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Intelligent Organic Vegetable Farming using Automatic Monitoring System

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Abstract
Organic farming is a way to produce organic crops without using pesticides, antibiotics or growth hormone. The objective of this project is to create a smart organic vegetable farm that can protect plants and the environment, reduce soil degradation, reduce pollution, control water quantities and enhance food safety. Water is the main source of growth of a plant. The idea used in this project is creatingorganic vegetable farm by feeding the plants with the water taken from aqua culture. Wastewater from aqua farm contains rich ammonia content. This ammonia will act as a natural fertilizer for the plants to grow fast and produce profitable yield.Excess water from the plant grow bed are filtered biologically and fed back to aqua farm. This idea is converted to smart system using sensors for measuring soil moisture, humidity, and temperature and environment light conditions. Arduino Mega is used as the controller that reads the sensor values, controls the water flow, and lights as per the requirement. The proposed system is suitable for installing at open or semi closed environment with less space and reduced water usage. As this organic farm can be integrated with aqua farms, farmers can double their income.

Keywords: *Organic vegetable, Arduino, smart garden*

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I. INTRODUCTION

Due to technological development and increase in population, it has become a difficult task for the environmental field to provide adequate and healthy food. In addition, it is extremely challenging to preserve water for the future needs. Hence, the entire world is focusing on the problem of food safety and water scarcity. One of the solution for the above said problem is producing organic vegetable with minimized use of water resource. Many researches are found in literature to irrigate the plants by recycling the wastewater [1].

The main objective of this project is to use the water effectively without wastage to irrigate the crops and to produce healthy organic vegetables. In order to achieve this, a cost effective system has been developed to monitor and control various properties like water, humidity, temperature and light that are required for the plant growth.

With the application of this system, it is possible to control the parameters of water used to irrigate plants, pay attention to the troubled soil in droughts [2]. The principle underlying this project is to design a cost effective smart organic farm to produce organic vegetables using Arduino as a controller to monitor and control the properties required for plant growth. The proposed technique produces organic vegetables by using the wastewater from fish farm that contains ammonia. Ammonia is a natural fertilizer that is essential for growth of a plant. Various factors affecting the plant growth are monitored by specific sensors like humidity and temperature sensor, moisture sensor, and LDR. Arduino is used as a microprocessor that receives input from the sensors and operates the water pump and light based on the requirement and environment conditions. Excess of water stored by the plant grow bed is allowed to drain for biological filtering. The filtered water can be used again to feed the fish farm so that no water is wasted in the complete process. This project is very useful for the farmers to increase their income in terms of organic vegetables and live fishes. This technique can be used even in a small area like backyard of the houses. In addition, the smart system is easy to install and maintain.

II. LITERATURE SURVEY

In the modern world, because of technology and industrial development many issues arise such as food security and water shortage. Therefore, the agriculture sector must be strengthened and at the same time, water usage has to be minimized at suitable level without wastage by using different techniques. Different parameters that can affect the farms such as soil, moisture, water level, compost and weather has to be considered. In real farms, it is difficult for the farmers to take care with their farms since all management are done manually [2].

Many countries have put their effort to end this problem. Analysis of the causes of the problem, identifying the methods to solve shortage of water, dealing with different weather seasons, food security, type of soil and ways of watering are challenging tasks for the researchers. In the initial stages, the solution was to use different irrigation methods, for example, recycling rain water to graze crops, surface irrigation, manual irrigation or the use of water tanks. However, there were a lots of challenges such as rain, watering pipes, plant exposed to various diseases and climatic damage. Therefore, it is necessary to search for some advanced technologies through the use of controllers [3].

The second solution was using microcontroller along with two functional components in the system. They are moisturizing the plant and water pumping. Moisture sensor checks the water level in the soil. Whenever the moisture level in the soil becomes less than the required level water is pumped in using a water pump. The advantages of using this method is monitoring several factors that affect the effectiveness of the soil, including soil moisture, water level, and evaporation quantities. However, there are some obstacles that affect the effectiveness of work, including control and knowledge of the water level, which leads to wastage of large amount of water. In addition, there exist a problem of controlling the pressure present in water pumps and timing of irrigation [4].

Later some systems were developed using microcontroller to automatically irrigate the plant when people are not present to take care of it even during the holidays. They used two sensors, which are moisture sensor and humidity sensor. The advantage of using such system was automatic management of farm, avoiding high humidity that is above 80% using humidity sensor and lastly measurement of soil moisture. However, there were some drawback using this systemsuch as light sensing and water recycling [2].

III. DESIGN MODEL

A. Power Supply Circuit

The proposed circuit operates with three levels of voltage. 5V DC, 12V DC and Single Phase 230V AC supply. In order to obtain 12V DC supply the power supply circuit shown in figure is used. The input 230V AC supply is stepped down to 12V AC. Using diode bridge rectifier 12V AC is converted to 12V DC. Capacitors are used as filter for smoothing. Voltage regulator LM7812 is used to regulate the output voltage to 12V in case of increased DC voltage at input of regulator. The 12V DC supply obtained from the power supply circuit is given to the Vin pin of the Arduino and to the two water pumps connected with relay.

