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Development of a Real-time Micro-controller Based Watering System

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Authors' contributions

This work was carried out in collaboration among all authors. Author AIO designed the study and the circuit diagram. Author MAS wrote the software code and did circuit simulation. Authors TTA and OOA carried out the literature searches and circuit development. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

The developed system consists of a solenoid valve and water pump which are directly linked to a microcontroller (ATMEGA-328PU) unit through a transistor -network based relay switching unit. A soil moisture sensor linked to the soil senses the dryness and wetness of the soil. The microcontroller and soil moisture sensor utilizes a 5V power supply unit given through a regulated supply via a regulator called LM7805.A 12V power supply units activates the normally open units of the relay linked to the solenoid valve and the pump. Whenever the dryness of the soil is sensed, the microcontroller decodes and sends an instruction to the solenoid valve to open and the water pump to start driving the water which is sprinkled through the sprinkler. The performance of the system has been evaluated and the response time is fast.

Keywords: Microcontroller; soil moisture sensor; solenoid valve; LCD; sprinklers.

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1. INTRODUCTION

Water is one of the essential natural resources needed by man for consumption and domestic use which includes Agriculture in which most of our crops and foods are grown for consumption, one of the major problems faced by man is water scarcity and since agriculture is an important and demanding occupation which requires large quantity of water, their is therefore the need for a system that provides efficient use of water [1].

The task of manually irrigating fields is very difficult and it takes time due to the difficulties in their work and negligence, they sometimes forget to switch off the pump system leading to wastage of water and sometimes they will forget to switch on the pump when the field is dry leading to damage of crops. In order to overcome this problem there is the need for the introduction of a smart irrigation system [2]. In agriculture, too much water or less water can cause damage to crops, since farmers cannot measure or monitor the dryness of the soil for watering, it means an automation is required in farming practices [3].

The smart irrigation system determines the soil moisture contents and provides water when necessary by minimizing the use of excess water. This device makes use of an irrigation sprinkler which is also called sprinkler or water sprinkler. The device is majorly use to irrigate corps, landscapes, lawn and other areas. The pipe layout is installed underground and the sprinkler is fixed on a pipe permanently raised few inches above the ground level [4].

An automatic irrigation system is a irrigation system that requires minimum or no surveillance since almost every system embedded in it are automated with the help of sensors, timers and mechanical appliances.

Irrigation system can also be used in the disposal of sewage and dust suppression. Since irrigation is closely related to drainage, it is often studied together. Drainage is the artificial or natural removal of surface or subsurface water in a given area [2]. In the irrigation system designed by Archana, Priya [2], so many sensors were incorporated but the major drawback in this invention is that a faulty sensor might offer a negative feedback on the watering process. Also, Khim Thandan Tun et al. [5] in their own work utilized a DC motor for pumping water which could at least cause wastage of water through leakage. Atmega 89C51 microcontroller was utilized by Subalakshmi R et al. [6] through mobile phone in the automation of garden watering. The shortcomings in this design are high implantation and maintenance costs. This developed system offers a serviceable, low cost, repairable and uninterruptable power supply with a 24 hour regular supply from a developed solar-inverter source. This design is a real-time and user friendly type.

2. SYSTEM DESIGN

2.1 The Working Principle of the System

This study is divided into five sections: power section, pump section, microcontroller section, sensor section and display section The moisture of the soil is detected using the soil moisture sensor, The moisture level of the soil is displayed in the LCD, if the current value of the soil moisture is less than the threshold value then the microcontroller will ON the respective solenoid valve and the motor to provide the water to the crops and plant. The solenoid valve requires 12v power and the microcontroller requires only 5v, the power can be step down with the help of a voltage regulator (LM7805). The soil moisture sensor sends electrical signals to the microcontroller .This system doesn't depend on electricity since it has it own power source which is the power inverter that supplies 220v AC. Fig. 2 and Fig. 4 show the inverter and designed instrument diagrams.

The hardware Used are:

Microcontroller (ATMEGA328pu), soil Moisture sensor, Solenoid Valve, 12 V DC Pump, Sprinklers, LCD display, diode(IN4007), MOSFET, variable resistor, CD4047 IC, 12V Battery, power supply.

The software used is:

C Programming (Arduino)

2.1.1 Sensor unit

Soil Moisture Sensor:

The soil moisture sensor senses the level of moisture in the soil, whenever there is shortage of water in the soil, the soil moisture sensor sends a High output signal else the Output signal is low. The amount of current flowing through the soil is proportional to the change in soil moisture. But using this method plants can automatically be watered whenever they need water. The module makes use of both digital and analogue outputs [4].

