Princess Sumaya University for Technology
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King Abdullah II Faculty of Engineering

Computer Engineering Department

Microprocessors and Embedded Systems

Project Report
Solar Power Auto-Irrigation System

Student	***Student ID***	***Major***	***Email***
Sarah Elaydi	20200853	NIS Engineering	sar20200853@std.psut.edu.jo
Hala Mohammed	20200755	NIS Engineering	hal20200755@std.psut.edu.jo
Mais Samer	20180940	Power Engineering	Mai20180940@std.psut.edu.jo

Abstract

The Smart Irrigation System presented in this project employs a PIC16F877a microcontroller programmed with MikroC to monitor the water level in a tank and assess the moisture content of the soil. The primary objective is to optimize water usage for plant irrigation.

The system utilizes ultrasonic sensors to measure the water level in the tank, providing accurate and reliable data for water reservoir management. Additionally, soil moisture sensors are embedded in the soil to gauge the moisture content, ensuring an informed decision-making process for irrigation scheduling.

Contents

Introduction and background

Conventional irrigation methods, reliant on manual labor and outdated water distribution systems, contribute to significant water wastage and inflated operational costs for farmers. The escalating global demand for increased food production, coupled with the imperative to conserve water resources amid climate change and unpredictable weather patterns, underscores the pressing need for innovative irrigation technologies.

In response to these challenges, the Solar Power Auto-Irrigation System emerges as a transformative solution. This project addresses the inefficiencies of traditional methods by offering a dependable, energy-efficient, and automated alternative for farmers, and any household. It seeks to revolutionize agricultural practices by introducing a sustainable approach to irrigation management.

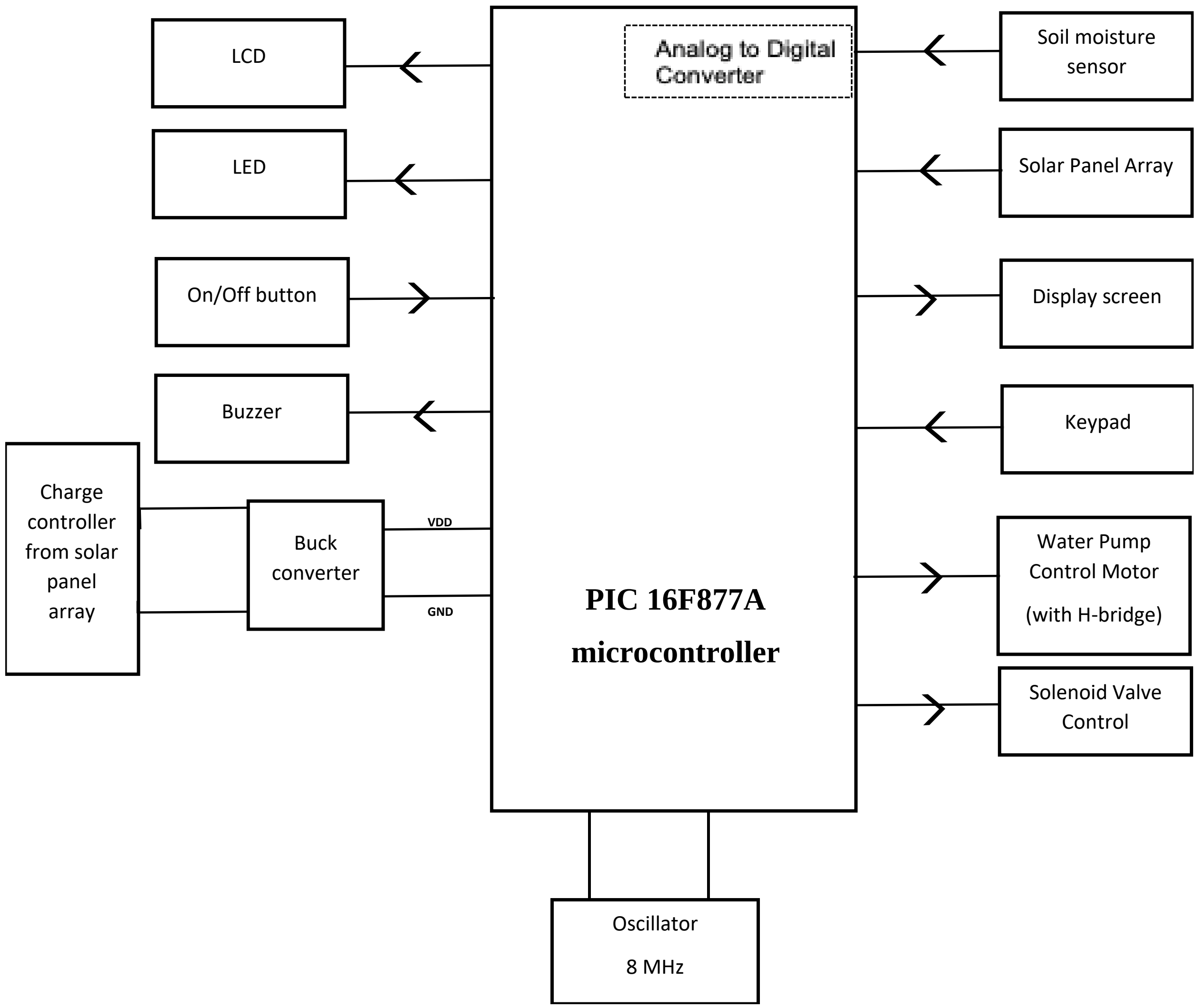
Our project was first motivated by just looking at our own backyard, a cluster of pots filled with dead plants. We wanted to put our embedded system design knowledge to develop a smart irrigation that will overcome previously mentioned limitations to help every household and farmer utilize their water need. By automating the irrigation process and utilizing solar energy, the project aims to address the challenges of manual labor, water wastage, and increased costs associated with conventional irrigation.