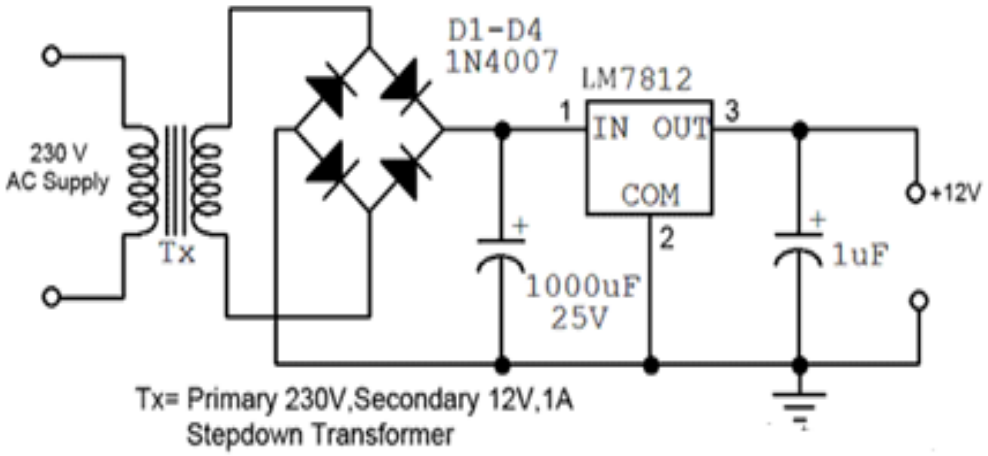

Figure 4.1 Power Supply Circuit

B. Main Circuit

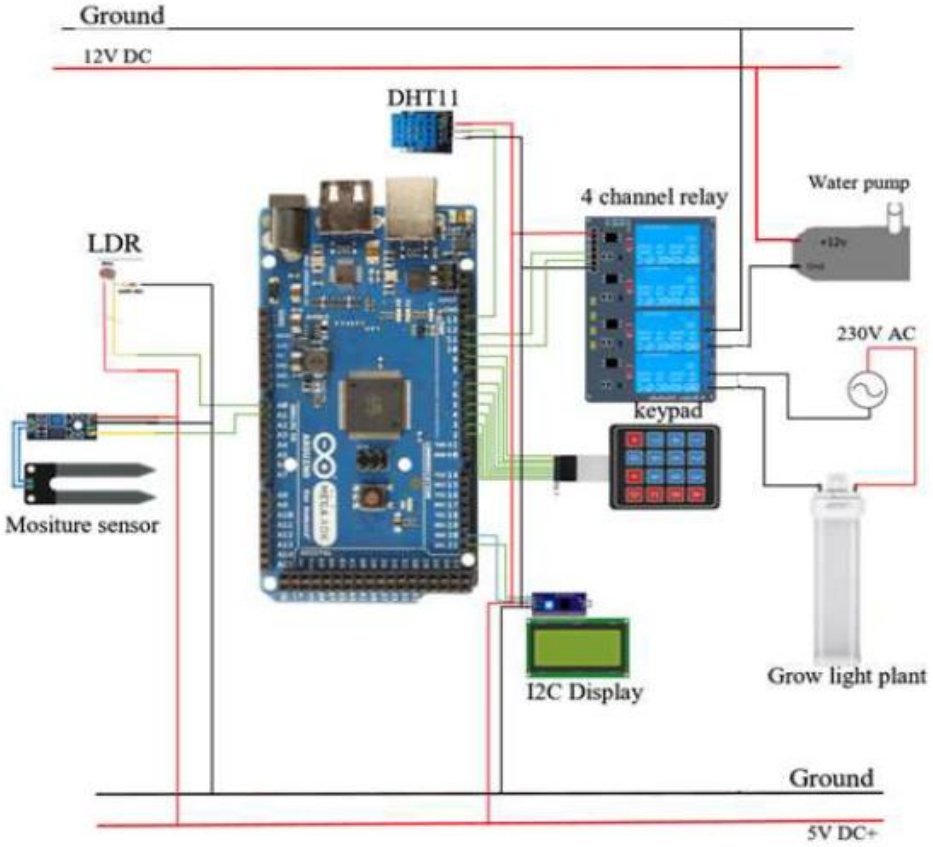

Figure 2. Main Circuit Diagram of Aqua monitoring system

C. Connection details

The main circuit diagram of the proposed system is as shown in figure 3.1.The circuit is powered using a 12V adapter. Arduino Mega internally converts it intoa 5V supply using the inbuilt voltage regulator. Sensors are connected to 5V supplyterminal from Arduino Mega board. The input sensing pins are connected atappropriate digital/Analog pins of Arduino. LCD with I2C and Relays are connectedas output pins from Arduino. Plant grow light and water pump are connected by usingrelay terminals. Water pump is operated by 12V adapter or a battery and the growlights uses direct 240V AC supply connected through relay.

