PIC Based Water Level Control

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Abstract

This paper focuses on the PIC Based Water Level Control system including the complete circuit design. The complete circuit design consists of three major components: PIC (Programmable Interface Controller), AC motor and LED (Light Emitting Diode) display. The PIC micro-controller based information display panel comprises of several integrated technologies, ranging from the PIC16F84A micro-controller which is the heart of the system used to control the LED display and motor. The control program for the microcontroller is written by Assembly programming language. This system can display the water level with LED. And also can drive and stop the motor automatically. This system is easy to use for many applications such as houses, offices, industries.

Keywords: Programmable Interface Controller (PIC), Light Emitting Diode (LED), Motor.

1. Introduction

New advancements microcontroller technologies have provided the opportunity to apply these technologies to numerous information display applications such as time, temperature, count down, prices, weight, quantities, speed, noise, ticket queue management system and in electronic sporting score boards showing results of games, to name a few. PIC are popular with developers and hobbyists alike due to their low cost, wide availability large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability. With the development of the technology, people use the automatic process at houses, offices, factories, etc…This paper intend to implement the automatic motor drive and continuously display the water level and to be the best choice for application development using Assembly Programming. Assembly is still considered by many PC users to be the easiest programming language to use. Nowadays, this reputation is being shifted to the world of microcontrollers. Microchip's assembly language is written by using MPASM software and MPASM is converted into hex file understand the PIC.

2. Related works

PIC microcontroller is a complete computer on a single chip. PIC microcontroller based waste water sample collection device has been designed to automatically collect the required amount of sample in the predefined time intervals. Detection is implemented by inspecting lots of sample that are collected from rivers at different times. These samples that are collected at different times must be protected without blending and required to study carefully and elaborately [1]. PIC microcontroller based information display panel system looks at integrating a MICROCHIP Peripheral Interface Controller (PIC), with three different display techniques and choosing the most suitable one for time/temperature and count down display applications. PIC microcontroller based information display panel comprises of several integrated technologies, ranging from PIC microcontroller which is the heart of the system used to control the display, the high intensity light emitting diode (LED) driver board used to switch on or off high intensity LEDs [2]. There are three types of display technique comprises of LED, LCD and seven segment display. Among these techniques, LED display is most suitable for this paper. PIC16F84A is the major part of the whole system.

3. PIC microcontroller

The heart of the paper is Microcontroller. Microcontroller is a chip, which contains CPU, memory, timer, input ports, output ports and work as a computer. So microcontroller is also called a computer on a chip. Microcontroller is the main core of computer's CPU. It required the fast processing

time. It always tries the processing time faster and faster. It also requires the larger amount of RAM. Microchip PIC micro MCUs combine high-performance, low-cost and small package size, offering the best price/performance ratio in the industry. PIC microcontroller program consists of a set of instructions stored in program memory which are executed sequentially. PIC microcontroller can build a circuit, but unless put some software into it, the circuit will be useless. In order to program the device, it is placed in a special programmer that supplies the correct signals in the correct manner to program the microcontroller. There are many types of PIC microcontrollers such as PIC16F628A, PIC16F84A and PIC16F877, etc. This system used the PIC 16F84A microcontroller [6]. PIC16F84A belongs to a class of 8-bit microcontrollers of RISC architecture and it has been one of the most popular for a long time. RISC stands for "Reduced Instruction Set Computer". The PIC16F84A devices come in 18- pins package as shown in figure 1.

