Development of Houseplant Automated Watering System based on Moisture and Temperature Humidity Condition

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***Abstract*—In this paper, the project is set up to find a viable and cost effective way of minimizing the use of water consumption. Impending scarcity wastage of this renewable resources, has led people to consider the use develop a system to preserve this natural resources. Using the controlled motor pump to watering the plant it is one of the ways to implement water management. Controlled motor pump is based on the input data from the soil sensor and temperature humidity sensor. This project therefore involves the design and implementation microcontroller using Atmega 328P based on Adurino Uno. The soil moisture sensor used to collect the analog reading of the soil moisture to ensure the soil is in moist condition whereas the temperature humidity sensor will record the reading of surrounding. All the reading will display on LCD as the information to user. The prototype's operation is achieved by connecting sensor to a microcontroller such that the motor pump will wait for input signal from the microcontroller. The programmed microcontroller hence delivers motor pump signal in periodical time intervals for the motor to pump water to the soil.**

Keywords—Atmega 328p, Adurino Uno, DC water pump, Water management

I. INTRODUCTION

Malaysia had the world's highest rate of forest loss from year 2000 to 2012, according to a latest global forest map developed in partnership with Google.[1] All this activity will lead to pollution of environment especially air pollution. This occurs because of the increasing the populations thus need an expansion to a city. Decreasing of open land in the city and people start to live in apartment, there is no place for gardening fans to pursue their hobby. Generally know that plant play an important role to the environment. Plant can counter excess carbon dioxide (CO_2) which is building up in our atmosphere and contributing to climate change. Trees leaves absorb CO_2, it also remove and storing the carbon while releasing oxygen into the air. In one year, an acre of mature trees absorbs the same amount of CO_2 produced by a car travel about 26,000 miles.[2] Having houseplant giving a few benefits that can be gain from it. Some of it is, the plants remove toxins from air up to 87% of volatile organic compounds (VOCs) every 24 hours. The NASA research also discovered that plants can purify that trapped air by pulling contaminants into soil, where root zone microorganisms change VOCs into food for the plant.[3] Having good quality of air give more fresh and healthy life. All this benefit will insist people to march towards having healthy air inside the house for those live in a city. Having the natural air purifier in a home is certainly good enough for average citizen compared with buying thousand dollar air purifier that use electricity. Being healthy is surely what everyone hoping to live for. Having houseplant is one of the ways to improve our health but for people live in city usually busy with their work.

Living in the city, where land are very limited and people improvise this problem by making people living in higher building where it can accommodate lots of people.[4] Second class citizen whom working in a city most likely prefer buying or renting in an affordable apartment compare to terrace house which is more expensive. People who working in a city tends to buy or renting in an affordable apartment compare to terrace house which is more expensive. Some of those who livings in apartment are also nature lover, they would want to have plant in their house as but there is no space to do so. They do not really have time to plant or take care of their plant if they had one. If they do have time but it not every day they can watch their plant. Moreover, they also need to have certain knowledge about the plant they want to grow so that there is no water wastage occurs and home planter tends to water their plat using a hose directly to the plant or some use watering pot. This way of watering is inefficient as amount of water being use by the method more than enough. Every plant has some needed condition to help the growth except for cactus plant, but they still need to be water sometime. Other than that, based on petunia plantation research the temperature can regulate plant growth and development by influencing developmental stages, such as germination, leaf unfolding, and flowering. Flower development rates in different bedding plants increase with increasing temperatures that range from the base temperature to the optimal temperature (T_{opt}). [5]

Houseplant automated watering system based on moisture and humidity condition is a project that can took care the plant on behalf of owner. It a control system of electronic circuit, purposely to water plant automatically thus reduces the usage of water and time spends for watering. This kind of project is evolving steadily mostly in agriculture industry and

farming industry worldwide. Most of researchers focus on the soil condition as their main substance. The

detected signal from the soil moisture sensor is processed by a conditional comparator circuit corresponding to different levels of actual soil moisture content.[6] Some of other project was aiming to bigger scale of field that implemented sensors which detect the humidity in the soil (agricultural field) and supply water to the field which has water requirement.[7] The application of automated watering system is very useful in term of saving a lot of human working time, number of man power if we compare it with traditionally watering the plantation for huge scale of farming area. It will be a reliable system that can assist the industry further with a proper water management and enhance plant productivity. This project is based on an Arduino by using Atmega328p as microcontroller, temperature humidity sensor and soil moisture detector. This kind of detector will measure the soil moisture using two probes planted in the soil. The probes detector will measure the moisture of the soil and send the data signal to microcontroller to be analysed. Temperature humidity sensor will measure the temperature and humidity of the plant surrounding and send data to microcontroller.

II. METHODOLOGY

There are some functioning components in this project. They are the temperature humidity sensor (DHT11), soil moisture sensor and motor pump. Thus the Atmega382p microcontroller is programmed using Arduino IDE software.