D. Plant grow bed formation

Vegetables like tomato are grown in plant grow bed. Grow bed contains smallamount of soil for rooting. Plant grow bed is a specially constructed arrangement. Itconsists of only less amount of soil to enable rooting of the plant and the remainingpart of the bed is covered using sand pebbles. Sand pebbles are special pebbles madeof clay compressed in form of small balls. These clay sand pebbles have the potentialto absorb the moisture and keep it with them for longer duration. By using such anarrangement, the wastage of water can be avoided. Also these sand balls act asbiological filter for purifying water. Excess of water is collected in Storage tank.Arduino Mega is programmed to read the analog/digital values from differentsensors connected. Each value read by the Arduino is checked with the prefixedvalues in Arduino program. The prefixed values are the range of values that has to bemaintained for essential growth of the plant. The sensors sense properties like humidity, light and moisture. Control measures are taken using Arduinoprogram. Output devices are activated through the command given by Arduinoprogram whenever the levels have to be maintained. Keypad is used as the userinterface to enter the choice for checking any particular routine like light, humidity ortemperature etc.

E. CIRCUIT OPERATION

(i) Light level checking

The operation of the circuit starts with checking the light level through LDR(light dependent resistor). Plant needs at least 18 hours of light for their essentialgrowth to convert light into energy. As the proposed system can be installed eitherindoor or semi enclosed environment artificial lights are mandatory. At any point oftime the intensity of the light can be measured by pressing keypad number 1. Arduinoreads LDR sensor. If the amount of

light is less, then Arduino sends HIGH signal torelay that operates the grow light. During the daytime the ON and off the growlight depends on intensity of light. However, from evening 6 pm to 12 mid night grow lightsare ON continuously.

(ii) Moisture checking

When number 2 is selected in the keypad, the Arduino continues to moisturechecking. If the level of the water is below the required level, then the Arduino sendsHIGH signal to relay that operates the input water pump to fill water. During thisprocess, the moisture sensor continues to check the water level. On reaching therequired level, relay is made LOW to switch off the pump.

(iii) Humidity and Temperature checking

Measurement of humidity and temperature of the surrounding is important topredict whether water is to be poured to the grow bed. In addition, Plants need adequatehumidity in the air for their growth. Key pad number 3 is used for selecting humidityand temperature checking. Arduino checks the humidity &temperature of the outsideenvironment using DHT11 sensor connected. If the humidity is less, Arduino displaywill alert toilette water. Arduino sends HIGH signal for the relay to activate waterpump to operate. Arduino continues to check the temperature of the air until a requiredtemperature is achieved. After reaching the correct temperature range Arduino willsend LOW signal to relay to switch off the water pump.

IV. RESULTS AND DISCUSSIONS

The proposed research work can bring out an efficient and economical solution to avoid wastage of water in agricultural forms. The proposed methods add value to the farmers in terms of income and less water utility. The proposed system requires only a small land area for installing fish farm and agricultural farms using an efficient integration model. Technology innovation is implemented by using advanced sensors to measure the required parameters. The overall operation of the system is controlled by Arduino programming that is very easy and economical to implement. At the outset, the proposed method will act as a hybrid model that combines science and technology together for a profitable business and healthier environment

The developed design is operated with two levels of DC voltage 12V and 5V respectively. Also single-phase 240V AC supply is required for some external devices like heater. The 12V DC voltage is obtained using transformer, bridge rectifier and voltage regulator. 12V DC supply is given as input for Arduino, Water in and out pumps. 5V DC supply required for PH Sensor, temperature sensor and Servomotor is obtained using Arduino 5V terminal. The following table illustrates the type of sensor with their range of allowable values used in the program.

TABLE 1 Range of values for sensors in Organic form

SNo	**Sensor**	**Analog reading range**	**Required Level**	**Controlling device**	**Voltage of controlling devices**
1	Moisture sensor 5V DC	0 to 550 Ohm	<300 Ohm	Water in Pump (operated by relay)	12V DC
2	LDR sensor 5V DC	0-1023 Ohm	>700 ohm	Grow lamp (operated by relay)	1 phase AC 230V,50Hz
3	Humidity &temperature sensor 5V DC	0-50 Celsius	< 25 Celsius	Water in Pump (operated by relay)	12V DC

V. CONCLUSION

The proposed research work can bring out an efficient and economical solution to avoid wastage of water in agricultural forms. The proposed methods add value to the farmers in terms of income and less water utility. The proposed system requires only a small land area for installing fish farm and agricultural farms using an efficient integration model. Technology innovation is implemented by using advanced sensors to measure the required parameters. The overall operation of the system is controlled by Arduino programming which is very easy and economical to implement. At the outset, the proposed method will act as a hybrid model that combines science and technology together for a profitable business and healthier environment.

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