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Tabletop Model of a Tilting Furnace

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***Abstract*— In industry, there are available a wide variety of furnace for mixing of the various solids like cement or for melting of metals before they are blended into other metals. However, with rapid growth of industry these processes have evolved from manual mixing to semi-automated one. There has emerged a requirement of such process in laboratory for mixing and analysing a sample quantity or in biological fields for accurate mixing of chemical to detect a disease. However, such a process in quite tedious and some cases unsafe. There have been attempts to make furnaces with minimal human interactions, they have succeeded only partially and now we have semi-automated furnace in industries.**
In this paper, we will see an attempt to necessarily provide a completely automatic control furnace for use in laboratories. Here we use the microcontroller using keilvison-4 to control the furnace which also provides a provision for controlling speed and direction that is displayed in LCD. The user is provided with a push button i.e. keypad which is pressed to select the desired mode and is also provided with a default mode called as homing(manual) where he can control the speed of the motor.

***Index Terms*— Homing, Microcontroller - AT89S52, KEIL µVision – 4, C- Programming Language.**

I. INTRODUCTION

From many past years, Industries and their products are playing a significant role in development of nation. Till now industries are dealing with furnaces in their process to manufacturing products. As they are dealt with problem that a man can undergo by the processes like mixing of chemicals manually taking place in the industries during manufacturing. The solution to overcome this problem is done by introducing an automation process for tilting and rotating the furnace. There are 3 of furnaces that is

- Home furnace
- Industrial furnace
- Metallurgical Furnace

A. Industrial Furnace

- An industrial furnace or direct fired heater is a equipment used to provide heat for a process or can serve as a reactor which provides heats of reaction.
- Tilt furnace" is one of the examples of industrial furnace.

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This paper is mainly concerned to various sectors within the chemical industries like petrol-chemical, dye, organic and inorganic industrial chemicals, ceramicproducts, agrochemicals, polymers and rubber, fragrances and flavours etc.

Tilting furnace is a single stage furnace. Tilting Furnace is used to effectively mix two or more chemical components while they are heated simultaneously. This mixing can be achieved by rotating the test tube that contains chemicals while they are heated. More effective mixing can be achieved by tilting the rotating test tube about an axis perpendicular to the axis of rotation. The Tilt furnaces are equipped with either Hand-Wheel, Electro-Mechanical or hydraulic tilt systems, depending upon the load being melted and customer preference.

Here we are using a furnace of acrylic material. Tilting and rotating can be achieved by implementing automation process by rotating DC motor which is under a control of the microcontroller. The microcontroller is burned with a program to perform specific operation and in default mode called 'Homing'. LCD display is used for display of parameters like speed, direction, ON/OFF the program, DC motor (10-20rpm), H-bridge for reversing the direction, AT89S52 microcontroller, position sensor etc.

Figure 1.Representation of the process

The session deals with the section II system design, section III implementation of hardware and software, section IV methodology, section V results, section VI conclusion, section VII future scope, section VIII references.

B. System Design

The system comprises of the following components shown in the block diagram.

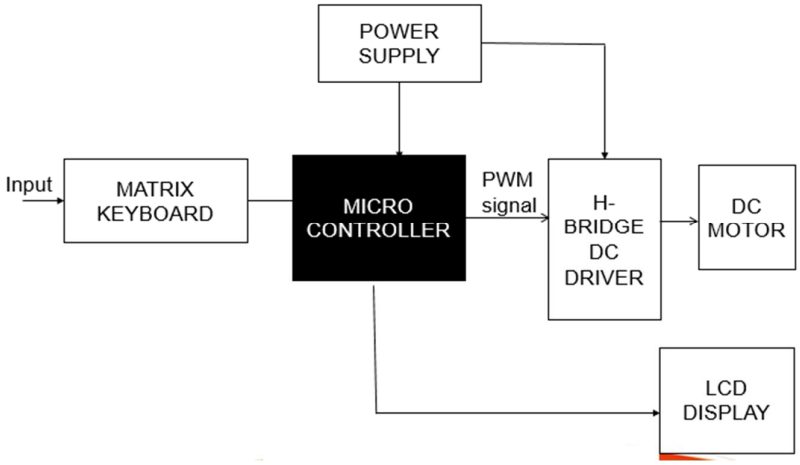

Figure 2. Block diagram of system

- Power supply: 5volts of power supply is given for LCD display, microcontroller and keypad.
- Microcontroller: Using AT89S52 microcontroller with CISC architecture, operating at 32MHz.
- LCD Display: 4*4 alphanumeric LCD for displaying direction, speed etc.…
- H-Bridge: To reverse the flow of the current in DC motor.
- Keyboard: It is used to give input to the microcontroller.

II. IMPLEMENTATION

A. Hardware

A printed circuit board (PCB) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate.

Microcontroller: Microcontroller, the main part of our control and automation process. Following AT89S52 Microcontroller is used. Inputs from keyboard and other parameters are inputted which are in turn controlled by the microcontroller. It also has a control over the dc motors.ROM-64KB, Operating frequency-32MHz with of Total 40 pins of 4ports.

Matrix Keyboard: Input for the process is given through the keyboard. We can control the start and stop operations using this keyboard interface and the parameters such as angles can be controlled.