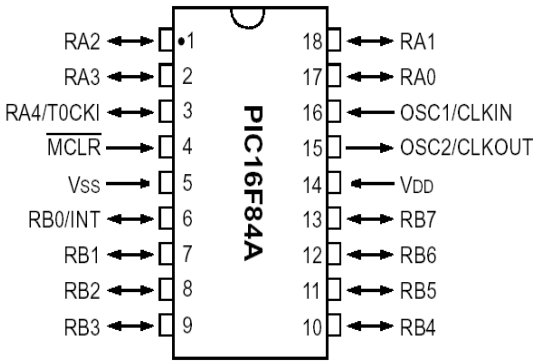

Figure 1. Pin diagram of PIC16F84A

4. System overview

Water is one of the most important needs for the human life. This controller circuit can control the water level in the overhead water tank and light up the LED corresponding to the water level, so this system is reliable. The levels of the water are displayed in the LED bar graph by using the floating ball sensor. It continuously displays the overhead water level. When water level start raise up, LED signal also raise up one after another and all LED turn on and then motor will automatically stop when the tank is full of water. This system uses AC motor which is supported to drive by TRIAC and optotriac. In this system, two PICs are used, one for motor drive and another for level display. In PIC(1), RB1(pin no 7) is used as output to drive motor, RB0(pin no 6) is used as manual interrupt switch and RA2(pin no 1) is used as low level and RA0 (pin no 17) is used as high level. In PIC(2), RB0 to RB5 are used as LED display and RA4 is sense as floating ball sensor's resistance. When the water is reaches under the low level, the motor is automatically drive and the water is touch the high level, the motor is automatically stop. If the user presses the switch, interrupt will be done. The overall block diagram of the system is shown in figure 2.

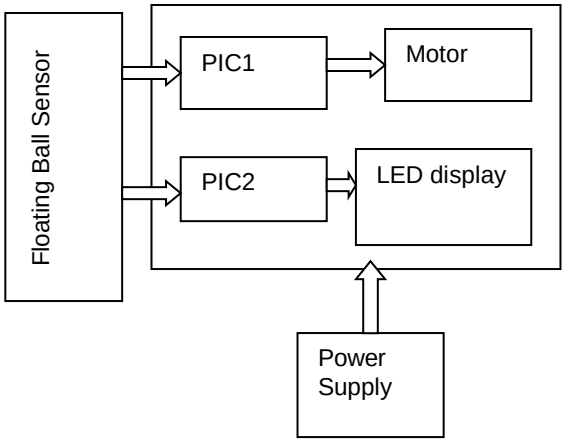

Figure 2. Overall block diagram of the system

4.1. Opto-triac

An opto-triac is a combination of a light source and a photosensitive detector. In the opto-triac, or photon coupled pair, the coupling is achieved by light being generated on one side of a transparent insulating gap and being detected on the other side of the gap without an electrical connection between the two sides (except for a minor amount of coupling capacitance) [3].

4.2. TRIAC

BTA/BTA08 TRIAC series is suitable for general purpose AC switching. They can be used as an ON/OFF function in applications such as static relays, heating regulation, induction motor starting circuits…or for phase control operation in light dimmers, motors speed controllers…[4].

4.3. Light Emitting Diode (LED)

LED is based on the semiconductor diode. LEDs are produced in a variety of shapes and sizes. The main types of LEDs are miniature, high power devices and custom designs such as alphanumeric or multi-color [5].

5. Implementation of the system

The hardware implementation, design consideration and control circuit will be described. The firmware program for the microcontroller is written by Assembly language that control hardware including motor drive as shown in figure 3 and display on LED as shown in figure 4.