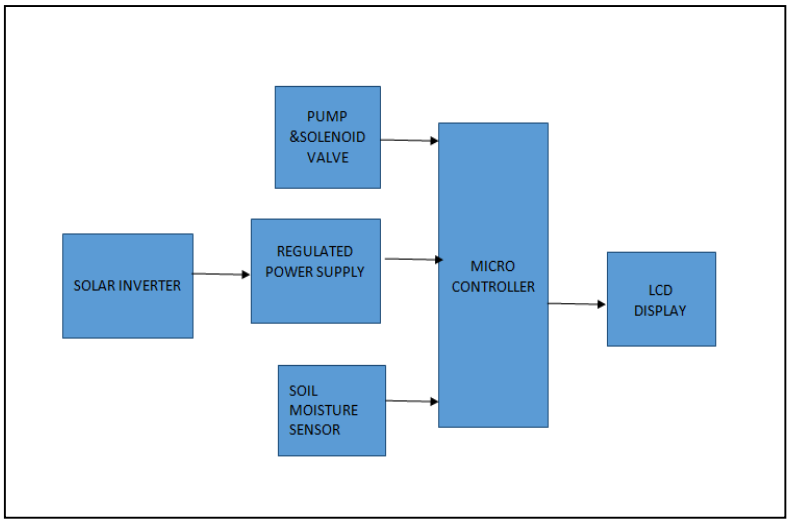

Fig. 1. Block diagram

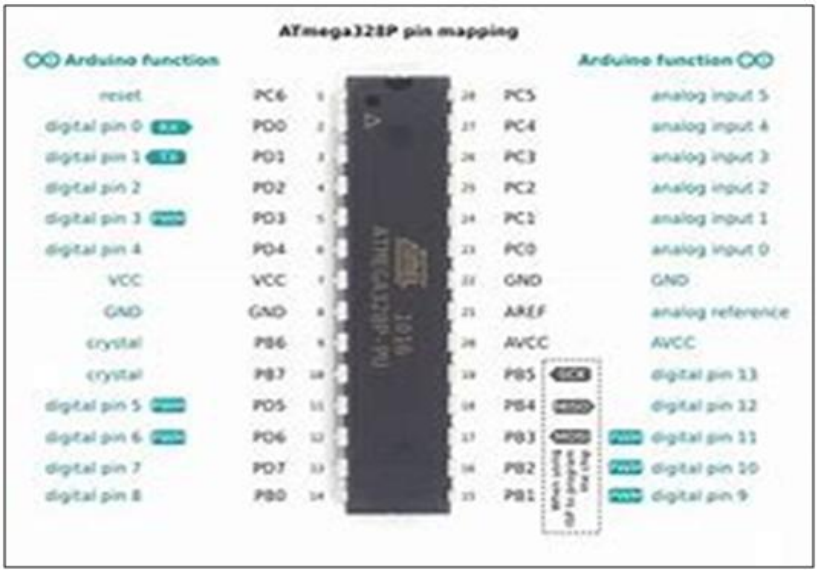

Fig. 2. Pin mapping of ATMEGA 328PU microcontroller

Features of soil moisture sensor:

1. Threshold level can be configured
2. Adjustable Sensitivity
3. Analogue and digital Output for accurate reading

2.1.2 Solenoid valve

This is used as an automatic switch which switches on and off the flow of water from the pump. It prevent excess flow of water.

2.1.3 12 V DC Pump

This is a mechanical device that increases the pressure of water flowing through the pipe

2.1.4 Diode (In4007)

It is used to rectify alternating current to direct current

2.1.5 Variable resistor

It is used to control the contrast of the LCD display.