Design

The biggest challenge we countered while working on the project was choosing a design where the plant can get sunlight while simultaneously placing the water pump in a position where it can get enough water. We finally decided on placing the plant along with the tank on one side of a box we made, and all the connections on the other side. The tank, a red bucket, was placed next to the pot, we placed the pump in the tank, and the hose in the pot. On the top we placed a lcd, with the LEDs, and a button.

Block diagram

Based on previously mentioned features, we built a block diagram including components that would assist in achieving them:



Components

Buzzer

Buzzers are electromechanical devices that produce sound or audible alerts. For our project, we used an active buzzer for alerting when the tank is empty.

Figure 1 Active Buzzer

LEDs

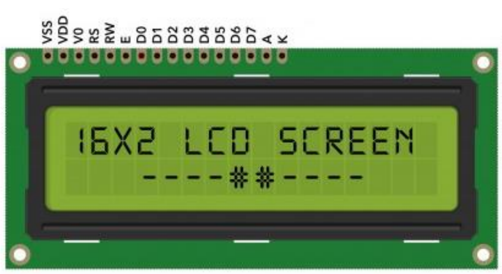
Light Emitting Diodes (LEDs) are semiconductor devices that emit light when an electric current passes through them. For our project, we used 1 red LED, 1 green Led, connected in parallel as a visual moisture alarm.

Figure 2 Red LED

Figure 3 Green LED

16x2 LCD Screen

LCD screens are used for displaying information in various electronic devices. For our project, we used it to display the required data regarding the moisture and distance.



No	Symbol	Function
1	VSS	Ground
2	VDD	5V +
3	V0	Contrast
4	RS	Register
5	RW	Read/Write
6	E	Enable
7	D0	Data bus
8	D1	Data bus
9	D2	Data bus
10	D3	Data bus
11	D4	Data bus
12	D5	Data bus
13	D6	Data bus
14	D7	Data bus
15	A	Anode (5V+)
16	K	Cathode (GND)

Figure 4 16x2 LCD Screen

Ultrasonic sensor

A sensor that can be used to detect the distance (a few cm up to 7 meters) from an object, outputs a digital signal. For our project, we used it to detect if the tank had enough water.

Figure 5: ultrasonic sensor

Moisture sensor

This sensor allows you to detect the moisture of the soil, and/or check if the sensor is dry or not, outputs an analog signal. For our project, we used it to detect if the soil has enough moisture or not.

