Arduino Skill Kit Demo Description

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Shenzhen Yuejiang Technology Co., Ltd

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Preface

Purpose

This Document describes how to build the demos of Arduino. Provides reference For beginners and non-electronics professional electronics enthusiasts.

Intended Audience

This document is intended for:

- Customer Engineer
- Sales Engineer
- Installation and Commissioning Engineer
- Technical Support Engineer

Change History

Date	Change Description
2018/01/31	The first release

Symbol Conventions

The symbols that may be founded in this document are defined as follows.

Symbol	Description
⚠DANGER	Indicates a hazard with a high level of risk which, if not avoided, could result in death or serious injury
⚠WARNING	Indicates a hazard with a medium level or low level of risk which, if not avoided, could result in minor or moderate injury, robotic arm damage
⚠NOTICE	Indicates a potentially hazardous situation which, if not avoided, can result in robotic arm damage, data loss, or unanticipated result
🕮NOTE	Provides additional information to emphasize or supplement important points in the main text

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1. Introduction

1.1 Overview

Arduino skill kit includes Arduino Mega2560 controller board, LED indicators, buttons, Grove speech recognizer and Pixy vision sensor, of which the demos are based on the Arduino Mega2560 controller board and developed by Dobot. This document describes the connection of each module, the realization processes with these demos, making the makers and the non-electronic professional electronic enthusiasts get started quickly and inspire their creative thinking.

1.2 Software Environment

Arduino is an open-source platform used for building electronics projects, consisting Arduino IDE and its core libraries. Please download Arduino **1.8.2**, of which the path is https://www.arduino.cc/en/Main/OldSoftwareReleases#previous.

After Installing the Arduino IDE, you need to configure it, the steps are shown as follows.

Step 1 Decompress the Arduino Demo package, and add the all library files (Dobot, Pixy) in the **arduino kit\libraries** directory to the **Arduino IDE installation\arduino-1.8.2\libraries** or to the **C:\Users\Administrator\Documents\Arduino\libraries** directory.

If successful, after you launch the Arduino IDE, you can view the corresponding libraries on the **Sketch > Include Library** menu of Arduino page, as shown in Figure 1.1.

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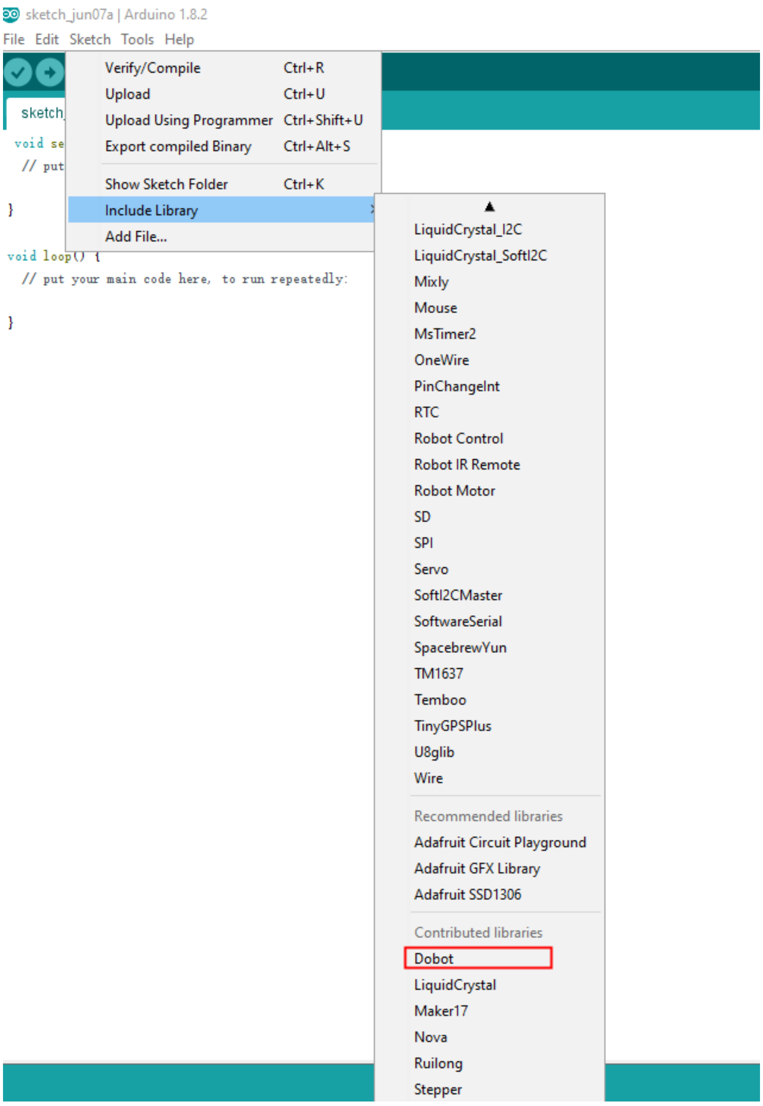

