VIETNAM NATIONAL UNIVERSITY, HO CHI MINH CITY

UNIVERSITY OF INFORMATION TECHNOLOGY

FACULTY OF COMPUTER ENGINEERING

Cao Phan Tien Dung - 19521387

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MIDTERM PROJECT

SMART GARDEN

CE224.M13.MTCL(EN)

HO CHI MINH CITY, 11/2021

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MENTOR

PhD. TRI NHUT DO

HO CHI MINH CITY, 11/2021

VIETNAM NATIONAL UNIVERSITY
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UNIVERSITY OF INFORMATION TECHNOLOGY

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom - Happiness

DETAILED TOPICS

VIETNAMESE PROJECT NAME: Khu vườn thông minh
ENGLISH PROJECT NAME: SMART GARDEN
Instructor PhD. TRI NHUT DO, Department of Computer Engineering
Implementation time: From: 08/10/2021 To: 19/11/2021
Student Perform: CAO PHAN TIEN DUNG – 19521387 NGUYEN VAN TIN 19521022 NGO MAN DAT - 19521333
Overview of the topic: The project proposes to build a smart garden system with a small scale. With the purpose of studying and executing intelligent system design. **The goal of the project:** System can collect data of the garden and this data will be stored and displayed in web app or mobile app. Besides, the system can work well in most of weather conditions. **Main content of the topic:** Programming language (s): C / C ++. (arduino)

<table>
<tr><td colspan="2">Sub-system (s): Blynk, Thinkspeak IoT,
Hardware: Esp8266 and sensor</td></tr>
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<tr><td><b>Certification of Instructor</b>
(Sign and clearly state full name)</td><td><b>HCM city, 2021 November 19</b>
<b>Student</b>
(Sign and clearly state full name)</td></tr>
</table>

TABLE OF CONTENT

PROJECT SUMMARY

This project proposes to build a smart garden which receives data from sensor and sends data to Thingspeak IoT server and receives the control signals from Blynk app .
This system will collect humidity, temperature, soil moisture, motor status data.

Chapter 1. INTRODUCTION

Our team's project includes a central controller and sensors to collect data from the environment. Devices display via hardware, phone as well as via web server.

With this project, we hope to promote the field of research on smart agricultural systems in the area in the particular as well as in the general of Vietnam.

Our system operates as an intelligent assistant that can help farmers observe their garden.

This assistant looks over the garden through sensors and report to the phone and web app. Then, farmers can know the conditions of their garden and make appropriate decisions.

According to the research process of our team, the most suitable soil moisture is in the range of 60 percent to 70 percent. Therefore, our device also has a smart state that the humidity below the allowable level will automatically control the irrigation device, and the soil moisture content is above the maximum allowable level, the irrigation device will must turn off.

As a result of what I have learned, I hope the system can serve farmers in particular and Vietnamese agriculture in general.

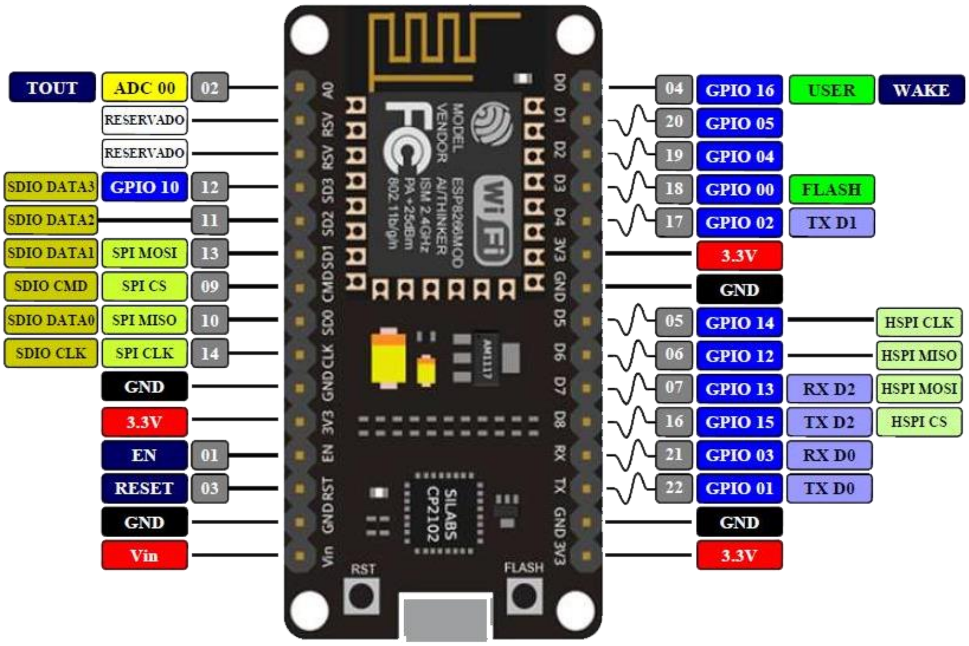
Chapter 2. BUILDING MATERIALS

2.1. List of material

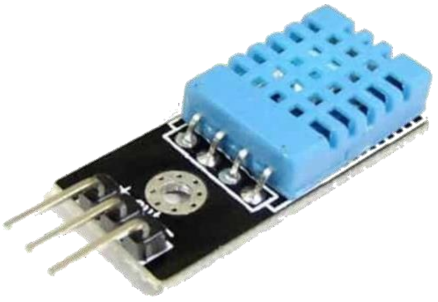
- ESP8266 NODEMCU
- Sensor DHT11
- Sensor Soil Moisture
- Sensor Touch TTP223
- Button
- LCD 16x2 I2C
- Motor 12V DC
- Led

