Microcontroller Based Pipe Forming System

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Abstract— *In this paper work, the attempt is to construct a simple model of an automatic pipe forming system, which uses sensors, control unit and drive unit to form the pipe. The main aim of this project is to learn in detail about how the automatic pipe forming system works and to understand the concept clearly. The activity involved in this project is to make the pipe forming system using Microcontroller to control the unit automatically. This system is built on the AT89S52 based Microcontroller, Stepper motors, Gear motors, Sensors, and Keypad for input and LCD for output. This concept is very useful to each and every company who works for pipe and tubes production on manually process. It has a much more advantages for production and economically.*

Keywords— Microcontroller, Stepper motor, Gear motor, LCD, Driver Integrated Circuits (IC's),Inner Diameter(I/D).

1. INTRODUCTION

During industrial visit, I have been visited Ratnamani Metals & Tubes Ltd. I have found problem in the production department, where the pipe forming system is based on manual operation. It requires a more man power to operate the system. During the discussion with the manager, it is come to know that the automation is required for the same system. Manually process of pipe forming system requires the much more improvement for fast and better production of items. As per suggestions and guidance, we are planned to operate the system automatically with the help of Microcontroller. Manually process have the following disadvantages;

- It's required more men power
- Time consumption is much more
- Less accuracy
- Required more electricity
- Economically very costly etc

So far, I could find the new solution for this problem and made a one demo model for this automation process. Which will eliminated all the demerits of the manual process.

2. DETAILS OF MANUALLY PROCESS

A manually pipe forming system requires more stage for its production. Which will have explained in following ways. In the Fig.1 shows that the manual pipe production process.

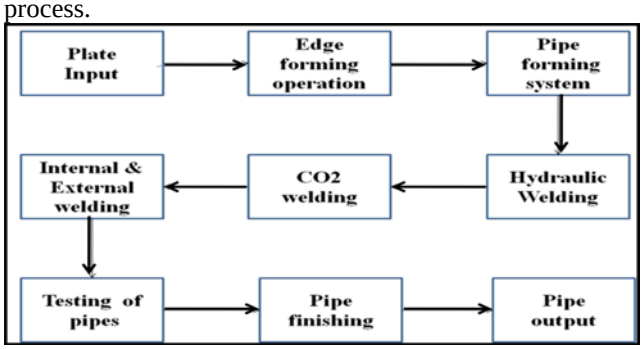

Fig.1

A. Edge Forming (Crimping) Operation

Select the die & punch according to pipe size. Depending upon the received plate from cutting operation, select the appropriate template for stroke marking on the plate at both end. Edge forming activity performs on plate having thickness above 10 mm. Set the die and punch on crimping press (as applicable). Keep the plate between the edges forming die & punch so that front end of the plate is aligned with die punch and start crimping activity. Lift the punch and checked the formed portion with help of I/D profile gauge and if I/D profile gauge found satisfactory then proceed further. If profile of the plate edge not meet with I/D profile gauge then reset the hydraulic pressure and perform the same as above. After completion of edge forming (crimping) operation plate transfer to forming operation.

B. Pipe Forming operation

Supervisor/Operator ensure that all operating system is in working condition & also ensures that all measuring& monitoring instruments have valid calibration. Keep the plate on forming press and Start forming from one end to middle of the plate in transverse direction as per stroke marking as shown in Fig.2 [5].

(a)Press the plate by punch on the stroke marking line and set the pressure to form plate as per required size.

(b) Lift the punch and check formed portion by I/D gauge.

Fig.2

If profile not meet with I/D profile gauge then reset the hydraulic pressure and perform the same as above.

After satisfactory completion of the operation, shift the plate sideways till the next marking line is aligned below the punch line. Repeat this process up to middle of the plate in transverse direction. Continue this sequence of operation by concurring checking with help of I/D profile gauge up to center stroke. Set the second end of the plate under the die & punch on stroke marking and start the forming activity by repeating above process till the pipe is formed in open-O- position. After completion of forming process, visual inspection of pipe body and I/D profile checking carried out by production supervisor. Production supervisor/ operator fill up the report at the end of the shift.

3. PROPOSED MICROCONTROLLER BASED PIPE FORMING SYSTEM

For atomization of system, we will use microcontroller IC (AT89S52) for controlling the whole system. In the Fig.3 shows that the functional block diagram of proposed system.

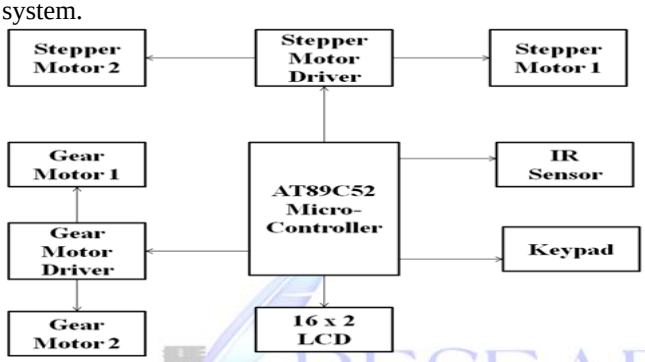

Fig.3

The input will be given by the keypad. The Octal Peripheral Driver Arrays (ULN2803 IC) is used to drive stepper motor. The stepper motors are used for shifting the plate into forward and backward direction and also set the step angles for formation of the pipe in perfect 'O' shape as per the Inner diameter (I/D) gauge. In the company the hydraulic press is used to provide the hydraulic pressure for the formation of the pipe. Instead of Hydraulic press, the gear motors are used for the pressure on the plate. The Quadruple Half-H Drivers (L293D IC) is used to drive the gear motors. The 16 x 2 LCD is used for display the output.