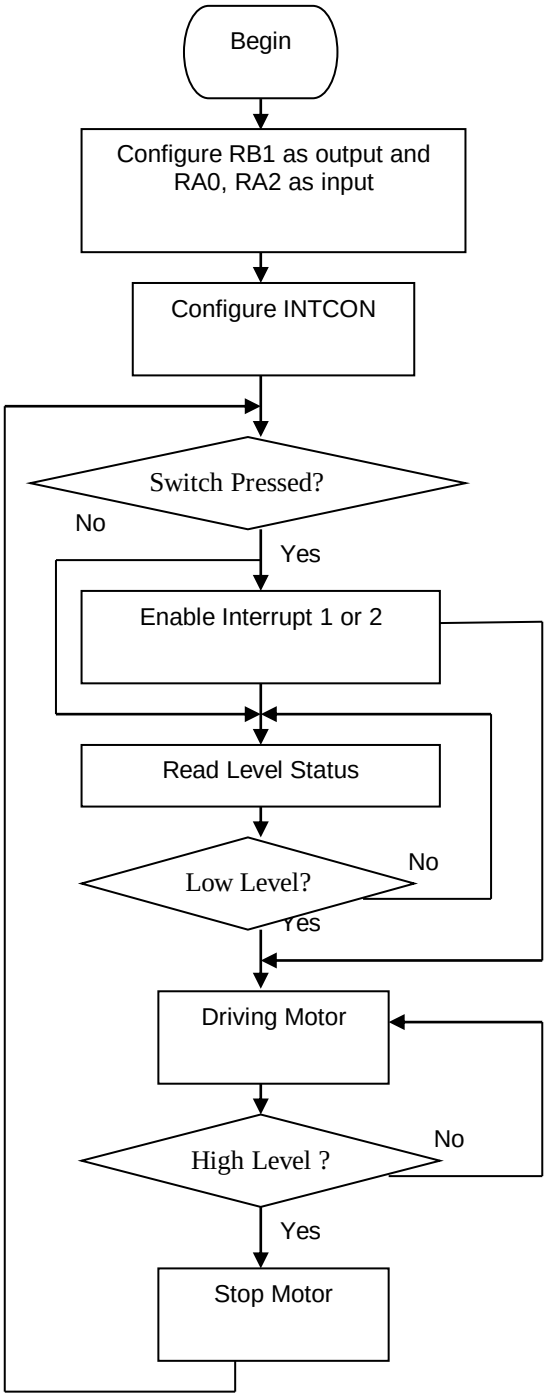

Figure 3. Flowchart of motor driving

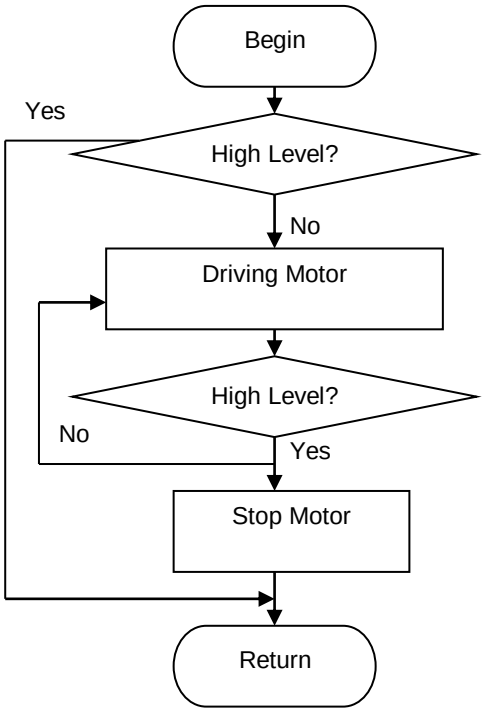

Figure 3.1. Interrupt 1

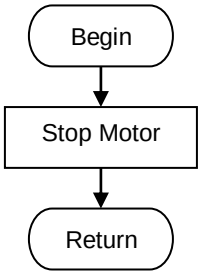

Figure 3.2. Interrupt 2

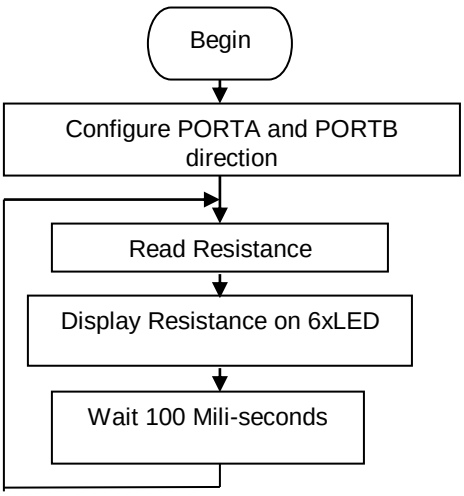

Figure 4. Flowchart of water level display

This system is used two transistors Q1 for low level sensor and Q2 for high level sensor. When the water is reaches below the low level, Q1 is ON. In the time microcontroller will operate the motor to fill the water in the tank until reaches the upper level. If the water is reaches the upper level, transistor Q2 is ON and motor is automatically stop, as shown in figure 5.

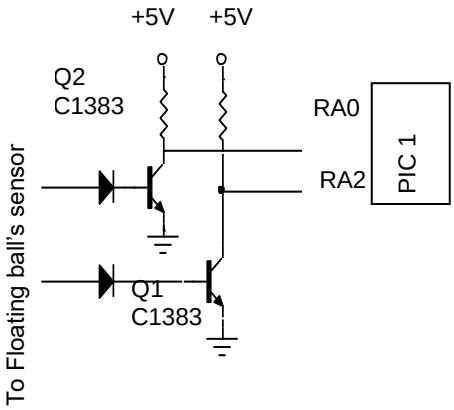

Figure 5. Circuit diagram of level sensor

In figure 6, the pump control circuit is made of an optotriac that provide physical insulation and a triac that implements current control. When the RB1 pin of the PIC1 is on, the optotriac triggers the gate pin of the triac to make it active. When the gate pin of the triac is active it passes the current and the pump begins to operate [7,8].