2.2. Diagram of materrials

- **ESP8266 NODEMCU**



- **Sensor DHT11**



- **Sensor Soil Moisture-**

- **Sensor Touch TTP223**

- **Button**

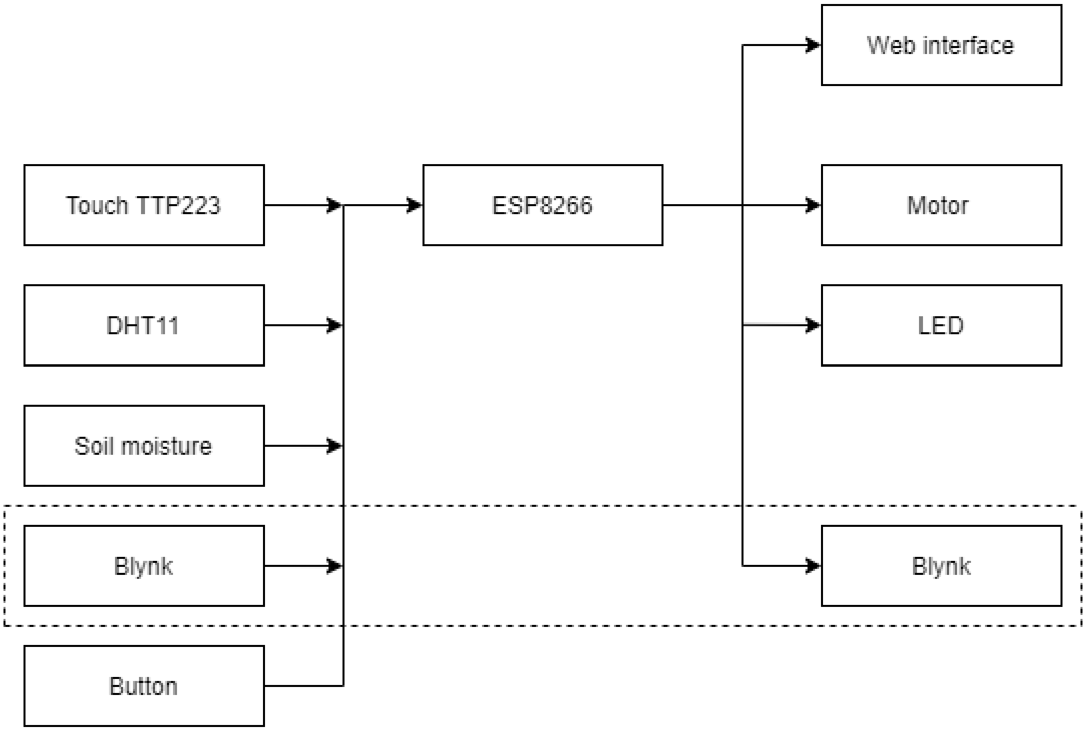
- **LCD 16x2 I2C**

- **Motor 12V DC**

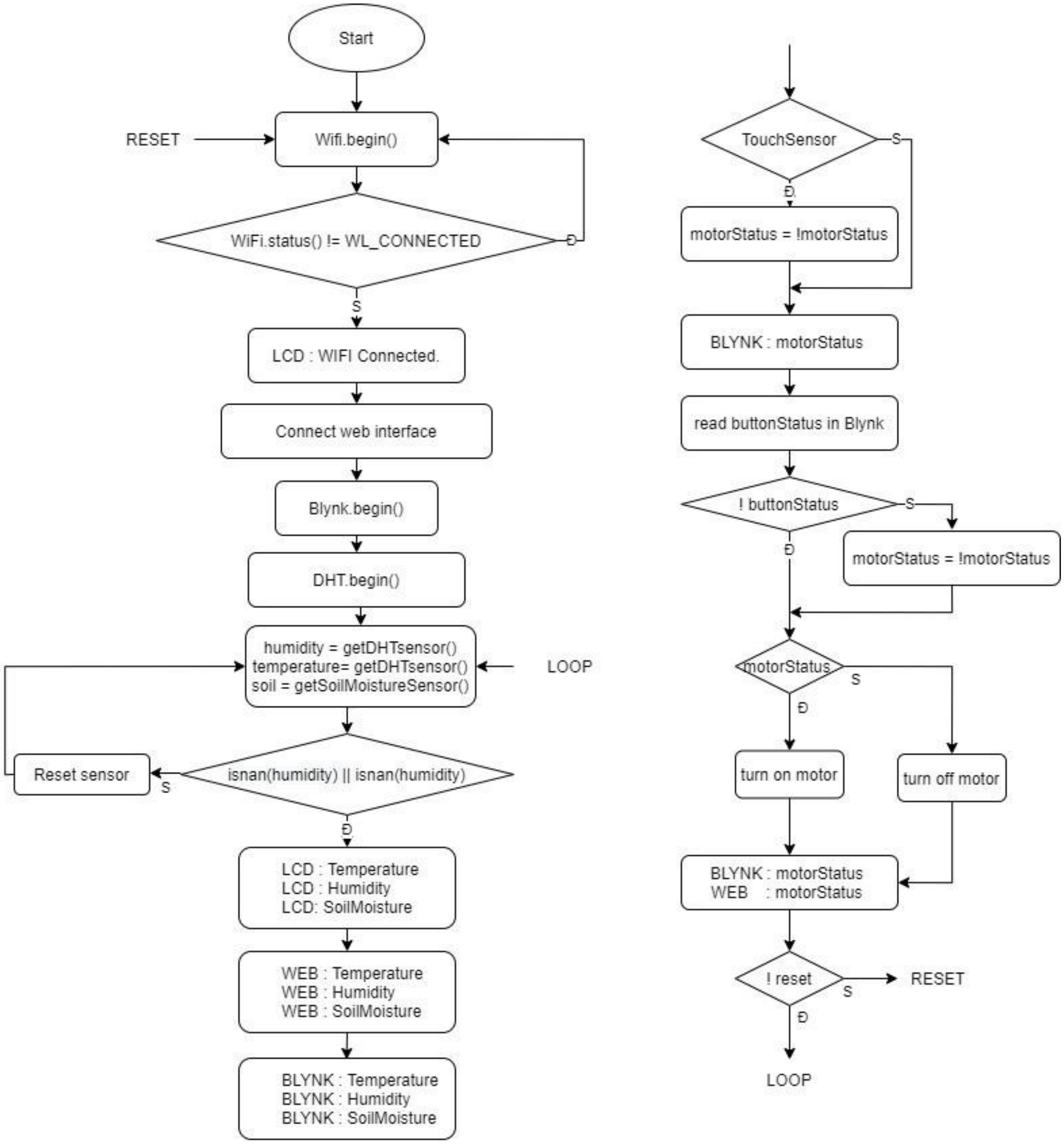
- **LED**

Chapter 3. FUNCTIONING DESCRIPTION

3.1. System diagram



Chapter 4. FLOW CHAR



Chapter 5. SOFTWARE DESCRIPTION

5.1. Arduino

Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling & uploading code to almost all Arduino Modules. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is available for all operating systems i.e., MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role in debugging, editing and compiling the code. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. The code is written by C and C++ language

