3.2.3 Voltage Regulators

The 78XX series of voltage regulators is a widely used range of regulators all over the world. The XX denotes the voltage that the regulator will regulate as output, from the input voltage. For instance, 7805 will regulate the voltage to 5V. Similarly, 7812 will regulate the voltage to 12V. The thing to remember with these voltage regulators is that they need at least 2 volts more than their output voltage as input. For instance, 7805 will need at least 7V, and 7812, at least 14 volts as inputs. This excess voltage which needs to be given to voltage regulators is called **Dropout Voltage**.

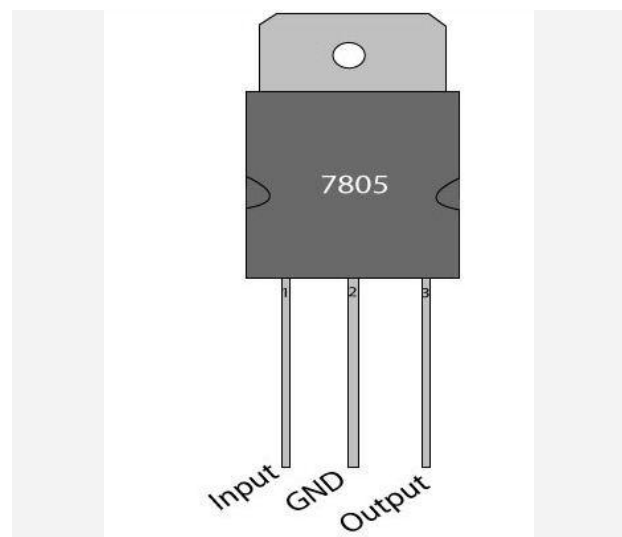**NOTE:** The input pin is denoted as '1', ground as '2' and output as '3'.

Fig3.5: Voltage Regulator Schematic

3.2.4 Diode Bridge

A bridge rectifier consists of an assembly of four ordinary diodes, by means of which we can convert AC Voltage into DC Voltage. It is found to be the best model for AC to DC conversion, over Full wave and half wave rectifiers. You can use any model you want, but I use this for the sake of high efficiency (If you are using the full wave rectifier model, you'll need a center-tapped transformer, and you will only be able to use half of the transformed voltage).
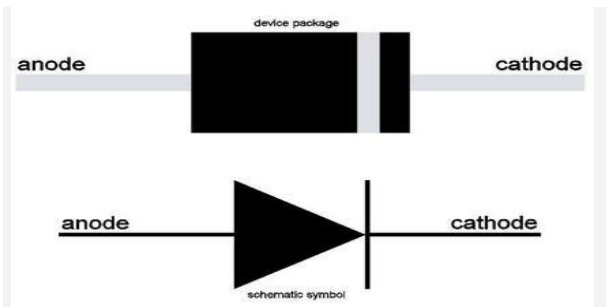
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Fig 3.6: Schematic and Illustration of a Diode

3.2.4 Filter Circuit

We filter, both the input and output of the voltage regulator in order to get the smoothest DC Voltage as possible, from our adapter, for which we use capacitors. Capacitors are the simplest current filters available, they let AC current pass through and block DC, so they are used in parallel to the output. Furthermore, if there is a ripple in the input or output, a capacitor rectifies it by discharging the charge stored in it.
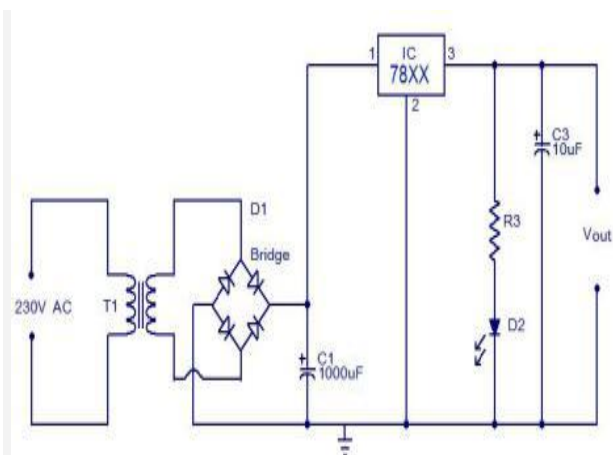

Fig 3.7: *Circuit Diagram*

The AC mains are fed to the transformer, which steps down the 230 Volts to the desired voltage. The bridge rectifier follows the transformer thus converting AC voltage into a DC output and through a filtering capacitor feeds it directly into the input (Pin 1) of the voltage regulator. The common pin (Pin 2) of the voltage regulator is grounded. The output (Pin 3) of the voltage

regulator is first filtered by a capacitor, and then the output is taken.

