# Automation of Water Control in the Field Football with Arduino Uno for Business Opportunity

Vol. 1 No. 2 (2024), pp 63–69
DOI 10.31603/itej.10688

Fikri Iqbaal Ardiansyah[1*], Nuryanto[2], Andi Widiyanto[3]

[1,2,3] Informatics Engineering Department,
Universitas Muhammadiyah Magelang,
Magelang, Indonesia

*Corresponding author:
Email: fikriiqbaal29@gmail.com

## Abstract

Football is not only carried out as an ordinary sport, but the sporting achievement itself is an asset that can popularize a region or country. In the smooth running of sports activities, stadium facilities were established to support the success of playing soccer. During the rainy season, the match will be disrupted due to the fact that the football field has excessive water, which hinders the match. The system used today to control excessive water on the soccer field is by using an impregnation system. Therefore, a tool is needed that can help reduce excess water during heavy rains. So a prototype water control device was designed on a football field using a soil moisture sensor that can detect soil moisture, using a water pump assisted by a relay to reduce the presence of excess water, as well as using a servo to raise and lower the tools used to spray water and also suck up water. All of these design components are controlled by Arduino uno. This test process if the soil is in soil moisture < 45% then Arduino orders the tool to work because at that humidity the soil is dry. If the soil moisture is > 55%, the servo and also the relay are ordered to work because at that humidity the soil is wet. The business opportunity for this tool is quite high remembering its role in excessive water control..

**Keywords**: Uncertainty Soil Moisture Sensor; Arduino Uno; Servo; Relay; Business Opportunity

## Introduction

In Indonesia, one of the most popular sports is football. Football is not only played as an ordinary sport, but sporting achievements are an asset that can popularize a region or country. For the smooth running of sporting activities, stadium facilities were established to support the success of football sports games. Based on the facts on the field, during the rainy season, field matches will be disrupted due to excessive water on the football field, which can hinder the match's progress.

The system currently used to control excessive water on football fields is an absorption system; however, using an absorption system is still impossible, or there is still water on the football field caused by rain. When the weather is too hot, the grass on the field turns yellow and dries. Watering the field is expected to help keep the elephant grass from turning yellow and drying out. The sprinklers must be spread out so that the watering process does not cause puddles of water on the football field (Latifa & Slamet Saputro, 2018).

Based on the description above, tools are needed to help control excess water to minimize the occurrence of waterlogging during the rainy season. Field soil can be controlled using Arduino

Uno, soil moisture sensors, relays, servos, and water pumps. The Arduino Uno functions as the system controller, the soil moisture sensor is responsible for detecting the level of moisture in the soil, the relay is responsible for turning on and off the pump, and the servo is responsible for raising and lowering the water spray (Nugroho et al., 2023).

On the other hand, in the future, this tool could be used as an opportunity to take it commercially. Many fields still have puddles of water during the rainy season, which can also be used to help monitor the condition of the soil so that the field can be used comfortably. Finally, this tool can be a development tool to overcome excessive water stagnation in field soil during the prolonged rainy season. It can help control soil conditions in the summer so that the grass does not dry out. Based on these problems, this research intends to create a system with the research idea "Automation of Water Control on Football Fields with Arduino Uno". The next section explains the research design, followed by a discussion of the findings. The conclusion will be delivered last.

## Literature Review

### *Business Growth*

Tool design is carried out before starting to assemble the tool. The aim of designing a tool is so that the tool you want to make can be assembled properly without any shortcomings. The design stage consists of several stages: designing the block diagram and the entire tool.

1. Block Diagram

   Blok diagrams show the main parts when creating or improving a system. Figure 1 is a block diagram of the tool.

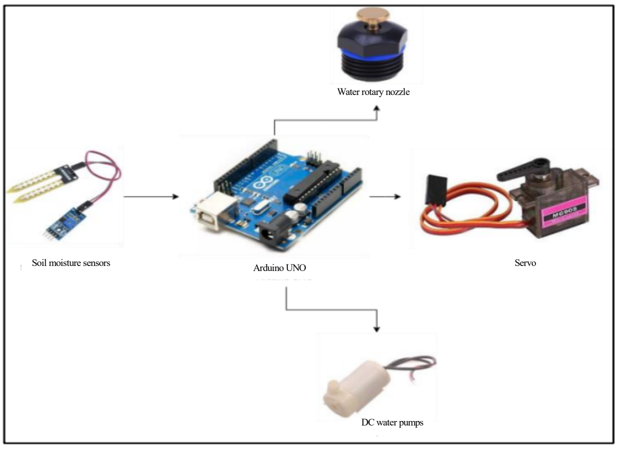


Figure 1. Tool Working Block Diagram

2. Tool Component Series

   The selection of components must be in accordance with the requirements so that when the tool is assembled, it can function as expected. Here is the entire series of tools created using the Fritzing application. The series of tool components can be seen in Figure 2.