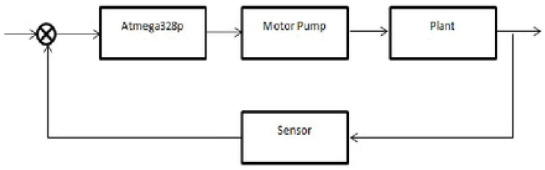

Figure 1 Block Diagram

A. Soil moisture sensor

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors. Water is a good conductor of electricity, so when the soil contain water then it will short circuit the sensor probe path.

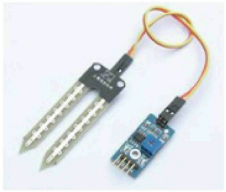

Figure 2 Soil Moisture Sensor

Value for completely saturated with moisture is ~660. Value range for the sensor is divided as, 0 ~300 (in water), 300~700 (humid soil), 700~1023 (dry).

B. Temperature Humidity sensor

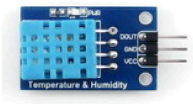

Figure 3 Temperature humidity Sensor

The temperature humidity sensor consist of a humidity sensing component, a NTC temperature sensor (or thermistor) and an IC on the back side of the sensor. For measuring humidity they use the humidity sensing component which has two electrodes with moisture holding substrate between them. So when the humidity changes, the conductivity of the substrate changes or the resistance between these electrodes changes. This change in resistance is measured and processed by the IC which makes it ready to be read by a microcontroller.

C. Liquid Crystal Display (LCD) 16x2

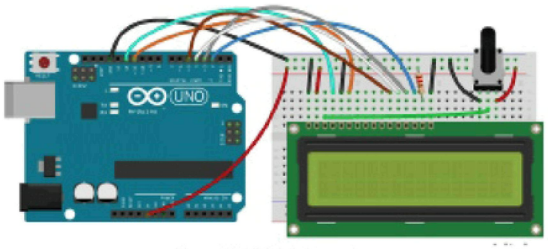

Figure 4 LCD 16x2 Connection

The resistor in the diagram above sets the backlight brightness. A typical value is 220 Ohms, but other values will work too. Smaller resistors will make the backlight brighter. The potentiometer is used to adjust the screen contrast. 10K Ohm potentiometer was used in this project, but other values will also work.

D. Flowchart

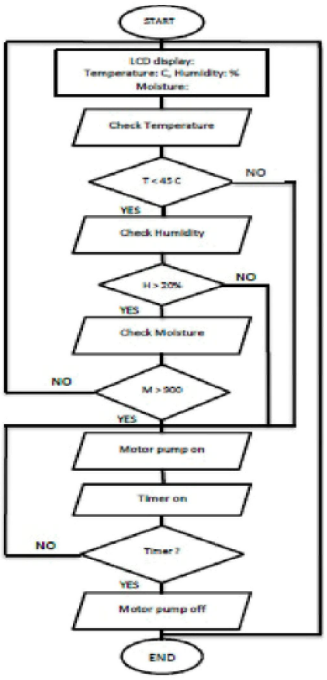

Figure 5 Flowchart

E. Programming

The Atmega328p microcontroller can be programmed with the Arduino IDE software.

1) Microcontroller Atmega328p need to set up with burned bootloader before compile with coding using Arduino software
2) Write coding in the software
3) Click "Verify" to save and check the coding error.
4) Select "Arduino Uno" from the Tools > Board menu to make sure the board is connected to the right Arduino.
5) Select "Port" from the Tools > Board menu to make sure the code is burn to the right port.
6) Burn the code by clicking upload button.

```
#include <LiquidCrystal.h>
#include <dht.h>
#define dataPin 7
const int analogInPin = A0;
int sensorValue = 0;
int digitalSoil = 6;
int pumpPin = 8;
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
dht DHT;
void setup() {
  lcd.begin(16,2);
  pinMode(digitalSoil, INPUT);
  pinMode(pumpPin, OUTPUT);
}

void loop() {
int readData = DHT.read11(dataPin);
  float t = DHT.temperature;
  float h = DHT.humidity;
  lcd.setCursor(0,0);
  lcd.print("Temp.: ");
  lcd.print(t);
  lcd.print(" C");
  lcd.print(" Moist.: ");
  sensorValue = analogRead(analogInPin);
  lcd.print(sensorValue);

  lcd.setCursor(0,1);
  lcd.print("Humi.: ");
  lcd.print(h);
```

Figure 6 Programming in Arduino ISE

F. Hardware design

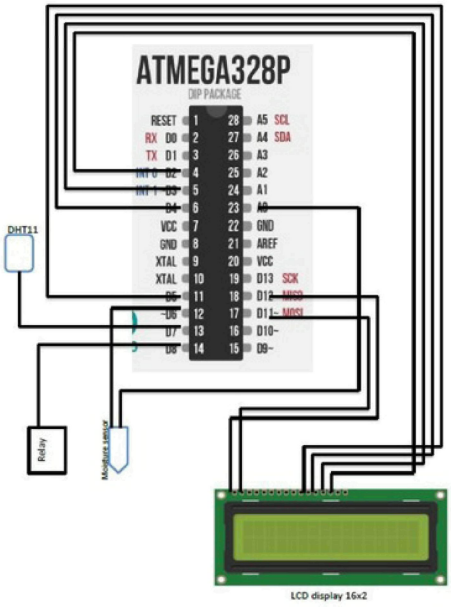

Figure 7 Circuit design

Figure 8 The display on LCD

The display will show the information of temperature, humidity and soil moisture reading. The LCD is in size of 16x2 and it not enough to display all three information, so the third information which is the moisture data is shown by moving the display to the left set in coding.