Make the circuit on a general purpose PCB and use a 2 Pin (5A) plug to connect the transformer input to the AC mains via insulated copper wires.[6]

3. 3 RELAY:

We know that most of the high end industrial application devices have relays for their effective working. Relays are simple switches which are operated both electrically and mechanically. Relays consist of a n electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays

The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. The high end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.

3.3.1 Relay design

There are four main parts in a relay. They are

- Electromagnet
- Movable Armature
- Switch point contacts
- Spring

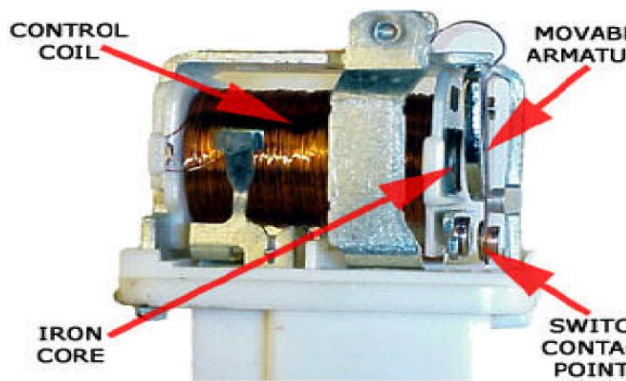The figures given below show the actual design of a simple relay.

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Fig 3.8: Relay Construction

It is an electro-magnetic relay with a wire coil, surrounded by an iron core. A path of very low reluctance for the magnetic flux is provided for the movable armature and also the switch point contacts. The movable armature is connected to the yoke which is mechanically connected to the switch point contacts. These parts are safely held with the help of a spring. The spring is used so as to produce an air gap in the circuit when the relay becomes de-energized
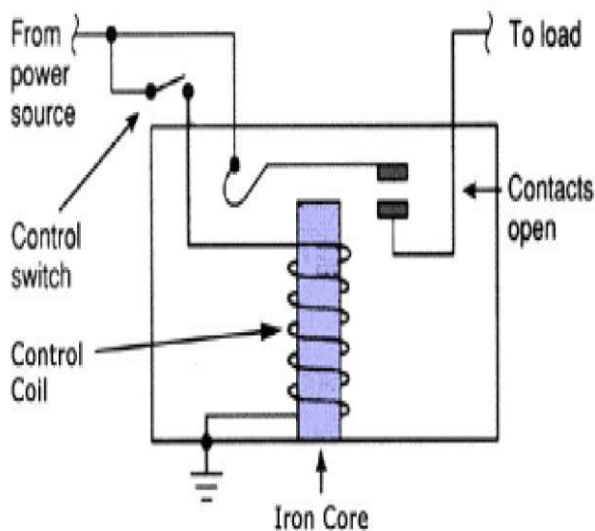

Fig 3.9: Relay Design

The diagram shows an inner section diagram of a relay. An iron core is surrounded by a control coil. As shown, the power source is given to the electromagnet through a control switch and through contacts to the load. When current starts flowing through the control coil, the electromagnet starts energizing and thus intensifies the magnetic field. Thus the upper contact arm starts to be attracted to the lower

fixed arm and thus closes the contacts causing a short circuit for the power to the load. On the other hand, if the relay was already de-energized when the contacts were closed, then the contact move oppositely and make an open circuit.

As soon as the coil current is off, the movable armature will be returned by a force back to its initial position. This force will be almost equal to half the strength of the magnetic force. This force is mainly provided by two factors. They are the spring and also gravity. Relays are mainly made for two basic operations. One is low voltage application and the other is high voltage. For low voltage applications, more preference will be given to reduce the noise of the whole circuit. For high voltage applications, they are mainly designed to reduce a phenomenon called arcing.

3.4 KEYPAD:

4x4 Matrix Membrane Keypad, this 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications.

Fig 3.10: Keypad

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3.4.1 Features

➢ Ultra-thin design

➢ Adhesive backing

➢ Excellent price/performance ratio

➢ Easy interface to any microcontroller

➢ Example programs provided for the BASIC Stamp 2 and Propeller P8X32A microcontrollers

3.4.2 Key Specifications

➢ Maximum Rating: 24 VDC, 30 mA

➢ Interface: 8-pin access to 4x4 matrix

➢ Operating temperature: 32 to 122 °F (0 to 50°C)

➢ Dimensions: Keypad, 2.7 x 3.0 in (6.9 x 7.6 cm) Cable: 0.78 x 3.5 in (2.0 x 8.8 cm)

3.4.3 Application Ideas

➢ Security systems

➢ Menu selection

➢ Data entry for embedded systems

Matrix keypads use a combination of four rows and four columns to provide button states to the host device, typically a microcontroller. Underneath each key is a pushbutton, with one end connected to one row, and the other end connected to one column.

