Password Based Circuit Breaker

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Abstract: The password based circuit breaker control system is a system that access only specified password to control the circuit breaker. Here, there is also a provision of changing the password. The system is fully controlled by the 8 bit microcontroller from 8052 family which has an 8KB of ROM for the program memory. A matrix keypad is interfaced to the microcontroller to enter the password while a relay driver IC is used to switch ON / OFF the loads through relays. The complete circuit is built with on board power supply. The power supply consists of a step down transformer 230/12V, which steps down the voltage to 12V AC. This is converted to DC using a Bridge rectifier. The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator which is required for the operation of the microcontroller and other components.

Keywords: Microcontroller, Voltage regulator, Relay, Relay Driver.

1. Introduction

Power System fault is defined as undesirable condition that occurs in the power system. These undesirable conditions such as short circuit, current leakage, ground short, over current and over voltage. Power system protection is the most important requirement in the industrial or domestic electrical to prevent equipment from damage cause by leakage current. The project is designed to control a circuit breaker by using a password for the safety of electric man. Critical electrical accidents to line men are on the rise during electric line repair due to lack of communication and co-ordination between the maintenance staff and electric substation staff. This proposed system provides a solution that ensures safety of maintenance staff or line man. The control to turn on/off the line will be maintained by the line man only because this system has an arrangement such that a password is required to operate the circuit breaker (on/off). This system is fully controlled by a microcontroller from the 8051 family. A matrix 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.

2. Description

Microcontroller

A microcontroller is an integrated circuit or a chip with a processor and other support devices like program memory, data memory, I/O ports, serial communication interface etc integrated together. The general schematic diagram of 8051 microcontroller is shown in fig. There are 3 system inputs, 3 control signals and 4 ports (for external interfacing). A Vcc power supply and ground is also provided. System inputs are necessary to make the microcontroller functional. So the first and most important of this is power, marked as Vcc with a GND (ground potential). Without proper power supply, no electronic system would work. XTAL 1 and XTAL 2 are for the system clock inputs from crystal clock circuit. RESET input is required to initialize microcontroller to default/desired values and to make a new start. There are 3 control signals, EA, PSEN and ALE. These signals known as External Access (EA), Program Store Enable (PSEN), and Address Latch Enable (ALE) are used for external memory interfacing.

Voltage Regulator

Voltage sources in a circuit may have fluctuations resulting in not giving fixed voltage outputs. Voltage...
regulator IC maintains the output voltage at a constant value. 7805, a voltage regulator integrated circuit (IC) is a member of 78xx series of fixed linear voltage regulator ICs used to maintain such fluctuations. The xx in 78xx indicates the fixed output voltage it provides. IC 7805 provides +5 volts regulated power supply with provisions to add heat sink as well. Let's look into some of the basic ratings to get an overview. Input voltage range 7V- 35V, Current rating $I_{\text{C}}=1\, \text{A}$, Output voltage range $V_{\text{MAX}}=5.2\, \text{V}$, $V_{\text{MIN}}=4.8\, \text{V}$.

**Relay**

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

**Relay Driver IC (ULN2003)**

ULN2003 is a high voltage and high current Darlington array IC. It contains seven open collector Darlington pairs with common emitters. A Darlington pair is an arrangement of two bipolar transistors. ULN2003 belongs to the family of ULN200X series of ICs. Different versions of this family interface to different logic families. ULN2003 is for 5V TTL, CMOS logic devices. These ICs are used when driving a wide range of loads and are used as relay drivers, display drivers, line drivers etc. Each channel or Darlington pair in ULN2003 is rated at 500mA and can withstand peak current of 600mA. The inputs and outputs are provided opposite to each other in the pin layout. Each driver also contains a suppression diode to dissipate voltage spikes while driving inductive loads.

![Figure 2. Block Diagram of Password Based Circuit Breaker](image_url)

3. **Principle**

The main component in the circuit is 8051 microcontroller. In this project 4x3 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.

4. **Operation And Working**
The provided circuit uses standard power supply of 230V. A step-down transformer is used to convert 230V into 12V. After that a bridge rectifier is used with an electrolytic capacitor of about 1000µF to convert it into DC voltage. Thus this DC output is unregulated, so voltage regulator IC LM7805 is used to convert 12V DC into 5V DC. DC voltage at the input of the regulator changes from 8V to 15V because of AC voltage variation from 160V to 270V the regulator output will remain constant at 5V.

For prevention from any noise generated during the operation of circuit the voltage regulator output i.e. 5V DC is further filtered by a capacitor of 10µF. One LED with a current limiting resistor of 330Ω in series is provided with this 5V point to indicate 5V power supply availability.

A 8051 Series Microcontroller is interfaced with keypad, relay driver, voltage regulator, LCD and C program module. Out of four ports of this series microcontroller the upper pins of port 1, i.e., pin 1.0 to pin 1.3 are connected to the row lines of the keypad and acts as output lines and lower pins i.e. pin 1.4 to pin 1.6 are connected to the column lines of the keypad and acts as input to the microcontroller. A 16×2 LCD is used to display the information which is connected to the port 0 and port 2 pins of microcontroller. A set of resistors which are connected to 8-data lines of the LCD are used to pulled up externally, as the port 0 has no internal pull up. And control lines of the LCD are connected to the Port 2 pins.

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. Now both the AC and DC supplies are switched on. LCD displays “enter password” then you have to enter the password with the help of keypad provided, you can see ‘*’ for each digit. Now if entered 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”. Since the password is user changeable, so to provide separate password the initial operating password is 9999. It will display ‘enter new password’. The new entered password is going to be stored and the person can change the status of circuit breaker only.

5. Acknowledgements

We are grateful to the management of SKIT, Jaipur for providing facilities and for guiding us throughout the work.

6. References