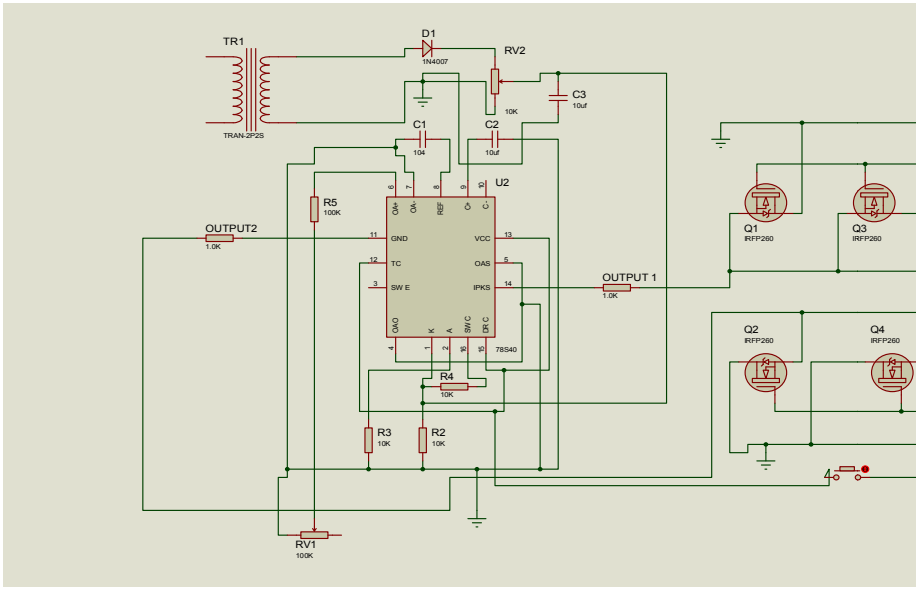

Fig. 3. Circuit diagram of the inverter section

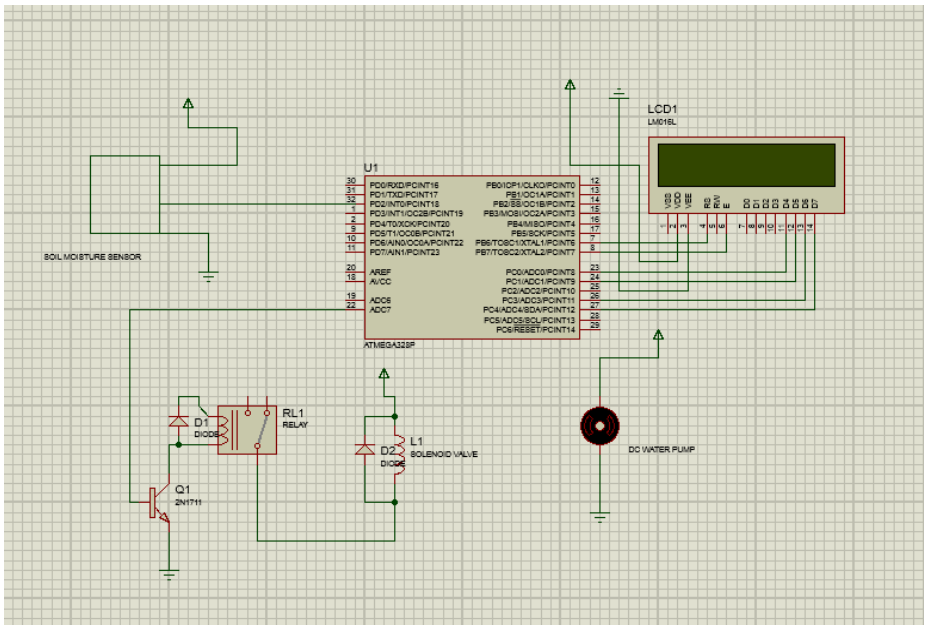

Fig. 4. Circuit diagram of the developed system

2.1.6 Voltage regulator Ic7805

This is used to step down the 12 v DC voltage supped to 5 v Dc which is then used by the microcontroller.

2.1.7 Microcontroller Atmega 328

It is a single chip microcontroller. This 8 bit microcontroller has 32 KB flash memory with read-write features. It has 32 general purpose working registers, and 3 flexible timer counters .It also has internal-external interrupts and serial to make programmable USART. It has 28 pins out of which maximum 18 pins are used. To make the microcontroller work with the Arduino IDE a 16MHz crystal is used and a 5v power supply and a serial connection is used [7].

Features of ATMEGA 328PU Microcontroller:

1. Flash program memory: 32kbytes
2. I/O pins: 23
3. 28-pin AVR Microcontroller
4. Timers: Two 8-\bit / One 16-bit
5. A/D Converter: 10-bit Six Channel
6. PWM: Six Channels
7. EEPROM Data Memory: 1 Kbytes
8. 28-pin AVR Microcontroller

LCD (16x2): It is used to display the current statistic on the screen.

