# Microcontroller-Based Water Supply Control System

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Abstract - The paper dwells on automation for water supply system: supply of water into the reservoir and digital system of automatic water level control by using the PIC series microcontroller.

Key words: water supply, pump, sensor, microcontroller, system, management, algorithm, automated, port.

## I. Introduction

Providing automation for water supply systems of buildings is necessary for increasing the efficiency of water generation and transport technological process, reducing electric power consumption and reliable supply of high quality water to consumers.

A water supply system comprises the water intake and water-purifying devices, pumping station, etc. At every stage of water generation, purification and supplying, there is required water pumping from one reservoir into the other and automatic control of water level for providing the qualitative purification and reliable water supply. The modern water supply systems represent a combination of mechanisms and instruments with sophisticated equipment, whose automation level predetermines their reliable operation. As of today, preservation of the fixed water (solution) level in reservoirs is provided by means of automated regulation systems, high price of which (4-5 times higher than the designed system) increases the cost of water [1,2].

Based on the above stated, automation of water supply system for enterprises and multistory buildings in the urban and suburb areas by using the modern series low-cost programming microcontroller is of high urgency. In contrast to the general-purpose computers, the programming microcontroller-based electronics and computing machinery equipped with the devices for transmission of signals of the executive mechanisms and sensors through inputs and outputs, represent the real time devices [3,4].

## II. Water Supply System

The main peculiarities of a water supply system as an object of automation are as follows: reliable guarantees of continuous operation; operation of devices in the conditions of variable loads and the necessity of providing more efficient operation of pump should be envisaged in the design of the automatic control systems.

The purpose of the automated water supply systems to ensure water pumping from a water catch basin (cellar) to the reservoir placed on the building (Pic. 1).

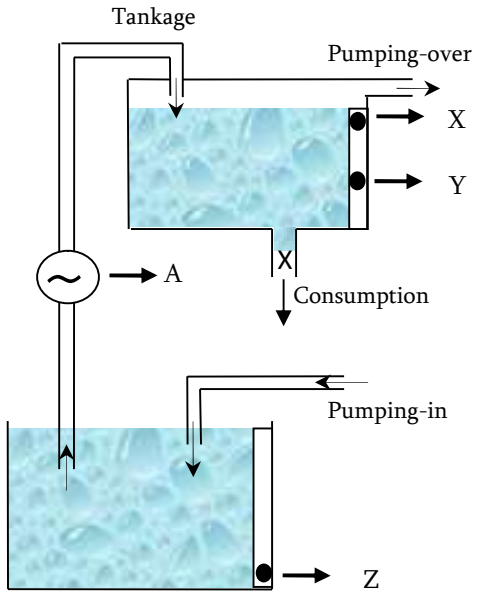
In the upper reservoir at a higher water level there is mounted the X sensor (floater), but on the lower level – the Y sensor. The Z sensor is mounted at a minimum level of a water catch basin.

When the water level in a water catch basin moved down to the minimum level, the logical 0 is generated on the Z sensor, but when the water level is higher

than the minimum level, on the Z sensor there is generated the logical 1.

During moving down of water level in the upper reservoir, on the Y sensor there is generated the logical 0, otherwisae, - the logical 1. When reaching a high water level, the X sensor generates the logical 1, otherwise – the logical 0.

Water is pumping over into the upper reservoir by pump, when the sensors generate accordingly Z=1 and Y=0, but when Z=0 or X=1, the pump is stopped. When the pump is running, A=1, otherwise, A=0.




Pic. 1 The scheme of a water supply system

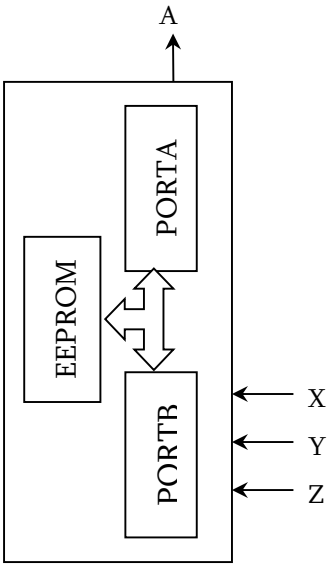
For solving the posed problem, we use the PIC16f84a series microcontroller, with a duodecimal number word that allows for one command execution instead of several ones. They have the following advantages [3,4]:

- Low cost;
- The reduced command system;
- Most of commands are executed during one mechanical cycle, duration of which is 400 nsec at clock frequency of 10 MHz.

The magnitudes of X , Y and Z states must be processed by microcontroller, and on the basis of them the magnitude of A must be devoped for swithing the pump on or off, i.e. X , Y and Z – are the input data, but the A represents output data.

## III. Water Automatic Control System Algorithm

Input and output of data from microcontroller is carried ot by means of ports. The PIC16f84a series microcontroller has two input-output ports PORTA and PORTB (Pic.2). Each output of ports can be programmed at the input or output. PORTA is a 5-bit lock. The direction of data transfer for each line is programmed separately by using the TRISA register and by setting or resetting bit0…bit4 bits. Setting of bit in 1 will fit the appropriate line at the output and bring to it the appropriate content of PORTA tire. During the powering up in accordance by default, all lines are fit at the input. PORTB is 8-bit bilaterally controlled port. The direction of the input-output is determined by setting or resetting the TRISB register. Setting of bit in 1 will fit the appropriate line at the intput. At this time, the output driver enters the high impedance state. Setting of bit in 0 will fit the port line at the output. During the powering up all lines are fit in accordance by default at the input [3,4].

