

ALPHA

(Automated Lucrative Poly House for Aquaponics)

John Rojo¹

U.G Student, Holy Kings College of Engineering & Technology, Muvattupuzha, Kerala, India¹

ABSTRACT: Aquaponics is a system in which fish and vegetables are grown in a single integrated unit. Now this system is getting popularity throughout the world. The current system is manually controlled and effective human attention is necessary for the efficient working of the system. In ALPHA I have integrated the aquaponics system in a greenhouse. The main feature of this system is that the controls of the Aquaponic system and the green house is fully automated with the aid of a custom built android app and an Arduino Uno controller. The working of an aquaponic system is that the plants are growing by the utilization of minerals from the fish waste, so no need to change the water in the fish tank, as the circulation of water in the grow bed will clean the water automatically. In ALPHA the parts of greenhouse such as exhaust fans and foggers are automatically triggered, based on the feedback from the temperature and humidity sensors. The fish in the tank are fed automatically on time basis.

KEYWORDS: Automation, Aquaponics, High tech Agriculture, Sustainable farming.

I. INTRODUCTION

Aquaponics is the symbiotic cultivation of plants and aquatic animals (Fish) in a recirculating environment. A recirculating aquaculture system (RAS) can be defined as an aquaculture system that incorporates the treatment and reuse of water with less than 10% of total water volume replaced per day. The paper will involve constructing the fish farming system, planning and implementing, design of android app, control system based on Arduino uno and maintaining the system. The system will include a 1000 liters tank for fish culture, a pump, pipes and fitting, Poly House, fully mechanized automatically controlled system and I barrel trays for planting the plants. The water from the fish tank is the source of nutrients for the plants in the system. As the plants absorb the nutrients, they purify the water. The growth of useful bacteria in the system will convert the fish waste to use full nutrients and allow the fish and plants to grow in a symbiotic relationship. This process creates a sustainable ecosystem where both plants and fish can live, using less water and space, producing no waste water and pollutants compared to conventional methods. This is an environmentally- friendly, natural food growing method which has the best attributes of intensive **aquaculture** and **hydroponics** without the need to discard any water or filtrate or add chemical fertilizers, and capitalizes on the benefits and eliminates the drawbacks.

It is my hope that our society will accept and implement these principles in their lives to work on environmental responsibility and sustainability in this community.

Design & Fabrication Of The System

To accommodate the system the floor space needed is $8m^2$ so the floor area is selected as $2x4m$.

