



# ACEBOTT

**Smart Home Basic Starter Kit  
for ESP32**

# Perface

## Our Company

ACEBOTT STEM Education Tech Co.,Ltd

Founded in China's Silicon Valley in 2013, ACEBOTT is a STEM education solution leader. We have a team of 150 individuals, including members from research and development, sales, and logistics. Our goal is to provide high-quality STEM education products and services to our customers. We are working together with STEM education experts and our business partners to produce successful STE products together. Our self-own factory also provides CEM services for our clients including logo customization on product packaging and PCB.

## Our Tutorial

This course and smart home learning kit is designed for 8+ children and teenagers to learn more about ESP32 board and smart home knowledge, sensors and circuit components. If you like to learn ESP32 smart home knowledge, this kit could provide you the knowledge and steps to build your own smart home together with Dr. Lumi.

## Through this kit, you can:

1. Learn how to effectively use the ESP32 board, including uploading code, understanding its features, and coding with the ARDUINO IDE.
2. Gain a solid foundation in the basics of the C language, as the ESP32 utilizes a simplified C/C++ programming language for controlling circuits and sensors.
3. Explore various electronic components such as LEDs, sensors, and motors, and understand how they work together in real-world smart home projects.
4. Enhance your maker skills by building your own smart home using the ACEBOTT kit, following step-by-step tutorials.
5. Implement essential functions like auto response, App control, and voice control in your smart home project.
6. Develop a comprehensive understanding of smart home technology, preparing you for more advanced learning in the future.

In summary, the ACEBOTT smart home learning kit is specifically designed to introduce beginners to the world of ESP32-based smart home development. With this kit, users can gain a comprehensive understanding of how controller boards and sensors function within the context of a smart home. By following the provided tutorials, individuals of all ages can acquire valuable knowledge about smart home technology and successfully build their own smart home projects.

## Customer service



[E-mail: support@cebott.com](mailto:support@cebott.com)

<https://cebott.com>

ACEBOTT is a dynamic and fast-growing STEM education technology company that strives to offer excellent products and quality services that meet your expectations. We value your feedback and encourage you to drop us a line at [support@cebott.com](mailto:support@cebott.com) with any comments or suggestions you may have.

Our experienced engineers are dedicated to promptly addressing any problems or questions you may have about our products. We guarantee a response within 24 hours during business days.

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# **Adventure Journey—The Exploration of the Lumi’s Home**

You are a child with rich imagination and creativity. Since childhood, you have been full of curiosity about science and technology. You like to make various small inventions and always want to improve the world around you.

One day, while you were organizing your bookshelf, you stumbled across a book. You open a page of your book and reveal a beautiful illustration of a magical building, the Lumi’s Home.

Excited, you start reading the description of the Lumi’s Home. The book describes how the building uses advanced technology to automatically turn on lights and obtain temperature and humidity data to provide a convenient life for its occupants. Fascinated by this idea, you decide to dive deeper into the mysteries of the Lumi’s Home and hope to build your own.

You ask around people you know, hoping to find out more about the Lumi’s Home. Finally, in a shop selling antiques, you meet an old man with a lot of experience. The old man tells you that the Lumi’s Home was designed and built by a legendary engineer.

The old man, seeing your eagerness and enthusiasm, took a drawing from the drawer and handed it to you. This drawing shows

the design and construction of the Lumi's Home, and the old man tells you that if you want to build your own Lumi's Home, learn various skills, including electrical engineering, programming and design.

You gratefully accept the drawing, and you decide to take up the challenge.

You go home and pull out the drawings to compare the illustrations in the book, and suddenly a strong light draws you in, and in an instant you find yourself in a whole new world.

You look around and find yourself in an amazing sight, the same building you've seen in drawings and books.

Before take a closer look at the Lumi's Home, a sudden flash of bright light made the Lumi's Home disappear.

Just then, a person suddenly appears in front of you and says, "Hi, young Creator, welcome to the Lost City, my name is Dr. Lumi, and it looks like you need some help."

"Dr. Lumi?" you ask, surprised.

"More accurately, I am a digital being, responsible for guarding the Lumi's Home."

You nod in understanding and ask, "Hey, Dr. Lumi, why did the Lumi's Home disappear?"

"What you see is a holographic projection of the Lumi's Home, which has long since disappeared," Dr. Lumi explained. "Now you have the drawings and you can reconstruct the Lumi's Home."

"What do I need to do?" you ask Lumi.

"Don't worry," the doctor explained. "I'm here to guide and help with the construction."

You feel a renewed sense of hope, and you open the drawings to rebuild the Lumi's Home. Dr. Lumi uses precise instructions to help you identify and assemble the scattered parts. Together, they check the status of each part and ensure that it is properly installed and connected.

[Click to get construction drawings.](#)

**Note: The connection of the DuPont line should be careful, or it may damage the Lumi's Home.**

After the construction is completed, you and Dr. Lumi stand in front of the Lumi's Home and admire the magnificence of its rebirth. However, Dr. Lumi reminds you that restoring the building is only the first step, and you need to restore the function of the Lumi's Home.

Dr. Lumi said: "Although we have succeeded in building the exterior of the Lumi's Home, it is not functional yet. We needed a powerful tool to make the Lumi's Home smart again, and that tool

was called Arduino IDE."

You look at Dr. Lumi curiously and ask, "What is Arduino IDE? What does it do?"

Dr. Lumi explained with a smile, "Arduino IDE is an open source integrated development environment dedicated to programming and developing projects based on Arduino boards. It provides us with a friendly programming interface and rich libraries to easily control the various components of the Lumi's Home."

Your eyes light up and you say, "That's great! I would love to learn and use the Arduino IDE to rebuild the Lumi's Home."

"Where should I start learning Arduino IDE?" you eagerly ask.

Dr. Lumi replied, "You can follow the hyperlink below to install the Arduino IDE on your computer."

[To install the Arduino IDE on Windows click here.](#)

[To install Arduino IDE for Mac OS click here.](#)

You excitedly turn on your computer and start downloading and installing the Arduino IDE. You can't wait for the installation to finish because you know it's the key to fixing the Lumi's Home.

After the installation is complete, Dr. Lumi confirms the model of the control board and tells you that this time you are using an ESP32 master board. However, you get a bit of a shock when you open the Arduino IDE and are surprised to see that there is no



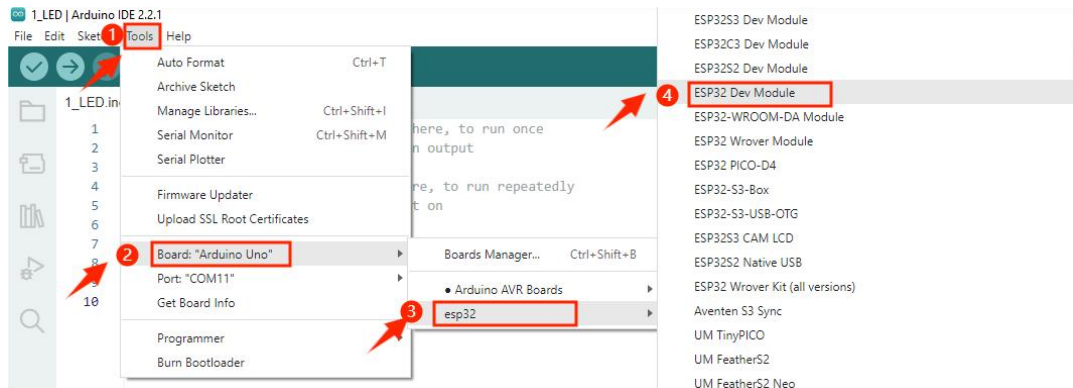
ESP32 board.

Noticing your confusion and disappointment, Dr. Lumi immediately came to your aid and said, "You can add the ESP32 plugin to the Arduino IDE by following the hyperlink below."

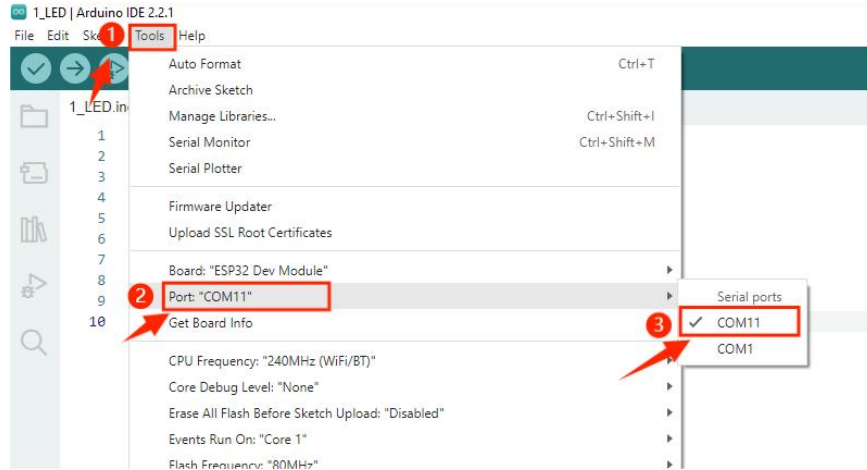
[Install the ESP32 plugin in the Arduino IDE.](#)

"Great, you've finished installing the software and simply seeing how to find the ESP32 in the software."

"The first step is to choose the right board by following these steps: **Tools > Board > esp32 > ESP32 Dev Module .**"

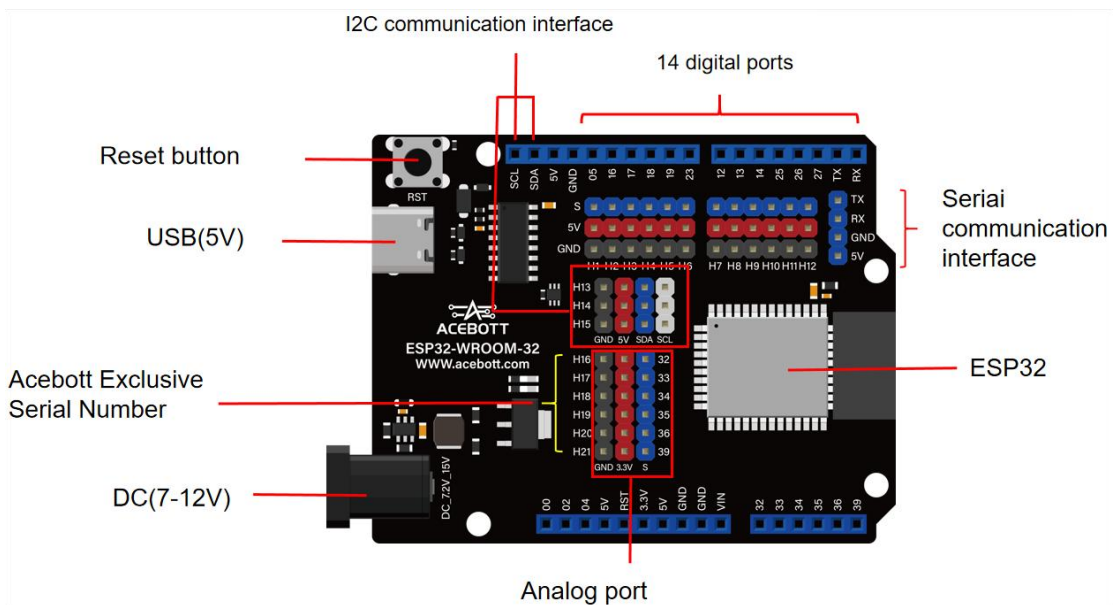


"Step two, follow these steps to select the correct port: **Tools > Port > COM11**(Select the appropriate COM port on your computer)."



Note: The COM port to connect to is usually not COM1. Click another COM port.

"Let's meet the brain of Lumi's Home, the ESP32 controller board."



Dr. Lumi looks at you now that your preparations have been completed and says expectantly, "The mission to restore the Lumi's Home has begun! Together we will bring it back."