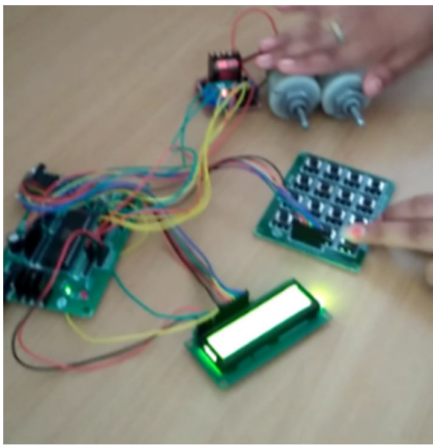

Figure 3 Operation setup

I2C EEPROM: I2C EEPROM is programmed to control the homing function of the furnace. EEPROM essentially used here is to save the configurable settings even when the power is turned off, so that the system starts with these configurations the next time it is powered on. This provides use a better larger storage space.

H-BRIDGE DC DRIVER: H-Bridge is used to have a speed control on a DC motor. It is defined as an electronic circuit that enables a voltage to be applied across a load in either direction.

LCD Display: LCD is a flat display panel used to display the parameter required by the tilt furnace.

Figure 4. LCD Display Parameter

B. Software:

Using keilmicrovision4 for programming. Compiler C.

III. METHODOLOGY

In this paper, we discuss the control of the automated tilt furnace. Here we program for various hardware components which involves in the operation of the automation in the tilt furnace. Initially the inputs are selected through a matrix keypad in turn provides the user to choose the desired operation modes. There are 4 modes need to be operated that is given from the keypad. The following modes are displayed on a LCD display in terms of the speed, direction parameters of respective mode. The LCD display used here is 4*4 alphanumeric displays. The tilted furnace operation is in turn controlled using a microcontroller. The tilt furnace here consists of two DC motors. DC motor is usually defined by a conceptual mechanism of changing flow of current in a motor either electro-mechanically or electronically. Here the DC motor is choosen by taking into consideration the torque, weight and if its speed can be adjusted as required, we also take in a safety factor of 5 while determining the torque. The torque as using a safety factor 5 is 0.2866N-M
A coupler and flange is used as mediator between the mechanical system and motor and to support DC motor respectively. Here the DC motors in which one is used for the rotation and other is used for the tilt operation of the furnace. The motors used are checked for the following safety factors of the tilt furnace. The torque range as per the calculations is found to be 0.978N-M. Here the DC motors are connected to the furnace using via a coupler. As per the user requirements the mode is selected and operation starts with rotation and tilting of the DC motors for which the speed is in turn controlled using an external PWM signal waveform and H-bridge. Pulse width modulation is a one of the modulation technique which is used for encoding information before transmitting it to a destination.

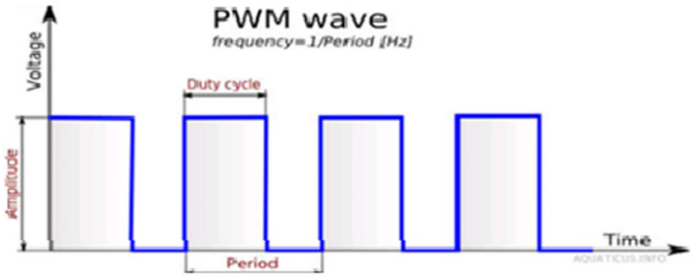

Figure 5. Pulse Width Modulation

Here the Pulse width modulation signal is programmed to control the speed of the DC motor. Here using a PWM Signal from the control would be preferable and easier control compared to other methods. We generate the PWM signal using the timer and interrupt based system. The use of PWM signal results in control of the DC motor in a well predefined manner. The concept of H-Bridge configuration is commonly involved to change the direction of a DC motor, which in turn used to apply impulsive stop the motor by brakes. It is used to change the flow of a current in a DC motor by providing voltage to it.

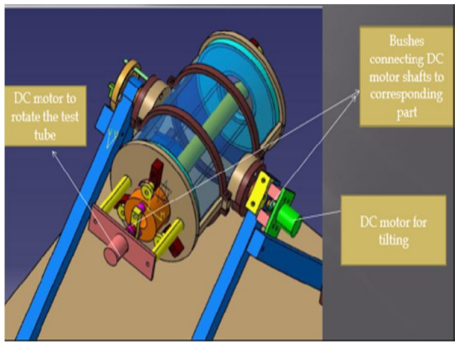

Figure 6. Running of DC motor

Figure 6. Picture of the whole designed Set Up

IV. RESULT

- The motors have been successful used to control the furnace.
- The various modes are successfully implemented.
- The display of various with speed is done successfully.

The resultant operating speed and direction of motors in various modes is as shown in the table:

TABLE I

MODE	Motor 1		Motor2	
	Speed (Rpm)	Direction	Speed (Rpm)	Direction
Auto Mode 1	40	Clockwise	40	Clockwise
Auto Mode 2	40	Clockwise and Counter-Clockwise	40	Clockwise and Counter-Clockwise
Auto Mode 3	40	Clockwise and Counter-Clockwise	60	Clockwise
Manual	40 40 40	Clockwise and Counter-Clockwise	40 60 80	Clockwise

V. CONCLUSION

This project as seen has resulted in automation of the tabletop model of tilt furnace.This project has been designed by implementing parameter such as direction and speed control of motors for different modes. This modes provides a limited freedom to the operator, but the speed can be set only by reprogramming. It reduces the manual labor when implemented in other fields of the industry as compared existing system. Thus the proposed paper increases accuracy and ensure correct mixing as compared to the existing system without any manual intervention.

FUTURE SCOPE

- The Tilt Furnace can be implemented in industries for replacing the manual or semi-automated ones in cement industries.
- In manual mode provision can be provided to dynamically increasing or decreasing the speed.
- It can be implemented for controlling the furnace remotely.
- Power electronics has made advancement of AC motors which can possible be replace a DC motors for many applications as like for tilting of furnace.