Figure 1.1 Add Dobot library

NOTE

In Arduino demos, the Dobot Magician, Pixy vision sensor may be used, so you need to add their APIs to load them into Arduino.

Step 2 Launch Arduino IDE.

Step 3 Select **Arduino/Genuino Mega or Mega 2560** on the **Tools > Board** menu, select **ATmega2560 (Mega 2560)** on the **Tools > Processor** menu, select the right serial port on the **Tools > Port** menu.

NOTICE

In Arduino demos, if the Dobot Magician or Pixy vision sensor is used, please open the corresponding demo with Arduino IDE and select the corresponding library on the **Sketch > Include Library** menu. If the speech recognizer is used, please select

SoftwareSerial on the **Sketch > Include Library** menu to build software serial communication.

2. FlickerLED Demo

2.1 Introduction

This Demo uses Arduino to turn on and off LED indicator.

2.2 Hardware Connection

The LED indicator and Arduino Mega2560 controller board are required in this demo.Figure 2.1 shows its connection process.

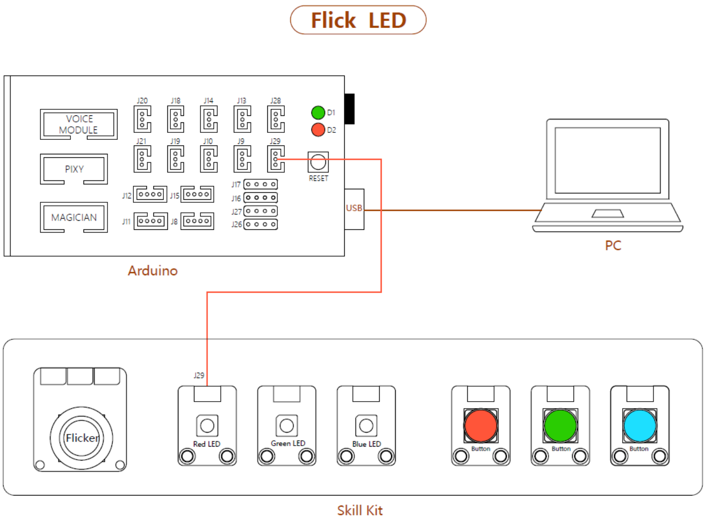

Figure 2.1 FlickerLED Connection

2.3 Realization Process

Figure 2.2 shows its realization process.

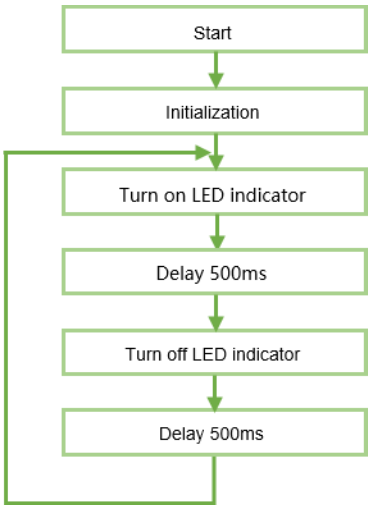

Figure 2.2 Realization process

2.4 Critical Code Description

（1） Define the pin of which LED indicator is connected to Arduino and set to output pin.

