

## Technique smart control soil moisture system to watering plant based on IoT with arduino uno

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### ABSTRACT

Water scarcity has become the most important challenge facing the world and a source of fear to the global community from the spread of famines due to the lack of agricultural production. For this reason, researchers seek to optimize the use of food resources, including water wealth. This project contributes to the legalization of the use of water resources. One of these methods is to solve the problem of a decrease in water resources, is drip irrigation systems. An affordable system was developed using soil moisture FC-28 hygrometer sensor compatible with arduino uno R3 and sending electrical signals based on voltage difference due to increased or decreased water in the soil to the monitor through the arduino for decision to operate irrigation pumps. The system is controlled by a software that allows the user to know the current state of the soil to choose the type of plant to determine the amount of water and the possibility of adding new types of plants to the program library and other features.

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## 1. INTRODUCTION

The growth of crops depends on the availability of land and arable water and an increase in investment in modern agricultural methods. Main challenges [1-6] that hamper agricultural development around the world due to the scarcity of water resources [7, 8] due to major climate changes and offset by an increase in the world's population and weak water consumption, which leads to increased demand for food. Therefore, it requires research on water resources, recycling, appropriate use of water and improvement of irrigation systems, including drip irrigation systems [9-11]. A drip irrigation system is an effective way to provide water for both plants and seasonal field crops [12, 13]. Drip irrigation provides an opportunity to flow water continuously and regularly [14-18], it also provides an opportunity for continuous flow of water in addition to many advantages in reducing water consumption and ensuring equitable agricultural distribution between plants, in light of humidity [19-21], temperature, agricultural soils and fertilizers used [22, 23], also reduces traditional losses such as deep filtration, runoff and increased soil salinity [24-28].

The drip irrigation system is a solution to many problems in dryland cultivation and improving the efficiency of agriculture through drip irrigation. The results showed that the majority of farmers appreciated the benefits such as saving water, reducing the cost of workers, increasing agricultural production and increasing its quality, simplifying the use of water, and limiting the spread of weeds [21, 29-32].

Swapnali and other researchers in 2018 used soil moisture sensors to sense the temperature and humidity, raspberry Pi with USB camera installed to surveillance the fields by internal network system [33]. The researchers G. P. and K., in 2016 have been able to measure soil moisture and temperature using moisture and temperature sensor. The drip irrigation valves open by a microcontroller. The irrigation status is updated using the PC. LCD using to display soil PH, temperature and humidity [34].

Kumar [16] in 2017 used the automatic plant irrigation system with arduino uno R3 and soil sensor to the senses moisture level in the soil and sending a signal to the water pump for turn ON or OFF. Humidity sensors were placed in two different places to measure humidity, and then the signal was transmitted to the arduino to estimate the amount of water [35]. Some researchers in 2019 had built a system based on microcontroller and soil moisture sensors. They used platform mobile to display moisture percentage data in graphical form, if it was found that the percentage of soil moisture with an initial value of 30-35% increased to 68.2%, so the system has open the valves to watering the plants [4]. Arduino uno, two humidity sensors, submersible water pumps, and relay mechanism are used in this research.

## 2. PROPOSED SYSTEM

The main objective of this research is to design an automatic plant irrigation system to control the amount of water using arduino uno R3 and soil moisture sensors and control of the system continuously through the monitoring station and scheduling the irrigation system by selecting the type of plant from botanical library that was proposed and contribute to reducing all costs (water, labor) and increase the agricultural production. The majority of soil moisture sensors are used depending on the relationship between soil moisture and the electrical potential difference. Table 1 illustrated the famous of moisture soil sensor [16-18].

Table 1. Famous types of moisture soil sensors

Types	Its items
1-Volumetric sensors	1-Refractometry (TDR) sensors, 2-Time Domain Transmissiometry (TDT) sensors, 3-Capacitance or Frequency Domain Refractometry (FDR) sensors
2-Tensiometers	To measure the tension between soil particles and water molecules.
3-Solid soil moisture sensor	1-Gypsum blocks 2-Granular matrix sensors.
4-Single-Point Measurement	1-ECH2O EC-52- CS650

The proposed system is a sustainable solution to enhance the efficiency of using water in agricultural fields according to the requirements of plants. This system works by using drip irrigation by connecting the sensors of the irrigation system to arduino uno and can be monitoring the system's operation through a computer, and the ability to choose the types of plants according to the program of the system, depending to the soil's need for moisture in the plant root area. The automatic irrigation system for farmers allows to determining the necessary amounts of water in due course. The proposed system is distinguished from other systems by automating the irrigation system by computer.

