MICROCONTROLLER BASED DAM GATE CONTROL SYSTEM

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ABSTRACT- **Each and every part of our life is somehow linked with the embedded products. Embedded systems are the product of hardware and software co-design. Embedded system is becoming an integral part of Engineering design process for efficient analysis and effective operation. From data analysis to hardware work, everywhere embedded products are the main interest because of its reliability and time bound perfection. Due to time complexity in electronic aspects embedded systems have become a major part of our daily life. This project describes the design of an embedded system for the "MCROCONTROLLER BASED DAM CONTROL SYSTEM". Personal Computer based electrical appliances control is an interesting Personal Computer based project, mainly useful for industrial applications, home automation, and supervisory control applications. This project gives exact concept of interfacing a high voltage electrical device or DC / AC motor to high sensitive personal computer system. We are using RS232 as the communication medium between personal computer and controller. We are controlling the dc motor by sending signals from the personal computer to controller. This project uses regulated 5V, 500mA power supply, LM7805 three terminal voltage regulators for voltage regulation. Full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer. Water level in a dam needs to be maintained effectively to avoid complications. This is generally performed manually which requires full time supervision by the operators & have fairly large staff complements. Moreover, the quantity of water released is hardly ever correct resulting in wastage of water & it is impossible for a man to precisely control the gates without the knowledge of exact water level and water inflow rate. The main objective of this project is to develop a mechatronics based system, which will detect the level of water and thereby the movement of gates can be controlled in a real-time basis which offers more flexibility. This system consists of a set of sensors connected to a stepper motor through an 8-bit microcontroller (AT89S52). The water level is detected based on the feedback from the mechanism used. Based on this data, the level of dam gate can be controlled using a stepper motor via personal computer.**

Keywords – DAM CONTROL SYSTEM, MICRO CONTROLLER, REGULATOR, TRANSFORMER.

1. INTRODUCTION

A Microcontroller is a computer-on-a-chip or a single-chip computer that contains the processor (the CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. Micro suggests that the device is small and controller tells that the device might be used to control objects, processes or events. Another term is Embedded Microcontroller tells that it support circuits are often built into or embedded in the devices for control.

You find microcontroller in all kinds of things never days. It is used for measures, controls, stores or displays information by placing microcontroller inside any device. The largest single use for microcontroller in automobiles-car manufactured today includes at least one microcontroller for engine control and more to control additional systems. In desktop computer, you may find microcontrollers inside keyboards, modems, printers, and other peripherals. In test equipment, microcontrollers make things easier to store measurement, to create and store user routines, and to display messages and waveforms. Consumer products like cameras, video recorders, compact-disk players, and ovens. And they are so many applications where we use microcontrollers.

A micro controller is similar to the microprocessor inside a personal computer. Examples are Intel's 8086, Zilog's Z80. Both microprocessors and microcontrollers contain CPU. The CPU executes instructions that perform the basic logic, math, and data moving functions of a computer. To make a complete computer, a microprocessor require memory for storing data and programs, and I/O interfaces for connecting external devices like keyboard and displays. In contrast, microcontrollers are a single chip computer because it contains memory and I/O interfaces in addition to the CPU. It tends to limit the amount of memory and interfaces that can fit on single chip, microcontrollers tend to be used in smaller system. Examples of popular microcontrollers are Intel's 8052, 89C052, Motorola's 68HC11 and Zilog's Z8.

The following are some of the capabilities of 8051 microcontroller:

- Internal ROM and RAM
- I/O ports with programmable pins
- Timers and counters

- Serial data communication

Motion control, in electronic terms, means to accurately control the movement of an object based on speed, distance, load, inertia or a combination of all these factors. There are numerous types of motion control systems, including; Stepper Motor, Linear Step Motor, DC Brush, Brushless Servo and more. This document will concentrate on Step Motor technology.

Like many conventional electric motors, a "stepper motor consists of a magnet and coils of wire. Whereas conventional motors spin continuously, a stepper motor moves around one small step at a time (hence the name). A stepper motor is a marvel in simplicity. It has no brushes, or contacts. Basically it's a synchronous motor with the magnetic field electronically switched to rotate the armature magnet around.

"The stepper motor is an electromagnetic device that converts digital pulses into mechanical shaft or spindle rotation". 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 rotations applied. The simplest way to think of a stepper motor is a bar magnet and four coils.

2. OBJECTIVES

To control the operation of opening and closing of Dam gate using the microcontroller and to design it using stepper motor.

3. METHODOLOGY

This is a simple project which is easy to build and also cheap, as all the parts are readily available on the market. With average background in engineering the model can be made easily and can be implemented.