Program 2.1 Initialization

```
int LED1 = 9;                                   //LED connects to the 9 pin


void setup(){
   pinMode(LED1,OUTPUT);                        //Set the 9 pin to OUTPUT
}
```

（2） Set the pin to HIGH or LOW to turn on and off the LED indicator.

Program 2.2 Set High/Low level

```
void loop(){
   digitalWrite(LED1,HIGH);                     //turn on the LED1
   delay(500);                                  //delay
   digitalWrite(LED1,LOW);                      //turn off the LED1
   delay(500);                                  //delay
}
```

3. AlarmLED Demo

3.1 Introduction

This Demo uses Arduino to turn on and off three different colored LED indicators. Only one LED indicator is on at a time.

3.2 Hardware Connection

The three LED indicators and Arduino Mega2560 controller board are required in this demo. Figure 3.1 shows its connection process.

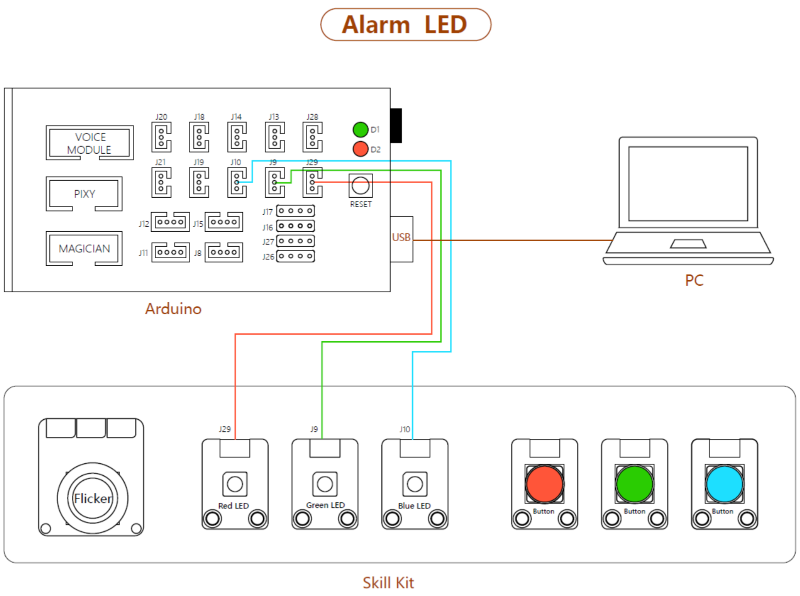

Figure 3.1 AlarmLED Connection

3.3 Realization Process

Figure 3.2 shows its realization process.

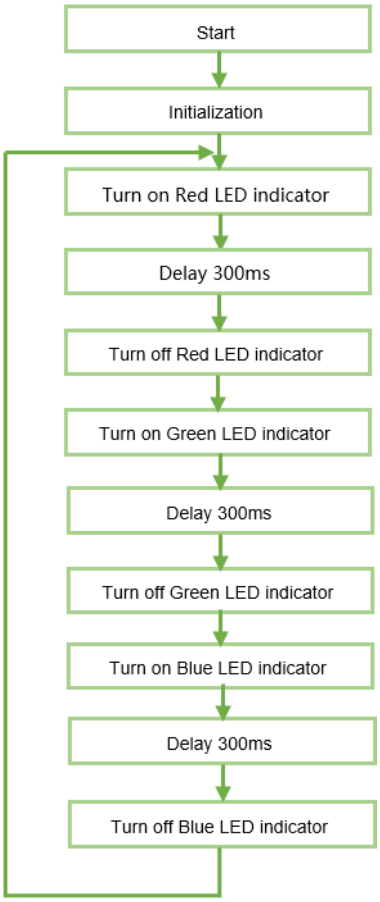

Figure 3.2 Realization process

3.4 Critical Code Description

（1） Define the pins of which LED indicators are connected to Arduino and set to output pins.

