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Microcontroller Based Water Level Detection and Pump Control Using Ultrasound

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***Abstract*— Water is the most important Nature's gift to the mankind. But water scarcity is one of the major problems being faced by major cities of the world and wastage during transmission has been identified as a major culprit. One of the motivations for this research is to deploy computing techniques in creating a barrier to wastage in order to not only provide more financial gains and energy saving, but also to help the environment and water cycle which in turn ensures saving of water for future. We presented our research in embedding a control system in which water level of both tanks are observed and at the same time water pump is also controlled on the basis of existing water level using ultrasound. Thus our system acts as a water level detector and automatic water pump controller. And it also helps to eliminate the cost and inefficiency of human interference associated with monitoring and controlling the pump while maximizing the performance and life span of the electric water pump.**

Keywords—ATmega 8 Microcontroller, Ultrasound device (HC-SR04), LCD (2X16)

I. INTRODUCTION

Sustainability of available water resource in many reason of the word is now a dominant issue. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Water is commonly used for agriculture, industry, and domestic consumption. Therefore, efficient use and water monitoring are potential constraint for home or office water management system. In last few decades several monitoring system integrated with water level detection have become accepted. Measuring water level is an essential task for government and residence perspective. In this way, it would be possible to track the actual implementation of such initiatives with integration of various controlling activities. Therefore, implementation of water controlling system makes potential significance in home applications [1-3].

The existing automated method of level detection is described and that can be used to make a switching device. Moreover, the usual method of level control for home appliance is simply to start the feed pump at a low level and allow it to run until a higher water level is reached at the water tank. This is not properly supported for adequate controlling system. Besides this, liquid level control systems are widely used for monitoring of liquid levels, reservoirs, silos, and dams etc. Usually, this kind of systems provides visual multi-level as well as continuous level indication. Proper monitoring is needed to ensure water sustainability is actually being reached, with disbursement linked to sensing and automation. Such programmatic approach entails microcontroller based automated water level sensing and controlling. This paper is organized in the following ways.

II. PROPOSED SYSTEM

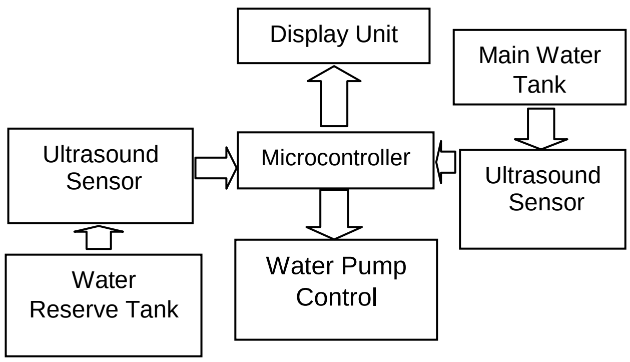

Figure 1. Block diagram of water pump control system

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Figure 1 shows the block diagram of water pump control system. The control system is designed using microcontroller, ultrasound sensor and display unit. So cost and energy requirement is optimized using very few components.

Here microcontroller is used as a heart of the system and others components are used as complementary equipment's for the system. Microcontroller reads existing water level for both tanks using ultrasound sensor and displays the level through an LCD module. Water pump is controlled on the basis of water level of both tanks.

First our control system is trained at level of 100% and 0% for both reserve tank and main tank of water. The next stage is to establish a system that can identify and display any water level as percentage using ultrasound. An algorithm has been developed such that when water level of main water tank is below low level (40% of total water) then the system checks the water availability in reserve tank. If sufficient water exists, it turns ON the water pump and when water level of main water tank is increased to high level (100% of water) it turns OFF the water pump and after that it measures and displays the water level of both tanks.

A. *ATmega 8 Microcontroller*

The Atmel® ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs close to 1MIPS per MHz. This empowers system designed to optimize the device for power consumption versus processing speed [4].

