Automated Plant Watering System with Arduino

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Abstract

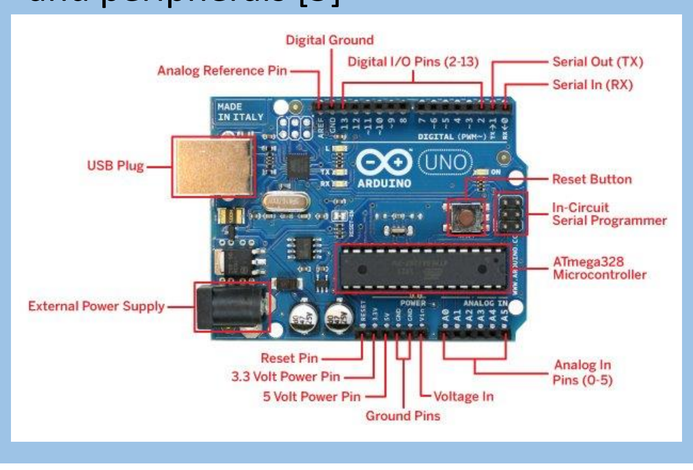
With automation playing a significant part in society today, understanding and leveraging its potential is critical for engineers. The goal was to understand the principles of electrical and computer engineering by working with this aspect using Arduino to create a watering system. This system uses a pump and moisture sensor to determine the best times to water the soil. When compared to other solutions on the market, this Arduino is lower-costing than most smart systems and more intelligent than timer systems. We found that our solution suffers from a few calibration flaws, but otherwise has the potential to save water if implemented into a product. This could be expanded on a larger scale with expanded functionality, especially with the Internet of Things (IoT)

Introduction

- Automation plays a big role in society
- Water efficiency is an issue
  - Majority of household water usage is used in outdoors [1]
- Goals:
  - Learn more about engineering
  - Learn about automation and efficiency
  - Understanding connection between hardware and software with Arduino

Background

- Automated Watering Systems
  - Based on solely or mix of timer, sensor and smart system
- Ohm's Law [2]
  - $\Delta V = IR$
- Transistor
  - Acts as switch by affecting current flow [3]
- Capacitor
  - Compensates for slight power losses and noise [2]
- Resistor
  - Reduces current and pulls down voltage when inactive [4]
- Arduino
  - Open sourced hardware and software platform for DIY projects and prototyping
  - Different designs for different applications
- Microcontroller
  - Mini-computer with processor, memory and peripherals [5]



Acknowledgements

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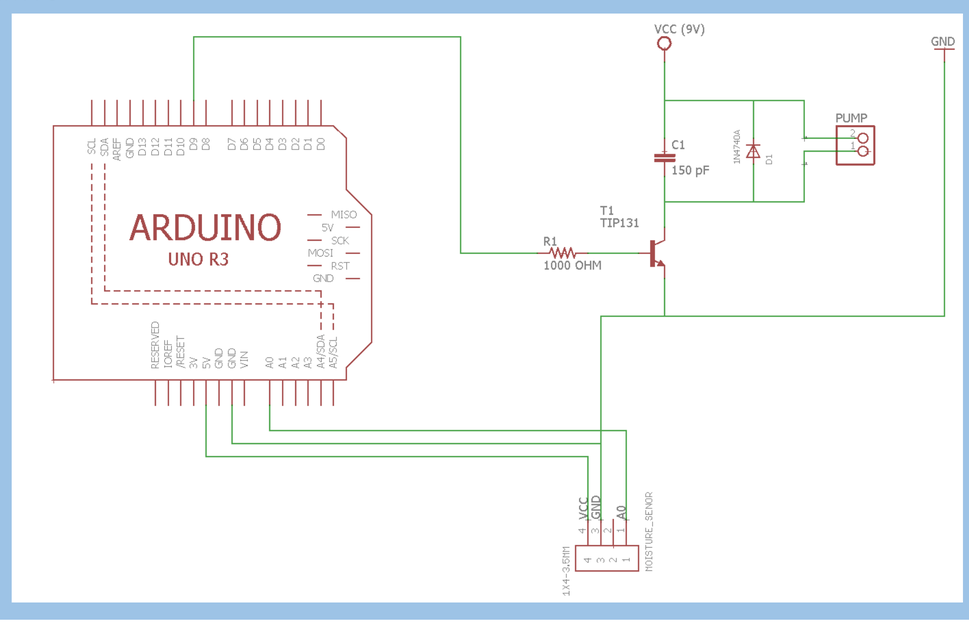
Design