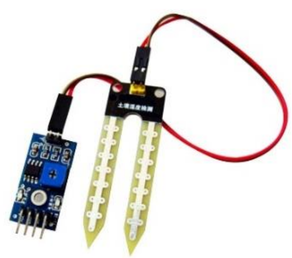


Figure 6: Moisture sensor

Water pump

They are small pumps powered by a battery, DC power supply, or solar panel. Their primary use is to circulate and pressurize liquids. In our project, we used it to pump water from the tank into the soil.

Figure 7: DC water pump

H-bridge

An electronic circuit that switches the polarity of a voltage applied to a load. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards. In our project, we used it to supply the water pump with voltage.

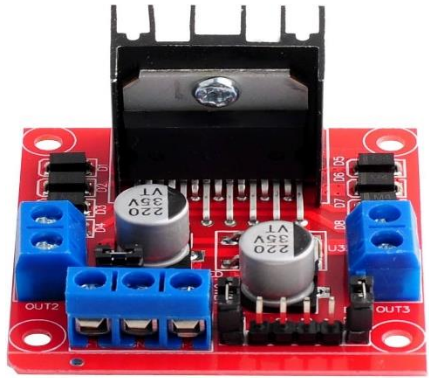


Figure 8: H-bridge

Push button

A mechanical device used to control an electrical circuit in which the operator manually presses a button to actuate an internal switching mechanism.

Figure 9: Push button

Final Design

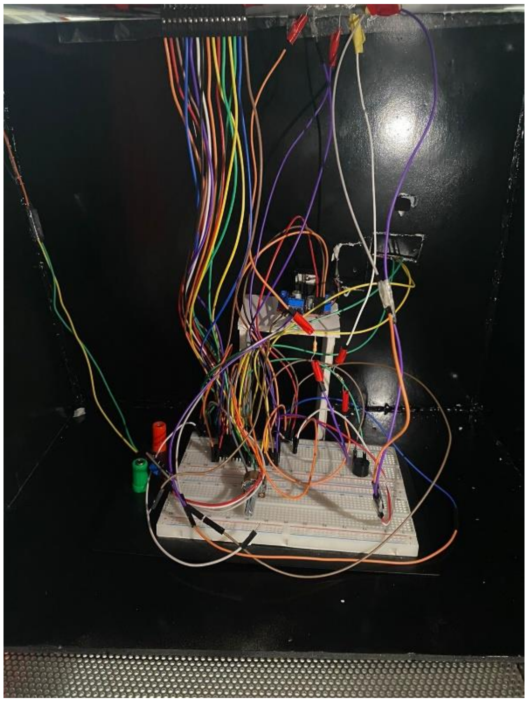


Figure 10: Bread board

Figure 11: Top view

Problems and Recommendations

While working on this project, our team faced many complications, some that we managed to solve, and some that we unfortunately were unable to overcome. Some of these problems are:

1. Temperature sensor:

   We initially had the LM35 sensor as an additional analog sensor. When we coded and connected it individually, the sensor worked perfectly, but when trying to connect it with the other analog sensor, the moisture sensor, the readings came out all wrong for both sensors.

2. Solar Panel:

   Our initial proposal had the solar panel as the power source for the system, but we faced problems when connecting it to the system, the battery needed a step up. The solar panel took too much time when charging the battery, as it was a 6V 1W panel, which wasn't efficient to get the best pressure from the water pump needed. In addition to the weather recently, the constant clouds and rain made it hard to test.

Conclusion

In conclusion, this project provided our team with valuable hands-on experience, allowing us to apply theoretical knowledge and overcome various challenges. Although we were unable to implement the project exactly as we had initially envisioned, we take great pride in accomplishing 98% of our initial goals. The project served as a platform for learning, skill acquisition, and problem-solving, ensuring a successful outcome despite the encountered hurdles.

Through extensive testing and evaluation, it has been demonstrated that the implemented algorithms and control logic effectively regulate the watering process, ensuring that plants receive adequate moisture without unnecessary water wastage. The use of the PIC16F877a microcontroller has provided a reliable platform for sensor interfacing, data processing, and decision-making, contributing to the overall intelligence of the system.