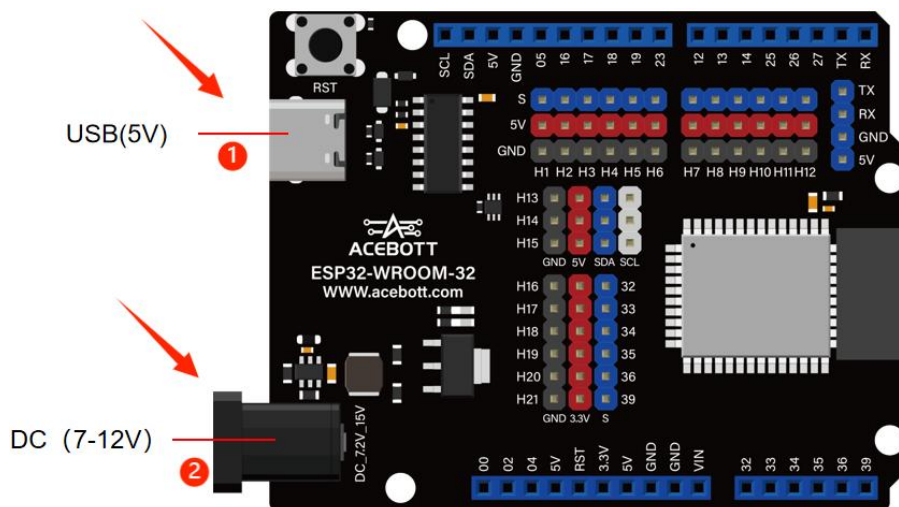
Your inner passion is rekindled because you realize that this is an important mission.

## Task 1: Repair the street lights to illuminate the yard

In the courtyard of the Lumi's Home, where the dim street lights cast a silence and gloom over the environment, Dr. Lumi decided to solve the power problem first.

Dr. Lumi scrutinizes the ESP32's power connection. It found that the ESP32 could be powered via a USB interface or via an external DC power connection.

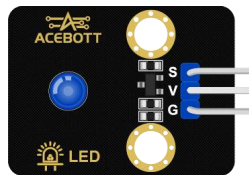
The doctor pointed to the intact power supply and said, "You see, the power supply only needs to be plugged into any of the following ports."



**Note: Due to the large number of connected electronic modules, the power supply of USB may be insufficient. Please confirm that 6xAA batteries have been installed.**

The ESP32's indicator lights up, indicating a normal power connection.

Dr. Lumi decided to fix the street lamp as the first task. Dr. Lumi pointed to the LED module on the street lamp and showed it to you in the yard. He explained, "This is an LED module, it can emit bright light, we will use it to repair the street lamp and make the yard bright again."



You look at the blue LED module and curiously observe it. Dr. Lumi opened the hologram and pointed to a picture. "For an introduction to the LED module, you can refer to the picture below."

#### **LED Module**

LED module is a component that integrates LED lamp beads, drive circuits, and shell to provide lighting, indicating, or display functions. According to the specific application requirements, the LED module can be a wide variety of shapes, sizes and colors, and its color depends on the material and the light emitting principle.

A high level output to the LED module means to turn on the LED light, and a low level output to the LED module means to turn off the LED light.

The LED module can also be controlled by analog signals, the larger the input signal value, the brighter the LED light.

You nod, but still a little confused, ask, "Dr. Lumi, what are currents and voltages? What do they have to do with LED modules?"

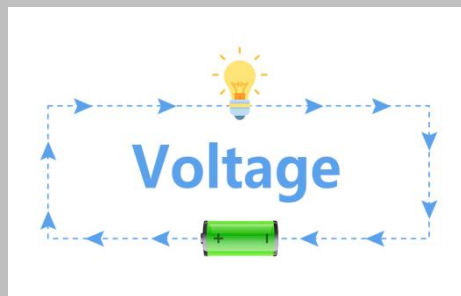
Dr. Lumi smiled as he opened the hologram and replied, "Good question. You can refer to the introduction in this picture."

### **Current and voltage**

**Current:** It represents the movement of electrons in a wire or circuit, much like water molecules flowing in a pipe.

**Voltage:** It represents the "driving force" of the current, like the water pressure in the flow of water.

**The direction of the current:** from the positive (high voltage end) of the power supply to the negative (low voltage end) of the power supply, like water flowing from high to low.



When an electric current flows through a light bulb, it lights up. In the same circuit, when the voltage is higher (higher pressure), the current is higher (faster water flow), the bulb will be brighter.

After carefully watching the presentation on current and voltage, you excitedly posed the question to Dr. Lumi: "Dr. Lumi, I want to know how to program an LED to turn on, can you teach me?"

Dr. Lumi smiled and opened the hologram and replied, "Sure!

Programming is a way to control electronic devices, we can use programming languages to control the LED lights on and off, you can refer to this instruction."

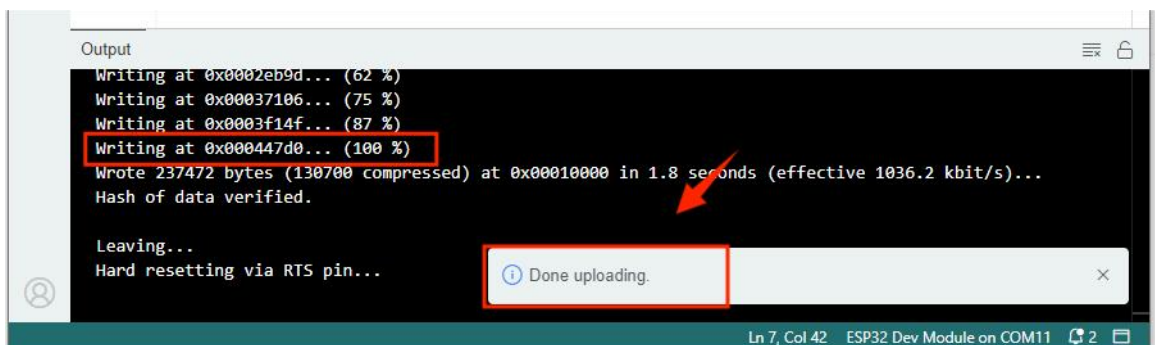
```
void setup() {  
  pinMode(5, OUTPUT); // set the pin 5 as output  
}  
void loop() {  
  digitalWrite(5, HIGH); //set the pin 5 to HIGH, turning on the LED  
  delay(1000); // delay for 1 second  
  digitalWrite(5, LOW); // set the pin 5 to LOW, turning off the LED  
  delay(1000); // delay for 1 second  
}
```

Of course, there's a simple way to open this hyperlink directly to the program: [Click to get the street lamp program.](#)

Remember to confirm the "Board" and "Port", and follow the prompts below to upload the program.

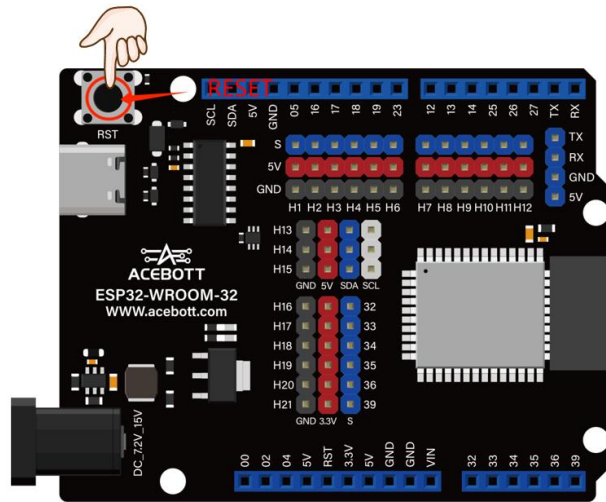
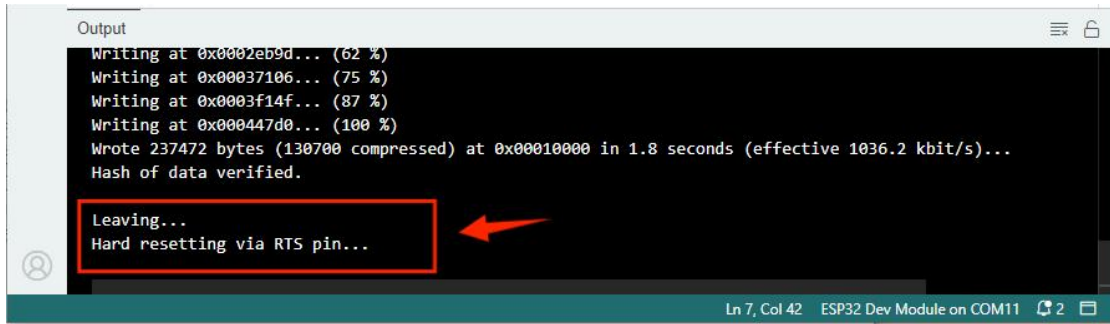


Program upload, when the progress display number to 100%, upload program ends.



After the program is uploaded, you can press the Reset button on the ESP32 controller board to restart the ESP32 controller board

and let the program start running again.



After uploading the program, the following effects will appear:  
the LED module will light up for one second and go off for one second.



The LED module starts flashing and gives off a bright glow.  
The street lights in the courtyard are re-illuminated, bringing  
warmth and vitality to the whole The LED module starts flashing

and gives off a bright glow. The street lights in the courtyard are re-illuminated, bringing warmth and vitality to the whole Lumi's Home.

You look out at the illuminated yard and say gratefully to Dr. Lumi, "Thank you for your guidance! Now the street lights are on again! I also understand the importance of current and voltage for LED modules."

Dr. Lumi responded with a smile: "You're welcome. Now we have taken the first step, come on!"

You look out at the illuminated yard and say gratefully to Dr. Lumi, "Thank you for your guidance! Now the street lights are on again! I also understand the importance of current and voltage for LED modules."

Dr. Lumi responded with a smile: "You're welcome. Now we have taken the first step, come on!"

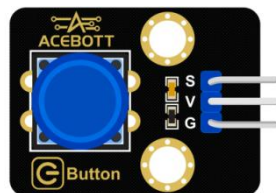


## Task 2: Save energy! Let's add a switch to control the light

In the courtyard of the Lumi's Home, you and Dr. Lumi are sitting together, thinking about how to save energy. You realize that the lights are still on when people are not in the yard, which is a waste of energy.

You ask, "Dr. Lumi, how can we do this without wasting energy?"

You look up and look at Dr. Lumi. "We could design a button switch for the light," says Dr. Lumi. "People could control the light as they want. In doing so, we are able to save energy and make the Lumi's Home smarter and greener."



You nod in agreement and ask, "What's a button switch?"

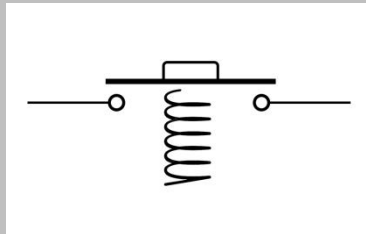
Dr. Lumi opened the hologram and explained, "You can refer to the diagram below for an introduction to the keypad module."

## Button Module

Button module is a common electronic component used to implement push-button switch operation in electronic devices.

The button module is composed of two electrode pieces and a spring button, the button is located between the two electrode pieces.

When the button is not pressed, the two electrodes of the button are disconnected, and the circuit is in the disconnected state; When the button is pressed, the two electrode pieces touch, forming a closed circuit.



"What's the difference between a switch module and an LED module?" you ask.

Turning on the holographic projection, Dr. Lumi further explained, "The switch module and the LED module play different roles in the circuit. You can refer to this diagram for details."

### **Input module and output module**

1. Input module: it refers to the signal transmitted to the control board through digital or analog pins from external devices (such as buttons, switches, sensors, etc.), and the control board can obtain the state information of the external environment according to these signals, such as key modules, various sensor modules, etc.

The pin on the control board used to get external information should be set to `pinMode (pin, INPUT)`.

2. Output module: refers to the process of sending signals or control information from the control board to external devices, and these output signals can be used to control LED lights, RGB lights, etc.

"So, how is the signal from the key module recognized and processed by the ESP32 master board?" you ask.

Dr. Lumi explains, "The ESP32 master board detects the status of the switch by reading the level of the pin. This button module that we use, when it's released, it sends a 1 to the computer, and when it's pressed, it sends a 0 to the computer."