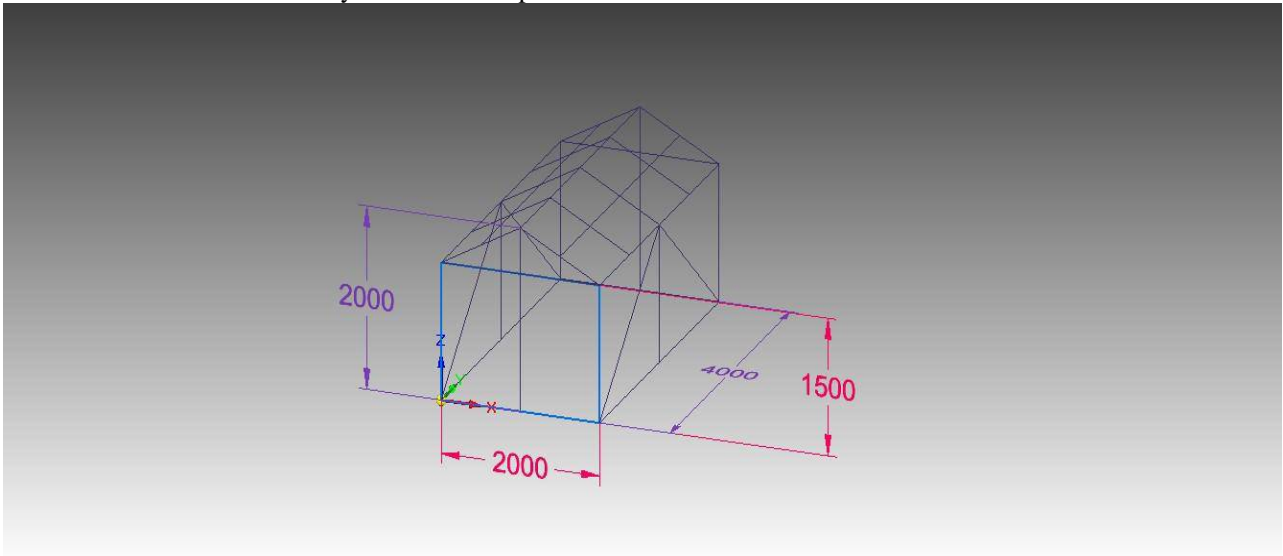


Fig1: Design and fabrication of the system

Solid Edge Model

The design is done as per the requirements and the analysis is done in the Ansys software and found that the design is safe with the cross section of 25mm and the material as PVC.

Design on ANSYS Software

The function of this analysis is to find out the strength of the frame that I decided to fabricate and the reactions occurred during its loading condition. The software helped in analysis of the materials.

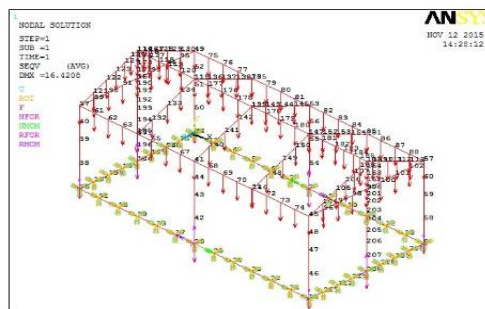


Fig 2: Boundary conditions

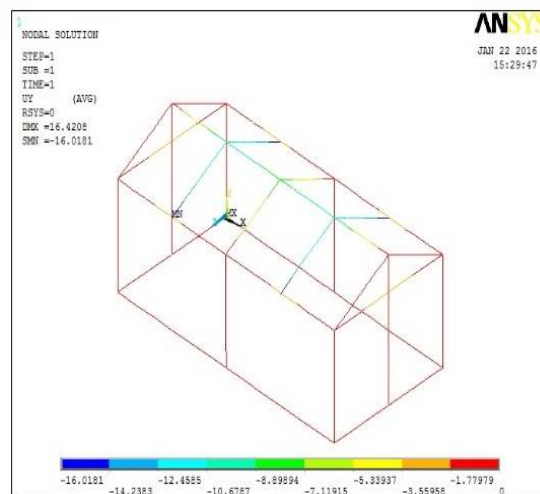
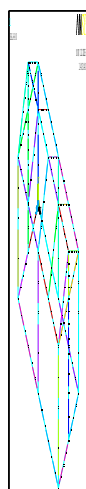


Fig 3: Displacement diagrams

Arduino UNO

The Arduino UNO is a simple programmable controller board. "Uno" means "One" in Italian language. It uses a specific programmed language to give directions. It consists of 14 digital input/output pins, a USB connection, a power jack, and a reset button. It also contains everything needed to support the microcontroller. Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Specification of the controller board :

- I. Microcontroller ATmega328
- II. Operating Voltage 5V
- III. Input Voltage (recommended) 7-12V
- IV. Input Voltage (limit) 6-20V



Fig 4: Arduino board

The Arduino program

The Arduino programming language is a simplified version of C++. If C++ is known programming the Arduino will be easier. If you do not know C++, no need to worry as only a few commands are needed to perform useful functions. The program controls my system. It will receive signals via Bluetooth and perform the assigned jobs as per the signal input in the app. The android application will generate the required signals and will control the operations on the base of the user inputs.