5.2. Source code

```
/*
KHAI BÁO PIN
*/
#define LED 2     //D4 led nguồn
#define MOTOR 13  //D7
#define DHTPIN 12  //D6
#define DOAMDAT A0 //analog
#define TOUCH 16  //D0
//#define SDA 5  //D1
//#define SCL 4  //D2

/*
KHAI BÁO THƯ VIỆN
*/
/*---------HIỂN THỊ-------- */
//#include <Wire.h>
#include <LiquidCrystal_I2C.h>
/*---------KẾT NỐI-------- */
#include <ESP8266WiFi.h>
#include <ESP8266HTTPClient.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp8266.h>
//web server
#include <ThingSpeak.h>
/*---------CẢM BIẾN --------*/
#include <DHT.h>
#include <DHT_U.h>
```

```

/*
KHAI BÁO BIẾN TOÀN CỤC
*/
//BLYNK
//#define BLYNK_TEMPLATE_ID           "TMPLxxxxxx"
#define BLYNK_DEVICE_NAME "My_System"
#define BLYNK_AUTH_TOKEN "a64YarnJsGcQ_jrmC1L0jJARj84M7u3y"
#define BLYNK_PRINT Serial
char auth[] = BLYNK_AUTH_TOKEN;
//THINKSPEAK
const char* server = "api.thingspeak.com";
unsigned long myChannelNumber = 1433980;
const char * myWriteAPIKey = "0B2TBIQVLGHX2V5X";
const char * myReadAPIKey = "C89KRRWFFEIGBWOE";

WiFiClient client;

 char ssid[] = "FPT Ngoc Nhan";
 char pass[] = "khongnoiduoc";

//char ssid[] = "ThanhTung";
//char pass[] = "984513194";

LiquidCrystal_I2C lcd(0x27,16,2);          //Khởi tạo biến lcd
#define DHTTYPE DHT11
```

```
DHT dht(DHTPIN, DHTTYPE);                //Khởi tạo biến dht

bool motorStatus = 0;
bool valTouch = 0;
/*
HÀM KHỞI TẠO
*/

void setup() {
  Serial.begin(115200);

  //Debug hardware
  debugHardware();

  //INIT LCD
  lcd.init();
  lcd.backlight();
  //Test lcd
  lcd.setCursor(4,0);
  lcd.print("WELLCOME");
  lcd.setCursor(2,1);
  lcd.print("TO MY SYSTEM");
  //Wifi connection
  WiFi.begin(ssid, pass);
  while (WiFi.status() != WL_CONNECTED)
  {
    delay(500);
    Serial.print(".");
  }
  Serial.println();
  Serial.println(WiFi.localIP());
  //Thinkspeak init
  ThingSpeak.begin(client);
  //lcd wifi connected
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Wifi Connected");
  lcd.setCursor(0,1);
  lcd.print(WiFi.localIP());

  //init blynk
  Blynk.begin(auth, ssid, pass);
  dht.begin();

  pinMode(DOAMDAT, INPUT);
  pinMode(DHTPIN, INPUT);
  pinMode(TOUCH, INPUT);
  pinMode(MOTOR, OUTPUT);

  /*START*/
  digitalWrite(MOTOR, LOW);
  delay(1500);
}
//Đọc giá trị nút nhấn V0 //trigger
```

```
BLYNK_WRITE(V0){
  motorStatus = param.asInt();
}
/*
HÀM LOOP
*/
void loop() {
  //lear lcd
  lcd.clear();

  //run blynk
  Blynk.run();

  //-------- Cảm biến độ Soil
  float Soil = getSoil();
  //-------- Cảm biến độ DHT
  int h = dht.readHumidity();          //Độ 'ẩm'
  float t = dht.readTemperature();       //Độ '`C'
  if(!getDHT(h,t)){return;}
  //
// motorStatus = getDataBlynk();
  //-------- Cảm biến touch
  getTouch();

  //Thiết lập ngưỡng tưới tự động theo độ ẩm đất
  ThresholdSoilMoisture(Soil);
  // --------Điều khiển motor
  digitalWrite(MOTOR, motorStatus);

  // --------Hiển thị ra lcd
  lcdRun(h, t, Soil, motorStatus);

  // --------Gửi dữ liệu lên blynk
  sendDataBlynk(h, t, Soil, motorStatus);

  ////Debug serial
  //debugValue(h,t,Soil);


  //Think speak send data to web server
