The Prototype of Automatic Water Sprinkle with Soil Moisture Sensor Based on ATmega 8535

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Abstract. This paper presents the design and realization of a ATmega8535 microcontroller based instrument for measuring soil moisture. Two probe for soil moisture sensor. This soil moisture sensor is connected to signal generator. When the soil moisture changes, then the impedance of sensor will change. This the frequency of output signal generator changes according to the soil moisture. This frequency change is then detected and used for knowing the soil moisture level. The instrument is also equipped with an on-off control signal that can be used for controlling the soil moisture level.

1. Introduction

This day, we often see people doing watering plants or irrigation manually / traditionally. Plant irrigation is usually a very time-consuming activity. Traditionally, all steps are executed by humans. With a system like this, control is very limited, and many resources are still wasted and what they do is ineffective and inefficient. Recently, irrigation or automatic irrigation control has been developed that uses voltage signals from dielectric probes related to ground water or by using a sensor. Research has shown that a properly configured soil moisture sensor can be watered automatically.

In making an automatic watering / irrigation system certainly requires an electronic control device that is able to control the work of the humidity sensor mounted on the ground. In the application of microcontroller technology is one system that can be used and developed to facilitate the process of controlling watering plants automatically. Microcontroller [1] can be used as the main controller of the soil moisture sensor that reads soil moisture content and is used as a control to start the watering pump. With this automatic sprinkler system, the soil moisture sensor will read soil moisture whether the soil is dry or if it is wet. When the soil is dry the sprinklers will flush until the soil gets wet and when it is wet the watering will stop by itself.

2. Methodology

Considering the extent of the problem has been explained, the authors make the boundaries of the problem, so that discussion, preparation, and making the system can be directed and achieved in accordance with the expected goals. The limitations of the problem is including:

1) Design and manufacture of prototypes of automatic plant watering devices using a minimum control system ATmega 8535 Microcontroller [2] – [4].
2) Automatic plant watering device prototype using 2 soil moisture sensor modules, each sensor placed in a pot containing the same type of soil and plants.
3) The prototype of the device is supplied using a power supply / power supply with an output voltage of 12 Volt DC
4) The watering system uses a filter water pump used in an aquarium.
5) The water that will be used to water the plants has been collected in a water reservoir with a capacity of ± 4.5 Liters
The prototype system for automatic watering plants is only set up for plants in small pots, with a sample of 2 plants.

A. Microcontroller ATMega 8535
   The AVR microcontroller [5] – [7] has an 8-bit RISC architecture, where all instructions are packaged in 16-bit (16-bit word) code and most instructions are executed in 1 (one) clock cycle, in contrast to MCS51 instructions which require 12 clock cycles. AVR can be grouped into four classes, namely the ATtiny family, the AT90Sxx family, the ATmega family and the AT86RFxx. Basically what distinguishes each class is memory, peripherals and their functions.

B. Real Time Clock (RTC)
   RTC is an electronic clock in the form of a chip that can calculate time (from seconds to years) accurately and maintain or store time data in real-time. Because these clocks work in real-time, then after the countdown process the data output is directly stored or sent to other devices through the system interface.

C. Soil moisture sensor
   YL-69 soil moisture sensor is a sensor that is able to measure the moisture of a soil. How to use it quite easily, which is to immerse the sensor probe into the ground and then the sensor will immediately read the soil moisture conditions. Soil moisture can be measured through the value that is available in the sensor.

D. Submersible pump
   Submersible pumps are operated in water and will suffer damage if operated in the absence of continuous water. This type of pump has a minimum height of water that can be pumped and must be met when working so that the pump has a long life time. This type of pump type centrifugal pump.

3. Implementation

The hardware design in this study was made with several parts, namely power supply, minimum system for microcontroller ICs [8] – [11], LCD interfaces, button interfaces for program settings, and driver relay circuits. The overall system functions and cabling are explained in Figure 1.
4. Result and discussion

A. Input unit

In this section, there are two soil moisture sensors of type YL-69 with their circuit modules, which will later be connected to the mini ATmega 8535 microcontroller system to transmit data or soil moisture values in pot A and pot B [12] – [14].

