

# Low Cost Thermocol Cutter

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**Abstract**— As we know radium cutting through PC is readily available from that, we got the idea of our project i.e. "Low cost, thermocol cutter". In this project the microcontroller is the backbone of the hardware circuitry. All the controlling actions are done by the micro controller. A hot rod basically the soldering gun is used for cutting purpose. Here, the thermocol is not actually cut, but it is melted at a specified temperature with the help of soldering gun. So this project is used for cutting different figures and shapes as per the program of the micro controller. Opto couplers are used to provide isolation between the micro controller and the hardware circuitry. Stepper motors are used for controlling the different directions of different axis. Thickness of the thermocol will depend upon the length of the cutter and its heating capacity. Alphabets and numerical are generally cut using this project but figures of all shapes and sizes can be cut up to the limit of the work platform.

**Index Terms**— Microcontroller AT89c51; Keil uvision4; Proteus; Stepper motor driver L298 IC.; Opto coupler as isolator

## I. INTRODUCTION

This is a micro controller based device that uses a hot rod to cut the three axis. The program is fed in the micro controller and is delivered to the cutter. This device can be used for cutting various figures and shapes as per the program. The program is written in micro controller and is delivered to the hardware. The hardware consists of an isolation circuit made of opto couplers and associated components. This is an electrical isolation to protect the circuitry from any ill effects. Data from the isolation circuit is given to the stepper motor drivers that control the movements of the three axis. Each axis is controlled by a separate motor, for the up and down movement and linear moments of that axis. A relay driver drives a relay for the heater for cutting the thermocol. Sensors are provided to indicate end limits of the work platform. These signals are fed directly to the micro controller through the signal conditioner and the isolation circuit. The thickness of the thermocol to be cut will depend on the length of the cutter and its heating capacity. Alphabets and numerals are generally cut, using this device but figures of all shapes and sizes can be cut up to limits of the work platform. As thermocol has become a popular medium for making cut outs and banners, this device comes in very handy as articles can be mass produced to exact specifications and same size.

## II. LITERATURE REVIEW

Our project is micro controller based thermocol cutter. Radium cutting through PC is available in market. In radium cutting the controlling actions are done by the PC and in our project the

controlling actions are done by the micro controller so the cost is reduced efficiently. If the metal used for cutting is changed and the speed of the stepper motor are increased by changing the step angle of the stepper motor, this project can be used for PCB drilling, diamond cutting and many other applications. This project consists of mostly digital IC's and a compact hardware circuitry, so this project is smaller in size and user friendly as compared to that of the radium cutting through PC. In radium cutting through PC a skilled labour is required as it is completed software oriented whereas in our project consists of simple keypad and a LCD display so there's no need of skilled labour.

## III. PROPOSED SYSTEM

In this microcontroller based thermocol cutter, here we have divided it into two sections, one is a hardware part and another is a software part.

### A. Hardware Specification Details

#### 1.1 Block Diagram

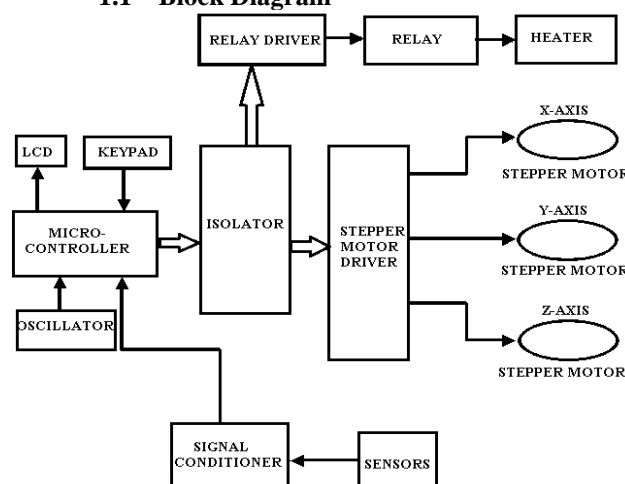


Fig.1: Block Diagram of Thermocol Cutter

The pattern to be cut is given to microcontroller through keypad and it is also displayed on LCD. Micro controller will process the given command and operate the stepper motor as per preprogram of the given pattern. The stepper motor is driven by stepper motor driver which is isolated with the microcontroller through Isolator. The sensors are used to sense the position of stepper motor as X-axis, Y-axis and to sense the temperature of the cutting tool. The sensors output is in the range of few milli volts hence the signal conditioner is used. Relay driver is used to control the relay for the on-off of the heater.