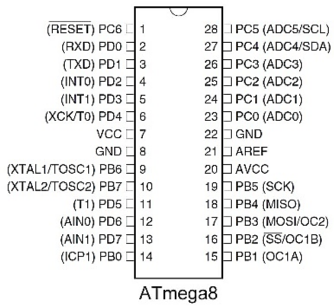

Figure 2. Pin diagram of ATmega 8 microcontroller

Features
• High-performance, Low-power Atmel®AVR®8-bit Microcontroller
• Advanced RISC Architecture
– 130 Powerful Instructions – Most Single-clock Cycle Execution
– 32 × 8 General Purpose Working Registers
– Fully Static Operation
– Up to 16MIPS Throughput at 16MHz
– On-chip 2-cycle Multiplier
• High Endurance Non-volatile Memory segments
– 8Kbytes of In-System Self-programmable Flash program memory
– 512Bytes EEPROM
– 1Kbyte Internal SRAM
– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
– Data retention: 20 years at 85°C/100 years at 25°C
– Optional Boot Code Section with Independent Lock Bits
In-System Programming by On-chip Boot Program
True Read-While-Write Operation
– Programming Lock for Software Security
• Peripheral Features
– Two 8-bit Timer/Counters with Separate Prescaler, one Compare Mode
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture
Mode
– Real Time Counter with Separate Oscillator
– Three PWM Channels
– 8-channel ADC in TQFP and QFN/MLF package
Eight Channels 10-bit Accuracy
– 6-channel ADC in PDIP package
Six Channels 10-bit Accuracy
– Byte-oriented Two-wire Serial Interface
– Programmable Serial USART
– Master/Slave SPI Serial Interface
– Programmable Watchdog Timer with Separate On-chip Oscillator
– On-chip Analog Comparator
• Special Microcontroller Features
– Power-on Reset and Programmable Brown-out Detection
– Internal Calibrated RC Oscillator
– External and Internal Interrupt Sources
– Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and
Standby
• I/O and Packages
– 23 Programmable I/O Lines
– 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF
• Operating Voltages
– 2.7V - 5.5V (ATmega8L)
– 4.5V - 5.5V (ATmega8)
• Speed Grades
– 0 - 8MHz (ATmega8L)
– 0 - 16MHz (ATmega8)
• Power Consumption at 4Mhz, 3V, 25°C
– Active: 3.6mA
– Idle Mode: 1.0mA
– Power-down Mode: 0.5µA

B. *Ultrasound device (HC-SR04)*

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The module includes ultrasonic transmitters, receiver and control circuit [5].