The program to run the system

```
#include "DHT.h"
int tempPin = 1 // for LM35
#define DHTPIN 2 // what pin we're connected to
#define DHTTYPE DHT11 // DHT 11
;DHT dht(DHTPIN, DHTTYPE);
int alpha=0;
void setup() {
  Serial.begin(9600);
  Serial.println("DHTxx test!");
  pinMode(12,OUTPUT);
  pinMode(11,OUTPUT);
  pinMode(10,OUTPUT);
  pinMode(9,OUTPUT);
  pinMode(8,OUTPUT);
  pinMode(7,OUTPUT);
  dht.begin();
}
void loop() {
  {
  if(Serial.available(>0){
    alpha = Serial.read();
  }
  if(alpha== 'a'){
    digitalWrite(13,HIGH);
  }
  if(alpha== 'b' ){
    digitalWrite(13,LOW);
  }
  if(alpha== 'c'){
    digitalWrite(12,HIGH);
  }
}
```

```

}
if(alpha== 'd' ){
    digitalWrite(12,LOW);
}

if(alpha== 'e'){
    digitalWrite(11,HIGH);
}
if(alpha== 'f' ){
    digitalWrite(11,LOW);
}
if(alpha== 'g' ){
    digitalWrite(10,HIGH);
}
if(alpha== 'h' ){
    digitalWrite(10,LOW);
}
if(alpha== 'i' ){
    digitalWrite(9,HIGH);
}

if(alpha== 'j' ){
    digitalWrite(9,LOW);
}
if(alpha== 'k' ){
    digitalWrite(8,HIGH);
}
if(alpha== 'l' ){
    digitalWrite(8,LOW);
}
if(alpha== 'm' ){
    digitalWrite(7,HIGH);
}
if(alpha== 'n' ){
    digitalWrite(7,LOW);
}
}
// Wait a few seconds between measurements.
delay(1000);
float h = dht.readHumidity();
// Read temperature as Celsius (the default)
float t = dht.readTemperature();
// Read temperature as Fahrenheit (isFahrenheit = true)
float f = dht.readTemperature(true);
float temp; // for LM35
// Check if any reads failed and exit early (to try again).
if (isnan(h) || isnan(t) || isnan(f)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
}
// Compute heat index in Fahrenheit (the default)
float hif = dht.computeHeatIndex(f, h);
// Compute heat index in Celsius (isFahreheit = false)
float hic = dht.computeHeatIndex(t, h, false);
temp = analogRead(tempPin); //For LM35
temp = temp * 0.48828125 + 5; //For LM35
Serial.print(h);
Serial.print(t);
Serial.print(temp);
} }

```

The circuit of the electronic components

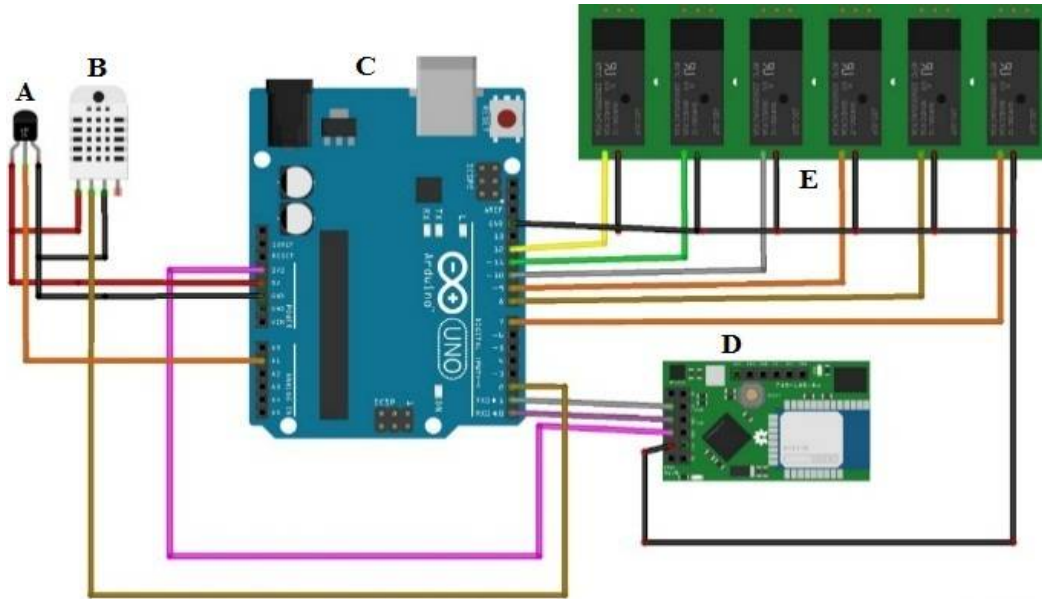


Fig 5: The circuit diagram of the control system

- A: LM35 Temperature sensor
- B: DHT11 Temperature and Humidity Sensor
- C: Arduino Uno Board
- D: Bluetooth Shield
- E: Relay Module