## 3. RESEARCH METHOD

As far as this proposed system concerned, the use of the automation irrigation sensor is a purpose of improving water use efficiency, the irrigation sensors provide information to the control system on how much water the cultivated land needs and the amount of water spent and the provide the system user with instant reports about water pumps which are turn ON or OFF. The main used hardware components in this research are: arduino uno R3, FC-28 soil hygrometer, water pumps, transistor 2n222, resistor (220 Ohm), connecting wires, batteries (5 V), pipes and drip, network of valves water, and line drip tube.

### 3.1. Soil moisture sensor

Uses the moisture sensor in the soil is used by implanting two electrodes (cathode anode) in the agricultural soil and after the water flows into the soil, these electrodes are affected electrically and send signals representing the electric voltage difference to arduino device and then to the pc to close or open the valves to ensure flow or close the water. Figure 1 shows the electrical circuit work. The soil moisture sensor consists of three pins (VCC, GND, SIG), VCC is the regulated DC supply voltage, GND is the ground, and the third (SIG) to send the signal to one of arduino's serial ports for reading soil moisture.

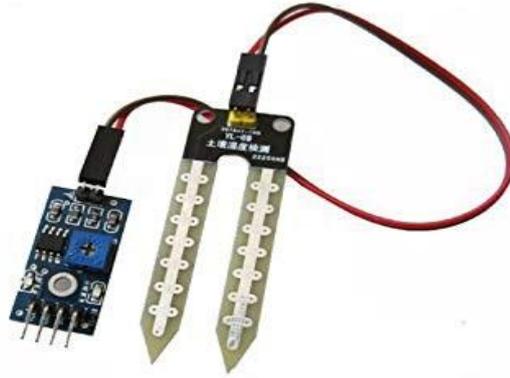


Figure 1. Soil moisture FC-28 soil hygrometer sensor

### 3.2. Circuit arduino and soil moisture sensor

Usually, water pumps need more electrical energy than the arduino board can provide, so pumps must be connected to an external power source. To control the opening or closing of the pump circuit, 2n2222 transistor is used in this work as switch in arduino circuit, to open and close the pump circuit by sending an electrical signal from one of its digital ports to transistor and the signal is either (5 V) or (0 V) to turn the pump ON or OFF. Figure 2 illustrated the circuit of arduino uno R3 with the soil moisture sensor.

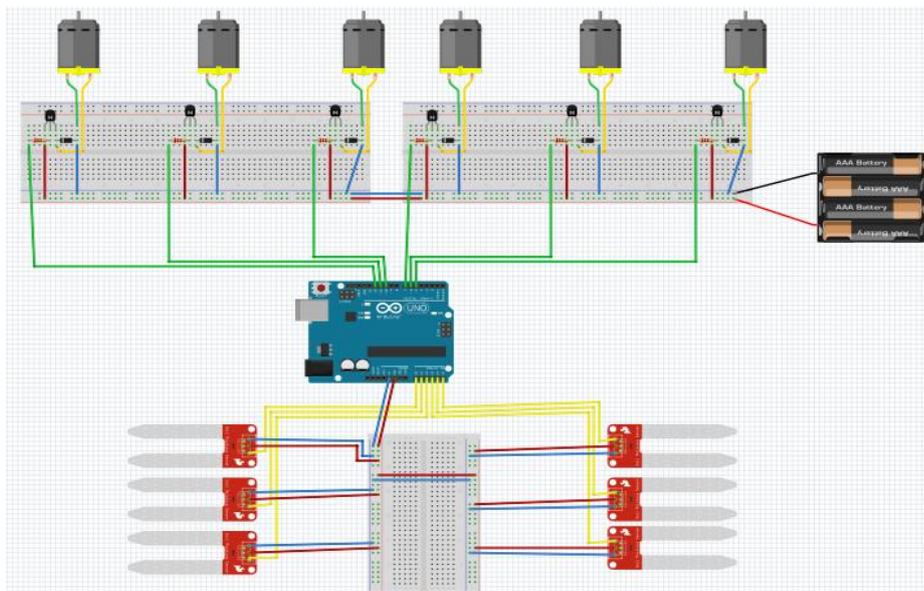


Figure 2. Circuit arduino and soil moisture sensor with water pump

### 3.3. Software design

The flowchart in Figure 3 shows the sequential steps for the system progress, from selecting the plant types to determine the quantity of water needed for each type of plant and then operating humidity sensors to determine whether the soil needs water and printing reports on the amount of water spent within 24 hours. Figure 3 shows the steps of how the system works.