Program 3.1 Initialization

```
#define Red_LED 9                                  //Red_LED connects to the 9 pin
#define Green_LED A1                               //Green_LED connects to the A1 pin
#define Blue_LED A3                                //Blue_LED connects to the A3 pin

void setup() {
  pinMode(Red_LED,OUTPUT);                         //Set the 9 pin to OUTPUT
  pinMode(Green_LED,OUTPUT);                       //Set the A1 pin to OUTPUT
  pinMode(Blue_LED,OUTPUT);                        //Set the A3 pin to OUTPUT
  digitalWrite(Red_LED,LOW);                       //Set the 9 pin to LOW
  digitalWrite(Green_LED,LOW);                     //Set the A1 pin to LOW
  digitalWrite Blue_LED,LOW);                      //Set the A3 pin to LOW
```

```
}
```

（2） Set the pins to HIGH or LOW to turn on and off the three LED indicators.

Program 3.2 Set High/Low level

```
void loop() {
  digitalWrite(Red_LED,HIGH);
  delay(300);
  digitalWrite(Red_LED,LOW);
  digitalWrite(Green_LED,HIGH);
  delay(300);
  digitalWrite(Green_LED,LOW);
  digitalWrite(Blue_LED HIGH);
  delay(300);
  digitalWrite(Blue_LED,LOW);
}
```

4. AdjustLED Demo

4.1 Introduction

This demo uses joystick to control the brightness of the LED indicator.

4.2 Hardware Connection

The LED indicator, joystick and Arduino Mega2560 are required in this demo. Figure 4.1 shows its connection process.

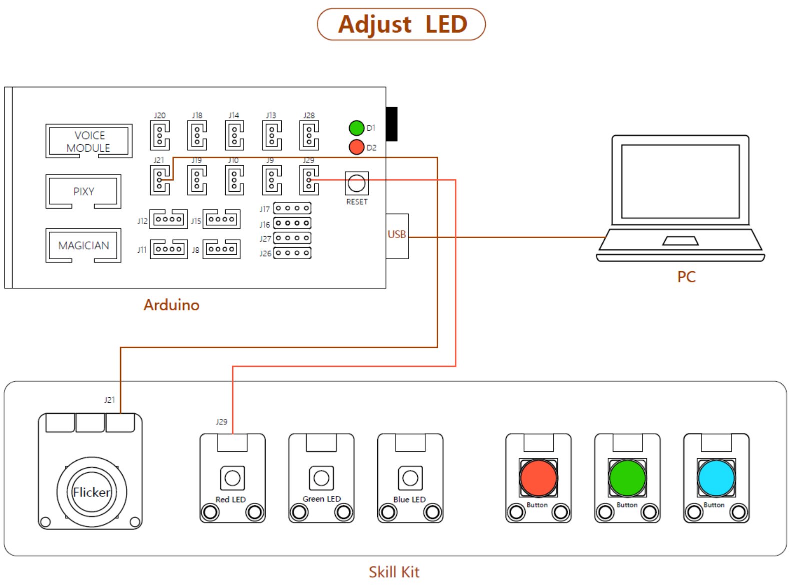

Figure 4.1 AdjustLED Connection

4.3 Realization Process

This demo controls the brightness of the LED indicator by moving joystick along X-axis. Figure 4.2 shows its realization process.

