Microcontroller Based Water Pump Auto Controller

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Abstract: Water is commonly used for agriculture, industry and domestic consumption. This application help in reducing the home power consumption and as well as water overflow. It is used PIC for controlling and Water Level Sensor for sensing water level. At first stage water level sensor is been made for sensing water level. Microcontroller is used to control the overall system automatically. Microcontroller takes input from the sensor units which sense the water level. After processing input variable, resultant output decides the water pump action (on/off) which respect to current water status of the tank.

Keywords: PIC, LED and Water Level Sensor

1.INTRODUCTION

This application introduces the notion of water level monitoring and management within the context of electrical conductivity of water. This application takes over the task of indicating and controlling the water level in the overhead water tank and the existence of water in the reserve tank. The level of water is display through the LED. If no water in the reserve tank, LED will display error. This circuit can be constructed by controlling PIC16F84A microcontroller from Microchip Corporation. The PIC16F628 can control the water valve by using DC motor to vary the water flow rate based on the comparison. This system is implemented by MPASM assembly language. The advantage of using microcontroller is that it is only a single chip to which we can program. This application has two main functions: detect the water level in the overhead water tank and the existence of water in the reserve tank. It can operate by using water level sensor to detect the water level and existence of water.

2.RELATED WORK

In this section, the work in the literature related to this system is described. The finding presented here are the continuation of a series of studies begun in 1998 by the Irrigation Training and Research Center (ITRC) at California Polytechnic State University (Cal Poly) , San Luis Obispo, California, on behalf of the Mid-Pacific Region of the United States Bureau of Reclamation (USBR) to test water level sensor under a variety of hydraulic conditions.

The goals for the original project were to determine the best way to monitor water level, and to develop a fast method for appraising sensors considered for irrigation district applications.

3. BACKGROUND THEORY

The control system is an interconnection of components forming a system configuration that will provide a desired system response. The basic for analysis of a system is the foundation provided by linear system theory, which assumes a cause-effect relationship for the components of a system. Therefore a component or process to be controlled can be represented by a block. The input-output relationship represents the cause-and-effect relationship of the process, which in turn represents a processing of the input signal to provide an output signal variable, often with a power amplification. Control systems are typically two types: open-loop control system, in which the control action is independent of the physical system output, and closed-loop systems in which the control action depends on the physical system output.

3.1. Open-loop Control System

An open-loop control system is utilizes a controller or control actuator to obtain the desired response. An open-loop system is a system without feedback. An open loop system utilizes an actuating device to control the process directly without using feedback.

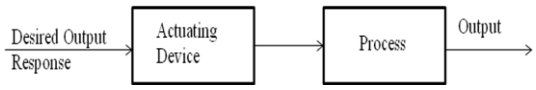

Figure 1. Open-loop control system

Open-loop systems have the advantage of being relatively simple and consequently low cost with generally good reliability. However, they often inaccurate since there is no correction or error.

3.2. Closed-loop Control System

A closed –loop control system, a closed-loop control system utilizes an additional measure of the actual output to compare the actual output with the desired output response. The measure of the output is called the feedback signal. A feedback system is a control system that tends to maintain a prescribed relationship of one system variable to another by comparing functions of these variables and using the difference as a means of control.

A feedback control system often uses a function of a prescribed relationship between the output and reference input to control the process. Often the difference between the output of the process under control and the reference input is amplified and used to control the process so that the difference is continually reduced. The feedback concept has been the foundation for control system analysis and design. A closed-loop control system uses a measurement of the output and feedback of this signal to compare it with the desired output.

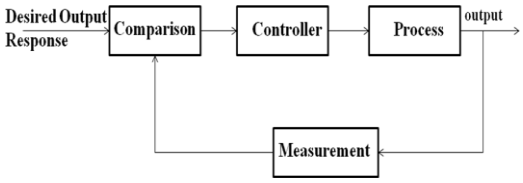

Figure 2. Closed-Loop control system

Closed-loop systems have the advantages of being able to match the actual to the required values. However, problem can arise if there are delays in the system. Such delays cause the corrective action to be taken too late and can, as a consequence, lead to oscillations of the input and instability. Closed-loop system is more complex and costly than open-loop system.

4. Construction of Water Pump Control System

To construct the water pump control systems involve some basic parts.