### 3.4. Operating system process stages

Initially, when the program is started by PC, all soil moistures sensors remain in waiting state until the plant type is chosen from the plant library then choosing the plant fields to be irrigated depending on humidity sensors to turn ON water pump in the light of the quantity of moisture measured by the soil moisture sensors as shown in the Figure 4.

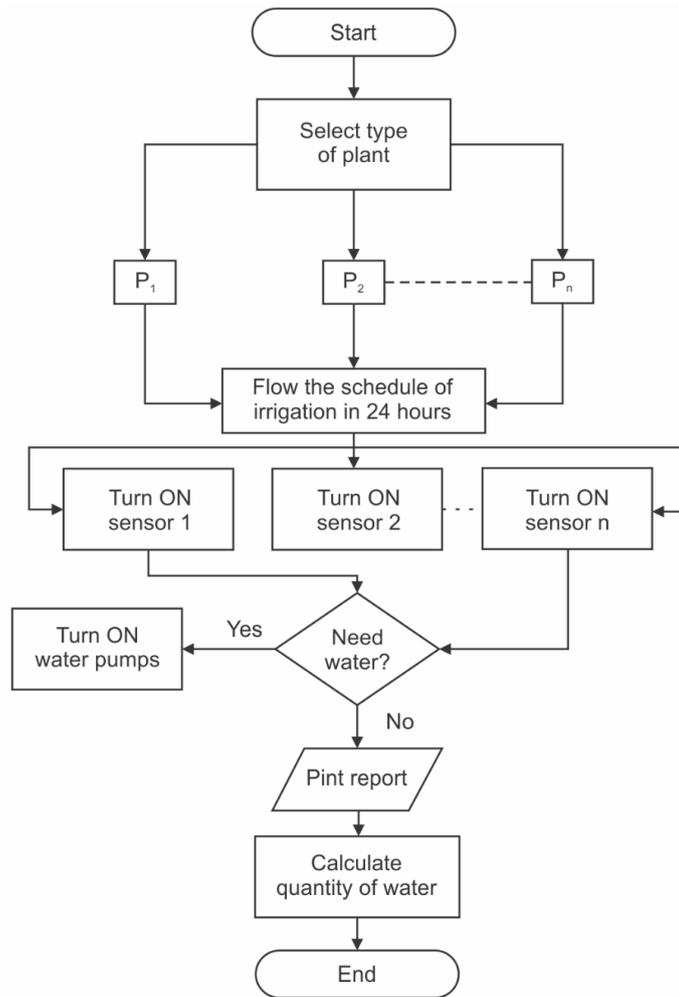


Figure 3. Flowchart of the system's work steps

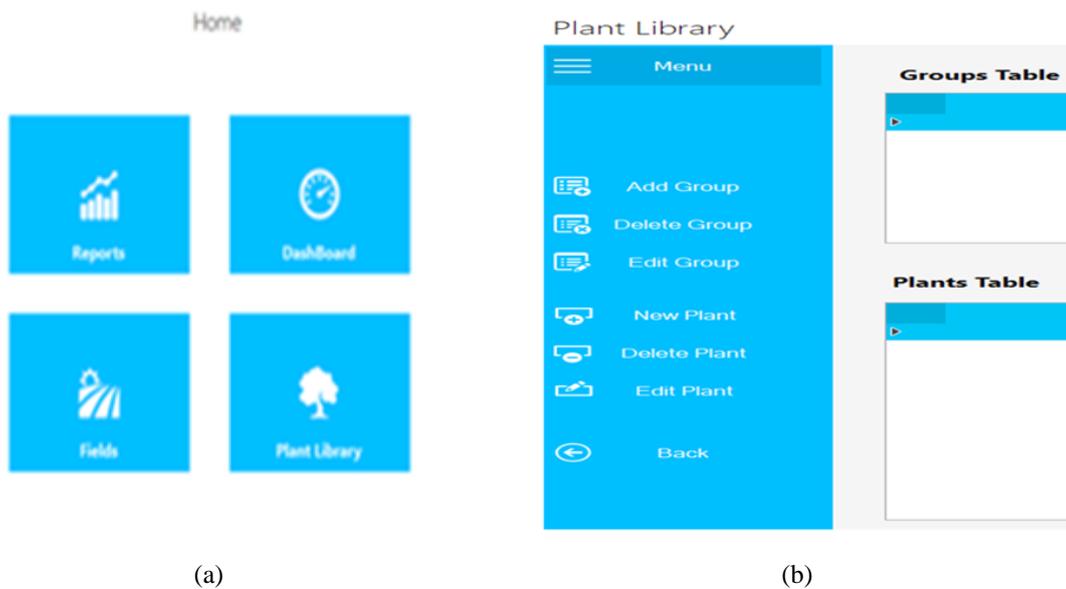


Figure 4. Main window of the proposed system, (a) Home, (b) Plant library



(c)

Figure 4. Main window of the proposed system, (c) Dashboard (Continue)

**4. RESULTS AND DISCUSSION**

A status report can be requested the situation of the quantity of water spent in each agriculture field as reflected in Figure 5 this allows continuous monitoring of sensors humidity in the plant field and water pumps which are working. Data can also be modified on the plant and new plant species are introduced. There is a large plant database with the amount of water suitable for each plant type as illustrated in Figure 6. An experiment was conducted on an agricultural field with an area of one thousand meters divided