Figure 9 Prototype of the system

There will be two source of power supply. One will power up the 12V motor pump and another one is a 9V battery will power up the standalone Arduino inside the box. Inside the box will have the motor pump and water container. Water container need to be refill by the user.

III. RESULT AND DISCUSSIONS

Pattern graph of humidity and temperature

The project takes place in level 4 of a housing building as it where is significant to high place of an apartment building. The result shows an analysis of a period of time on humidity and temperature taken during the day and early night.

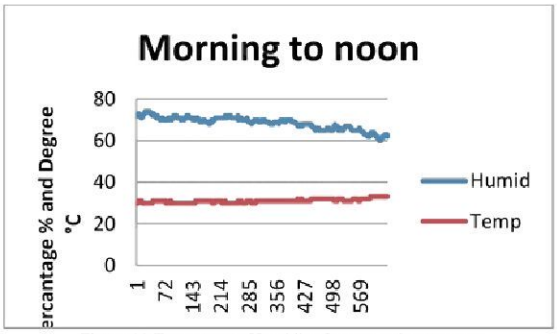

Figure 10 Temperature Humidity from morning to noon

Even though the weather is unpridictable the garph show an increasing pattern as what it should theorycally. The humidity is scatter because of the effect of wind that increase the humid.

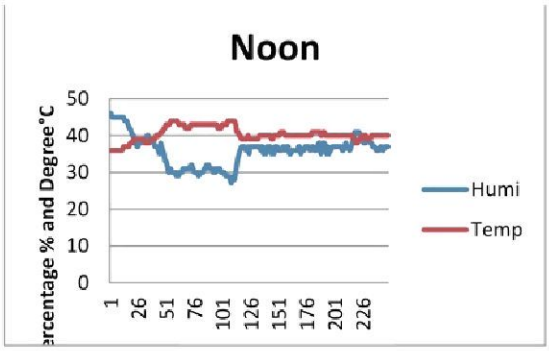

Figure 11 Temperature humidity from at noon

As can be seen on the figure, at noon the temperature are usually hot where the highest temperature being recorded is at 44°C. Whereas the humidity is opposite of the temperature where from the observation shown the percentage of humidity is low at noon.

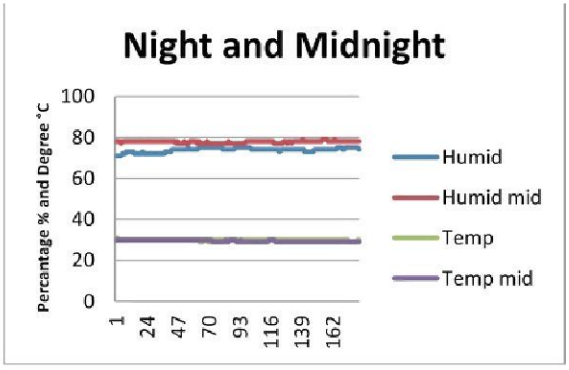

Figure 12 Temperature humidity from early night to midnight

In the early night (interchange from day to night), the graph show high humidity reading which the highest reading at 75%

and temperature around 30°C to 29°C. As in the middle of the night, the humidity increases up to 78% almost at the limit of the sensor can measure at 80% and the temperature remain 30°C to 29°C.

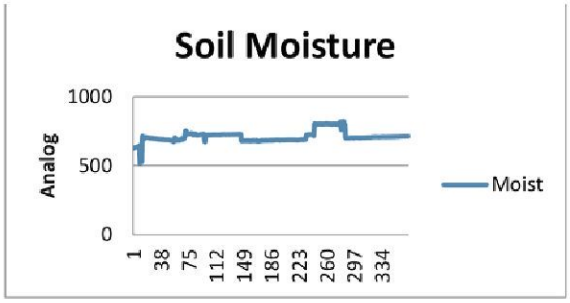

Figure 13 Soil moisture sensor reading

The data of moisture taken when the probe inserted into wet soil

IV. Conclusion and Recommendation

As conclusion, the minimum usage of water is achievable using a proper system thus helps in conserving water and bills. From the analysis, it can be seen that at constant temperature, high relative humidity reduced transpiration rates and resulted in slower water and nutrient uptake in the roots of plant, leading to a lower plant development rate. Hence, under high relative humidity conditions, plants had a longer vegetative growth phase and later flowering times.[5] In another hand, growing houseplant provide some benefit to people living in the hustle of city as it can reduce noise pollution. The increment of houseplant certainly helped in absorbing greater decibel noise.[8] The houseplant automated system can be explored to a bigger scale but will increase the cost of the system to have a larger tank and more soil moisture sensor.

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