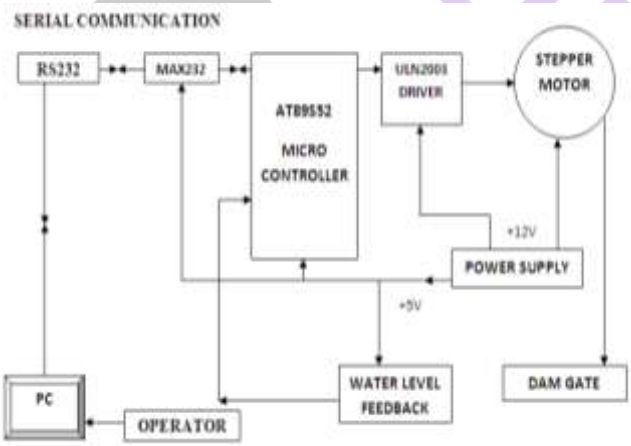

Figure 1: Block diagram

3.1. Circuit Diagrams

This circuit design for supervisory control over serial communication makes use of the following main components

1. AT89S52 Microcontroller
2. 7805 Regulator
3. ULN2003 driver
4. Stepper motor-1Kg Torque
5. Serial port communication- MAX 232 & RS 232
6. Transformer- 12-0-12
7. IC 7404
8. IC 7408
9. DB9 connector
10. Piezo-Buzzer

In this circuit design microcontroller is the main component. The 9th pin of the microcontroller is given to the reset pin. The other end of the reset pin is given to the power supply of 5V. A capacitor of 10µ/25V is connected between the supply and the reset button. A resistor of value 8.2KΩ is connected between the 9th pin and ground. A crystal oscillator is connected between the 18th and 19th pin. To this crystal oscillator of 11.592MHz two capacitors of 22pf are connected and the other ends of capacitors are grounded. The 31st and 40th pin of the microcontroller are given to the supply of 5V. The 20th pin is grounded.

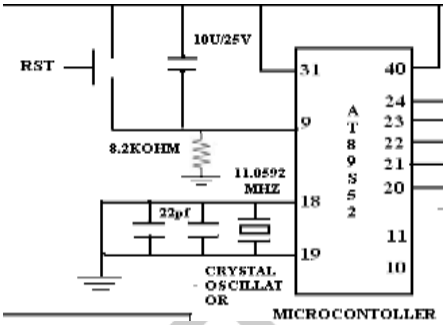

Figure 2: Microcontroller pin description

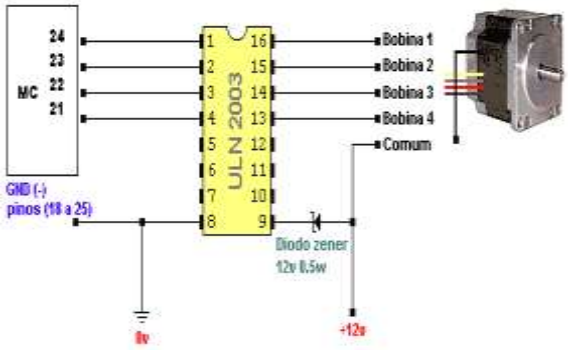

Figure 3: Various connections from a ULN 2003 driver

The pins 21-24- are connected via resistors to the ULN2003 driver which drives the stepper motor. The 10th and 11th pin i.e. receive and transmit pins of the microcontroller are connected the 9th and 10th pins of the serial communication MAX 232 respectively. Since the RS232 is not in the standard form to make it compatible with the TTL CMOS we make use of MAX232. The MAX232 is used for receiving the value from serial port and the output of which is given as input to the microcontroller. Capacitors of value 4.7µ/25Vor 0.1µ are connected between 6-16, 2-15, 1-3 and 4-5 pins respectively. The 16th pin is given to the supply and the 15th is grounded. The 8th and 7th pin i.e., RIN & T2OUT are connected to the 2nd and 3rd pins of DB9 connector.

