Designing of the Arduino system based Oxygen and Nutrition Feeding Automation System of a Hydroponic System using real time clock

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Abstract - Agriculture is the pillar of India's economy. The present agricultural scenario is a combination of successful endeavors and mistakes in India. To be a global producer in agriculture production we need a new technology which can improve the productivity and profitability of our major farming systems. One such technology used in India is the Hydroponics which is a new breakthrough in farming because it does not use soil as a planting medium, and uses water instead. In the hydroponic system, the nutrition and fertilizer used is mixed into water, which is then referred to as hydroponic nutrition. Along with hydroponic nutrition the system also requires air (oxygen) supply for efficient production, the oxygen is supplied through an electric external air pump. In this research paper we will explore the technique to automate the system with the help of Arduino technology, using necessary sensors and Arduino system based real time clock.

I. INTRODUCTION

Agriculture is one of the most important pillar of economy of any country, same is for our country, one of the most important resource in conventional farming is the usage of Land for crop cultivation, most of the farmers in the country are habitual of generic form of cultivation, which includes, extensive usage of chemical based fertilizers and pesticides, due to given situations, present farmers are facing the dilemma of growing the food in regular manner while compromising the ill effects of chemicals used in farming, causing diseases like cancer, skin diseases, neural diseases and many other.

Due to recent scope of urbanization and industrialization, existing finite land source for cultivation is decreasing exponentially, moreover not all land available is suitable for required form of cultivation, which led to the scope of new form of technology, here comes Hydroponics in the picture.

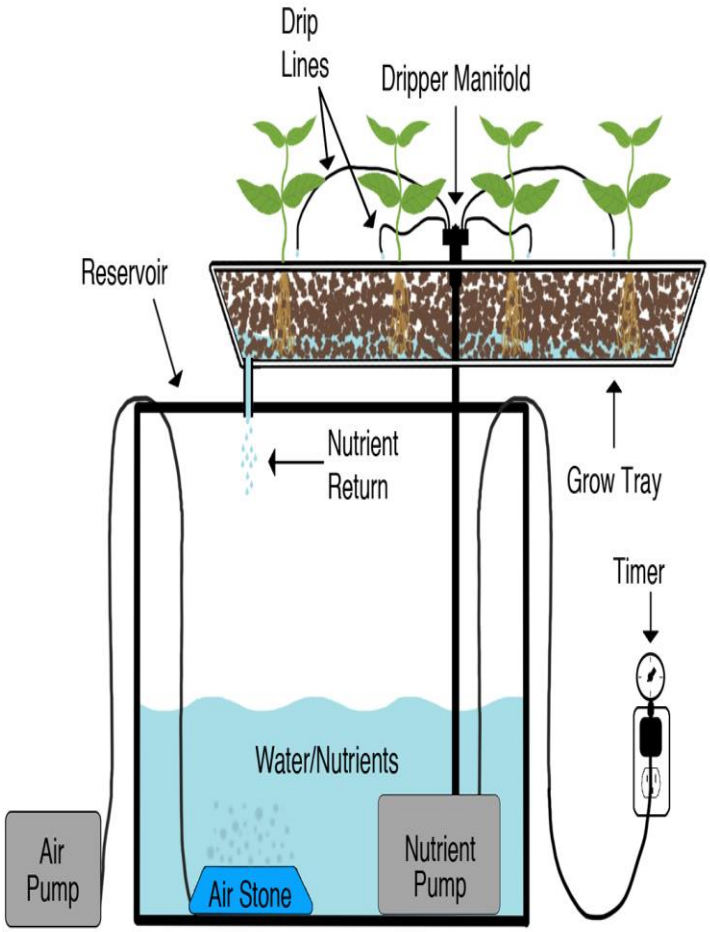
Hydroponics is a technology, in which the medium of growing the crop is water not soil, because there is no usage of soil, there is negligible chance of contamination of crops with harmful chemicals, and even soil based pests are not there to hamper the crop, in the absence of soil, the nutrients are directly added into the water, not only that water is regularly provided aerial flow to provide oxygen.

While designing this research paper when we enquired the rural farmers about this design, they directly asked us to design a hydroponic system, which is easy to use for every layman and farmer (without much usage technical jargons) and it should be cost effective that means economical for the farmers. So, in this research paper, we have designed an automation system for Hydroponic system, this system is automated very simply with the usage of Arduino based RTC, the timer for water output can be customized at the backhand through C language.

II. Method

A hydroponic system generally contains, pots with hollow clay to stabilize plant, these pots are submerged in water containing explicitly added nutrients, these nutrients like Urea, nitrogen and many other are explicitly added in the water, based on the number of plants in the system, generally there are external electric pumps to

provide aerial flow(oxygen) which are switched on periodically.



While designing this Hydroponic automation system, we had two goals one was to design a very simple automation system for layman to use with least maintenance and other was to keep the cost of overall system very low, so that farmers in country can use it practically.

