An Automated Microcontroller Based Liquid Mixing System

Dr.A.S.C.S.Sastry[1], K.N.H.Srinivas[2], Ch V S R G Krishna[3], Ch.Sesha KiranKumar[4]

1. Professor, Dept of ECE Kakinada institute of Engg &Technology, Kakinada.
2. Professor Dept of ECE Sri Vasavi Engineering College, Tadepalligudem.
3, 4 M.Tech students, Sri Vasavi Engineering College, Tadepalligudem.

Abstract*:* This paper introduces a systematic approach to design and realize a temp and volume based liquid mixing system using three low cost micro controllers. The primary function of this system is to mix different liquids of required ratio and temperature. The architecture of mixing system consists of two sub systems. They are 1) Electronic sub system 2) Mechanical sub system. In this paper the electronic sub system is developed with the help of three Atmel AT89S51micro controllers for controlling and hand shaking purposes, Two LM35 sensors for sensing temperature and ADC'S are used. The mechanical sub system consists of two geared DC motors to allow the liquids in required ratio for mixing.

I INTRODUCTION

The industrial automation evolution in current manufacturing system demands established rules between equipment manufacturers and customers that use production techniques based on operation and integration of automatic equipment. Now a days automated machines are in demand for they make numerous activities not only easier but also efficiently. These machines require minimal human intervention to do its job.

Manual Control**:** In this all actions related to process control & automation are taken care by the operators. One of the major drawbacks of this method is the likely human errors & consequently its effect on quality of the final product. The manual control has its own limitations with regard to mass production techniques & hence this method cannot provide the consumer with quality goods at an affordable price. The safety or efficient use of raw material & energy are all subject to the correctness & accuracy of human action.

Hard-wired Control: This was considered to be first step towards automation. Here the contactor & relays together with timers & counters were used in achieving the desired level of automation Bulky& Complex Wiring, Involves lot of rework to implement changes in control logic.

Electronic Control: With the advent of electronics, the logic gates started replacing the relays & auxiliary contactors in the control circuits. Process control is a statistics and engineering discipline that deals with architectures, mechanisms, and algorithms for controlling the output of a specific process. The logic functions previously accomplished by components such as electromechanical relays, drum switches, mechanical timers/counters, etc., for the control and operation of manufacturing process equipment and machinery. Aprogrammable controller is a digital electronic apparatus with a programmable memory for storing instructions to implement specific functions, such as logic, sequencing, timing, counting, and arithmetic to control machines and processes. In this system uses three micro controllers that functions as the brain of the system to which all the operating functions of each module are chronologically programmed in it. The quantity of each ingredient to be dispensed is controlled and monitored by the micro controllers programs.

II DESIGN CONSIDERATION

The system has several electronic and mechanical components- all of which are divided into five groups namely, the microcontroller board, the dispensers, the sensors,dcmotors and the mixing container. Figure 1 shows the physical structure of the dynamically reconfigurable temperature and volume base liquid mixing system to which all the five components are strategically placed.

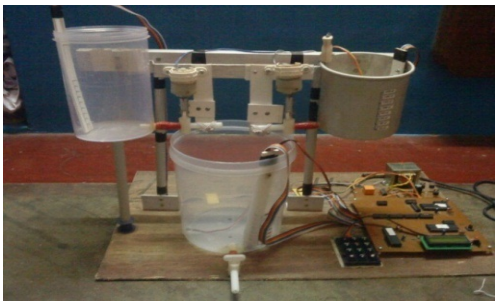

Fig.1 Physical structure of the dynamically liquid mixing system

The microcontroller board consists of keypad, LCD unit, microcontrollers and ADC's. The first component of the microcontroller board is keypad & LCD unit. It serves as

the interface where the user can access and operate the machine. It is a 3x4 keypad and is capable of displaying data in its 16x2 LCD display. It is also used to show the status of the system whether it is ready to accept inputs or not. It is placed in the middle of the system.

The microcontroller board of the system as shown in figure1.It is the most important component since it serves as the brain of the whole system. The prototype utilizes three microcontrollers' µc1, µc2, µc3.

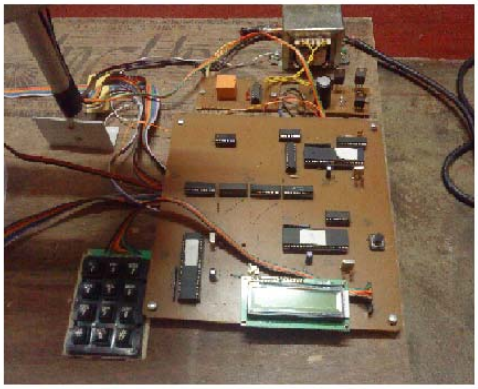

Fig.2 Microcontroller board

Basically, the µc3receives data from the key pad & LCD Unit as inputted by the user and delivers this data to theµc1. Theµc1 functions as collect volume data in dispenser1 and collect temperature from mixing container. Theµc3collect the volume and temperature fromµc1.if the required volume is not present in dispenser1it was programmed to display in the LCD unit an error message that indicates "please fill the dispenser1 with sufficient liquid". Similarly check the required volume and temperature indispenser2.If the required volume is not present in dispenser2 it was programmed to display in the LCD unit an error message that indicates "please fill the dispenser2 with sufficient liquid". If getting sufficient volume in dispenser2 check for temperatureif required temperature is not in dispenser2, display a message. Please wait and switch on the heater. After getting required temperature check the mixing container is empty or not. If the mixing container is not empty it was programmed to display in the LCD unit an error message that indicates"Please clean the mixing container".