### B. Components Used

[a]AT89c51uc-8051 based Fully Static 24MHz CMOS controller with 32 I/O Lines, 2Timers/Counters, 6 Interrupts/2 Priority Levels, UART, Three-Level Program Memory Lock, 4K Bytes Flash Memory,128 Bytes On-chip RAM. Microcontroller is used for controlling the stepper

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motor in the required direction. Direction means, it will decide the steps to be taken for the particular alphabets or numbers.

**[b]Dual Phototransistor optocoupler IC MCT6- Features** Two isolated channels per package Two packages fit into a 16 lead DIP socket Choice of three current transfer ratios.

**[c]L298 H-bridge Dual Bidirectional Motor Driver-** This Dual Bidirectional Motor Driver is based on Very popular L298 H-bridge Dual Motor Driver Integrated circuit the circuit will allow you to easily and independently control two motors upto 2A each in both directions.

**[d]CD40106BC Hex Schmitt Trigger – Features** Wide supply voltage range: 3V to 15V High noise immunity: 0.7 VDD (typ.). Low power TTL compatibility:

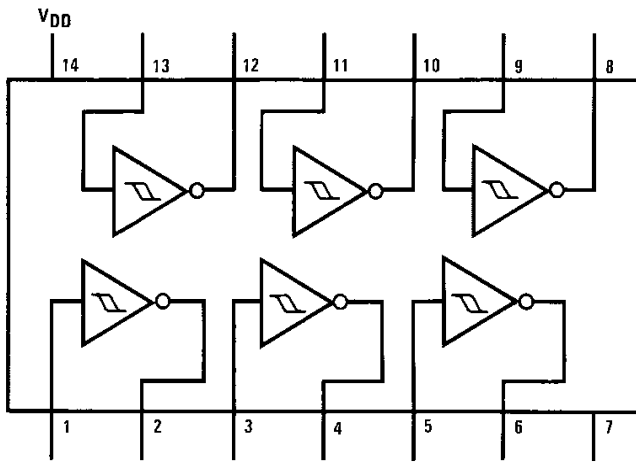


Fig.2: Schmitt Trigger IC CD40106BC

**[e]Keypad -** In this project we use 6x6 matrix keypad. In this keypad that consists of all numerical and alphabets. The keypad is used for entering the characters and numerical to the microcontroller. Also it is use for

changing the fontsize. Keyboards and LCDs are the most widely used input/output devices of the 8051, and a basic understanding of them is essential.

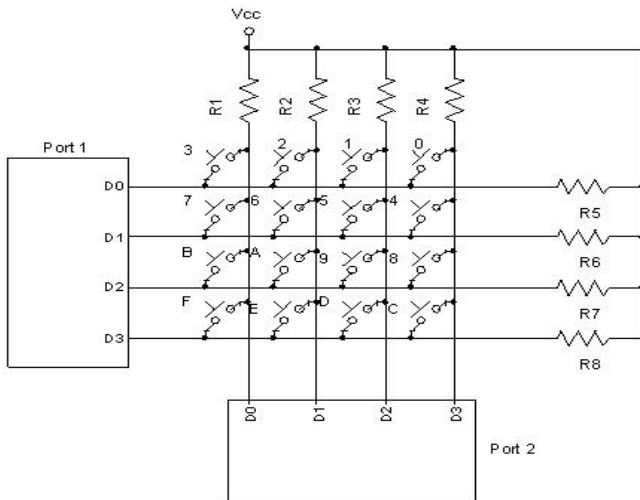


Fig.3: Keypad Interfacing with 8051

**[f] LCD Display -** Liquid Crystal Display (LCD) which we have used is 2x16 LCD i.e. two lines each with 16 characters. We have used the LCD in 8 bit mode i.e. 8 data lines are required. Other than 8 data line one RS, one RW and one

Enable line is also required. The RS line is used to select whether the data or instruction is being transferred between the controller and the LCD. The RW line is used to indicate if data is being read from the LCD or written into the LCD. The RW pin is pulled low when data is being sent to the LCD. The Enable pin is basically a latch pin which tells the LCD that the data is available on the data lines. The resistor R7 is used to set the intensity of the backlight.