In figure 2.1, you can clearly see the overall structure of the automated hydroponic system, our goal was to set initial timer using Arduino technology and real time clock to construct a relay for the given electrical pumps for supplying nutrients and air to the water. There is a bar in the grow tray, which maintains a particular level of water required for the growth of plant, excessive water is drained out back the reservoir, this method also helps in saving usage of water, by using the same water again and again for supplying nutrients and oxygen.

III. Design

The automation system of the hydroponic system is based on Arduino Uno based chip set, which is programmable in C language, along with chip set we also require a relay module and a Real Time Based clock (DS3231 RTC), our design has a very simple layout to first add the library of RTC, available online. Using that library, we can very easily install and update existing time on it,further we can customize the system, with timer on/off time through programming.

Number of Days	Nutrient (in milliliter)
7	9
15	18
30	36
60	72
120	144

After studying the nutrition requirement in details we concluded, that a given set of six plants, requires in total 18 ml of nutrients within the span of 15 days, which can be explicitly added monthly or as per the convenience of the farmer.

The given table provides the number of days and volume of nutrient respectively a farmer can choose to replenish the nutrition in reservoir tank. Apart from it, the timer is required to run the pump for at least 3 hour everyday which is easily programmable.

Our automation system includes, Arduino Uno chipset which can be connected to RTC in the given manner, after this we can install the Library of RTC to update the present time in-built Coin Battery.

Present time installation can be easily done through opening the library code, of the DS3231 RTC library code, and tweaking it as per the requirement in the given manner. Kindly note that we also need to update the Date and Day initially explicitly in the code, moreover this step is only required to be done only initially for once because further on the Day and Time is remembered by the Coin Battery.

After the date and time is successfully updated, we can move further and design our overall system of hydroponic automated system, further Arduino chip set and RTC is connected to Relay module, which is lastly

connected to 220V source and input of pump power through bread board, in total only 3 specific parts were required to design this system. After designing the system it will look like this.(Fig. 3.2)

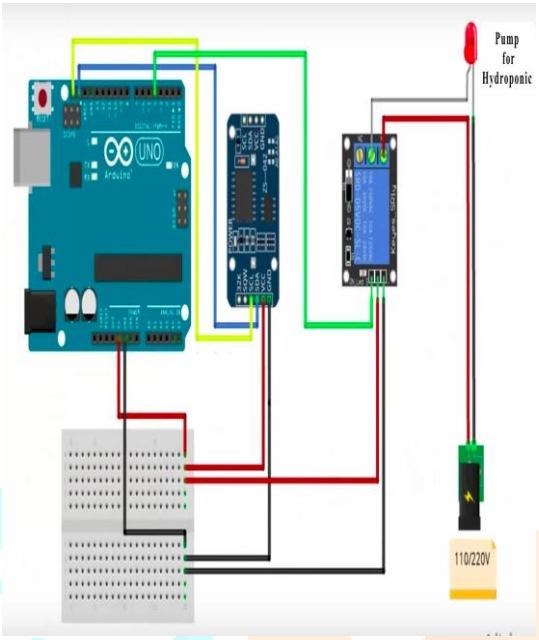


Fig. 3.2

After this basic designing, open the Arduino Driver, which can be downloaded for free online (link mentioned). In the driver, customized code is entered, which would switch on/Off the power source every day, as per the requirement of the user. Further given code is entered compiled and installed on Arduino Chip Set. this would load the program onto the chip, and system will start running.

IV. Cost Analysis

One of the major goal of this project was to design a cost effective Automated Hydroponic system, we were successful in keeping the price of overall system less than 2500/- rupees, which makes it incredibly useful for both urban and rural farmers, moreover it also means that this project has good practical usage.

Equipment	Price (In Rupees Online)
Arduino Compatible UNO	430
DS3231Real Time Clock	140
5V Relay Module	120
3V Coin Batteries	110
Jumper Cable	130
Breadboard	170
Hydroponic Set	1200
Total Price	2300

```
#include <DS3231.h>

int Relay = 4;

DS3231  rtc(SDA, SCL);
Time t;

const int OnHour = 12;
const int OnMin = 24;
const int OffHour = 12;
const int OffMin = 25;

void setup() {
  Serial.begin(115200);
  rtc.begin();
  pinMode(Relay, OUTPUT);
  digitalWrite(Relay, LOW);
}

void loop() {
  t = rtc.getTime();
  Serial.print(t.hour);
  Serial.print(" hour(s), ");
  Serial.print(t.min);
  Serial.print(" minute(s)");
  Serial.println(" ");
  delay (1000);
```

Fig. 3.3

V. Conclusion

In this research paper we have tried our best to design an automated hydroponic system exactly as per the real requirement of the urban and rural farmers, there were two challenges to design a basic automation system for agriculture which farmers can use easily without prior knowledge of Technical skills, that means an automated system for a layman, science is only useful when it has an practical application in daily life, second challenge was the to maintain the cost of the overall system so that it is not costly to implement like other existing automation system, we have succeeded in both the challenges, though there is full scope of automating even more with water pipes and valves, but it is too complex and costly to execute, we will try our best to find support for this design to launch it in the retail market, because this product is for the Indian farmers.

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