The second component is the dispenser. The system has two dispensers. Two dispensers contain ingredients used in producing the liquid mixing.

Fig. 3 Prototype dispenser

Fig3&4 shows the prototype dispensers fill with the water. Moreover, it can hold approximately 3000ml.

Fig.4 Prototype dispenser

The third component of the system is sensors. It consists of two sensors their job is to collect the temperature and volumepresent in dispensers through LM35 temperature sensor and liquid level indicators. A water level sensor was placed inside the dispenser together with the pumps. Its operation was based on the shorting of two pins; that is, if the liquid was in contact with the two pins, they were shorted otherwise, they were open. If one of the water level sensors was open, the system informed the user via an LCD unit. To signal the user which one of the containers had insufficient ingredient required for an operation for an operation.

Fig .5 sensor circuitry present inside the tank

The fourth component of system consists of two high torque geared dc motors for controlling the valves of the dispensers it will responsible for mixing of the liquids to be with greater speed and accuracy.

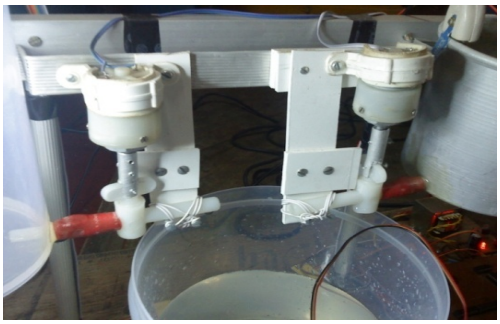

Fig.6Valves interface to geared DC Motors

The fifth component is the mixing container as shown in figure7. It is where the dispensed ingredients are mixed by the valves. It comprises of a valve and a dc geared motor. The dc motor is responsible for opening the valve for getting required volume and temperature.

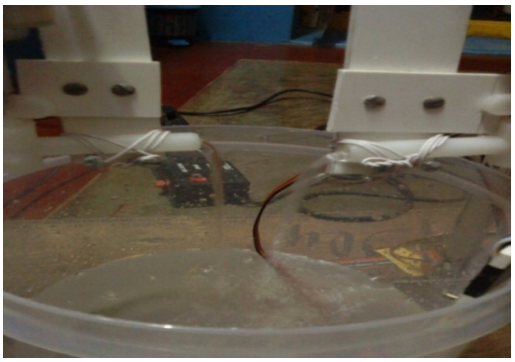

Fig.7 Mixing container

The working principle of dynamically reconfigurable liquid mixing system is explained with the following Algorithm.

III ALGORITHM:

µC1

- Collect volume data from Tank1
- Send it to µC3
- Collect Temperature from Main Tank
- Send it to µC3

µC2

- Collect volume data from Tank2
- Send it to µC3
- Collect Temperature from Tank2
- Send it to µC3

µC3

- Initially display a message:
  Enter Volume: _ _ _ _ ml.
  Enter Temp._ ___ °C
- Collect volume data and temperature from µC1.
- If the required volume is not in Tank1, display a message "Please fill the tank1 with sufficient liquid".
- If sufficient liquid in Tank1 check Tank2 for volume and temperature. If the required volume is not in Tank2, display a message "Please fill the tank2 with sufficient liquid".
- If getting sufficient volume check for temperature. If required temperature is not in tank2, display a message. Please wait and switch on the heater.
- After getting required temperature check whether the main tank is empty or not. If not empty display a message "Please clean the main tank".
- After success full completion of previous step, continue the process by powering the motor simultaneous by checking the volume and temperature in main tank.
- Finally after getting required volume and temperature display a message "Process completed successfully".

IV SIGNIFICANCE

This system uses three microcontrollers that functions as the brain of the system to which all the operating functions of each module are chronologically programmed in it. The quantity of each ingredient to be dispensed is controlled and monitored by the microcontrollers programs. Now a days automated machines are in demand for they make numerous activities not only easier but also efficiently. These machines require minimal human intervention to do its job.This paper is developed with very low cost microcontrollers which are very widely available in consumer electronics market. The program is developed with the help of keil evaluation version IDE which is most popular tool available for microcontrollers. The simulation of system is done in proteus simulator which is helped debugging logical errors which makes the system improper functioning in practical situation. So from the above it is very clear that this system can be easily developed with low expenditure.

V CONCLUSION

The automated microcontroller-based liquid mixing system provided a very satisfactory performance with a minimal percentage error. The utilization of a microcontroller has been accomplished in the form of the AT89S51 microcontroller. The decision to use three microcontrollers was based on the elimination of idle time and the optimization of the mixing process. In addition to this, the utilization of the various proposed components such as dispensers, sensors, pumps, relays, dc motor and an input device was also accomplished.

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