  thinkspeakRun(h, t, Soil, motorStatus);
  // --------Hiển thị ra lcd
  lcdRun(h, t, Soil, motorStatus);

//  delay(70);    //Delay for control lcd
}

void debugValue(int h, float t, int Soil){
   //Debug data
  Serial.print("Nhiet do: ");
  Serial.print(t);
  Serial.println(" `C");
  Serial.print("Do am:     ");
  Serial.print(h);
  Serial.println(" %");
  Serial.print("Do am dat: ");
  Serial.print(Soil);
  Serial.println(" %");
  Serial.println("");
}
void sendDataBlynk(int h, float t, int s, bool myMotor){
  Blynk.virtualWrite(V0, myMotor);
  Blynk.virtualWrite(V1, t);
  Blynk.virtualWrite(V2, h);
  Blynk.virtualWrite(V3, s);
}
void ThresholdSoilMoisture(int doamdat){
  //60 - 70 is perfect
  int minThreshold = 50;
  int maxThreshold = 90;
  if(doamdat < minThreshold){motorStatus = 1;}
  if(doamdat >= maxThreshold){motorStatus = 0;}
}
bool getDHT(int h, float t){
  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return 0;
  }
  return 1;
}
int getSoil(){
  //-------- Cảm biến độ ẩm đất
  int doam = 0;
  int doamVal = 0;
  for(int i = 0; i<10; i++){
    doam += analogRead(DOAMDAT);
  }
  doam = doam/10;
  doamVal = map(doam, 400, 1024, 100, 0);
  if(doamVal >= 100){
     doamVal = 100;
  }else{
    if(doamVal <= 0){
      doamVal = 0;
    }
  }
  return doamVal;
}
void getTouch(){
  int Touch = analogRead(TOUCH);
  int thresholdTouch = 100;
  if(Touch >=  thresholdTouch){
      motorStatus = !motorStatus;
      while(Touch >= thresholdTouch){
      if(Touch < thresholdTouch){break;}
      Touch = analogRead(TOUCH);
      }
  }
```

```
}
void debugHardware(){
  //Debug hardware
  pinMode(LED, OUTPUT);
  for(int i = 0; i<3; i++){
  digitalWrite(LED, HIGH);
  delay(200);
  digitalWrite(LED, LOW);
  delay(200);
  }
  digitalWrite(LED, LOW);
}
void thinkspeakRun(int h, float t, int s, bool motorStatus){
  if (client.connect(server,80)){
    ThingSpeak.writeFields(myChannelNumber, myWriteAPIKey);
    ThingSpeak.setField(1, t);
    ThingSpeak.setField(2, h);
    ThingSpeak.setField(3, s);
    ThingSpeak.setField(4, motorStatus);
  }
  client.stop();
}
void lcdRun(int h, float t, int s, bool motorStatus){
  lcd.clear();

  lcd.setCursor(0,0);
  lcd.print("T:");
  lcd.setCursor(2,0);
  lcd.print(t);
  lcd.setCursor(6,0);
  lcd.print("'C H:");
  if(h<10){
  lcd.setCursor(13,0);
  lcd.print(h);
  lcd.setCursor(14,0);
  lcd.print("%");
  }else{
    if(h!=100){
      lcd.setCursor(12,0);
      lcd.print(h);
      lcd.setCursor(14,0);
      lcd.print("%");
    }
    else{
      lcd.setCursor(12,0);
      lcd.print("100%");
    }
  }
  lcd.setCursor(0,1);
  lcd.print("RL:");
  lcd.setCursor(3,1);
  if(motorStatus){
  lcd.print("ON");
  }else{
    lcd.print("OFF");
  }
  lcd.setCursor(6,1);
  lcd.print(" Humi:");

  if(s<10){
    lcd.setCursor(13,1);
    lcd.print(s);
    lcd.setCursor(14,1);
    lcd.print("%");
  }else{
    if(s!=100){
      lcd.setCursor(12,1);
      lcd.print(s);
      lcd.setCursor(14,1);
      lcd.print("%");
    }
    else{
      lcd.setCursor(12,1);
      lcd.print("100%");
    }
  }
// delay(10);
}
```