4.1. PIC16F84A Microcontroller

The PIC16F84A belongs to the mid-range family of the PIC micro® microcontroller devices. . There are two memory blocks available in the PIC16F84A which are program memory and data memory. The program memory contains 1K words, which translate to 1024 instructions, since each 14-bit program memory word is the same width as each device. The data memory (RAM) contains 68 bytes. Data EEPROM is 64 bytes. There are also 13 I/O pins that are user-configured on a pin-to-pin basis. Some pins are multiplexed with other device functions.

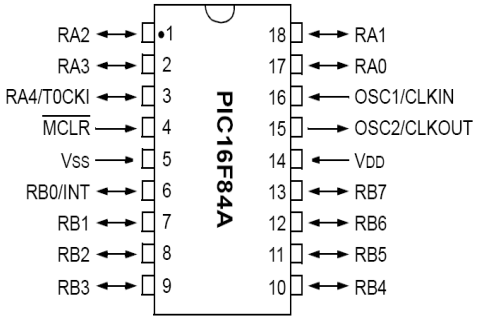

Figure 3. Pin Diagram of PIC16F84A microcontroller

Figure 4. PIC16F84A Microcontroller

4.2. Water Level Indicator

For water level indicating unit we can use some LED light which will work for water level indicating. By touching different water levels through water level sensor, LED should be indicated as on/off.

4.3. Water Level Sensor

Level sensors are used to determine the amount of product in holding tanks and process tanks. In this application water level sensor unit consist two parts, one sensor is used in reserve tank and other three sensors placed inside overhead water tank. When sensor touches water , nozzles and connecting rod get electronic connection using water conductivity.

4.4. Power Supply

Power supply is a fundamental circuit in the electronic system. The dc power supply is essential component in modern electronic equipment system as they need a wide variety of dc voltage for their operation. The whole circuit is used to supply 5 voltage dc power supplies. It is built by using filter, rectifier and IC regulator.

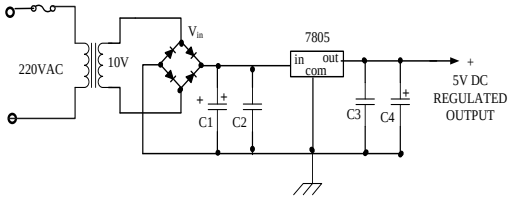

Figure 5. Power supply of the whole circuit

4.5. Clock Oscillation Circuit

The clock oscillator makes the operation clock of PIC. It performs as an external clock generator to execute the instructions of the program. The external timer we have used in our system is crystal oscillator 4 MHZ.

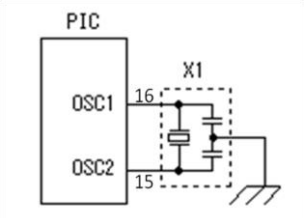

Figure 6. Clock oscillating circuit

4.6. Relay Circuit

Off Operation: When the microcontroller sends 0 volt to the base of the transistor then it becomes off and its emitter and collector becomes open. Then no ground signal (0V) is collected in the relay circuit. The negative side in the cable of motor pumps getting positive signal (+5V). The motor pump will be off due to getting positive signal (+5V) at one side and 220V ac at the other end.

On operation: Transistor becomes on when the microcontroller sends positive signal (+5V) and its emitter and collector become short. Relay circuit and motor pump will get ground signal (0V) and for this reason the motor pump will be ON due to getting ground at negative side and 220V ac to the other side.

5.Hardware and software Implementation

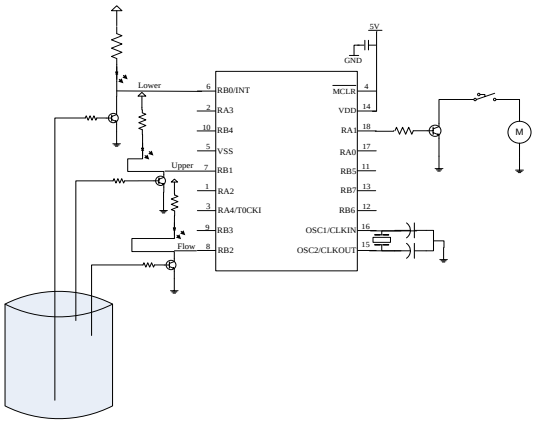

Figure 7. The circuit diagram of the water pump auto controller

OSC1 (pin16) and OSC2 (pin15) of the microcontroller are connected with a crystal oscillator. MCLR (pin4) and V_{DD} (pin14) is used for power supply.