A flicker of insight crossed your eyes: "So it is! How can you program intelligent control?"

Dr. Lumi opened the hologram and said, "You can refer to this instruction."

```
volatile int buttun = 0; // define a global variable named 'button'
void setup() {
  pinMode(5, OUTPUT); // set pin 5 as output for controlling the LED
  pinMode(26, INPUT); // set pin 26 as input for reading the button state
}
void loop() {
  if (digitalRead(26) == 0) { // check if the button is pressed (low level)
    while (digitalRead(26) == 0) {
      delay(200); // use delay to debounce the button and wait until it's released
    }
    buttun++; // increment the button count
    if (buttun % 2 == 1) {
      digitalWrite(5, HIGH); // if the button press count is odd, turn on the LED
    } else if (buttun % 2 == 0) {
      digitalWrite(5, LOW); // if the button press count is even, turn off the LED
    }
  }
}
```

You can directly click the hyperlink to open the program directly: [click to get the switch lights.](#)

You upload the program to the ESP32 master. When the switch is pressed, the light will come on, bringing comfortable lighting to the room. When the switch is pressed again, the lights turn off, saving energy.



You and Dr. Lumi hope that this energy efficient lighting system will inspire more people to pay attention to energy conservation and environmental protection.

### Task 3: Breathing lights

In the courtyard of the Lumi's Home, you sit with Dr. Lumi and discuss how to make street lights look smarter.

Puzzled, you ask, "Dr. Lumi, how can the intelligence of a street lamp be demonstrated?"

Dr Lumi replied: "If we turn a street lamp into a breathing lamp, it will look more alive and intelligent."

You wonder, "Dr. Lumi, how do we achieve the breath-lamp effect?"

"The principle of the breathing lamp is to create a breathing lamp effect by gradually increasing and decreasing the value of the LED brightness, and we can use pulse width modulation (PWM) technology to achieve this," explained Dr Lumi with a smile.

"What is PWM?"

Dr. Lumi patiently replied, "PWM is to control the brightness or speed of the device by controlling the ratio of time between the high and low levels of the signal, refer to the introduction of PWM below."

**PWM**

PWM is the abbreviation for "Pulse Width Modulation" . Use different duty cycle to simulate the "analog output". The duty cycle is the proportion of time in a pulse cycle that is high to the total cycle time, the unit is % (0%-100%).

By changing the duty cycle of the PWM, the average voltage of the output signal can be changed to realize the output of the analog voltage.

PWM can use the statement "analogWrite(pin,dutyCycle)" to implement a PWM with a specified duty cycle, where the value of pin is the pin of the control board and the value of dutyCycle is between 0 and 255, where 0 is the duty cycle 0% and 255 is the duty cycle 100%.

For example, the statement "analogWrite(pin,127) " has a duty cycle of 50%, which means that if you plug in 5V, it is equivalent to only putting in 2.5V.

Your eyes light up: "So."

Dr. Lumi smiled and nodded. "Yes, in the breath lamp program, we control the input voltage using the analogWrite function, which takes a number between 0 and 255 as a parameter, indicating the level of voltage. The smaller the value, the smaller the voltage, the darker the LED light; The higher the value, the higher the voltage, and the brighter the LED."

"Let's get started!" you say excitedly.

Dr. Lumi smiled encouragingly. "You can refer to this instruction."

```
void setup() {
  pinMode(5, OUTPUT); // set pin 5 as an output
}
void loop() {
  for(int i=0;i<255;i++){ // loop from 0 to 254
    analogWrite(5,i); // write the value of 'i' to pin 5 (PWM output)
    delay(5); // delay for 5 milliseconds
  }
  for(int i=255;i>0;i--){ // loop from 255 to 1
    analogWrite(5,i); // write the value of 'i' to pin 5 (PWM output)
    delay(5); // delay for 5 milliseconds
  }
}
```

Of course, I will also provide you with the easiest way to open this hyperlin: [Click to get the breathing light program.](#)

After uploading the program, the following effect will appear: the LED module will gradually light up and then gradually extinguish.



In the courtyard of the Lumi's Home, you and Dr. Lumi have finally succeeded in applying the breathing lamp effect to a street lamp. The whole street of Lumi's Home glows soft and warm in the night, like a living light.

## Task 4: Add eyes to the street lamp

You and Dr. Lumi feel the soft, warm glow of the breathing lamp in the courtyard of the Lumi's Home.

"What do you think intelligence is?" Dr. Lumi asked.

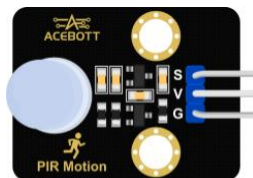
You think for a moment, and you reply, "I think intelligence is the ability to automatically sense and adapt to the environment."

Dr. Lumi nodded in praise. "Good, you're getting the intelligence right."

Dr Lumi continued: "So to make street lights smarter, we can use the PIR sensor to detect whether there are people around the street lights. This way, when someone approaches the street lamp, it will automatically light up; When there is no one, it will automatically go out, which will make the street lights more intelligent and energy efficient!"

You nod excitedly, "Great! Let's do it!"

Dr Lumi said: "OK, let's understand what the PIR sensor is."





**PIR sensor**

PIR sensor is a device that detects human motion based on infrared radiation. When someone or other hot object enters the sensing range of the sensor, the object will cause changes in infrared radiation, so as to be detected by the sensor.

The characteristic of the sensor is that only when the external radiation causes the temperature change of the sensor itself, the corresponding electrical signal will be output. When the temperature change becomes stable, the signal output will not be generated anymore, so it is only sensitive to the human body in motion.

In addition, when the human body is sensed, the sensor will output a high voltage signal with a delay time. If the human body is still present in the sensor range, the sensor will continuously maintain a high voltage signal. Only when the human body leaves, the delay ends and the sensor signal will turn to low voltage.

You nod in understanding, then say excitedly, "How do you program a street light to turn on when someone approaches?"

Dr. Lumi opened the hologram and smiled encouragingly. "You can refer to this instruction."

```
void setup() {
  pinMode(5, OUTPUT); // set pin 5 as output for controlling the LED
  pinMode(14, INPUT); // set pin 14 as input for reading the PIR sensor signal
}
void loop() {
  if (digitalRead(14) == 1) { //if the PIR sensor detects a person (signal is 1),
  turn on the LED
    digitalWrite(5, HIGH);
  }
  else if (digitalRead(14) == 0) { // if the PIR sensor does not detect a person
  (signal is 0), turn off the LED
    digitalWrite(5, LOW);
  }
}
```

You can open the program by clicking on the hyperlink: [Click to](#)

[get the PIR light program.](#)

"The code is simple," Dr. Lumi explains. The program reads the state of the sensor to determine if someone is approaching. If someone approaches, light the LED; If there is no one, put the LED out."

After you've gone through the code, upload it to your ESP32 console. When you stand near a street lamp, the light comes on; When you leave, the lights go out.



You say excitedly, "Great! Now the street lights are smart!"

You feel very satisfied because of your creativity and efforts to make street lighting smarter and greener.

## Task 5: Human body induction alarm

As time went on, dusk came, and it was going to be night. You and Dr. Lumi are sitting in the courtyard of Lumi's Home, thinking about how to make it smarter and safer at night.

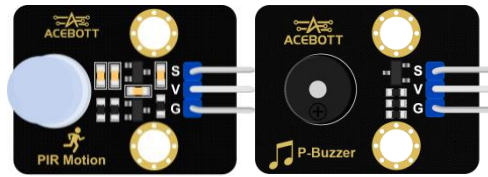
You stare around you and travel to this strange place, surrounded by forests, lakes, and few people.

You think and say, "The Lumi's Home needs a smarter security system. We need a device that can sense if someone is approaching."

Dr. Lumi thought quietly for a moment, then suddenly his eyes lit up and he replied excitedly, "I have a great idea! We can create a human body sensing alarm system. It can be used to determine whether someone is approaching and send out an alarm sound in time. So we can keep the home safe, especially at night."

Your eyes glint with excitement and you ask, "What electronic modules are we going to use to make this system?"

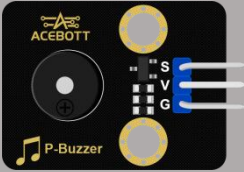
Dr. Lumi turns on the hologram, and the picture above shows the actuators needed: "a P-Buzzer is needed, together with the PIR sensor, and these components can help us achieve a human sensing alarm system."



You look at the picture, look up and ask, "What's a P-Buzzer? What does it do in our system?"

Dr. Lumi turns on the holographic projection and patiently explains, "P-Buzzer is a sound device. You can refer to the picture below."

### P-Buzzer



Buzzer is a common electronic component that generates sound signals. It consists of an oscillating circuit and a piezoelectric ceramic element. When voltage is applied, the ceramic vibrates, producing sound.

P-Buzzers require the input of an external oscillating signal, usually driven by a variable frequency square wave signal to produce sound, a common frequency between 2kHz and 5kHz.

You nod and say expectantly, "How would you code that?"

"The idea of our programming is to use the PIR sensor to detect if someone is approaching, and when the sensor detects someone is approaching, the P-Buzzer is programmed to emit an alarm sound. You can refer to this command," explained Dr. Lumi.

```
void setup() {  
  pinMode(14, INPUT); // set pin 14 as input for reading the PIR sensor signal  
  pinMode(23, OUTPUT); // set pin 23 as output for controlling the buzzer  
}  
void loop() {  
  int presence = digitalRead(14);  
  if (presence == 1) {  
    tone(23, 1000); // make an alarm sound  
    delay(2000); // lasts 2 seconds  
    noTone(23); // stop the alarm sound  
  }  
}
```

You can open the program by clicking on the hyperlink: [click to get the PIR Buzzer program.](#)



You double-check the code to make sure there are no errors, upload the program to the ESP32 controller board, and then wait, waiting for the results of the first test.

You slowly approach the PIR sensor. PIR sensors detect an approaching person, and P-Buzzer immediately sounds.

You and Dr. Lumi look at each other with satisfaction because your human body sensing alarm system has worked successfully.

## Task 6:Gas detection

You and Dr. Lumi are sitting quietly in the courtyard of the Lumi's Home, enjoying the quiet evening. Suddenly you hear a cry for help from the forest and the crackling of flames in the distance.

The two of you immediately became alert and went out into the distance. In the distance, the forest was burning, and the light of the fire lit the night sky and filled the air with smoke.

You and Dr. Lumi are touched by the threat of fire, and you decide to go to the scene of the fire and do what you can to help those in danger.

When you arrived, chaos reigned, and the inhabitants of The Lost City were doing their best to extinguish the flames. This is the first time you've met the rest of The Lost City, you and Dr. Lumi immediately go into action, working together to put out the fire.

Minute by minute, after everyone's joint efforts, the fire was finally brought under control. The people of the Lost City look gratefully at you and Dr. Lumi.

Back at the Lumi's Home, you and Dr. Lumi are worried about how to further improve the safety of your living environment. Suddenly, you both thought of something crucial at the same time -- a fire alarm should be installed in the Lumi's Home.

You have an important question for Dr. Lumi: "But what sensors can detect a fire?"

Dr. Lumi thought for a moment, turned on the hologram and said, "We can use the MQ-4 gas sensor, which you can see in the diagram below."



#### MQ-4 gas sensor

The gas sensing material used in the MQ-4 gas sensor is tin dioxide ( $\text{SnO}_2$ ), which has a low conductivity in clean air. When there is combustible gas in the environment where the sensor is located, the conductivity of the sensor increases with the increase of the concentration of combustible gas in the air. A simple circuit is used to convert the change in conductivity into an output signal corresponding to the concentration of that gas.

MQ-4 gas sensor has high sensitivity to methane and strong anti-interference ability to alcohol and some other interfering gases.

Special reminder: After the sensor is powered on, it needs to be preheated for about 20S, and the measured data is stable. The heating of the sensor is a normal phenomenon, because there is an internal heating wire.

"Are gas sensors controlled in the same way as PIR sensor?"  
you ask.

Dr Lumi explains: "Unlike PIR sensor, which input digital signals, gas sensors input analog signals."

Puzzled, you ask, "What is a digital signal and what is an analog signal?"