A. Schematic diagram of automation system

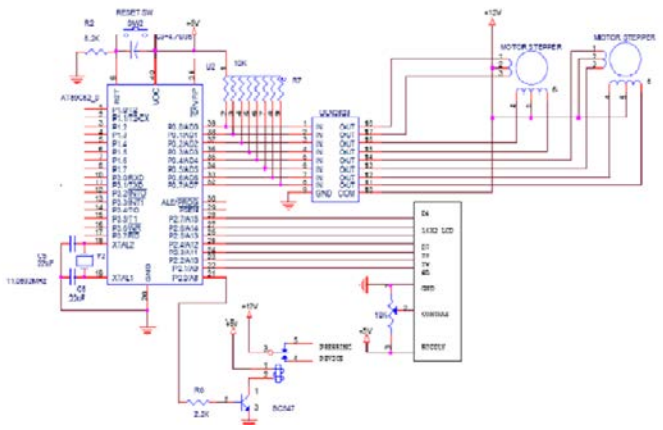

Fig.4

In the Fig.4 shows that the schematic diagram of new automation system. The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory [1]. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

- Microcontroller:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The Atmel AT89S52 is a powerful microcontroller which provides highly-flexible and cost-effective solution to many embedded control applications. It is used for controlling the LCD, keypad, stepper motors, gear motors, sensors. The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry [2].

- Stepper Motor:

Stepper motors are electromechanical devices that convert a pattern of inputs and the rate-of-change of those inputs into precise rotational motion. The rotational angle and direction for each change (step) is determined by the construction of the motor as well as the step pattern input. Control of a stepper motor comes from applying a specific step sequence; rotational speed is controlled by the timing of the applied steps. It is used to count step angle for the plate forming [3].

- Gear Motor:

A gear motor is a type of electrical motor. Like all electrical motors, it uses the magnetism induced by an electrical current to rotate a rotor that is connected to a shaft. The result is that the gears greatly increase the amount of torque the motor is capable of producing while simultaneously slowing down the motor's output speed. The motor will not need to draw as much current to function and will move more slowly, but will provide greater torque. It is used to provide the pressure for the forming press.

- Infra-Red Sensors:

Based on a simple basic Idea, this sensor is easy to build, easy to calibrate and still, it provides a detection ranges (range can change depending on the ambient light intensity).It is used for sensing marking on the plate.

- LCD Display:

Some of the most common Liquid Crystal Display (LCDs) connected to the 8052 is 16x2 display. This means 16 characters per line by 2 line. For output display like indications [4].

- Quadruple Half-H Drivers :

The Quadruple Half-H Drivers (L293D) are quadruple high-current half-H drivers. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V [6]. This device is designed to drive inductive loads such as dc gear motors, as well as other high-current/high-voltage loads in positive-supply applications. It is used to drive the +12volt gear motor.

- Octal Peripheral Driver Arrays :

It is designed to be compatible with standard TTL families and Darlington arrays. The ULN2803 has a 2.7kW input resistor for 5V TTL and CMOS. It is used drive the +12volt stepper motors [6].

B. Simulation and results

In the Fig.5 shows that the power supply circuit for system.

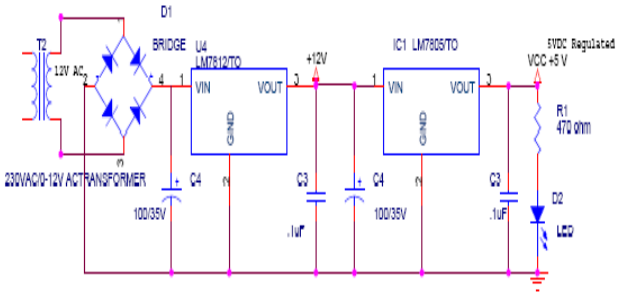

Fig.5

Power supply was to create an ac to dc power supply that could be used for a variety of standard dc output voltages. The power supply was designed to operate on ac voltages ranging between 110 and 230 Vac [2]. The output provided by the power supply provides users with 5Vdc and 12Vdc, which is shown the simulation in the Fig.6.