   Figure 2 consists of some elements. Firstly, the *Arduino Uno.* Arduino Uno is a microcontroller board based on the ATmega328, a series of boards useful for running control of an electronic circuit. Arduino Uno has 14 digital input/output pins, six analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button (Biantoro et al., 2020)—next, the *Soil Moisture Sensor.* Soil Moisture Sensor is a module for detecting soil moisture, which can be accessed using a microcontroller such as Arduino. This soil moisture sensor can used in agricultural systems, plantations, and hydroponic systems using hydroton (Anggriaswati & Sutopo, 2022; Hariman, 2023)—furthermore, the *DC Water Pump.* The water pump is a tool that can help control the water content on the ground surface. The way this water pump works is that when there is excessive water, the water pump will suck up the water and then help drain it to the water reservoir provided. Moreover, *Servo Motor.* A servo motor is a device or rotary actuator (motor) designed with a closed-loop feedback control system (servo) to be set up or adjusted to determine and ensure the angular position of the motor output shaft. A servo motor consists of a DC motor, a series of gears, a control circuit and a potentiometer. Following that, *the Relay.* A relay is an electromechanical component consisting of two parts: an electromagnet (coil) and a mechanical (a set of switch contacts). It relays a function to assist in disconnecting or connecting electric current automatically. Finally, the *LCD I2C (Liquid Crystal Display).* LCD I2C is an LCD layer module that is compatible with Arduino. This module consists of an LCD layer and an integrated I2C controller, which allows users to connect to the Arduino with just the SDA (Serial Data) and SCL (Serial Clock) pins. To use it requires additional libraries on the Arduino idea, such as "LiquidCrystal_I2C". With this library, users can easily display text, adjust the position of the text, and control other features.

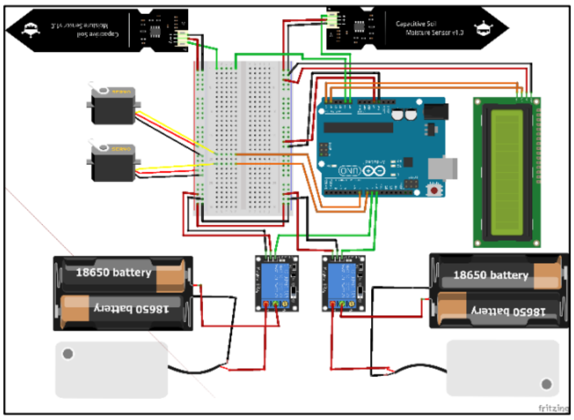


Figure 2. Tool Component Series

## Research Method

The system testing carried out tests the working function of the sensors used. The data obtained from the sensor will then be sent to the microcontroller for calculations to convert into percent and also to find out how long the pump is on. Calculating conversion to percent can be obtained using the following equation (Cahyanto, 2019).

Humidity = (100 – (sensor value x 0.14) ……………………………………………………….(1)

0.14 is obtained from 100 / 700 where 100 is the conversion in percent form and 700 is the maximum value of the sensor reading. Calculating the length of time the pump is on can use the following equation (Hendrawan, 2022).

When the humidity value is above normal.

X = (Y – 47%) / 1.5 ……………………………………………………………………………(2)

When the humidity value is below normal.

X = (47% – 47%) / 1.5 ………………………………………………………………………….(3)

where,

X : Time (seconds)
47% : Normal humidity value
Y : Soil moisture value
1.5 : Change in humidity value per second

## Results and Discussion

The flow diagram is the work process of an Arduino-based water control automation tool. The flow diagram can be seen in Figure 3.