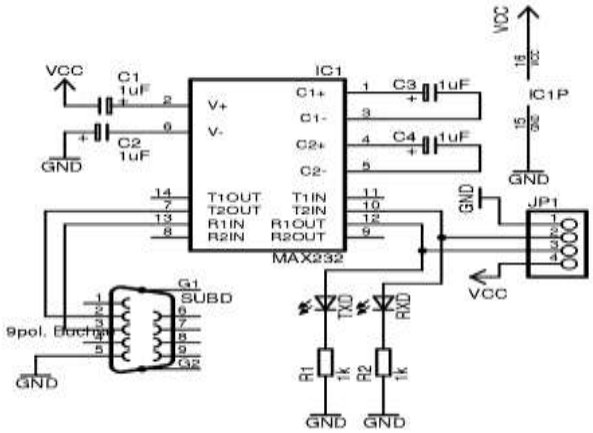

Figure 4: Connections from max232 standard

In telecommunications, **RS-232** (Recommended Standard 232) is the traditional name for a series of standards for serial binary single-ended data and control signals connecting between a *DTE* (Data Terminal Equipment) and a *DCE* (Data Circuit-terminating Equipment). It is commonly used in computer serial ports. The standard defines the electrical characteristics and timing of signals, the meaning of signals, and the physical size and pin-out of connectors. The 5th pin o the RS232 is grounded. The microcontroller acts as an interface between the user instructions and the stepper motor. The 9th pin of ULN2003, high voltage, high current Darlington transistor arrays is given a supply of 5V. The 8th pin of the ULN2003 is grounded and the 13th, 14th, 15th & 16th are connected to the 1kg torque, 5pin stepper motor.

In the supply circuit, a 12-0-12 step down transformer is made use. The primary of the transformer is given to the 230V supply. In the secondary side the two terminals are given to the anodes of the IN 4007 diodes. The cathodes of these two diodes are functioned and given to the 7805 regulator. A capacitor of value 1000µf/25v is connected between the 1st and 2nd of the regulator and a capacitor of value 100µf/25V is connected between 2nd and 3rd pin. The 3rd pin of the regulator is given to the 5V supply. Thus the transformer step down the supply voltage of 230V to 12V is given to the input pin of voltage regulator.

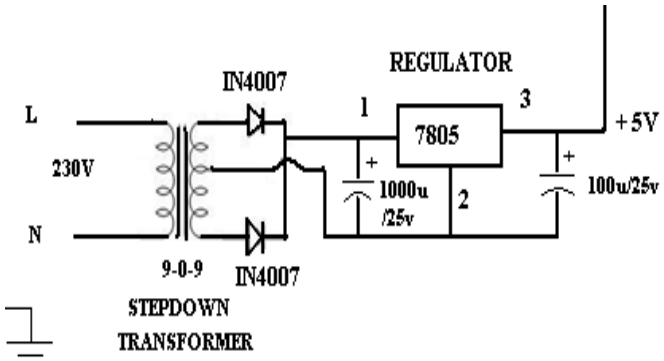

Figure 5: circuit diagram of LM7805 voltage regulator

WATER LEVEL INDICATOR CIRCUIT DESCRIPTION AND CONNECTIONS:

The circuit uses five sensors to sense the different water levels in the Dam. Sensor G is connected to the negative terminal (GND) of the power supply. The other four sensors (L through O) are connected to the inputs of NOT gate IC 7404.When there is a high voltage at the input pin of the NOT gate, it outputs a low voltage. Similarly, for a low voltage at the input pin of the NOT gate, it outputs a high voltage. When the dam is empty, the input pins of IC 7404 are pulled high via a 1-mega-ohm resistor. So it outputs a low voltage.

As water starts filling the dam, a low voltage is available at the input pins of the gate and it outputs a high voltage. When the water in the dam rises to touch the low level, there is a low voltage at input pin 1 of 7404 and high output at pin 2. Pin 2 of the gate is connected to pin 10 of gate (3B) 7408, so pin10 also goes high. Now as both pins 9 and 10 of gate (3) 7408 are high, its output pin 8 also goes high, which indicates water level at low-level. Similarly, when water in the tank touches the half level, pins 13 and 12 of AND gate becomes high. As a result, its output also goes high, which indicates water level is medium. At this time, pin 9 of gate 7408 also goes low via gate pins 3 and 4 of IC 7404; output of pin 8 of 7408 goes low. When the water tank becomes full, the voltage at pin 11 of gate (7404) and pin 11 of gate 7404 goes low. Output pin 6 of gate (7408) goes high which indicates the water tank is full. When water starts overflowing the tank, pin 11 of another gate of 7404 goes low to make output pin 10 to high. The buzzer sounds to indicate that water is overflowing the tank and you need to raise the gates immediately to control overflow of water. Use a non-corrosive material such as steel strip for the five sensors and hang them in the water tank as shown in the circuit diagram. Use regulated 5V to power the circuit.