Power Supply: A 12 V power supply is used to power the DC pump and the solenoid Valve

2.1.8 The inverter unit

Is a circuitry that convert or changes direct current (DC) to alternating current (AC). The inverter requires a DC source for it to work since it doesn't produce power by itself but requires a DC sources, the overall power handling of the circuitry depends on the input voltage(12 V), the output voltage(220 v AC) and the frequency (50 hz)

3. RESULTS AND DISCUSSION

The soil moisture sensor has been instructed to operate on the analogue pin on ATMEGA 328P-PU through the analog read mode of the Arduino Integrated development environment has been coded in an automatic way to do comparism between the threshold value (numeric value of the soil in the dry state) of the soil moisture sensor and the analogue read mode. Once a value equal to or greater than the threshold value is reached, the software instructs the microcontroller to digitally control the relay, solenoid valve and DC pump.

Fig. 5 shows the functionality of the developed system after a successful watering process. Fig. 6, Fig. 7 and Fig. 8 show the different hardware parts of the developed system while Fig. 9 depicts different circuitries embedded in the system.

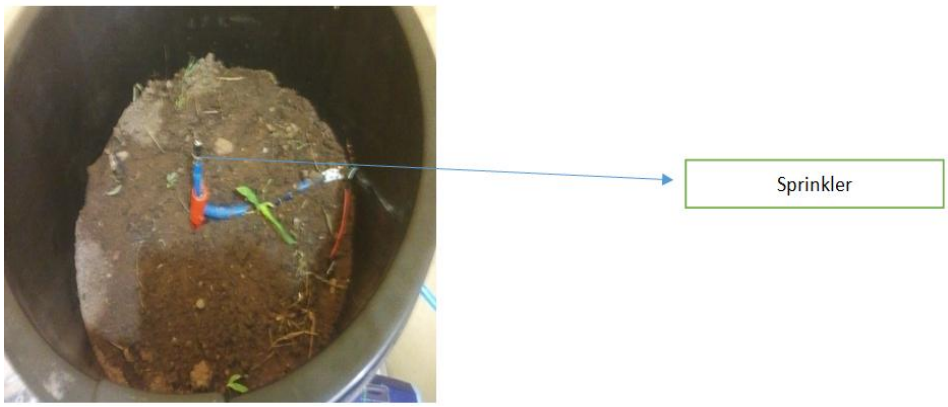

Fig. 5. Image of the Watered mini garden

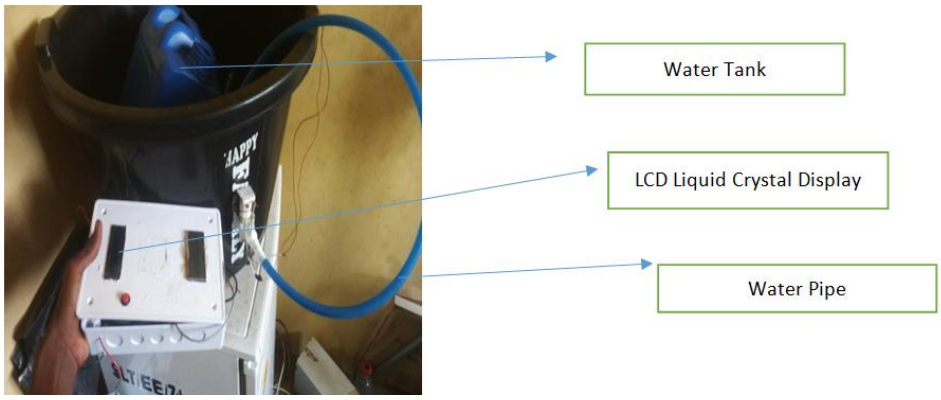

Fig. 6. Image of the system

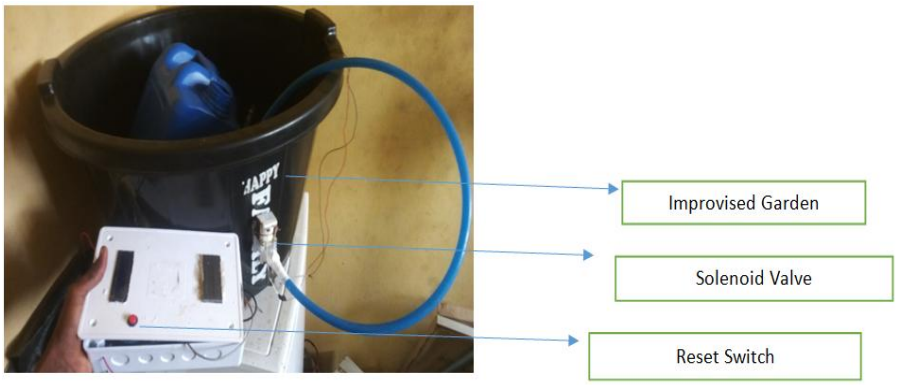

Fig. 7. Exterior image of the system

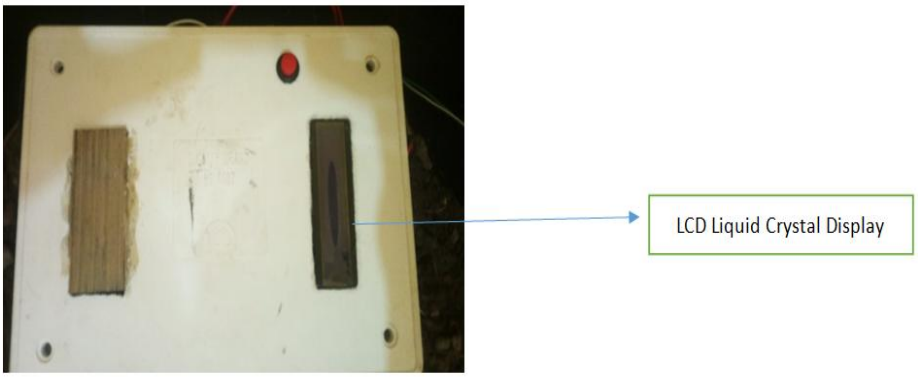

Fig. 8. Front view of the system

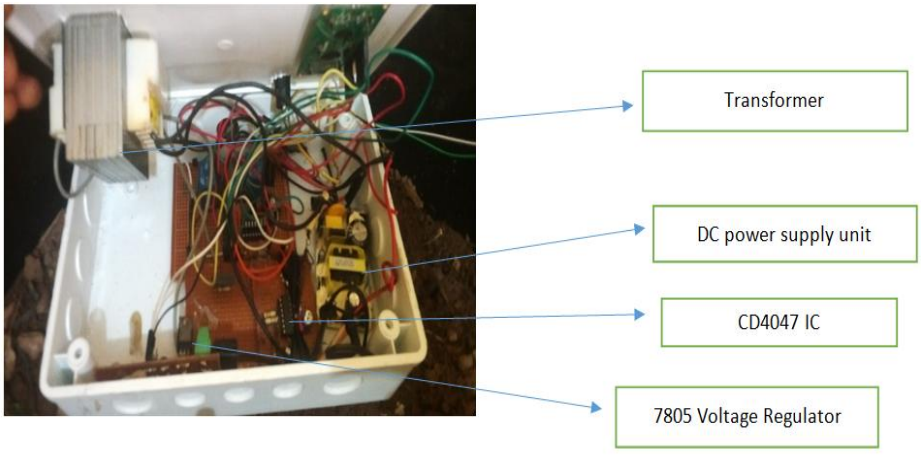

Fig. 9. Interior view of the system

4. CONCLUSION