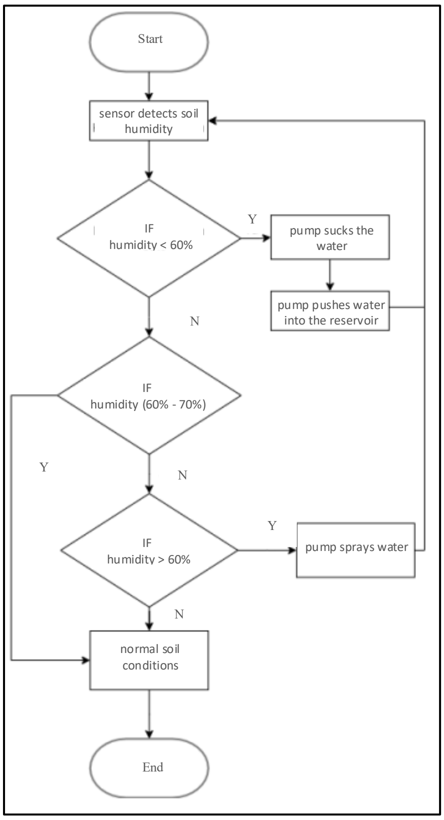


Figure 3. Process Flow Diagram

The flow diagram in Figure 3 illustrates how the sensor detects and manages soil moisture conditions to ensure optimal irrigation. Initially, the sensor assesses the soil's moisture level to determine whether it is wet, damp, or dry. This is done by measuring the humidity percentage in the soil.

When the sensor detects that the soil's humidity percentage is less than 60%, it indicates it is relatively dry. In response, water is pumped and distributed to the existing reservoir to increase the moisture content. This process ensures that the soil receives adequate hydration. After the water is distributed, the sensor re-evaluates the soil moisture to ensure the conditions have improved. Upon re-evaluation, if the sensor detects a humidity percentage between 60% and 70%, it signifies that the soil is in a satisfactory condition. This range is considered appropriate for maintaining healthy soil moisture levels, ensuring that the plants or grass receive the necessary amount of water without over-saturation.

Conversely, the soil is classified as dry if the sensor measures a humidity percentage exceeding 70%. In this scenario, the microcontroller activates the irrigation system, commanding it to spray water evenly across the grass area. This distributed watering helps restore the soil moisture to optimal levels, preventing the grass from drying out and maintaining a healthy growth environment. Overall, the system described in Figure 3 demonstrates an automated and efficient method for managing soil moisture, leveraging sensor technology to maintain appropriate irrigation levels and ensure the health of the vegetation.

*Tool Testing*

The tests carried out in this research tested the soil moisture sensor and relay and the length of time required for the pump to turn on based on the humidity level obtained. The soil moisture sensor was tested in the initial test, and the results are obtained in Table 1.

**Table 1. Descriptive Statistic**

| No | Humidity Level | | Pump ON Time(s) | |
|---|---|---|---|---|
| | Sensor 1 | Sensor 2 | Water pump 1 | Water pump 2 |
| 1 | 29% | 24% | 10,6 | 14 |
| 2 | 30% | 27% | 10 | 12 |
| 3 | 25% | 22% | 13,3 | 15,3 |
| 4 | 23% | 24% | 14,6 | 14 |
| 5 | 29% | 24% | 10,6 | 14 |
| 6 | 70% | 69% | 16,6 | 16 |
| 7 | 55% | 61% | 6,6 | 10,6 |
| 8 | 66% | 71% | 14 | 17,3 |
| 9 | 64% | 66% | 12,6 | 14 |
| 10 | 67% | 71% | 14,6 | 17,3 |

Next, tests are carried out on the relays and servos. This test is carried out by looking at the output of each relay at the normally open (NO) terminal and the condition of the relay after being given the command. The relay and servo test results can be seen in Table 2

**Table 2. The Result of Regression Analysis**

| No | Sensor 1 | Sensor 2 | Relay 1 | Relay 2 | Servo 1 | Servo 2 |
|---|---|---|---|---|---|---|
| 1 | 29% | 24% | ON | OFF | ON | ON |
| 2 | 25% | 22% | ON | OFF | ON | ON |
| 3 | 30% | 27% | ON | OFF | ON | ON |
| 4 | 70% | 69% | OFF | ON | ON | ON |
| 5 | 55% | 61% | OFF | ON | ON | ON |

Based on the results of the implementation and testing that have been conducted, a prototype water control device for a football field has been successfully designed to meet the expected specifications. This device leverages soil moisture sensors to accurately detect the moisture levels within the soil, ensuring optimal hydration for the playing surface.

When the soil moisture sensor detects a humidity level below 45%, the system identifies the soil as dry. In response, the Arduino microcontroller issues a command to the servo motor to elevate the water spray mechanism to the ground surface. Concurrently, the relay activates the pump to spray water onto the field. This coordinated action effectively addresses the dry condition by supplying the necessary water to maintain suitable moisture levels.

When the soil moisture sensor detects a humidity level above 55%, indicating that the soil is sufficiently wet, the Arduino microcontroller sends a command to the servo motor to open the water drainage path. Simultaneously, the relay instructs the pump to extract excess water from the soil. This process ensures that the ground stays saturated, thereby maintaining the ideal conditions for the turf.