Fig.4: LCD Display 16\*2

**[g]Sensors -** Here we are using infrared sensor (IR) to determine the platform limitations. The output of the sensors is given to the micro controller through the signal conditioner. As per the sensor indications the micro controller determines the platform limitations. Using the sensors we defines the zero position of all the axis. An IR sensor is a device which detects IR radiation falling on it. There are numerous types of IR sensors that are built and can be built depending on the application. Proximity sensors (Used in Touch Screen phones and Edge Avoiding Robots), contrast sensor (Used in Line Following Robots) and obstruction counters/sensors (Used for counting goods and in Burglar Alarms) are some examples, which use IR sensors.

**[h]Isolation -** The isolation consists of opto couplers. It is used for sharpening the signal and also used to protect any ill effect from the hardware circuit. The output of the isolation is given to the stepper motor drivers. In electronics, an opto-isolator, also called an optocoupler, photocoupler, or optical isolator, is a component that transfers electrical signals between two isolated circuits by using light.[1] Opto-isolators prevent high voltages from affecting the system receiving the signal. [2]

Commercially available opto-isolators withstand input To – output voltages up to 10 kV. [3] and voltage transients with speeds up to 10 kV/s. [4] A common type of opto – isolator consists of an LED and a phototransistor in the same opaque package. Other types of source - sensor combinations include LED-photodiode , LED - LASER, and lamp-photoreistor pairs. Usually opto -isolators transfer digital (on-off) signals, but some techniques allow them to be used with analog signals.

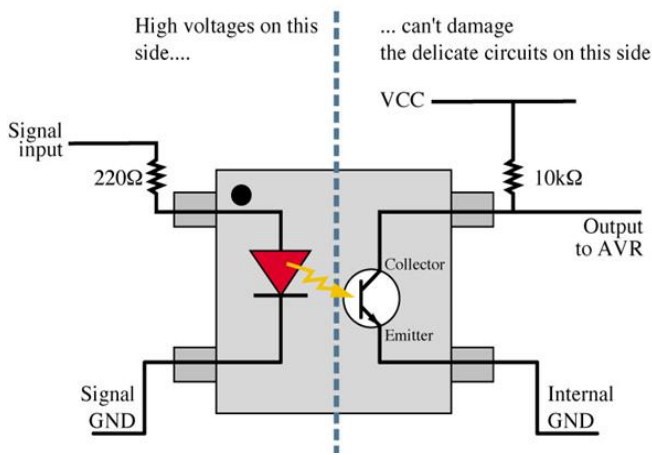


Fig.5: Optocoupler

[i] **Stepper Motors** - There are three axis namely X, Y and Z-axis. Separate stepper motor is used for the different axis. As per the programming the stepper motor moves. The X-axis and Y-axis stepper motor is used for the forward and backward movements and the Z-axis stepper motor is used for the up and down movement of the cutter. A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper

sequence. The motors rotation has several direct relationships to these applied input pulses. The sequence of the applied pulses is directly related to the direction of motor shafts rotation. The speed of the motor shafts rotation is directly related to the frequency of the input pulses and the length of rotation is directly related to the number of input pulses applied.



Fig.6: Stepper Motor

[j] **Relay** - The main purpose of relay is to ON-OFF the heater. The relay driver is used for controlling the relay. A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits, repeating the signal coming in from one circuit and re-transmitting it to another. Relays were used extensively in telephone exchanges and early computers to perform logical operations. Relays are

devices which allow low power circuits to switch a relatively high Current/Voltage ON/OFF. For a relay to operate a suitable pull-in and holding current should be passed through its coil. Generally relay coils are designed to operate from a particular voltage often its 5V or 12V. Over here we have used a 12v relay with which we can switch 5A load current. This relay is also commonly known as CUBE Relay. The relay basically consists of five terminals, two of them are used for the coil and the remaining three consists of a common pole and one Normally Closed (NC) and Normally Open Pole. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contractor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