Chapter 6: SUB-SYSTEM PART

6.1. Building application

6.1.1. Blynk

1. What is Blynk?

Blynk is developed to help users who are not very familiar with programming, simple drag and drop block interface on the phone application, flash firmware on arduino devices like UNO, Nano with ethernet shields; esp32, 8266 wifi which does not require too much knowledge - step by step just follow.

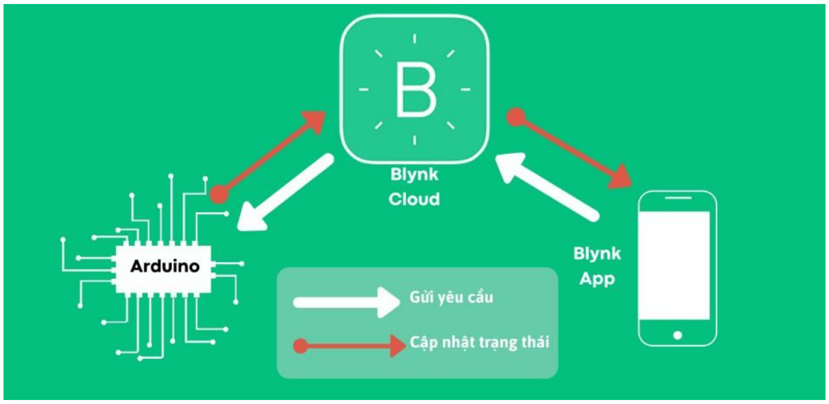
2. What can Blynk do?

Deploying a smart home system, remoting monitor, etc., the only limit is your ability as well as your creativity.

Widgets such as: push button, display value, value pull bar, draw diagram,... allow to control the arduino's GPIOs, turn on and off the relay, control home appliances.

Blynk's strength can be connected everywhere.

More specifically, you can share the control panel with other users (friends, relatives, ...) to use the same system.



3. Describe how Blynk works:

The arduino device is responsible for controlling the devices in the house via relays that plug directly into the arduino GPIOs, or any other type of communication if you can use it (RF, Uart). This device requires a network connection (ESP8266, ESP32, ...)

4. How to deploy a control system using Blynk?

If you can do it yourself, go to the link to find out. If you want a more visual description, please wait for my video. Remember to follow me to receive updates.

Basic steps:

Download Blynk app on PlayStore/App Store

Register an account, the dashboard interface will appear. Set up a

console.

You can see more of my posts here.

Download the arduino library to your computer, flash it on the board, connect to the network.

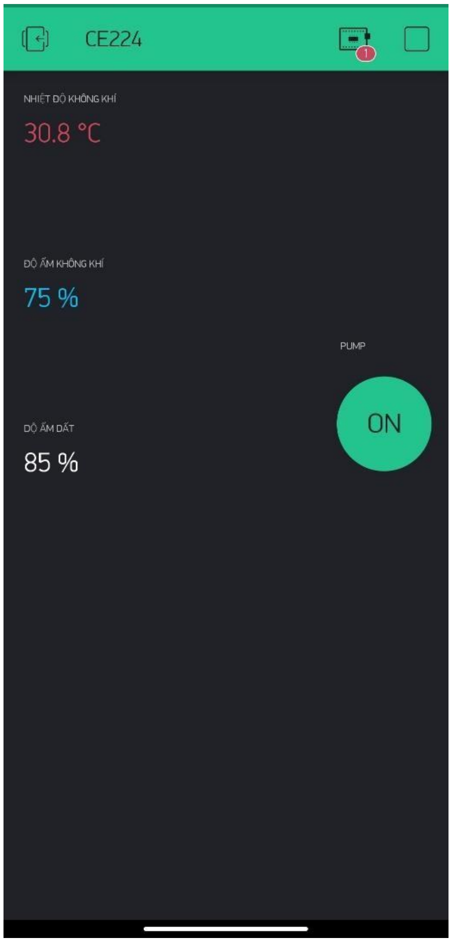
After the arduino successfully set up, App Blynk will notify you that the device is working.

5. What is the limit for Blynk?

With the free version, you can only use a limited number of widgets, each widget takes up an amount of "energy", when you bring up the main screen, you will lose this part, it like a fee. Want to put out more control page control is required to have more "energy".