The prototype demonstrates a robust and efficient system for managing soil moisture on a football field. Integrating soil moisture sensors, an Arduino microcontroller, servo motors, and relays enables precise and automated control of irrigation and drainage. This ensures that the playing surface remains in optimal condition, enhancing the quality of the field and contributing to the overall maintenance of the sports facility.

## Conclusion

Based on the research on automating water control on a soccer field using Arduino Uno, it can be concluded that all system components work as intended. The soil moisture sensors effectively detect the moisture levels in the soil, providing real-time data to the Arduino microcontroller, which then drives the water pump and relay system. This automation ensures that the system will automatically initiate watering if the soil is dry. If there is excess water or puddling, suction will automatically be activated to remove the excess water. This demonstrates the effectiveness of soil moisture sensors in accurately detecting and responding to soil moisture levels, thereby maintaining optimal conditions for the turf.

The success of this prototype opens up significant opportunities for commercialization and represents a promising business venture. With the increasing demand for efficient and sustainable water management solutions, particularly in climate change and water scarcity, such an automated system has broad market appeal. The application of this technology extends beyond soccer fields to various other sectors, including residential gardens, commercial landscaping, agricultural fields, and industrial sites.

In residential settings, homeowners can benefit from an automated watering system that ensures their lawns and gardens receive the precise amount needed, reducing water waste and promoting healthier plant growth. Commercial landscapers can utilize this technology to maintain large green spaces efficiently, providing consistent care while minimizing labor costs and water usage. Agricultural applications are particularly compelling, as precise soil moisture management can significantly enhance crop yields, reduce water consumption, and contribute to more sustainable farming practices.

Moreover, industrial applications can benefit from this technology by maintaining optimal soil conditions in parks, golf courses, and other recreational facilities. The ability to monitor and control soil moisture automatically can lead to substantial cost savings, improved environmental outcomes, and enhanced asset management. Given these diverse applications, the development and commercialization of this automated water control system represent a lucrative business opportunity. Companies can market this technology as a comprehensive solution for water management, emphasizing its efficiency, sustainability, and cost-effectiveness. Additionally, with the growing emphasis on smart home technologies and the Internet of Things (IoT), integrating this system with existing smart home ecosystems can further enhance its appeal to tech-savvy consumers.

In conclusion, the research on automating water control using Arduino Uno demonstrates not only the technical feasibility of the system but also its vast potential for commercial application. By addressing a critical need for efficient water management, this technology offers a promising avenue for business development, with significant benefits for various sectors. The successful deployment of this system can lead to improved soil monitoring, optimized water usage, and sustainable practices, making it a valuable addition to the market.

## References

Anggriaswati, R., & Sutopo, Y. (2022). Evaluasi Genangan pada Lapangan Sepak Bola di Stadion Sultan Agung Kabupaten Bantul. *Citizen : Jurnal Ilmiah Multidisiplin Indonesia*, *2*(3), 560–568. https://doi.org/10.53866/jimi.v2i3.119

Biantoro, A. W., Anggraini, R., & Subekti, S. (2020). Pengembangan Alat Deteksi Dini Asap Dan Kebocoran Gas Pada Tabung Lpg, Pencegah Kebakaran Skala Rumah Tangga. *Faktor Exacta*, *13*(2), 113. https://doi.org/10.30998/faktorexacta.v13i2.6587

Cahyanto, I. D. (2019). *Prototype Pengontrol Pintu Air Irigasi dan Drainase Berdasarkan Kelembaban Tanah berbasis IoT* [D3 Thesis]. Universitas Negeri Yogyakarta.

Hariman, I. (2023). Sistem Kontrol Sistem Kontrol Lampu Pemanas Pijar Menggunakan Sensor LDR Dan DHT11 Pada Greenhouese Treed. *Jurnal Teknologi Informasi*, *3*(1), 11.

Hendrawan, Y. D. (2022). *OTOMATISASI PENGALIRAN LARUTAN ASAM DAN BASA TANAMAN AIR AQUASCAPE BERDASARKAN KANDUNGAN PH BERBASIS IOT*. Universitas Muhamamdiyah Magelang.

Latifa, U., & Slamet Saputro, J. (2018). Perancangan Robot Arm Gripper Berbasis Arduino Uno Menggunakan Antarmuka Labview. *Barometer*, *3*(2), 138–141. https://doi.org/10.35261/barometer.v3i2.1395

Nugroho, S. F., Bestari, A. H., Nurkhalifah, A., Restuaji, Y., & Sekaranom, A. B. (2023). *Flood Vulnerability Analysis on Paddy Fields Using the Spatial Multi-criteria Evaluation Method: A Case Study of Bantul Regency-Indonesia* (Vol. 2015). Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-122-7_11