Figure 3. Ultrasound sensor HC- SR04

The basic principle of work

(1) Using IO trigger for at least 10us high level signal

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning

Test distance = (high level time × velocity of sound (340 m/s) / 2

C. LCD (2X16)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on [6].

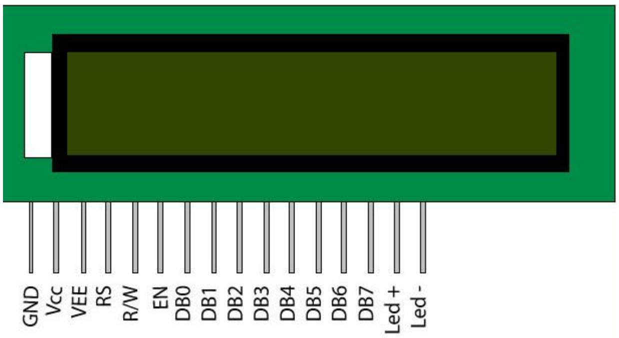

Figure 4. Pin diagram of 2X16 LCD

III. DESIGN AND IMPLEMENTATION

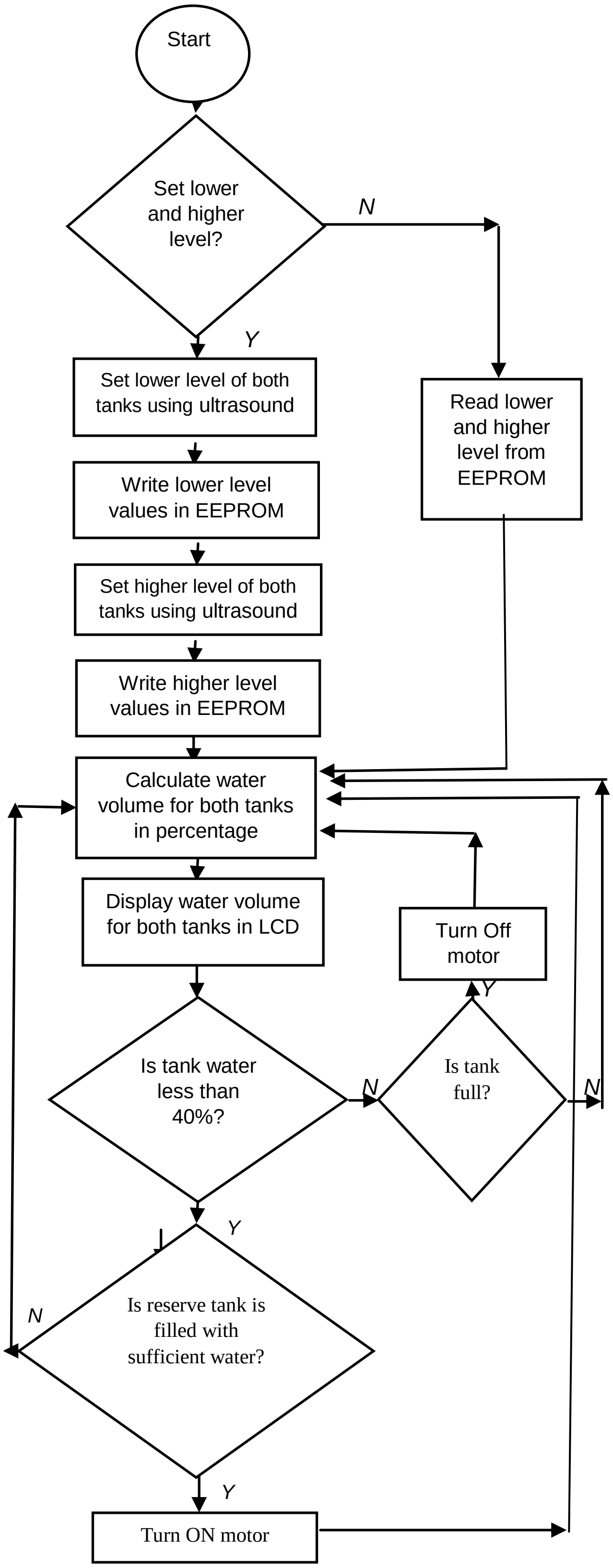

Figure 5. Flow chart of water pump control system

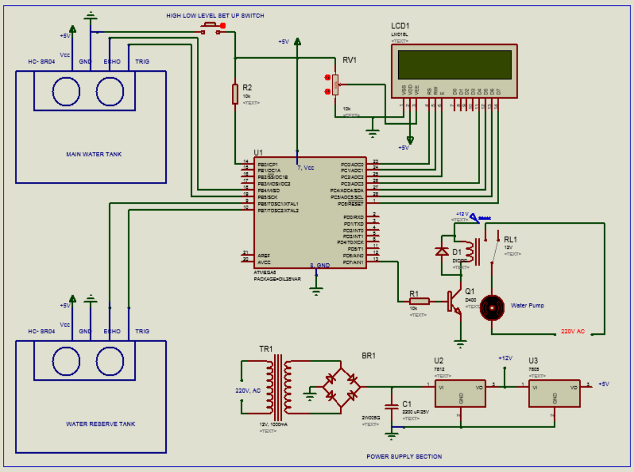

Figure 6. Circuit diagram of water pump control system

For experiment this design we have been using an 8 bit microcontroller ATmega 8, Two ultrasound sensors (HC-SR04) , 2X16 LCD, And +5V and +12V power supply is provided to our control circuit using voltage regulator ICs LM7805 and LM7812 respectively and shown in figure 6.

First lower level and higher level for both tanks are trained and saved to EEPROM. Then water levels of both tanks are monitored using two ultrasound sensors. When water level of main tank is decreased below 40% of total water then our system automatically checks availability of sufficient reserve water and if the condition satisfies then our system turns ON water pump and continues until the main tank is filled (100%). We used AVR studio 4 programming software to write and compile program. Then hex file is loaded using AVRpal.NET3.1.0 software.

IV. CONCLUSION

Automatic water pump control system employs the use of different technologies in its design, development, and implementation. The system used microcontroller to automate the process of water pumping in tank storage system and has the ability to detect the 100% level of water in a tank, switch on/off the pump accordingly and display the status as percentage on an LCD screen. This research has successfully provided an improvement on existing water level controllers by its use of ultrasound instead of direct contact with water or use of AC/DC power into the water thereby eliminating risk of electrocution.

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BIOGRAPHY

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