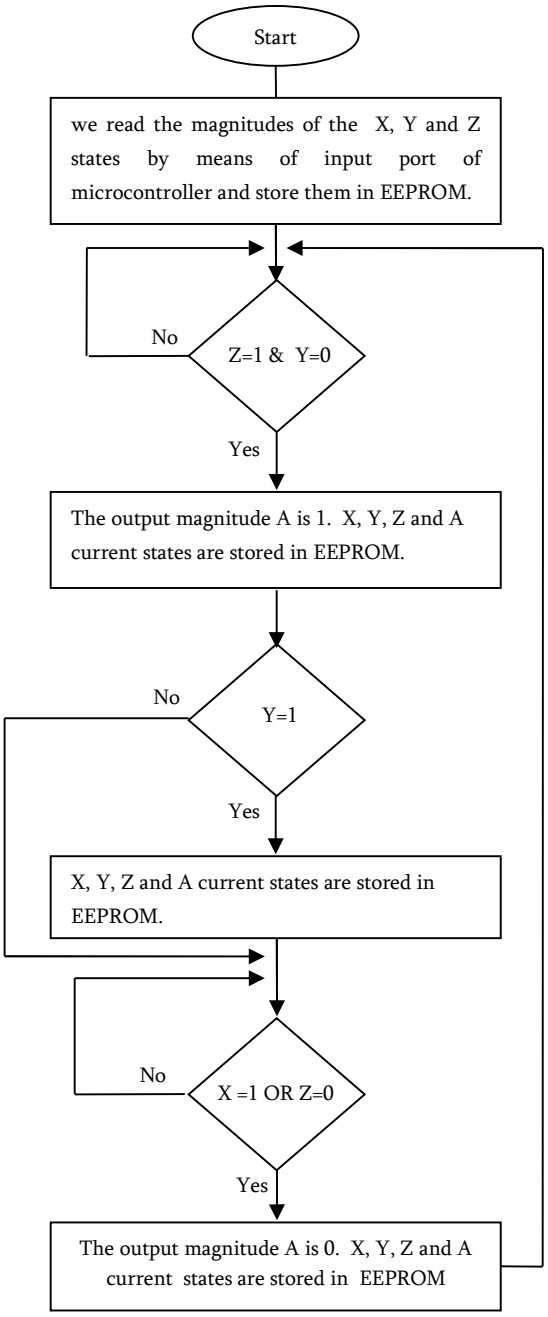



Pic.2. The structure of PIC16f84a Series Microcontroller

We input the magnitudes of X , Y and Z states by means of RB1, RB2, RB3 lines of PORTB. The A state magnitude displayer is a RA0 line of PORTA. The RA0

line of PORTA should be programmed at the output, but RB1, RB2, RB3 lines of PORTB – at the input.

The block-diagram of the functioning algorithm of the water level automatic control system is shown in Pic. 3.

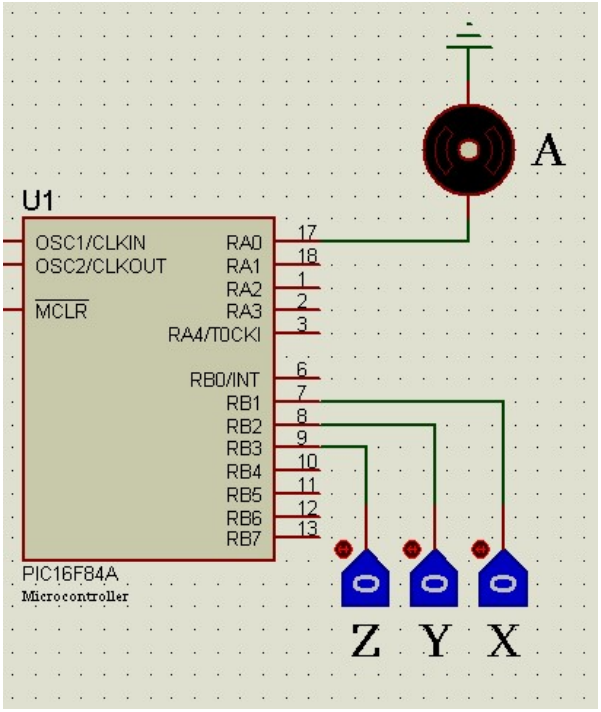



Pic. 3 The Block-Scheme of a Water Automatic Control System Algorithm

IV. The Program Implementation of System

The program intended for recording in microcontroller has been developed on the assembler in MPLAB development environment. The program simulation was carried out in Proteus medium.

Proteus program is a powerful tool for the electronic systems modeling. By means of it, we can construct a diagram, attach the hex file to microcontroller and see how it works. In case of errors in the program or diagram, we will correct them. Then we will physically construct the diagram. Proteus contains the program for creating schematic diagrams of electronic devices, the ISIS program for modeling their operation and the ARES program for design of printed boards [5].




Pic. 4 Automatic Control System Simulation

## V. Conclusion

The introduction of the water level automatic digital control systems developed on the basis of PIC series microcontroller, which accordingly were provided with software and tested by the Assembler software language and by using the MPLAB software package will lead to: reduction in the number of the maintenance staff; possibility of the real time control of the pump operation mode and sensors parameters; reducing costs of water due to the cheapness of system; the possibility of data transferring from the objects distanced away from the control stations and operative control of water dispatch by means of any telecommunication channel.

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