into four areas, it is about 250 meters per one, and a set of humidity sensors were distributed evenly in the soil to turn ON the irrigation drips systems, and the results were obtained as shown in the Figure 7.



Figure 5. Report for situation quantity of water spent in each field

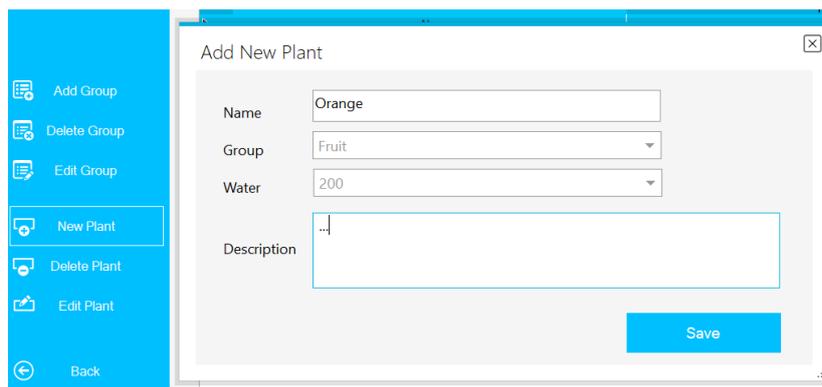


Figure 6. Edit plant library

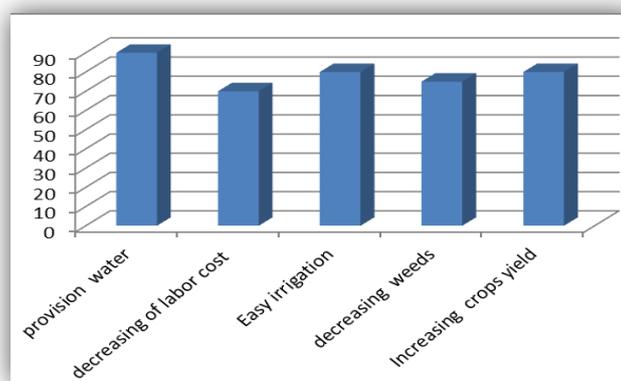


Figure 7. Benefits of drip irrigation

## 5. CONCLUSION

The drip irrigation system is one of the systems in Internet of Things (IoT) that depend on sensors and automatic control in system through a computer system that is connected to arduino uno R3. The proposed system aims to know the level of moisture in the soil and then water the land with the necessary water, depending on the type of plant and the amount of water allocated to it. This system reduced reliance on the human factor and reduced energy costs, in addition to increasing yields of crops and a decrease in the amount of wasted water. The system can be developed by adding other sensors such as temperature and the air humidity and using a GPS to monitor the status and control of all devices remotely by mobile.

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