There are two ways to add “energy”. You can pay extra - in app purchase. Or deploy a local server. For a small project, I think it is better to buy more energy from the supplier

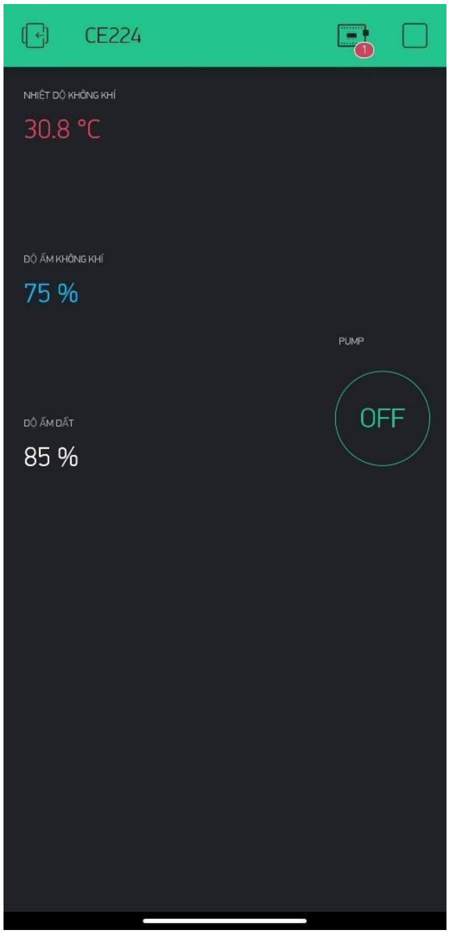
My project



NHIỆT ĐỘ KHÔNG KHÍ
30.8 °C

ĐỘ ẨM KHÔNG KHÍ
75 %

ĐỘ ẨM ĐẤT
85 %



NHIỆT ĐỘ KHÔNG KHÍ
30.8 °C

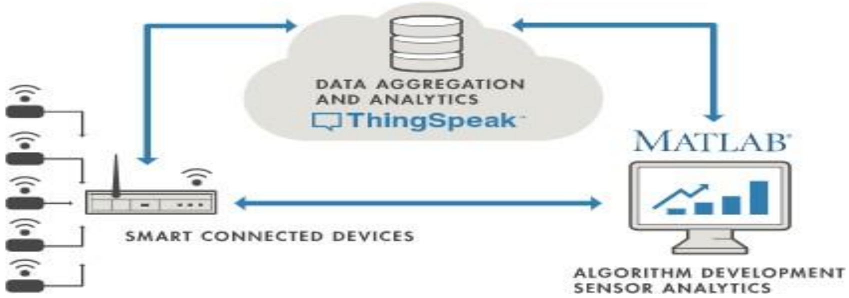
ĐỘ ẨM KHÔNG KHÍ
75 %

ĐỘ ẨM ĐẤT
85 %

6.1.2. Think speak IoT

1. ThingSpeak for IoT

ThingSpeak™ is an IoT analytics platform service from MathWorks®, the makers of MATLAB® and Simulink®. ThingSpeak allows you to aggregate, visualize, and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices or equipment. Execute MATLAB code in ThingSpeak, and perform online analysis and processing of the data as it comes in. ThingSpeak accelerates the development of proof-of-concept IoT systems, especially those that require analytics. You can build IoT systems without setting up servers or developing web software. For small- to medium-sized IoT systems, ThingSpeak provides a hosted solution that can be used in production.



1. ThingSpeak Key Capabilities

ThingSpeak allows you to aggregate, visualize and analyze live data streams in the cloud. With ThingSpeak, your data is stored in channels. Each channel stores up to 8 fields of data. You can create as many channels as you need for your application.

2. Connect Your Hardware to ThingSpeak

You can use any Internet-connected device with ThingSpeak. When sending data from your devices or equipment, you can use native libraries for common embedded hardware prototyping platforms like Arduino®, Espressif ESP8266 and ESP32, Particle and Raspberry Pi™. You can also send data to ThingSpeak from machines or local gateways using a REST

API or an MQTT API. In addition, the following vendors have built integrations to ThingSpeak to make setup even easier:

LoRaWAN®

Things Network

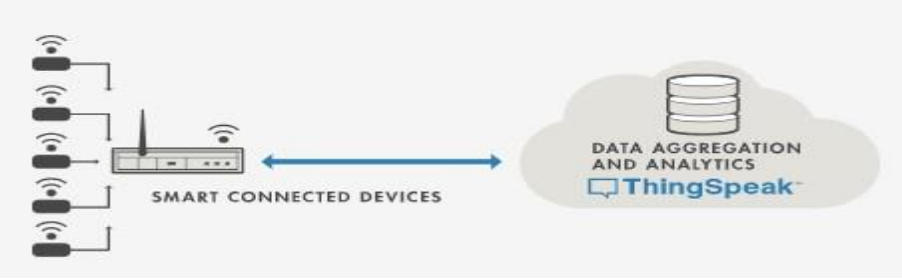
Senet

Libelium

Beckhoff

Particle devices

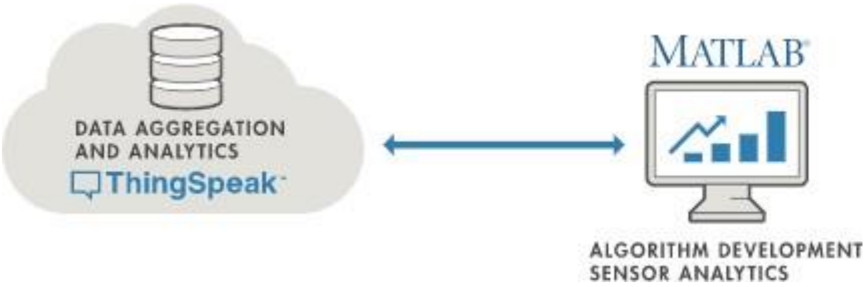
If you are a Simulink user, you can use Simulink blocks in your models to write data to ThingSpeak.



3. Access Your Data Both Online and Offline

ThingSpeak stores all the information you send it in one central location in the cloud, so you can easily access your data for online or offline analysis. Your private data is protected with an API key that you control. When you are logged in to your ThingSpeak account, you can use the web to securely download the data stored in the cloud. You can also programmatically read your data in CSV or JSON formats using a REST API call and the appropriate API key. Your devices can also read data from a ThingSpeak channel by subscribing to an MQTT topic. Import data from third-party web services including climate data from NOAA, public utility data from local utility providers, and stock and pricing data from financial providers. You can use that data together with the data you are collecting from your devices and equipment to investigate correlations and develop predictive algorithms.

MATLAB users can import data stored in ThingSpeak into the MATLAB desktop environment using the thingSpeakRead function.

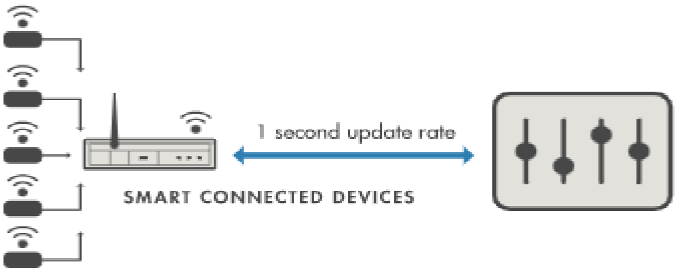


4. Remotely Visualize Sensor Data in Real Time

ThingSpeak automatically charts the data that you send it, so you can remotely monitor your devices or equipment from anywhere. View your data from any web browser or mobile device. Share read-only views of your data with the clients and colleagues that you specify. Alternatively, you can use ThingSpeak to manage your data, and you can build your own front end for your clients and customers to log in to.

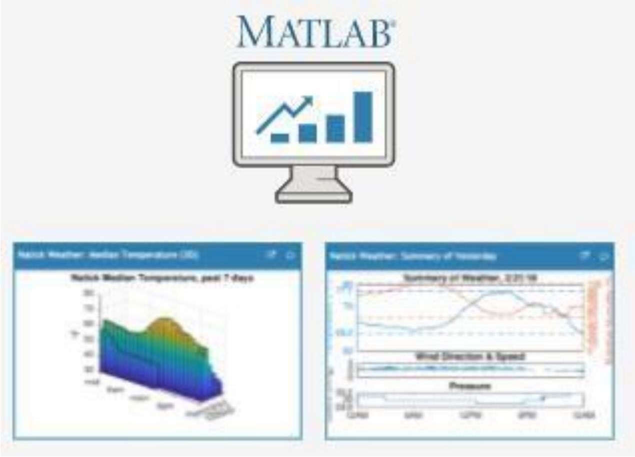
5. Control Devices Online with One Second Update Rates

With a commercial ThingSpeak license, you can send data to ThingSpeak as fast as once every second. This not only enables near-real time monitoring of your devices, but it allows you to set up control loops from the cloud. For example, you could configure ThingSpeak to turn a light on when your motion sensor detects a person has walked into a room. For applications that require faster response times, the best practice is to have the control loop at the edge closer to the hardware.



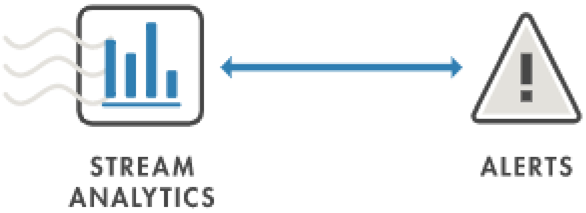
6. Perform Computations and Build Custom Visualizations

With the MATLAB engine built into ThingSpeak, you can perform calibrations, develop analytics, and transform your IoT data. You can also use the MATLAB engine built into ThingSpeak to build custom charts. With a commercial ThingSpeak license, you can run MATLAB calculations that last up to 60 seconds. A commercial ThingSpeak license also enables you to use MATLAB Toolboxes for machine learning, signal processing, system identification, and more with ThingSpeak, provided you have a license for the toolbox.