RB0 (pin6) of the microcontroller is used to detect the low level water in the overhead tank. RB1 (pin7) of the microcontroller is used to detect the high level water in the overhead tank. RB2 (pin8) of the microcontroller is used to detect the existence of water in the reserve tank. RA0 (pin17) is used as an output pin to connect the water pump. Water pump is connected with an output pin of microcontroller via a relay circuit. Relay circuit is connected with a transistor. The collector of this transistor is connected with the relay circuit and the emitter is grounded.

Firstly, RB1 (pin7) sense the ground signal that show there is no water in the tank at the upper level. Then RB0 (pin6) sense the ground signal that show there is no water in the tank at the low level. So, motor will be on. To switch on the motor, RB2 (pin8) detects the existence of water in the reserve tank. If no water available in the reserve tank, RB2 (pin8) sends a signal that controls the whole circuit and switch motor off for a certain amount of time. An error LED will display when no water available. And when the timer becomes on, RB2 (pin8) sense the reserve tank again. RB2 (pin8) senses ground signal that switch motor on.

Then, RB0 (pin6) senses positive signal (+5V) that water tank has low level water. LED will show low level. RB1 (pin7) senses positive signal(+5V) that water tank has upper level water. LED will show upper level. When water tank is full then water pump should becomes off. When the water is decreasing from the tank by home use, the display LED should start to become off high level after low level. At that time, RB0 (pin6) and RB1 (pin7) sense ground signal. So water pump should become automatically on again. The operation should automatically perform as a cycle.

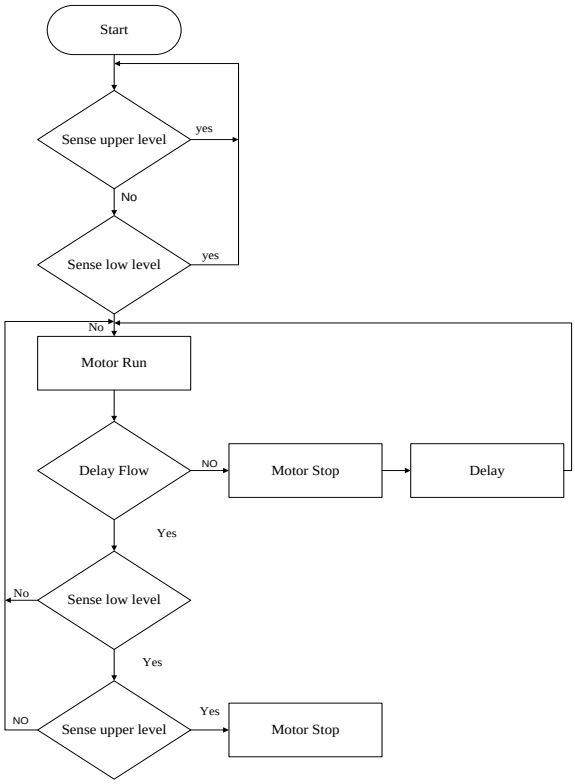

Figure 8. Flow chart of the system design

6. Conclusion

Water is one of the most important basic needs for all living beings. But a huge amount of water is being wasted during daily life due to lack of control. This application tried to overcome these problems and implemented an efficient automated water level monitoring and controlling system. This application work was to establish a flexible, economical and easy configurable system which can solve water losing problem. This application used a low cost PIC16F84A microcontroller which is the key point to reduce cost.

7. Further Extension

An obvious direction for future work is to improve a web based water level monitoring and controlling network which flexibility would offer us to control this system from any place via internet even with different type of devices like laptop or mobile phone.

References

[1] RICHARD C. DORE, ROBERT H. BISHOP, Modern Control Systems, Ninth Edition.

[2] Phyo Min Theim, PIC Based Temperature Controller, M.C.Tech., 2007.

[3] Thein Zarli Myint, Implementation of Automatic Water Pumping System Using Microcontroller, M.C.Tech.,2009.

[4] Microcontroller chip Technology, 2001, PIC16F84A Datasheet www.microchip.com.

[5] http://www.micorpowerdirect.com/PDFFiles/ Application_Notes/ Power Supply Theory of Operation.pdf.

[6] http:// www.itrc.org/ reports/ sensors/ summary.pdf.

[7] http:// www.iaeng.org/ publication/ WCECS2010/ WCECS2010-PP220-22u.pdf.

[8] http:// www.itrc.org/reports /sensors/summary.pdf