"Digital and analog signals are two types of signals that are commonly used in communications and electronics," Dr. Lumi patiently explains. "You can refer to the diagram below."

### Digital signals and analog signals

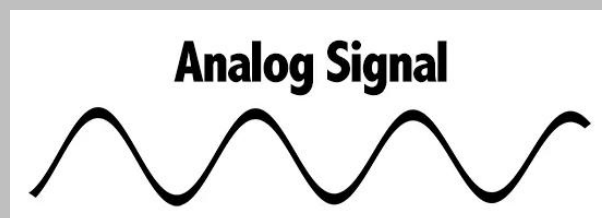
#### 1. Digital signal

A digital signal is a discrete signal that can only take a finite number of discrete values. In digital signals, the value of the signal is determined at different points in time and is usually expressed in binary form, mean 0 and 1. In simple terms, a digital signal is a signal with only two opposing states.



#### 2. Analog signal

Analog signal is a kind of continuous signal, which can take any continuous value in time and amplitude. In analog signals, the value of the signal can be at any amplitude level at any time and can be represented as a continuous waveform. Analog signals are characterized by continuity and infinite accuracy, and are suitable for applications with continuous changes in audio, video, sensor signals, etc.



You can't wait to ask, "How can I see the concentration of combustible gases?"



Dr. Lumi thought about it. "Don't worry," he said. "Just follow this code."

```
void setup() {  
  Serial.begin(115200);  
  pinMode(32, INPUT); // connect the MQ-4 gas sensor to pin 32  
}  
void loop() {  
  int gasValue = analogRead(36);  
  Serial.println(gasValue);  
  delay(2000);  
}
```

You can open the program by clicking on the hyperlink: [Click to get the gas concentration serial port display program.](#)

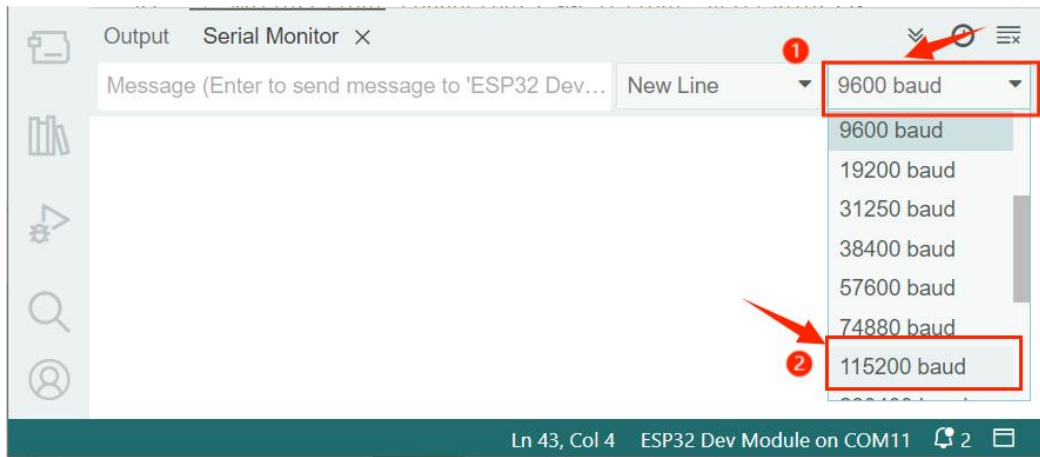
Dr. Lumi smiled and replied, "This code reads the analog value of the gas sensor and displays it on the serial monitor."

After you double check the code, you upload it to the ESP32 controller board.

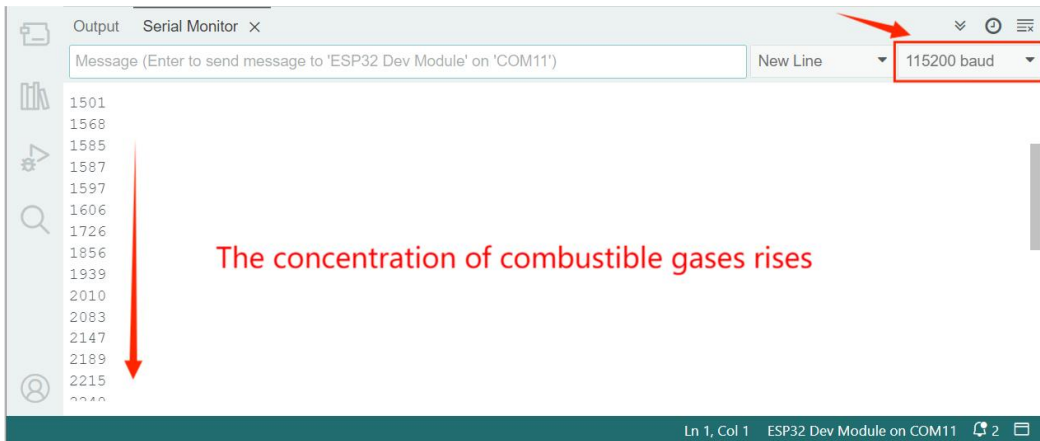
"Once the program is uploaded, open the serial monitor and set the baud rate of the serial monitor to 115200 to see the real-time information from the MQ-4 gas sensor."



"Turn on the serial monitor and set the baud rate to 115200 as shown below."



"If there is combustible gas floating to the MQ-4 gas sensor, the serial monitor value will increase and continue to change."



You nod your head to indicate understanding.

## Task7: Combustible gas alarm system

After installing the gas sensor, you and Dr. Lumi look up at the bright moonlight, look at The Lost City under the dim moonlight, and enjoy the scenery around you.

You are pleased with your newly installed gas sensor, which displays the concentration of combustible gases on a serial monitor.

However, you suddenly think of something. You then tell Dr. Lumi, slightly worried, "If we turn off the serial monitor or leave the home, we won't be able to see even if the concentration of combustible gas exceeds the limit."

Dr. Lumi thought for a moment and then replied, "You're right. We need an alarm system that can send us alerts."

"Is it possible," you ask, "to create an independent combustible gas alarm system with P-Buzzer, so that we can receive the alarm in time even if we are not staring at the serial monitor to observe the data?"

Nodding in agreement, Dr. Lumi went on to explain, "Now we need to write the code to control the behavior of the buzzer. The programming idea is that when the gas sensor detects that the

flammable concentration exceeds a safe threshold, we will trigger the buzzer to emit a sound. This way, even when we are not at home, we can take timely action through voice alerts."

You nod your head in understanding, and ask, "How would you program an alarm to emit an excessive concentration of combustible gases?"

Dr. Lumi thought for a moment, opened the hologram and said, "You can refer to this code."

```
void setup() {
  Serial.begin(115200); // initialize serial communication
  pinMode(23, OUTPUT); // set the buzzer pin as output
  pinMode(32, INPUT); // connect the MQ-4 gas sensor to pin 32
}
void loop() {
  int smokeValue = analogRead(32); // read the value from the MQ-4 gas sensor
  if (smokeValue > 2000) { // if the gas value is greater than 2000, turn on the
  buzzer
    tone(23, 1000); // turn on the buzzer
    delay(1000); // lasts 1 seconds
  } else {
    noTone(23); // stop the alarm sound
  }
  Serial.print("Smoke Value: "); // print the gas value to the serial monitor
  Serial.println(smokeValue);
  delay(1000); // delay for a period of time
}
```

You can click the hyperlink to open the program: [Click to get the gas buzzer program.](#)

You double-check and upload the code to your ESP32 controller board.



The buzzer now emits a sound when the gas sensor detects that the concentration of combustible gas exceeds a safe threshold. In this way, the possible fire risk can be known in time.

## Task 8: Melodious lullaby

You and Dr. Lumi are sitting in the yard with the lights on, feeling the soft, warm glow.

Dr Lumi said: 'The yard is a bit boring now.'

You reply, "Yes, Dr. Lumi, it would be nice to have some music to accompany it."

Dr. Lumi smiled. "Music? This P-Buzzer, which we use all the time to sound an alarm, can actually produce sound by emitting an electrical signal, and of course it can play music."

You nod and say, "I see, but how do you use P-Buzzer to play music?"

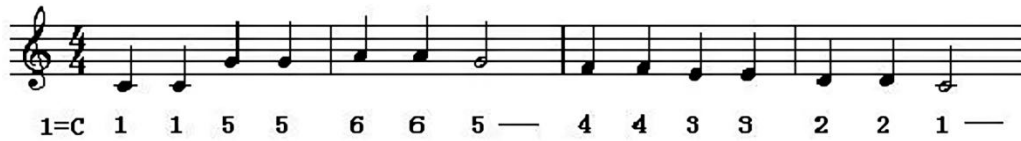
"Each note has a specific frequency and duration," explains Dr Lumi. We can control the buzzer to emit different notes by sending electrical signals. P-Buzzers can play sound by changing the frequency of the voltage to change the pitch."

"Can P-Buzzer play Little Star?" you ask.

Dr Lumi continued: "The buzzer can change the pitch by changing the frequency of the voltage, just determine the frequency of each note in Little Star and then play the song Little Star."

After some research, you and Dr. Lumi were able to find the note score and a list of frequencies for "Little

## Star."



| note  | frequency (Hz) | note  | frequency (Hz) |
|-------|----------------|-------|----------------|
| C (1) | 261.63         | F (4) | 349.23         |
| C (1) | 261.63         | F (4) | 349.23         |
| G (5) | 392.00         | E (3) | 329.63         |
| G (5) | 392.00         | E (3) | 329.63         |
| A (6) | 440.00         | D (2) | 293.66         |
| A (6) | 440.00         | D (2) | 293.66         |
| G (5) | 392.00         | C (1) | 261.63         |

After some hard work, you finally completed the writing of the music program under the guidance of Dr. Lumi.

```
const int notes[] = {
  262, 262, 392, 392, 440, 440, 392,
  349, 349, 330, 330, 294, 294, 262
}; // store the sound frequency for each note of Little Star
const int noteDuration = 300;
void setup() {
  pinMode(23, OUTPUT); // set the buzzer pin as output
}
void loop() {
  for (int i = 0; i < sizeof(notes) / sizeof(notes[0]); i++) {
    tone(23, notes[i], noteDuration); // play the current note
    delay(noteDuration); // pause for the duration of the note
    noTone(23); // stop playing the note
    delay(150); // add a small delay between notes
  }
}
```

You can open the program by clicking the hyperlink: [Click Get Music Player.](#)

With the execution of the code, a melodious melody sounded in the yard. The sound of music is like the breeze blowing leaves, bringing vitality and happiness to the whole yard.



## Task 9: LCD display information

As the night gets deeper and deeper, you feel the chill of the night, and suddenly you make a sneezing sound. Dr. Lumi asked with concern, "Are you cold?"

You rub your nose gently and reply, "Yes, it's a bit cold. It's colder at night than it is during the day, so it's a little chilly."

Dr. Lumi hands you a bracelet and says, "You can wear this thermostat bracelet. It's a smart device that automatically adjusts its temperature according to your body temperature and helps you stay comfortably warm."

You feel so happy that you take the thermostat bracelet from Dr. Lumi and put it on your wrist. As the heating function of the constant temperature bracelet starts, you feel the warm feeling and the coolness is gradually dispersed.

"Temperature," you say thoughtfully, "can only be felt, but not seen."

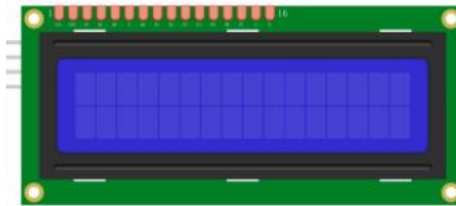
You get curious and start exploring how to visualize this unseen data and ask Dr. Lumi questions.

Dr. Lumi mused for a moment, then said, "Although we can't see temperatures directly, we can use technology to visualize them. For example, the LCD can display a variety of words, images and

numbers, we can use it to present a variety of data."

Your eyes light up with curiosity and you ask, "Really? How can we display the temperature data on the LCD screen?"

"First, let's understand how LCD displays information," explains Dr Lumi.