The project is comprised of three parts

- Controller
  - Arduino Uno R3 with Atmel ATmega328P
  - Receives info from moisture sensor
  - Sends command to pump
- Information Sensors
  - Moisture Sensor
  - Directly connected to Arduino
- Actuator
  - Water Pump
  - Connected to capacitor, diode and for power stability
  - Transistor acts as switch for Arduino to control pump



Execution

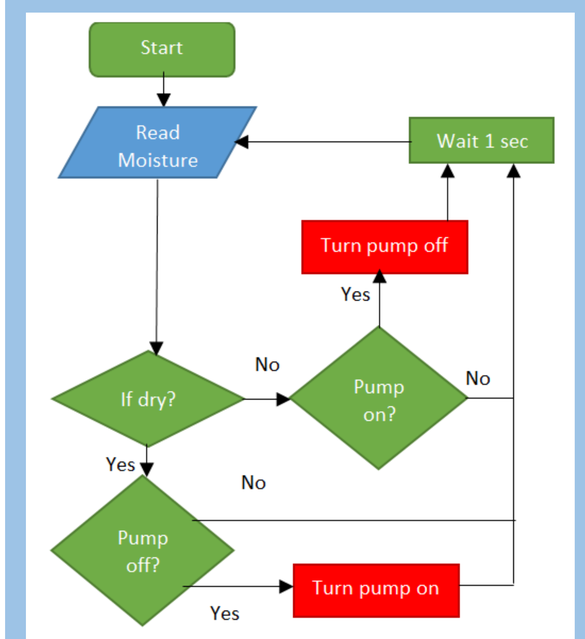


Table 1: Core Components

Component	Cost (CAD)
Arduino Uno R3	$33.00
Breadboard	$5.00
Total	$38.00

Table 2: Expandable Components

Component (per piece)	Cost (CAD)
Pump	$12.00
Transistor (NPN TIP131)	$1.50
Capacitor (105pF)	$0.08
Jumper Wires	$0.50
Diode (1N4740A) (per pc)	$0.32
Moisture Sensor (per pc)	$11.00
Piping (per metre)	$1.02
Total	$26.42

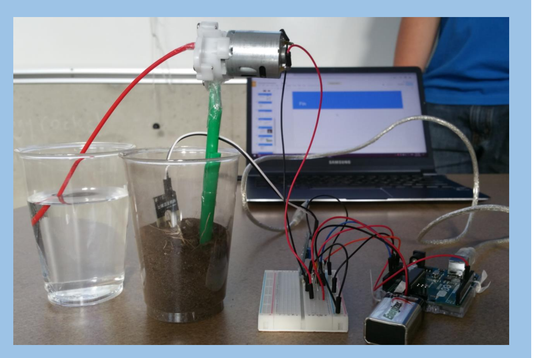


Table 3: Comparison of Solutions

Per pc	T	T+S	S+I	S - Proj
Core	$99.99	$72.99	$279.99	$38.00
Expand	-12 pc-	~$50.00	~$50.00	$26.42
Total	$99.99	$129.99	$329.99	$64.42

Where T = Timer, S = Sensor, I = Smart

- Arduino reads moisture sensor and determines whether pump needs to turned on/off
- Compared to other solutions, the Arduino water system is more affordable.

Findings and Areas of Improvement

- Automated water system using Arduino allows for efficient water delivery compared to hand-watering while also being cost effective versus commercial products.
  - Only dispensing water when needed via moisture sensor
- Moisture sensor and programming needs to be re-calibrated
  - Incorrect readings result in over-flow of water
  - Pump running too fast for water to permeate soil
- Improving functionality and durability
  - Current system not water-proof (exposed wiring and prongs on sensor, pump, etc.)
  - Adding lighting, humidity sensor, IoT abilities (send info to user, getting info from other devices, etc.)

Conclusion

- Goals were accomplished
  - Learned more about electrical and computer engineering through circuitry
  - Adapting hardware and software is challenging
  - Successfully created an efficient automated system, albeit with a calibration issue

References

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