B. Processing unit

In the processing unit is the most important part in this system. There is a minimum range of ATmega 8535 Microcontroller system, LCD Display module, a set of button settings and sensor modules. In this unit, the sensor will set the humidity value limit by pressing the set 1 button to set the humidity value limit on sensor 1, and set 2 to set the humidity value limit on sensor 2, and run the system [15] – [18].

C. Output unit

In the output unit, the output of the Atmega 8535 microcontroller is connected to the relay driver circuit to activate the water pump motor. This system uses a relay driver circuit with an NPN transistor and a 12-volt relay [19]–[25].

D. System test

Testing this prototype can be done with the following steps:

1) Connect the power cable to the power supply with the electrical socket. Press the 'on' power button. If it is active, the green indicator light on the power supply unit will light up and the LCD display will light up [26].

2) On the LCD display a clock will appear, the reading of the soil moisture value on sensor 1 and sensor 2, as well as the status of the water pump.

3) Prepare 2 potted plants and fill pot A with dry soil, and pot B with wet soil. Place the two pots in the pots provided on the prototype, right under the pipe.

4) Fill water in the water reservoir, until the water pump is fully submerged in water.

5) Calibrate the sensor with the program command, when sensors 1 and 2 are dry, the sensor value is 0.

6) Program and enter data into the ATmega 8525 Microcontroller IC on the process unit to enable automatic control on the prototype.

7) Setting the humidity sensor limit values 1 and sensor 2, by pressing the "set 1" button and then setting the value using the "up" and "down" button at a value of 300.

8) After adjusting the humidity value limit on sensor 1 then press 'set 2' to set the humidity value limit on sensor 2. Make the same value as the humidity value limit on sensor 1, which is 300.
9) After setting the humidity value limit on sensor 2, press the "set 2" button again, to return to the LCD display initial display. Thus the prototype is ready to detect soil moisture values.

10) To check the sensor function and device prototype, insert sensor 1 into the ground in pot A and sensor 2 into the ground in pot B, and pay attention to the LCD display.

In soil conditions in pot A, the sensor detects a soil moisture value of 64 which means that the value is less than the soil moisture limit value that has been set at the beginning of the program at 300 (<300) so that the soil is categorized as dry.

In soil conditions in pot B, sensor 2 detects the soil moisture value of 717 which means that the value is more than the soil moisture limit value that has been set at the beginning of the program at 300 (>300) so that the soil is classified as wet or humid.

And in this prototype, if one of the sensors detects the soil is already in a humid or wet condition, then the pump status will be "off".

11) After checking the condition of the sensor, the next step is to test the relay control circuit and the water pump operation at the output unit. Place the two sensors in pot A, which was detected previously as having dry soil conditions, pay attention to the soil moisture value on both sensors and the motor status on the LCD.

In sensor 1 it detects the soil moisture value in pot A of 124. And in sensor 2 it detects the soil moisture value in pot A of 154. Soil conditions detected by both sensors have a value <300 so that it is included in dry soil conditions, so the pump status will live "On" to start watering.

5. Conclusion

In the final project research of making a prototype of an automatic watering plant with humidity sensor based on ATmega 8535 Microcontroller, the author can draw the following conclusions:

1) The making of this prototype is designed to monitor the level of moisture in the soil. This system is used to activate / deactivate the watering system / pump by adjusting the level of soil moisture. The prototype process / control unit was implemented using the ATmega 8535 Microcontroller while for sensing it was implemented using a YL-69 type soil moisture sensor. And that is used to implement the display of the sensor readings and program output is a 2x16 LCD Display, while for water pump control in the watering system uses relay switching driver.

2) The prototype design is divided into 4 parts / units namely; 1) power supply part; 2) input units; 3) process unit; and 4) output units.

3) The working principle of the prototype device, depends on reading the value of the two sensors and setting the program included in the ATmega 8535 Microcontroller. In this prototype both sensors are set to the soil moisture limit value of 300. And when one sensor reads the humidity value of the soil more than 300 which means the soil is wet, the water pump will be 'off' and the watering process stops. And if one of the sensors reads a moisture value from the soil of less than 300 which means the soil is dry, the water pump will "on" start the watering process.

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