#### **LCD 1602 I2C Module**

LCD (Liquid Crystal Display), a passive display, that is, the liquid crystal itself does not emit light, it needs a backlight source to provide background light brightness, the use of electric field to control the arrangement of liquid crystal molecules, so as to change the light through and block, realize image display.

LCD 1602 I2C Module just as its name implies, this module is consist of 16 characters x2 lines LCD display module (can display 32 ASCII characters), and a module with I2C communication interface, default I2C address 0x27, with a blue potentiometer on the back, Can be used to adjust the backlight (when the character display is not clear, need to adjust the backlight, let the character display clearly).

Excited, you ask, "How do you write a program to make an LCD display say 'Hi,Lumi'?"

"Programming the LCD screen itself is complicated, but there are libraries available," says Dr Lumi.

Puzzled, you ask, "What is a library? And how do you use it?"

Dr. Lumi smiled and replied, "Libraries can make complex programs easy to write. You can see how to use them in the document" [Adding Libraries](#) ".

You follow the method, add the library to the Arduino IDE, and ask, "How can I program an LCD to display text?"

Dr. Lumi opened the hologram and replied, "You can refer to this program."

```
#include <Wire.h>
#include <hd44780.h>
#include <hd44780ioClass/hd44780_I2Cexp.h>
hd44780_I2Cexp lcd(0x27, 2, 16); // create the LCD1602 object
void setup() {
  lcd.begin(16, 2); // initialize the LCD, set the number of rows and columns
}
void loop() {
  lcd.clear(); // clear the LCD display
  lcd.setCursor(0, 0); // set the cursor position to the first row, first column
  lcd.print("Hi,Lumi"); // print "Hi, Lumi" message at the current cursor position
  delay(2000); // delay for 2 seconds
}
```

You can click the hyperlink to open the program: [click to get the LCD display welcome to the program.](#)

Make sure you have the LCD screen properly connected and adjust it accordingly.

After you upload the program, you feel very excited. You press the reset button on the ESP32 controller board, and suddenly the

screen lights up with the words "Hi,Lumi"! You are very happy that you have learned another way to communicate with Dr. Lumi.



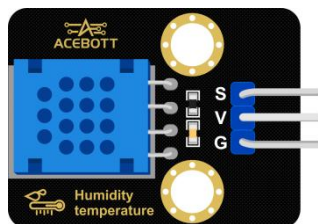
## Task 10: LCD display temperature and humidity

Once you've managed to display a text message on the LCD screen, you're curious about how to display the invisible temperature and air humidity.

You turn to Dr. Lumi for help.

"I just displayed text on the LCD screen, but I want to know how to display the invisible temperature and air humidity, can you help me?"

Dr. Lumi smiled and replied, "Sure! To display the invisible temperature and air humidity, we can use a temperature and humidity sensor. It can sense the temperature and humidity of the surrounding environment, and pass these data to the ESP32 controller board, and then we can display them on the LCD screen, let's learn about temperature and humidity sensors."



### **DHT11 Temperature and humidity sensor**

Temperature and humidity sensor is a sensor based on the digital temperature and humidity sensor DHT11, it is a combination of temperature and humidity sensor, it converts the physical temperature and humidity through the temperature, humidity sensor and the corresponding circuit into a digital quantity that can be directly read by the data acquisition equipment. The temperature range is 0°C ~ 50°C. The accuracy is  $\pm 2.0^{\circ}\text{C}$ , the humidity range is 20% ~ 80%, and the accuracy is 5%.

You nod, expectantly, and ask, "How do we read the sensor data and display it on the LCD screen?"

Dr. Lumi smiled and replied, "You can refer to the following instructions for programming."

```
#include <Wire.h>
#include <hd44780.h>
#include <hd44780ioClass/hd44780_I2Cexp.h>
hd44780_I2Cexp lcd(0x27, 2, 16); // create the LCD1602 object
#include <DHT.h>
DHT dht25(25, 11);
void setup() {
  Wire.begin();
  lcd.begin(2, 16); // initialize LCD1602
  lcd.backlight(); // turn on the backlight
  delay(500);
  lcd.clear();
  dht25.begin(); // initialize LCD screen and temperature/humidity module
}
void loop() {
  lcd.setCursor(1 - 1, 1 - 1); // set the cursor position to the first row and first
column
  lcd.print("T:"); // display "T:"
  lcd.setCursor(3 - 1, 1 - 1); // set the cursor position to the third column of the
first row
  lcd.print(dht25.readTemperature()); // display the temperature value of the DHT
sensor
  lcd.setCursor(9 - 1, 1 - 1); // set the cursor position to the ninth column of the
first row
  lcd.print("H:"); // display "H:"
  lcd.setCursor(11 - 1, 1 - 1); // set the cursor position to the eleventh column of
the first row
  lcd.print(dht25.readHumidity()); // display the humidity value of the DHT sensor
  delay(200); // delay 200 milliseconds
}
```

You can click the hyperlink to open the program: [click to get the LCD display temperature and humidity program.](#)

You clap your hands excitedly to show that you understand. After you check the program carefully, you upload the code to the control board. After uploading successfully, the LCD screen displays the temperature and humidity data of the surrounding environment.



You are ecstatic and take off the temperature bracelet, feeling the temperature around you. For the first time, you have successfully transformed invisible information into visible information.



## Task 11: RFID doorbell

It's a long night in The Lost City, and you and Dr. Lumi wake up to warm sunlight streaming through the Windows. You take a deep breath of fresh air and feel the warmth of the morning sun. Suddenly heard a familiar voice outside the door, is a panda partner wearing glasses!

The panda partner shouted excitedly, "Good morning! What a beautiful day! I heard that the seaside scenery is very beautiful. Would you like to see it together?"

You and Dr. Lumi look at each other, then nod cheerfully to accept the panda companion's invitation. You've always wanted to go to the beach, and this is the perfect opportunity.

As you're getting ready to leave, you look at the door, look around, and ask, "Dr. Lumi, can we design a doorbell for our friends?"

"Good idea," says Dr Lumi. "We could design a doorbell that recognises a proprietary key."

"How do we do that?" you ask, puzzled.

"You can use RFID technology," explains Dr Lumi. "You just put your own key card in the card reading area and you can get the card ID and then use P-Buzzer to make a sound."



You go on, "What is RFID technology?"

Dr. Lumi thinks, turns on the hologram, and says, "You can read about RFID here."

#### RC522 RFID I2C Module

Radio-Frequency Identification (RFID) is a technology for wireless identification and tracking of objects. It is based on the principle of wireless communication by using RFID tags and RFID readers to communicate.

**RFID Tag:** An RFID tag is a small chip that contains a unique identifier UID (usually a numerical code) as well as some memory for storing additional information. These tags are usually composed of RFID chips and an antenna.

**RFID Reader:** An RFID reader is an electronic device that generates radio frequency signals and sends them to nearby RFID tags. The reader is also responsible for receiving the response signal from the tag and decoding the tag's information.

**Rf communication:** When an RFID reader sends an RF signal, it activates nearby RFID tags. The passive RFID tag obtains energy from the reader's signal as well as the operation command and uses it to send its own response signal. Active RFID tags have their own power supply, so they can actively send signals.

You nodded in understanding and said, "We can give each of

our friends in The Lost City a special card."

"Yes," agrees Dr Lumi.

You think about it and ask, "But when the doorbell rings, how do you know who it is?"

Dr Lumi said: "Then the serial monitor shows the identification of the card information, each person has a different UID information, you can know who is coming."

You happily say, "OK, how do we program it?"

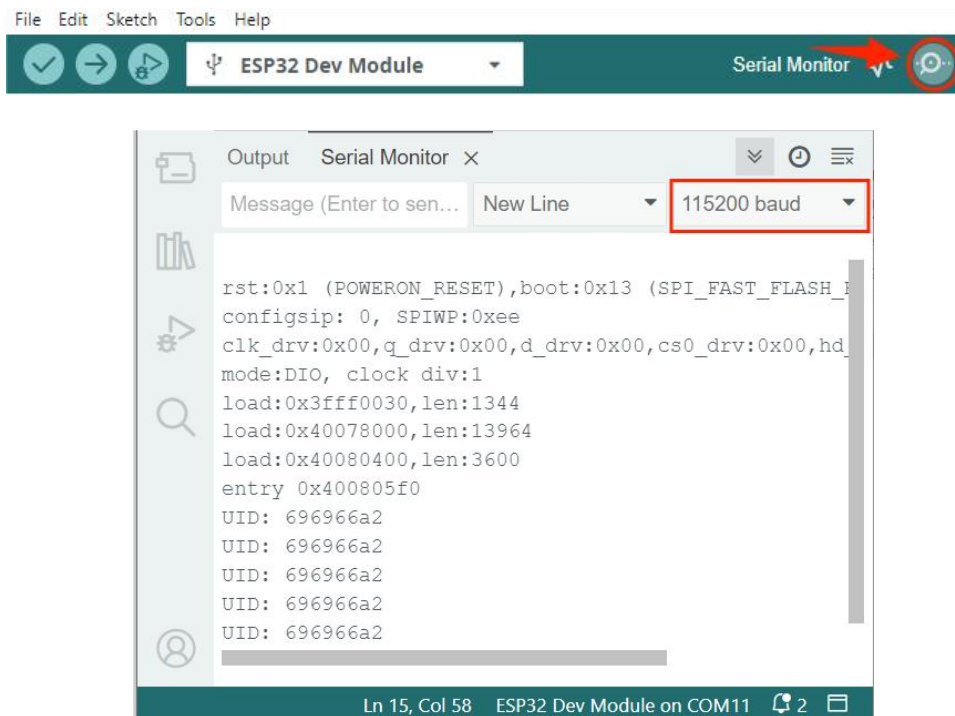
Dr. Lumi thought for a moment and said, "You can refer to this instruction."

```
#include <MFRC522_I2C.h> //call the RFID library
MFRC522 mfrc522(0x28); //configure RFID address
String rfid_str = ""; //define the variable of string type to read the card number
void setup() {
  Serial.begin(115200); //initialize the serial port, see the card number used to
  Wire.begin(); //initialize i2c serial port
  mfrc522.PCD_Init(); //initialize RFID module
  delay(500); //wait for the end of the servo rotation
  pinMode(23, OUTPUT); //buzzer pin
}
void loop() {
  if (!mfrc522.PICC_IsNewCardPresent() || !mfrc522.PICC_ReadCardSerial())
  { //if no new card present or if not successfully read card serial number
    delay(50);
    return; //go back to the main program and start over
  }
  rfid_str = ""; //clear the read card number variable first
  for (byte i = 0; i < mfrc522.uid.size; i++) {
    rfid_str = rfid_str + String(mfrc522.uid.uidByte[i], HEX);
  } // store the card number verbatim in the string variable rfid_str
  Serial.print("UID: ");
  Serial.println(rfid_str);
}
```

```
tone(23, 1000); // turn on the buzzer
delay(1000); // lasts 1 seconds
noTone(23); // stop the alarm sound
}
```

You can click the hyperlink to open the program: click to get the UID serial port display and doorbell program.

"Once the program is uploaded, open the serial monitor and set the baud rate of the serial monitor rate to 115200. When the card is near the RFID module, the card identification number is seen in the serial monitor and the P-Buzzer sounds."



If nothing is displayed on the serial monitor, press the reset button on the ESP32 controller board after confirming that the baud rate is set correctly.

After designing the keybell, you, Dr. Lumi, and your panda partner walk out the door excited to have a good time at the beach.

## Task 12: RFID door opening

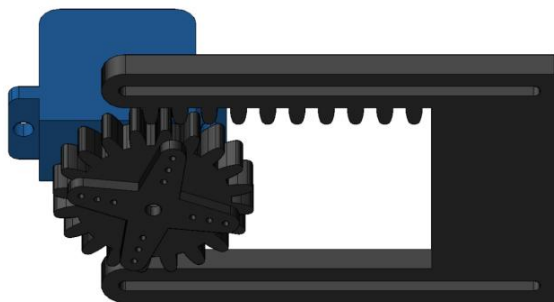
When you and Dr. Lumi get home from the beach, you're tired. You sit together in the living room and enjoy the warm, cozy atmosphere. The aftertaste of the sea breeze still ripples in your heart, and your thoughts begin to drift.