The Android App

The app developed in the platform of MIT App Inventor controls the whole system, in the app user have the provision to input the time for fish feed its duration and the set values for temperature and humidity and also the time to trigger the grow lights

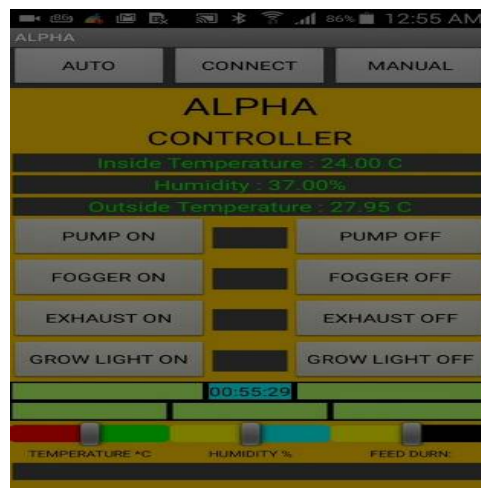


Fig 6: The android app



Fig 7: The android app program

Working of the system

The user can set the required inside temperature and humidity in the Android app and the app will check the input value with the real time value from the sensors which are coupled to the Arduino board the values of inside temperature, outside temperature and inside humidity are read on the Arduino board and is send to the android app using the Bluetooth shield. The comparison of the input value is done and the required action such as switching on and off of the respective components such as humidifier, exhaust fan, feeder, grow light and pump is done.

Table1: Comparison with existing system

SI No	ALPHA	Normal Farming & Aquaponics
1	Automated temperature & humidity control	Not automated
2	Automated fish feeder	Manual feeding
3	Time based triggering of grow light	Manual operated if present
4	No need of human assistance	Human assistance is needed in each step
5	Can incorporate ph. Sensor if needed	No such options
6	Most modern approach to farming	No such aspect
7	Cost effective	Man power is costly

II. CONCLUSION

Aquaponics is a method which is especially appealing to those seeking to promote more sustainable food production systems. It involves the production of both fish and vegetables. I designed a polyhouse to enable efficient year round operation. This design provides a solid starting point for prospective aquaponic greenhouse builders, The design provides a solid foundation for future constructions, I also designed a modular, easily replicable aquaponic growing system. The design of the system includes all components to run the system without much human assistance.

REFERENCES

- [1] Keith Connolly And Tatjana Trebic, Optimization Of A Backyard Aquaponic Food Production System , Bree 495 Design 3, Bioresource Engineering, Presented to Dr. Vijaya Raghavan, Faculty of Agricultural and Environmental Sciences ,Macdonald Campus, McGill University.
- [2] Donald S. Bailey, James E. Rakocy, William M. Cole And Kurt A. Shultz ,Economic Analysis Of A Commercial- Scale Aquaponic System For The Production Of Tilapia And Lettuce, University Of The Virgin Islands, Agriculture Experiment Station St. Croix, U.S. Virgin Islands.
- [3] James E. Rakocy¹, Michael P. Masser² and Thomas M. Losordo³, Recirculating Aquaculture Tank Production Systems: Aquaponics Integrating Fish and Plant Culture SRAC Publication No. 454, November 2006 Revision.
- [4] AQUAPONICS RESEARCH PROJECT, The relevance of aquaponics to the New Zealand aid programme, particularly in the Pacific, Commission Report, Prepared by Hambrey Consulting for New Zealand Aid Program Ministry of Foreign Affairs and Trade December 2013.
- [5] Designing an Aquaponic Greenhouse for an Urban Food Security Initiative – Extended Report By Rashid Chatani Gabriel Demeneghi RedonHoxha Khazhismel Kumykov Blaine Rieger An Interactive Qualifying Project submitted to the Faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfilment of the requirements for the degree of Bachelor of Science, Report Submitted to: Matt Feinstein Worcester Roots Project Professors Stephen McCauley and Lorraine Higgins Worcester Polytechnic Institute, Date: 30 April 2015.