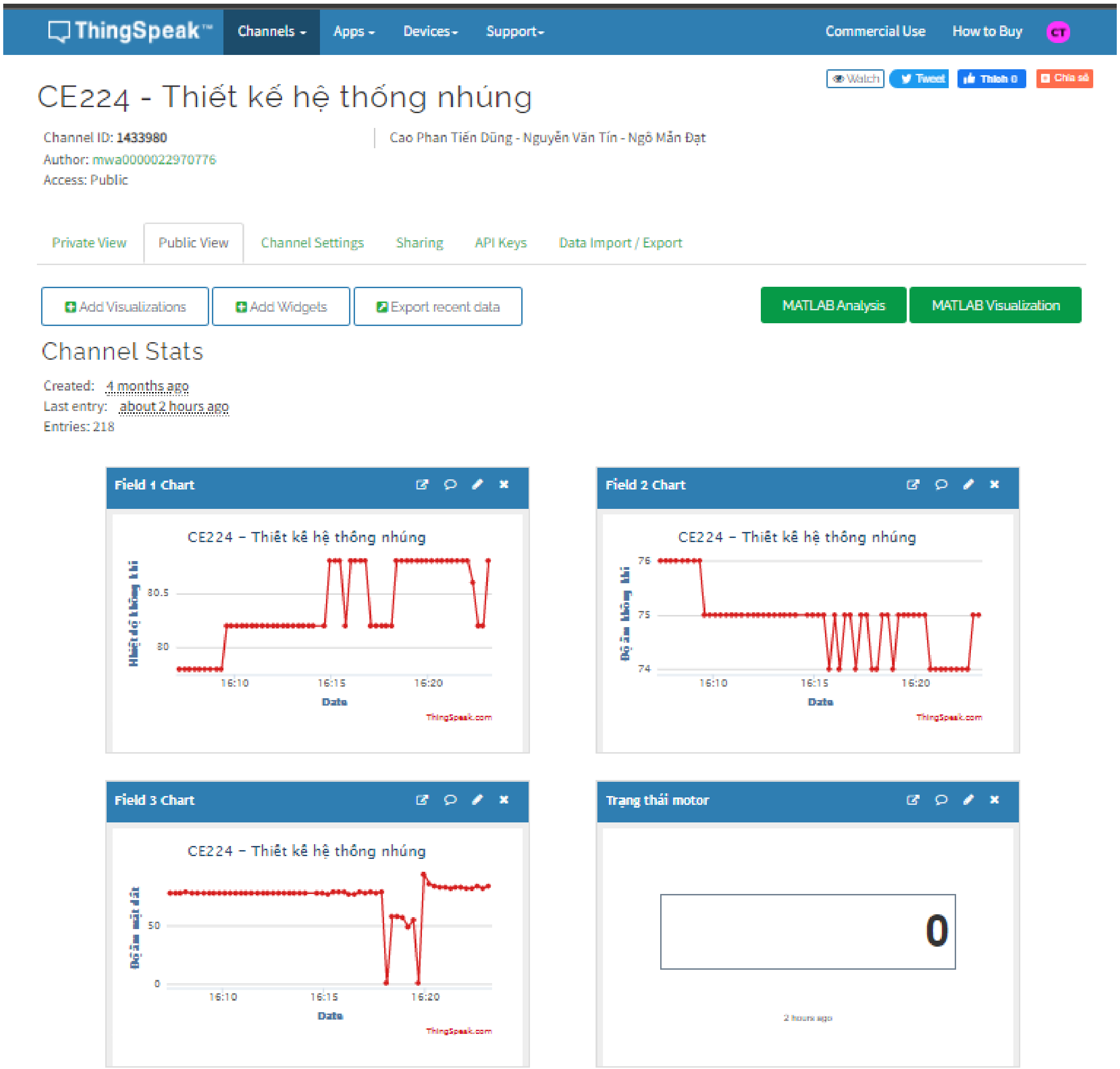


7. Create Streaming Analytics, and Integrate with Your Systems

Operationalize your analytics using the Time Control and React apps. With the Time Control app, you can schedule a computation to run once a day, once an hour, or as quickly as once every 5 minutes. The React App is used for condition monitoring. You can monitor the data coming in from your devices and set up an alert when the data indicates something may need attention. For example, you could configure ThingSpeak to send an email when the humidity on your plant floor exceeds a certain value. More broadly, your analyses can trigger events that push data from ThingSpeak to other web applications like Salesforce via REST APIs.



8. My project



CE224 - Thiết kế hệ thống nhúng

Channel ID: 1433980
Author: mwa0000022970776
Access: Public

Cao Phan Tiến Dũng - Nguyễn Văn Tín - Ngô Mẫn Đạt

Channel Stats

Created: 4 months ago
Last entry: about 2 hours ago
Entries: 218

REFERENCES.

[1] https://thingspeak.com/pages/commercial_learn_more
[2] https://tinhte.vn/thread/review-blynk-ai-cung-lam-duoc-iot.3322306/
[3] https://www.semanticscholar.org/paper/Smart-Garden-Management-System-Shireen-Devi/dbb3b28fec4f415ec8899c8fb7715e8304a0944f