You stare silently at the door of Lumi's Home, your eyes full of thought and expectation. A novel idea strikes you, and you say slowly, "Dr. Lumi, I was wondering if we could have the keybell automatically open the door after the card is identified."

Dr. Lumi thought for a moment and then answered quietly, "Of course, we can. First we need to change the structure of the door and write a program to open it automatically."

You smile and nod, and you decide to try this new idea together.

You begin to adjust the structure of the Lumi's Home Gate, adjusting the way the door moves with the help of a simple mechanical structure called a rack and pinion.



Dr. Lumi informs you that SG90 servo module is used this time.

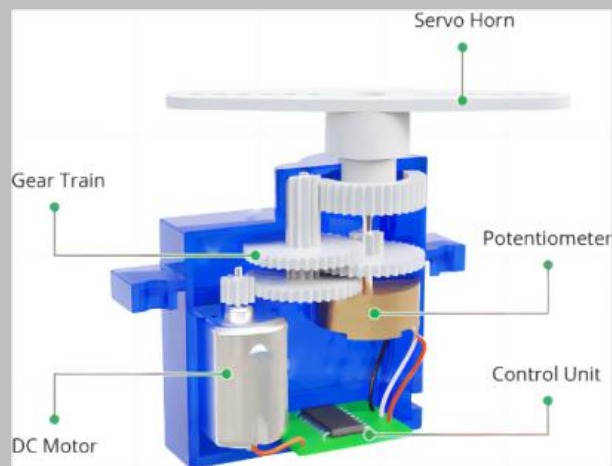
"What is that?" you ask, puzzled.

Dr. Lumi opened the hologram and pointed to a picture. "You can refer to this for an introduction to the SG90 servo module."

### SG90 Servo motor

The main structure of the servo is shown in the following figure, which mainly has several parts: shell, variable speed gear set, motor, adjustable potentiometer, control board, and steering wheel.

Its working principle is that the control board receives the control signal from the signal source and drives the motor to rotate; The gear set reduces the speed of the motor by many times, and magnifies the output torque of the motor by corresponding times, and then outputs; The potentiometer and the last stage of the gear group rotate together to measure the rotation Angle of the servo shaft; The circuit board detects and judges the steering gear rotation Angle according to the potentiometer, and then controls the steering gear to rotate to the target Angle or stay at the target Angle.



The workflow is as follows: control signal → control board → motor rotation → gear set deceleration → steering wheel rotation → position feedback potentiometer → control circuit board feedback.

"Please note that the SG90 servo module needs to be calibrated before use, otherwise it is easy to damage the servo," said Dr. Lumi.

You ask, "How do you calibrate the servo module?"

"Don't worry," explains Dr Lumi. "I've simplified the process and it will be automatically calibrated once the program is uploaded."

You nod your head in understanding, then ask, "How do you program a card to open the door?"

"You can refer to this code," Dr. Lumi said patiently.

```
#include <MFRC522_I2C.h> //call the RFID library
#include <ESP32Servo.h> //call servo library
MFRC522 mfrc522(0x28); //configure RFID address
String rfid_str = ""; //define the variable of string type to read the card number
Servo servo_18; //configure servo pins
const int door_close = 5; //define the angle of the door servo to close the door,
which can be modified according to the actual situation
const int door_open = 100; //define the angle of the door servo to open the door,
it can be modified according to the actual situation
void setup() {
  Serial.begin(115200); //initialize the serial port, see the card number used to
  Wire.begin(); //initialize i2c serial port
  mfrc522.PCD_Init(); //initialize RFID module
  servo_18.attach(18, 500, 2500); //initialize servos
  servo_18.write(door_close); //let the servo turn to the initial position
  delay(500); //wait for the end of the servo rotation
}
void loop() {
  if (!mfrc522.PICC_IsNewCardPresent() || !mfrc522.PICC_ReadCardSerial()) {
    //if no new card present or if not successfully read card serial number
    delay(50);
    return; //go back to the main program and start over
  }
}
```

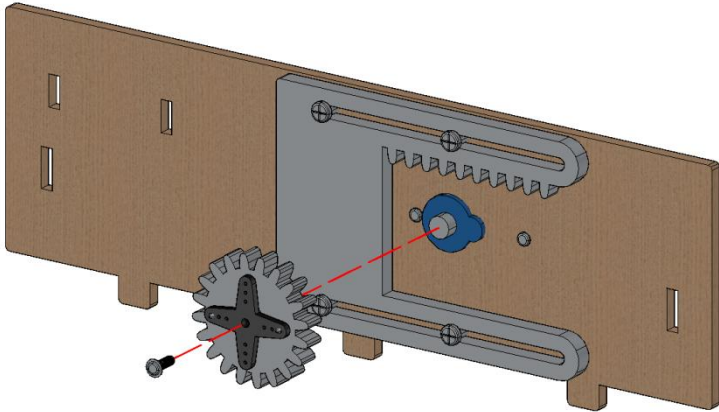
```

rfid_str = ""; //clear the read card number variable first
for (byte i = 0; i < mfrc522.uid.size; i++) {
  rfid_str = rfid_str + String(mfrc522.uid.uidByte[i], HEX);
} // store the card number verbatim in the string variable rfid_str
Serial.print("UID: ");
Serial.println(rfid_str);
servo_18.write(door_open); //open door
delay(2000); //wait two seconds, can be changed
servo_18.write(door_close); //close the door
}

```

You can click the hyperlink to open the program: [click to get RFID door opening program.](#)

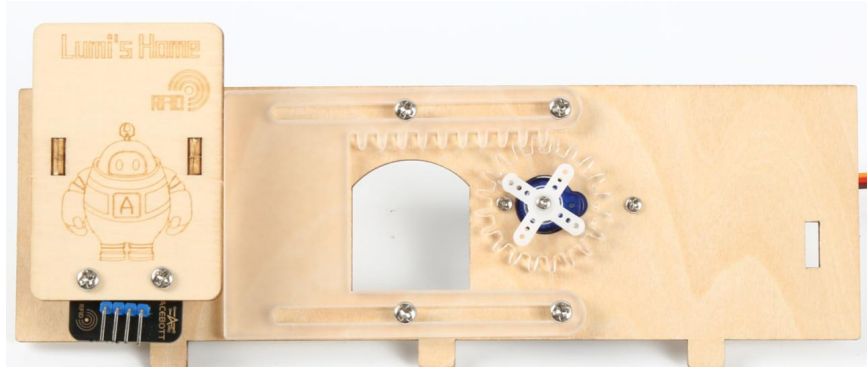
After the program upload is completed, the servo will be calibrated first. After calibration, the servo will be in a static state. At this time, the acrylic door should be closed, and then manually install the acrylic gear on the servo.



Finally, when everything is ready, you have the first test you've been waiting for. You pick up a key card and gently approach the RFID module at the door.



The RFID module immediately sensed the key card signal and quickly triggered the program, and the door opened.



You and Dr. Lumi are both excited about this moment.

## Task 13: Turn on the WIFI light

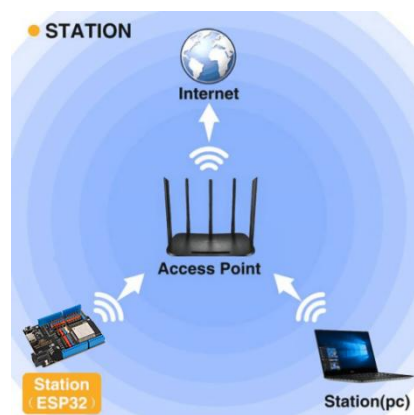
As night falls, you and Dr. Lumi have a fun day playing by the sea. You're both physically and mentally exhausted, but the darkness in the yard makes you feel uneasy.

You look out the window at the darkness, and you turn to Dr. Lumi and ask, "Dr. Lumi, it's too dark in the yard. Is there any way to turn on the lights remotely? "

Dr. Lumi blinked and thought for a moment. Then it came up with a new idea: "We can use WIFI to control the lights remotely."

You ask, "What is WIFI?"

Dr. Lumi begins to explain the concept of WiFi to you: "WiFi is a wireless networking technology that connects devices to the Internet through wireless signals so that we can control the lights wirelessly."



After you carefully observe the picture, you light up and say: "So, you need to connect the computer or mobile phone to the WIFI, and

then connect the ESP32 controller board to the same WIFI as the computer or mobile phone through the program."

"A computer or phone can connect to WIFI by entering a passcode," you ask incredulously. "How can the ESP32 controller board connect to WIFI?"

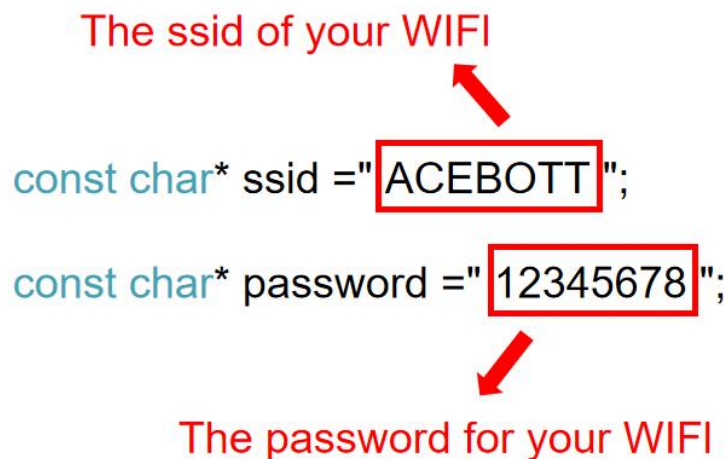
"Just change the ssid and password in the program below," Dr. Lumi said, showing off part of the code needed.

The ssid of your WIFI

```
const char* ssid = "ACEBOTT";
```

```
const char* password = "12345678";
```

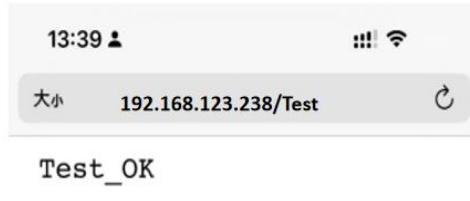
The password for your WIFI



"That is to change the ssid(WIFI name) and password (WIFI password) into the same WIFI as the computer or mobile phone", you understand later replied, "Let the computer communicate with the ESP32 controller board through WIFI, and then enter instructions in the browser's web page to control the ESP32 controller board."

"Yes, you understand exactly. It's like writing a letter to someone, you need to address it. In order to enter instructions in a computer, you also need to give the address to receive instructions. The

format is 192.168.123.238/Test, where '192.168.123.238' is the address (IP address will change depending on WIFI network), '/' is the interval symbol, and 'Test' is the instruction."



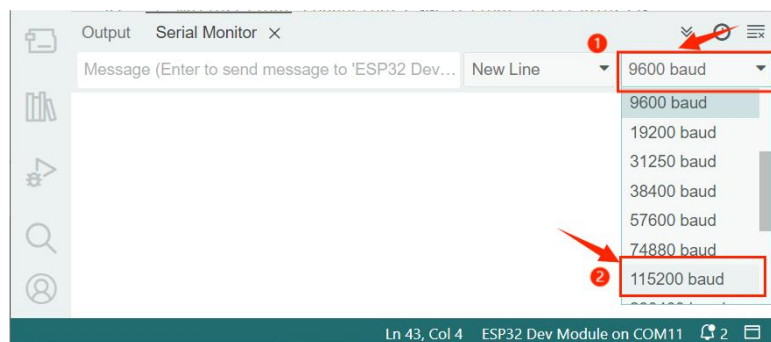
"Let's try it out. Let's start by controlling street lights."

Dr Lumi continued: "First let's open the program and change the ssid and password."

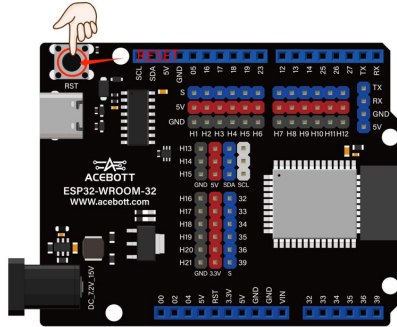
Click to get WIFI control LED program.