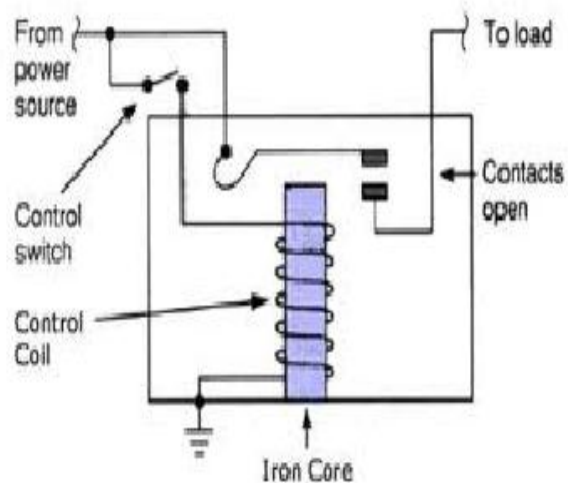


Fig.7: Relay Driver

#### IV. SOFTWARE SPECIFICATION DETAILS

Keil development tools for the 8051 microcontroller Family support every level of developer from the Professional applications engineer to the student just learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-board Computers support ALL 8051-compatible derivatives and help you get your projects completed on schedule.

- A51 Macro assembler
- BL51 linker/ locator
- OH51 object-HEX converter
- C51, ANSI C compiler
- LX51 extended linker
- OHX51 extended object-HEX converter
- uVision debugger
- FlashMON51 target monitor

A. System flowchart

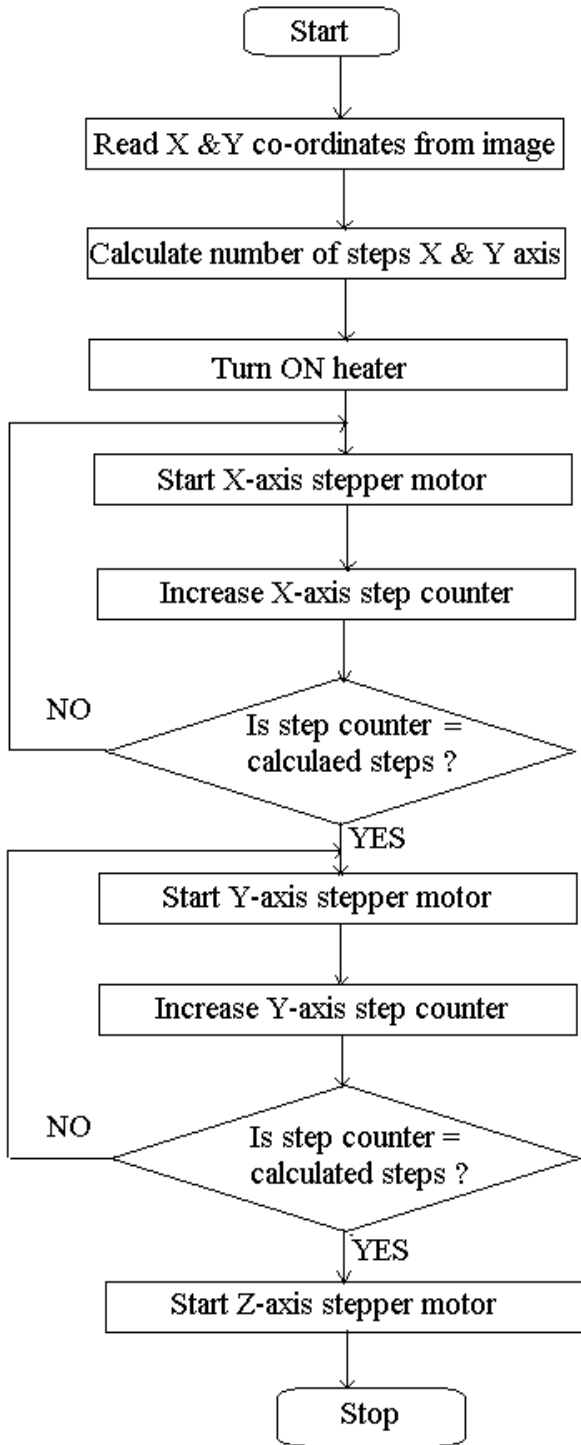


Fig.8: Flow Chart Of Thermocol Cutter

V. CONCLUSION

This project is designed for the cutting of the thermocol with the help of micro controller. This project can be used for preparation of banners, wordings, for decoration purpose, to create sign and symbols, and for making of road indicators. The project is micro controller based so all the controlling actions are done by the micro controller. By the use of micro controller the cost of the project is reduced efficiently. And the project is environmental and user friendly.

VI. REFERENCES

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