The microcontroller based smart irrigation system has been designed and tested successfully. The system is less expensive compared to other conventional methods and the purpose of the design was achieved. Whenever the moisture level is found to be below the threshold level, the moisture sensor sends the signal to the

Microcontroller board which triggers the relay connected to the Water Pump to turn ON and activates the solenoid valve to allow the supply the water, the sprinkler starts to sprinkle water. When the programmed watering process is completed, the controller automatically turns off the water pump and deactivates the solenoid valve.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Abhishek Gupta, Shailesh Kumawat, Shubham Gang. Automatic watering system. Imperial Journal of Interdisciplinary Journal. 2016;2(4):1123-1127.
2. Archana, Priya. Design and implementation of automatic plant watering system. Presented at International Journal of Advanced Engineering and Global Technology. 2016;4(1):1567-1570.
3. Sonali D. Gainwar Dinesh, Rojatkar V. Soil parameters monitoring with automatic irrigation system. Presented at International Journal of Science, Engineering and Technology Research. 2015;4(11):3817-3819.
4. Balaji, M. Sudha. Solar powered auto irrigation system. Presented at International Journal of Emerging Technology in Computer Science and Electronics (IJETCSE). 2016;20(2):203-206.
5. Khim Thandan Tun, Hayman OO, Cho Thet. Automatic watering system using arduino. International Journal of Creative and Innovative Research Studies. 2019; 2(3):178-186.
6. Subalakshmi R, Anu Amal. GSM based automated irrigation using sensors. National confenrece of on Emerging Trends in Electronics, Instrumentation, Automation and Control (ETEIAC) organized by Department of EIE, Karpagam College of Engineering; 2016.
7. Microship Atmel Corporation; 2016. Available:http://atmel.com

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