"Of course, the first time with a difficult, strictly follow the steps, slowly will understand."

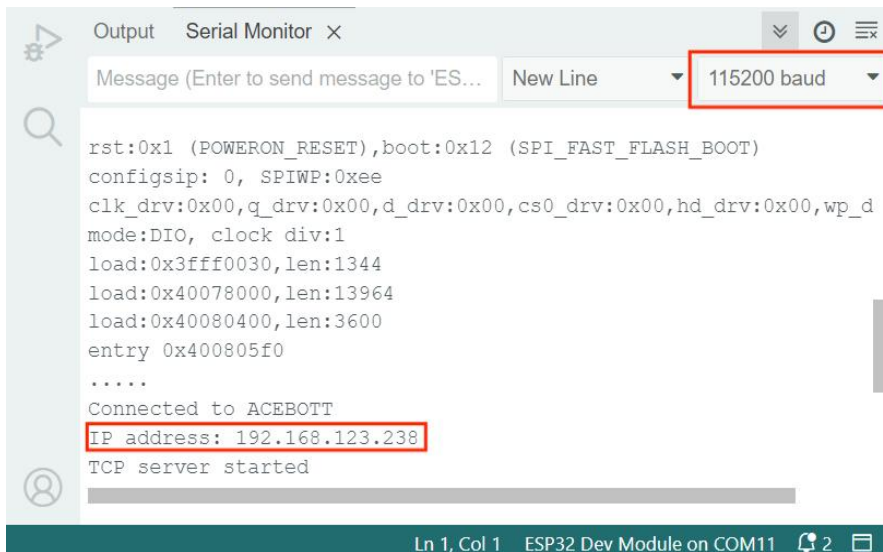
After uploading the program, open the serial monitor and set the baud rate to 115200.



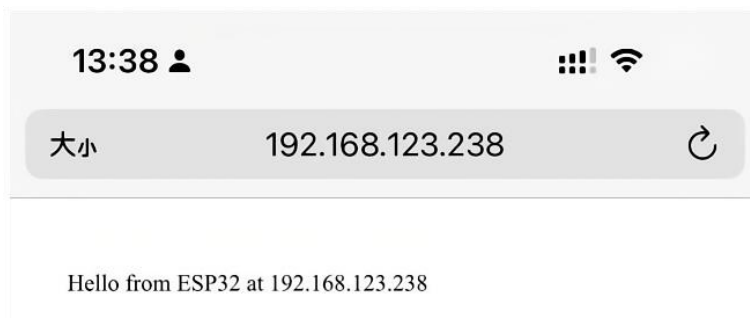
Then press the reset button on the ESP32 controller board.



The result is shown as follows:



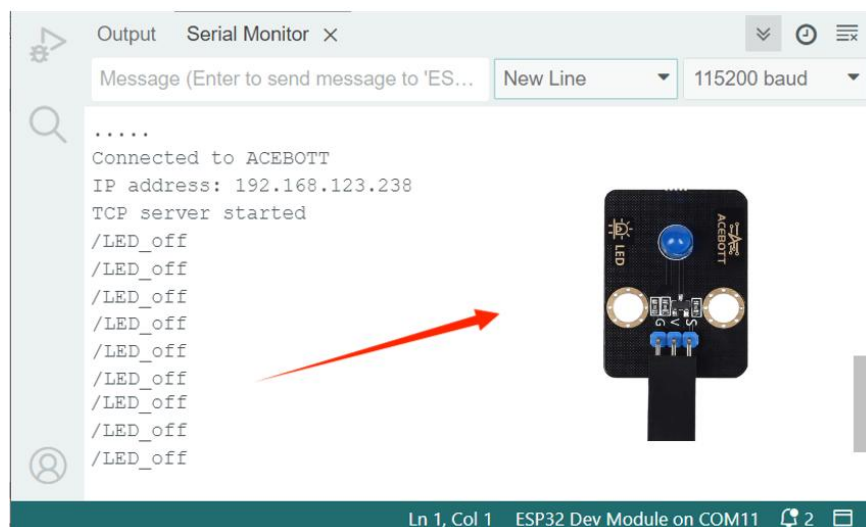
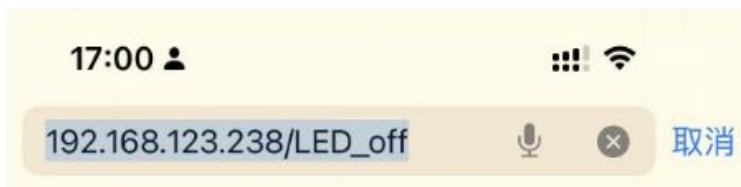
When you type 192.168.123.238 in the browser address bar (a device connected to the same network), it will display as follows:



Enter 192.168.123.238/LED\_on in the browser address bar, and confirm. The serial monitor will display as follows, and the LED light will turn on.



Enter 192.168.123.238/LED\_off in the browser address bar and confirm that the serial monitor will display the following, and the LED light will be turned off.



After some hard work, you have successfully completed the

procedure of turning on the WiFi light. Now just follow the steps and enter the instructions, and the yard lights will come on, bringing you safety and comfort.

You feel very satisfied. You deeply appreciate the convenience of technology and the benefits of smart home systems.

## Task 14: WiFi Buzzer

Night fell slowly, and all was quiet except the beautiful song of the nightingale. You are moved by the beautiful music and your mind goes back to the lullaby. Suddenly, you have an idea of whether you can use WiFi to control P-Buzzer and create your own music.

You turn to Dr. Lumi and say, "Dr. Lumi, I have an idea! I want to control the P-Buzzer through WiFi and create beautiful music. What if we could have seven buttons for seven syllables in the browser interface and be able to control the buzzer to emit the corresponding tone?"

Dr. Lumi smiled and responded, "Of course! It's an interesting idea."

"How would you program a WiFi-controlled P-Buzzer?" you ask.

"The idea is to create a simple and intuitive user interface on the browser interface," Dr. Lumi patiently explained. "It consists of seven buttons, each of which represents a syllable. The seven syllables are mapped to different frequency values, and the buzzer is controlled to play the corresponding tone through the WiFi."

You nod your head to indicate understanding.



"You can refer to the [WIFI Control P-Buzzer program](#)," Dr. Lumi said. "You can just click on it to open the program."

"Remember to change the ssid and password in your application," Dr. Lumi says.

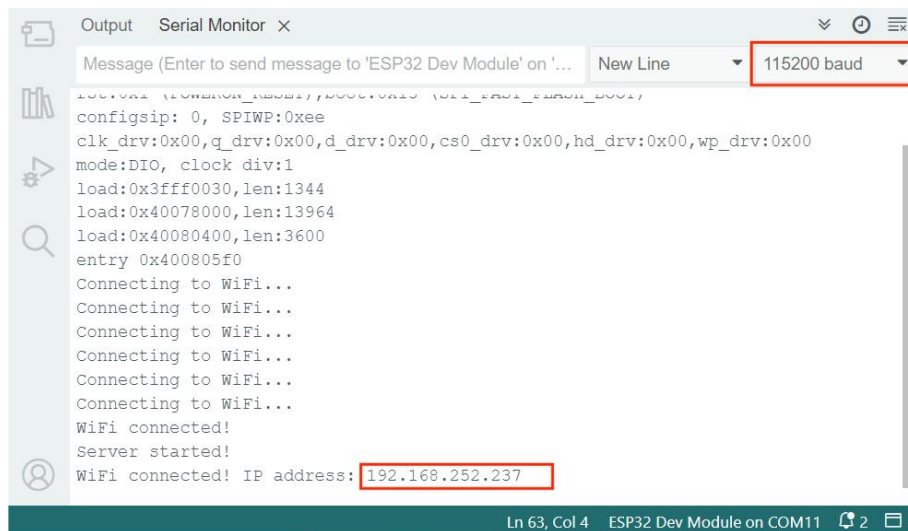
The ssid of your WIFI

```
const char* ssid = "ACEBOTT";
```

```
const char* password = "12345678";
```

The password for your WIFI

After uploading the program, open the serial monitor and set the baud rate to 115200, then press the reset button on the ESP32 controller board, and the results are shown as follows:

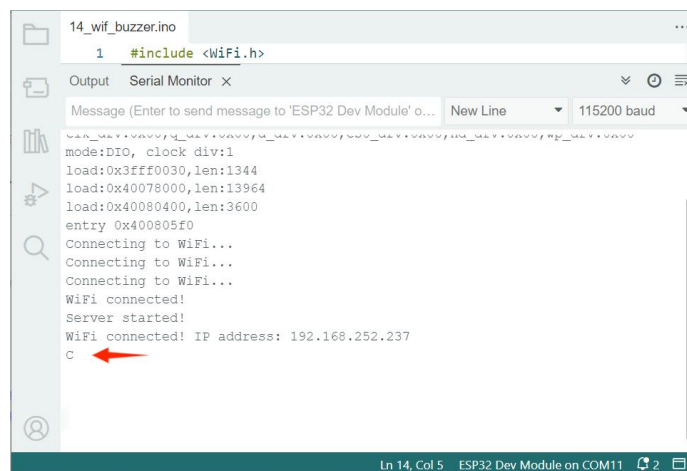


```
Output Serial Monitor x
Message (Enter to send message to 'ESP32 Dev Module' on '... New Line 115200 baud
I2C0:0x1 (POWERON_RESET)/00000000 (WAKE_UP_RESET)/00000000
configspi: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:1
load:0x3fff0030,len:1344
load:0x40078000,len:13964
load:0x40080400,len:3600
entry 0x400805f0
Connecting to WiFi...
Connecting to WiFi...
Connecting to WiFi...
Connecting to WiFi...
Connecting to WiFi...
Connecting to WiFi...
WiFi connected!
Server started!
WiFi connected! IP address: 192.168.252.237
Ln 63, Col 4 ESP32 Dev Module on COM11
```

When you type 192.168.252.237 into your browser's address bar (the device connected to the same network as the ESP32), it will display the following:



Click C, then the serial monitor will display as follows, while the P-Buzzer sounds.



By controlling the buzzer over WiFi, you and Dr. Lumi have created a new interaction that combines your creativity and music. You feel so satisfied, and this evening becomes your night of music.

## Task 15: WIFI controls the door

You're in your room, learning how to use the WiFi control, when suddenly there's a knock on the door. Open the door and it's a panda partner.

The panda partner said excitedly, "Last time we played at the beach, you said you wanted to go fishing. It's a fine day today. We can go fishing in the forest Lake."

You feel very happy, you like nature and the fun of fishing, so without hesitation to accept the panda partner's invitation.

You and your panda partner decide to go fishing after noon.

As you prepare your fishing supplies in your room after your panda partner has left, Dr. Lumi asks out loud, "Did you forget to close the door?"

You touch your head and say shyly, "Sorry, I was so excited about fishing that I forgot to close the door."

You suddenly think: WIFI can also be used to open the door? This allows you to close the door remotely even if you forget to close it. So you ask Dr. Lumi about this.

"Yes," Dr. Lumi said. "Just connect the ESP32 to a WIFI network and connect your phone or computer to the same WiFi network and you can control it remotely."

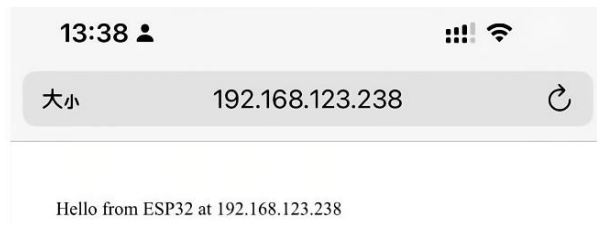
"How do you write a program?" you ask.

Dr Lumi explained: "You can refer to [the WIFI controls door program](#), which you can tap directly to open."

After uploads and setup, you and Dr. Lumi test the WIFI controls the door function."

After uploads and setup, you and Dr. Lumi test the WIFI controls door function.