4. OPERATION:

For the operation of circuit breaker through a password, program is written in keil software and created into a .hex file that is further burnt onto the controller with the help of flash magic. Connections are given as per the circuit diagram. While giving the connections, it should be made sure that there is no common connection between AC and DC supplies.5V power supply circuit is to be used to provide regulated 5V DC to the controller. Now both the AC and DC supplies are switched on. Relay output pins gets 230V, so they should not be touched. LCD displays "enter password".

Enter the password with the help of keypad, you can see '*' for each digit. Now if the password is correct then the circuit breaker state changes and displays status line on the LCD screen. If the password is wrong then it displays "access denied".
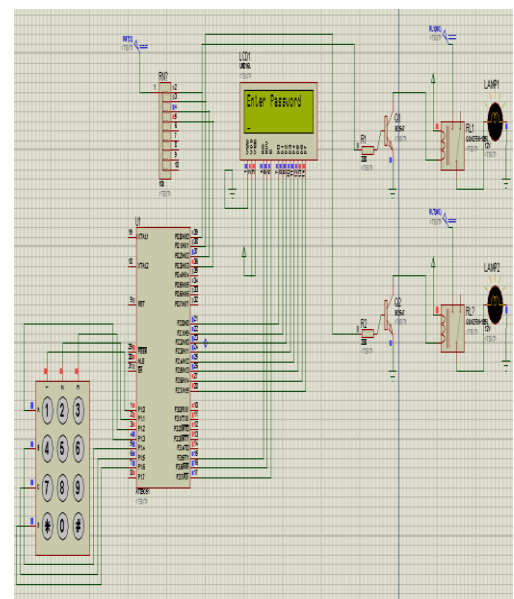

Figure 4.1 schematic diagram

Since this is a user changeable one, to change the password click on '*', '#'. It will display 'enter password'. Here the circuit is provided with a master code that is used to access the circuit by anyone.

For changing the password, this master code is to be entered. Then after entering the master code, LCD displays, 'new password'. Now any password of will can be entered. After that it displays 'confirm password' i.e., the new entered password is going to be stored and the person can change the status of circuit breaker only by this new password.

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5. APPLICATIONS AND ADVANTAGES

5.1 Applications:

- Used in electrical substations to ensure line man safety
- This system is used in buildings and houses
- Used in hotels and shopping malls to save the power.

5.2 Advantages:

- Avoids electrical accidents to line man
- Project is simple and easy
- Uses commonly available components

6. RESULTS

This proposed system provides a solution, which can ensure the safety of the maintenance staff e.g. line man. The control to turn ON/OFF the line lies with the line man only. This system has an arrangement such that a password is required to operate the circuit breaker (ON/OFF). Line man can turn off the supply and comfortably repair it, and return to the substation, then turn on the line by entering the correct password. Since it has the provision of changing the password, person can give any password of his will and have his work done safer.

PASSWORD	Load
6777	Load 1
4567	Load 2
6778	Load 3
6789	Load4

Table 6.1 passwords and loads

The status of device when all loads are OFF is shown in fig 6.1
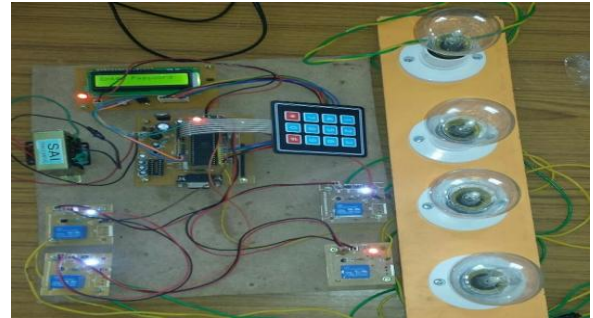

Figure 6.1 all loads are OFF

INPUT=6777   OUTPUT=LOAD 1 ON

When password "6777" is pressed, then first load turns ON as it corresponds to first load and it is shown in fig 6.2. In the same way if again the same password is pressed then first load turns OFF.

Figure 6.2 load 1 ON

7. CONCLUSION:

- ❖ It can work on a single given known password

- ❖ The password to operate can be changed and system can be operated efficiently with the changed password
- ❖ No other person can reclose the breaker once the changed password is given into system other than the person who had changed it.

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❖ It gives no scope of password stealing. It is effective in providing safety to the working staff
❖ It is economical
❖ It can be easily installed

The system is fully controlled by a microcontroller from 8051 family. A matrix

8. FUTURE SCOPE:

❖ Further the project can be enhanced by using an EEPROM for user to change the password for a more secured system.

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keypad is interfaced to the microcontroller to enter the password. The entered password is compared with the password stored in the ROM of the microcontroller. If the password entered is correct, then only the line can be turned ON/OFF. Activation / deactivation of the circuit breaker is indicated by a lamp (ON/OFF).

❖ It can also be interfaced with a GSM modem for remotely controlling the electronic circuit breaker via sms.