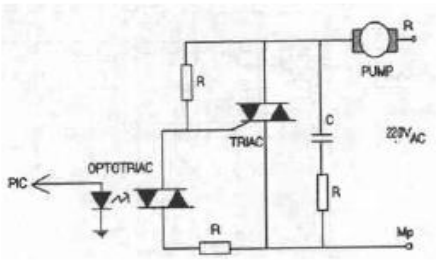

Figure 6. Pump control circuit

In figure 8, resistor and capacitor series circuit is called time delay circuit. The delay time is also varying by varying the resistance value increase or decrease. So the delay time is directly proportionally to the resistance value. The system is used as the floating and its end is connected in variable resistor, can vary 0Ω to 10kΩ. When the water level is low, variable resistor is 0Ω and water level is high, variable resistor is 10kΩ. In resistor and capacitor series circuit, PIC's RA4 pin is connected between R and C is shown in figure 7.

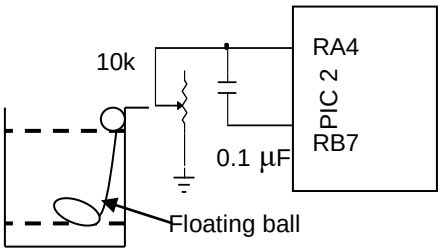

Figure 7. Circuit diagram of floating ball sensor

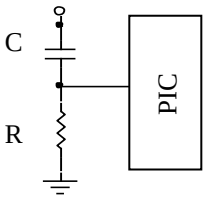

Figure 8. Time delay circuit

In figure 9, the levels of water are displayed in the LED bar graph by using floating ball sensor. The value of the time interval between not detected and detected is display in 6 x LED.

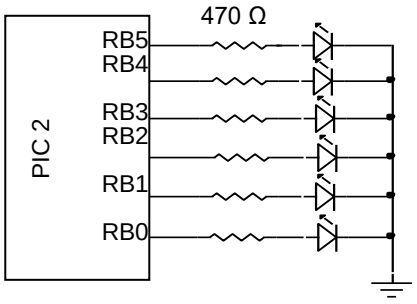

Figure 9. Circuit diagram of level display

If electricity is gone out during the automatic water filling process is doing, automatic motor drive is fail. User can operate or stop the motor anywhere between under low level and high level by pressing the interrupt switch. Even if the user does not stop the motor, the motor will be stopped automatically when the water level reach upper level, as shown in figure 10.

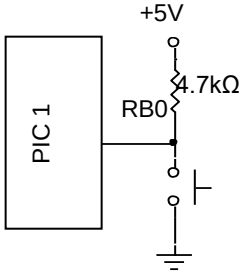

Figure 10. Manual switch

This system is used to implement the water level control and motor drive for filling water. In figure 11, the overall circuit diagram is showed with photo. In figure 12, the construction of hardware design for overall process at the state of full water and all 6 x LED are light up.

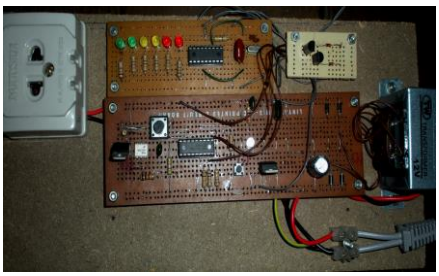

Figure 11. Photo of overall circuit

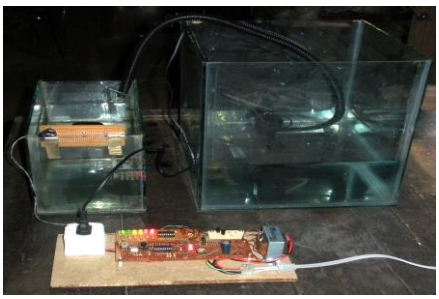

Figure 12. Photo of overall process

6. Conclusions

This system includes the hardware design and software implementation. Firstly, the theory and architecture of PIC microcontroller are studied. Then apply these techniques to design and construct the water level control and drive motor. In the real time, water is very important in every country and also necessary for health. In this system, people do not need always look after the water level because LED is always display the water level. By using this system, no need to worry about empty water and overflow in the tank.

7. References

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