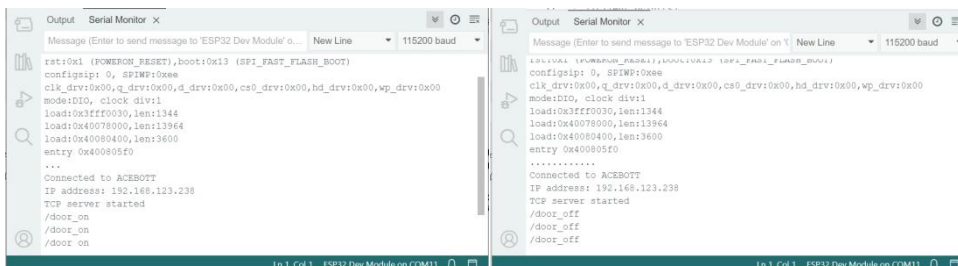
When you pick up your phone, open the browser and type in 192.168.123.238, it looks like this.



When you type 192.168.123.238/door\_off(door\_on) in your browser's address bar, you get the following result:



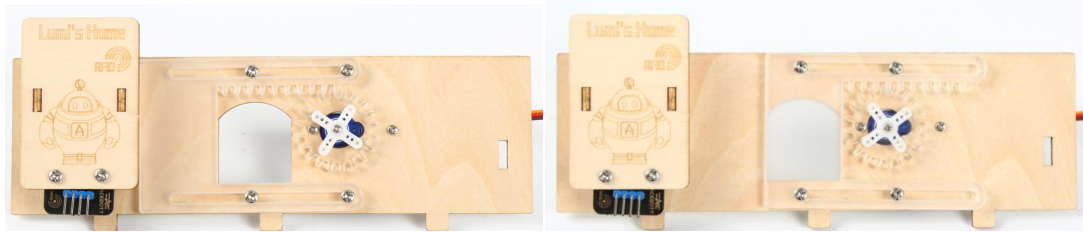
Remember to click OK, then the serial monitor will display the following:



When you type 192.168.123.238/door\_on in the browser, you

will hear the servo module rotate and the door slowly open.

Similarly, when you type `192.168.123.238/door_off` in the browser, the door closes slowly.



## Task 17: A new interactive control

"Dr. Lumi, is there another way to control the Lumi's Home?"

"Good, that's a great question," Dr. Lumi looks at you with pleasure. "Putting the control system in the phone solves this problem. I have prepared an App, through which you can easily control the Lumi's Home from your mobile device."

"How do I install it?"

"You can search for 'ACEBOTT' on your Mobile device's app store, download it and install it," says Dr Lumi.



If the ACEBOTT app is installed, can I directly control the Lumi's Home?"

Dr. Lumi shook his head and said, "No, you need to write the control program to the ESP32 controller board first, and then the APP can be used. Notice that the phone and the ESP32 controller board need to be connected to the same WIFI."

"You can use the APP to control the Lumi's Home program," Dr. Lumi thinks. "You can tap it directly to open the program."

"You need to change the SSID and PASSWORD in your app to

your own SSID and PASSWORD," Dr. Lumi warns.

When you're done, [upload the program to the ESP32 controller board.](#)

Then Dr. Lumi said, "Now it's time to download proprietary apps. If you have an IOS device, you have to search for ACEBOTT in the App Store and download it.

"How do I download it for Android?"

"If you have an Android device, you need to search the Google Play Store for ACEBOTT and download it."

Follow this method to download and install the program.

"Dr. Lumi explained, pointing to an icon on the phone's screen.

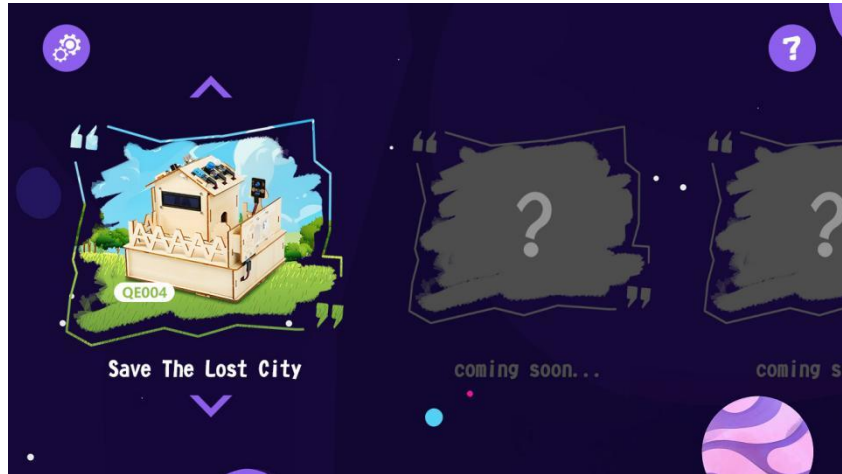
"You just tap the icon and it opens the app."



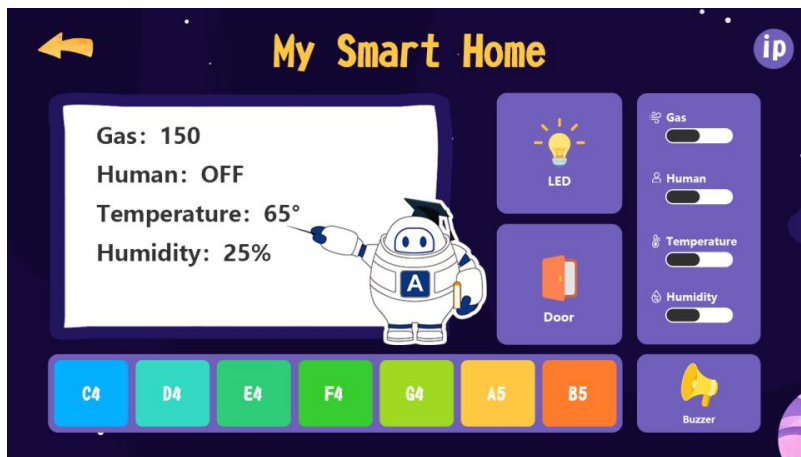
"The next thing you see is this open screen."



"Next, you will be brought to The product selection screen. Click the arrow to select the QE004 product for 'Save The Lost City.'"



"After entering, you will enter the functional control screen of the Lumi's Home, and then click the 'ip' icon to connect to the ESP32."

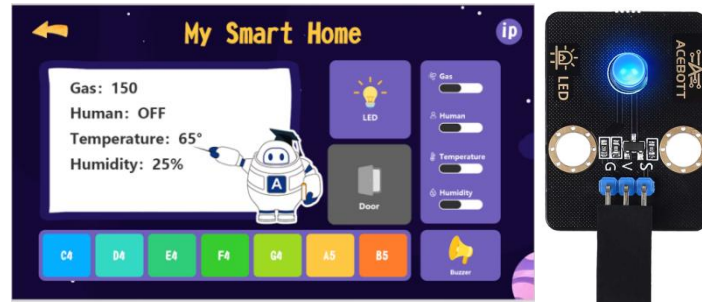


You can enter the IP address in the App according to the IP address displayed in the serial monitor and click connect. When you see the 'Connected Successfully' prompt, you need to click the cross in the top left corner to get back to your smart home."

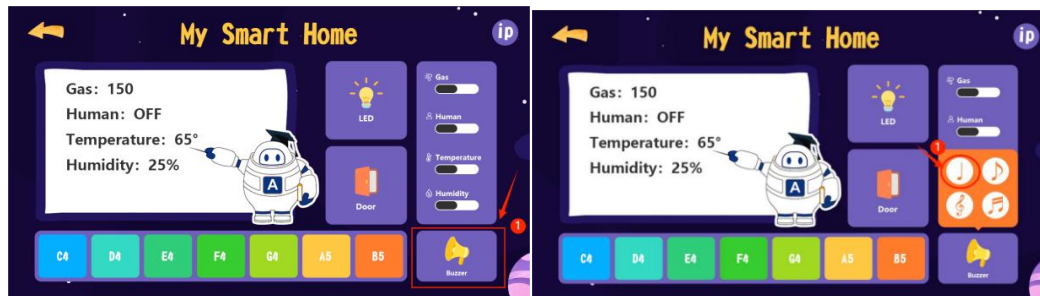




"Once the connection is successful, click the corresponding icon to enable the corresponding function. If you need to turn on the street light, you can choose the function button :LED. So you can see the street lights come on, as shown below."



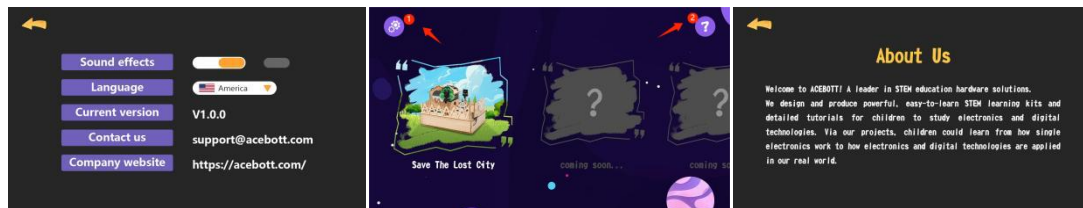
"And there's a special feature in this APP that's hidden. Click on the Buzzer icon to show that each button in this feature represents a song and can play four songs."



**Note:** In the program, we set the alarm value of combustible gas to 2000. During the warm-up period of the sensor, the value may exceed 2000, so the alarm will be set at the beginning. You can adjust the alarm threshold according to your needs.

You look closely at the screen and see a simple and intuitive interface. Each device has an on-off button, and by clicking the button, the state of the device can be controlled. In addition, there

are some additional options such as background music selection, language selection, about us and other functions.



You are very excited and satisfied with the application. This means that no matter where you are, with your phone in hand, you can easily control the system by WiFi.

"This is so convenient," you say excitedly, looking gratefully at Dr. Lumi. "Thank you, Dr. Lumi!"

You pick up your phone with confidence and continue to explore and use this portable control system.

## End

You and Dr. Lumi happily arrive at the fishing spot you agreed with your panda partner and find yourself beside a beautiful lake whose water is as clear as a green mirror. The surrounding is a dense forest with tall trees surrounding the lake, adding a sense of mystery to the place.

On the surface of the lake, the wind gently blowing, rippling microwave, sunlight through the leaves of the gap on the surface of the lake, forming a shimmering beam. The grass by the lake is covered with all kinds of colorful flowers, and butterflies are flying among them, creating a vibrant scene.

On the other side of the lake was a dense forest with towering trees and dense canopies forming a green canopy. The sun splashes on the ground through the cracks in the leaves. Occasionally, a small animal poked its head out of the woods and curiously observed everything about the lake.

There are also some wild flowers and bushes near the lake. Flowers of various colors are gently swaying in the breeze, sending out a charming fragrance. Butterflies and bees fly among them, collecting pollen, adding to a lively and cheerful atmosphere.

There are some rocks and roots at the edge of the lake, which provide an ideal place for fishing. You and Dr. Lumi find a comfortable location, roll out your fishing gear, and get ready to go fishing.

The joyful singing of birds in the distance, accompanied by the breeze, brings a sense of peace and quiet to the lake. Once in a while a small fish jumps out of the water and makes a splash, surprising you and Dr. Lumi.

You and Dr. Lumi are sitting by the lake, gazing at the reflection on the lake, and feeling the beauty of nature. When the sun is shining on the lake and the breeze is blowing on your cheeks, you feel very peaceful and relaxed. You talk, share stories and experiences, and laugh in the air from time to time.

Suddenly, you feel a slight tug, and you know a fish is on the hook. You excitedly begin to reel in the line, carefully pulling the fish up. However, as the hook gets closer to the water, you are surprised to find that it is a glass bottle.

Curiosity drives you to open the glass bottle. When the cap is lifted, the light inside suddenly glistens and makes your eyes squint. When you open your eyes again, you find yourself at home next to your bookshelf.

You feel a little confused, and you remember everything that

happened in the last few days as if you were in a dream. You look around and see that the glass bottle is still tightly held in your hand. You carefully take the note out of the bottle, unfold it, and find a picture drawn on it.

It's the drawing of the Lumi's Home.

A fantastic adventure is over, the next adventure is about to begin.....