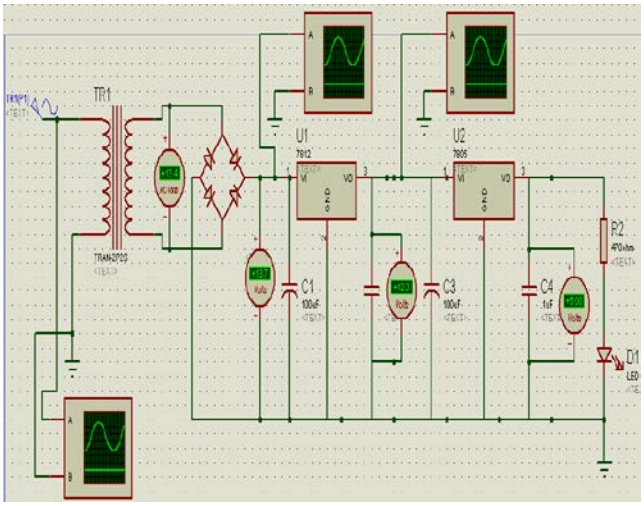

Fig.6

The total power delivery for the 12V from the IC 7812 and 5V from IC 7805 voltage regulator output. Thus the total power delivery sums up to 85W. The output waveform +12volt and +5volt shows in the following Fig.7. The major design issues discussed include the transformer, C filter and control.

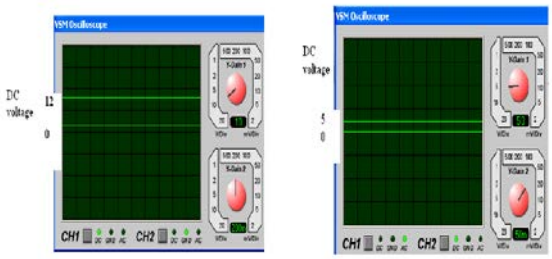

Fig.7

The performance of the power supply is determined by the regulation of the output voltages and the overall efficiency of power conversion from ac to dc. In the Fig.8 shows the hardware of LCD interface with microcontroller using power supply circuit.

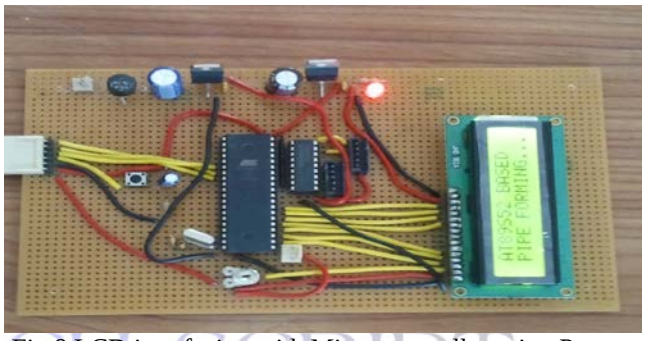

Fig.8 LCD interfacing with Micro-controller using Power Supply Circuit

Stepper motor is used for stepwise punching operation. Using this technology, we can mold or turn any type of pipe with any diameter. In the Fig.9 shows that the simulation result of stepper motor with rotation motion, which has controlled by ULN2803 driver IC [6].

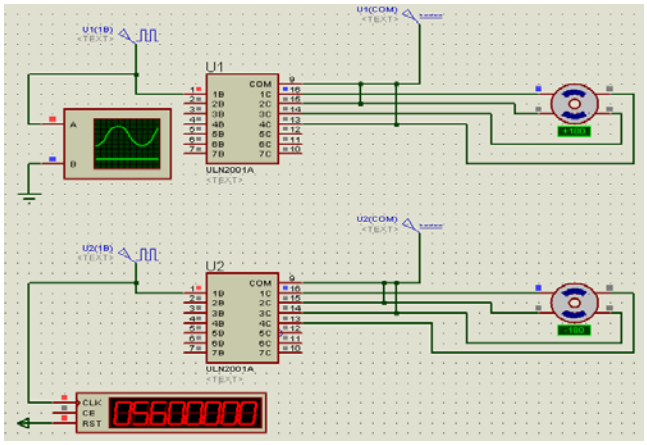

Fig.9 Simulation of stepper motor with Driver IC (ULN2803)

The complete demonstrate hardware model found in the following Fig.10.

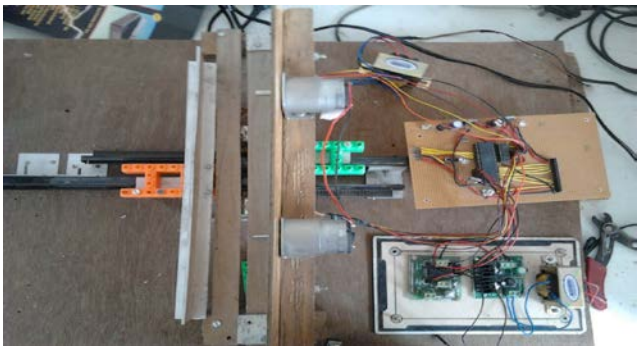

Fig.10

4. CONCLUSION

From this project work, it is concluded that the results obtained are very accurate and the operation is successfully performed according the program written and loaded to the Microcontroller IC (AT89S52). It can be implemented on various pipe and tubes making companies instead of manually pipe forming system without man power. This project will also contain good accuracy and more reliable. Different application of the Microcontroller can be performed by little bit modification in the circuit.

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