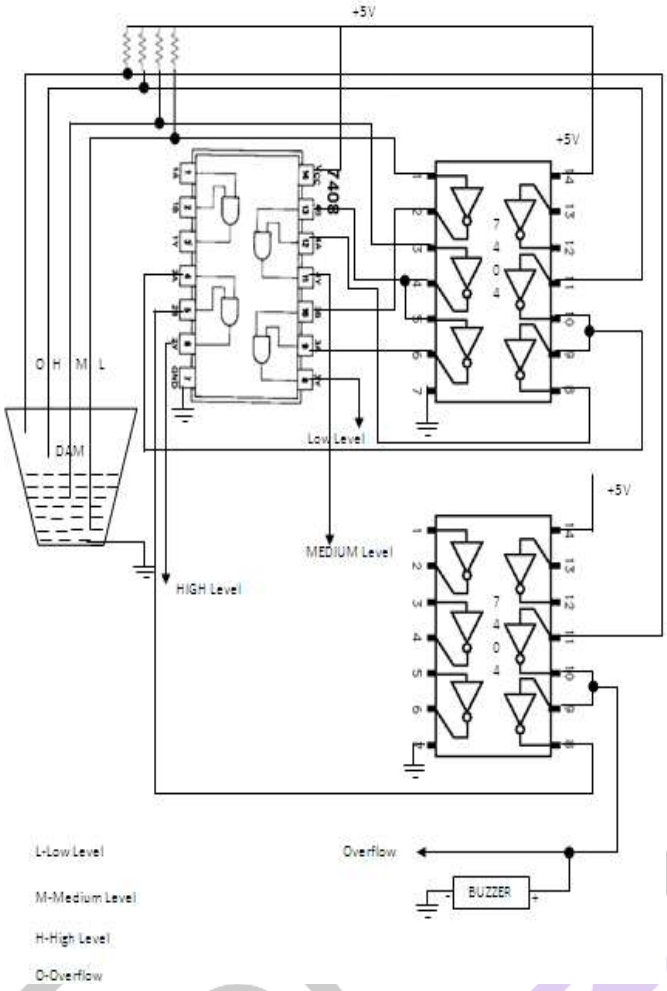

Figure 6: Water level indicator circuit

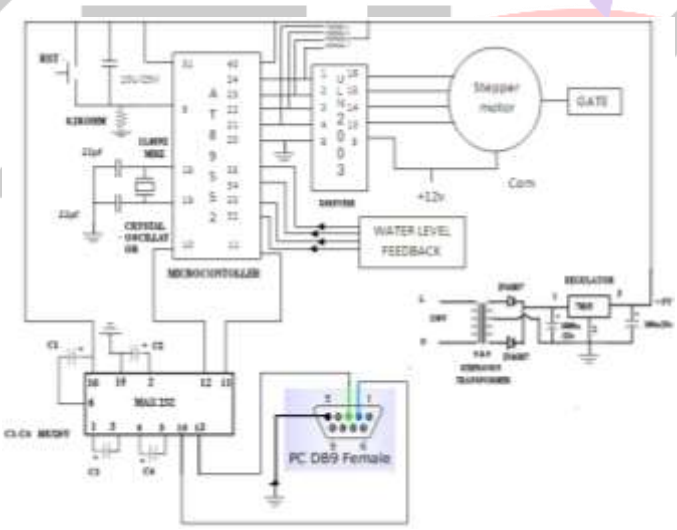

Figure 7: Over all circuit diagram

4.CONCLUSION

In order to complete the project, the hardware is initially tested on bread board. Subsequently, the hardware is wired on general purpose PCB. This software is written in C language and simulation is tested on pc. Afterwards the code is dumped into an 89s52 micro controller. The integrated hardware and software is tested successfully. The principle proved thorough this project can be utilized in many real time applications.

This project, **"MICROCONTROLLER BASED DAM GATE CONTROL SYSTEM"** facilitates us to control the gates of a dam depending on the water level.

Here as a part of our project to exhibit the control, we control the operations of a stepper motor with the help of serial port communication.

This project if implemented will help the people in a very major way by saving their time in this busy daily routine. Efficient control over the device can be achieved in real time applications.

Keil IDE has provided an easy user interface for the project. The program code is compiled using the keil c compiler.

With all the above discussion a conclusion can be made that the system **"Supervisory Control over serial communication"** has wide range of real time applications in industrial sector and domestic sectors as well.

There is a lot of scope for further development of the system with this idea using all technical advancements.

5. FUTURE WORK

RF modem can be used for applications that need two way wireless data transmission. It features high data rate (adjustable baud rate) and longer transmission distance. The communication protocol is self-controlled and completely transparent to user interface. The module can be embedded to your current design so that wireless communication can be set up easily.

This module works in half-duplex mode. Means it can either transmit or receive but not both at same time. After each transmission, module will be switched to receiver mode automatically. The LED for TX and RX indicates whether IC is currently receiving or transmitting data. The data sent is checked for CRC error if any. If chip is transmitting and any data is input to transmit, it will be kept in buffer for next transmission cycle. It has internal 64 bytes of buffer for incoming data.

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