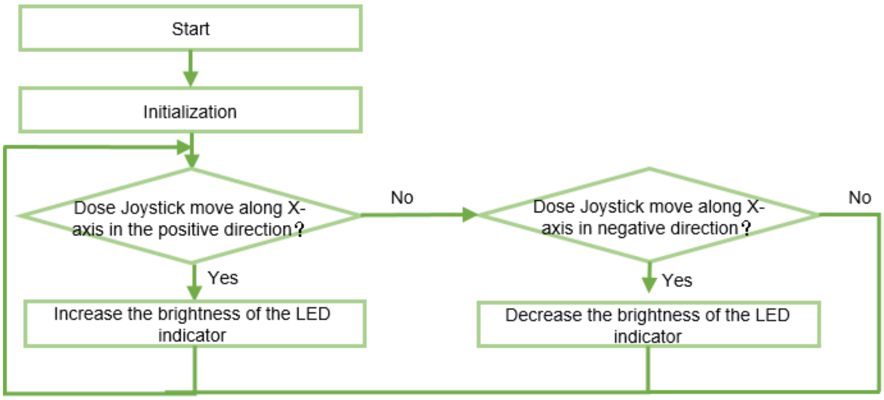

Figure 4.2 Realization process

4.4 Critical Code Description

（1） Define the pins of which LED indicator and joystick are connected to Arduino. The PWM interface on the Arduino Mega2560 controller board is used when adjusting the brightness.

Program 4.1 Initialization

```
#define LED 9                    //LED connects to the 9 pin
#define JoyStick_X 7             //JoyStick X connects to the A7 pin
```

（2） Define the brightness variation frequency of LED indicator.

📖NOTE

When moving joystick along X-axis or Y-axis, the analog values change from 0 to 1023, as shown in Figure 4.3. The homing position of the joystick is at (x,y: 512,508).

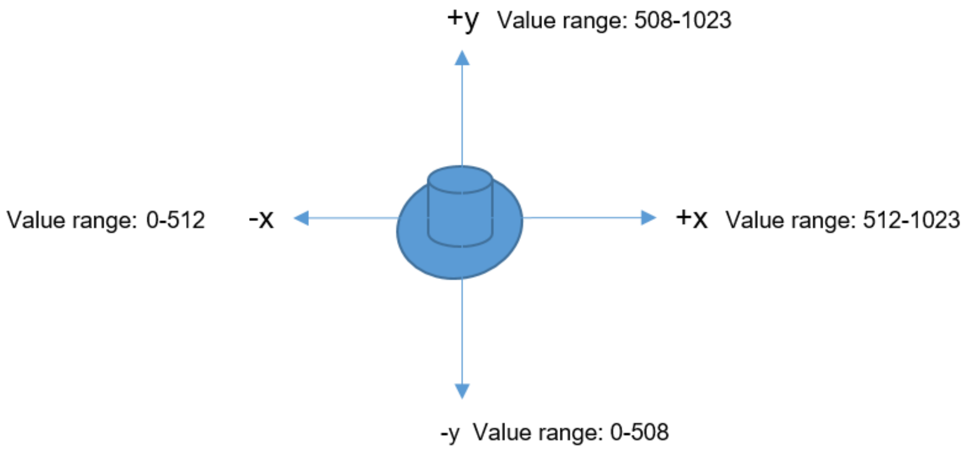

Figure 4.3 Analog value range

Program 4.2 Define the brightness variation of LED indicator

```
if(x > 520)                  // JoyStick moves along X-axis in the positive
                             //direction, increase the/brightness. You can customize
                             //the threshold. In this demo, we set to 520
  i = i + 0.1;
else if(x < 500)             //JoyStick moves along X-axis in negative direction,
                             //decrease the brightness
  i = i - 0.1;
if(i >= 255)                 // The brightness range of LED is from 0 to 255
  i = 255;
else if(i < 0)
  i = 0;
else
```

```
    i = i;
```

（3） Adjust the brightness of the LED indicator over joystick.

Program 4.3 Adjust the brightness of the LED indicator over joystick

```
analogWrite(LED,i);                                    //Adjust the brightness of the LED indicator
```

5. Button Demo

5.1 Introduction

This demo uses three different colored buttons to turn on and off the corresponding colored LED indicators respectively.

5.2 Hardware Connection

The three buttons, three LED indicators and Arduino Mega250 are required in this demo. Figure 5.1 shows its connection process.

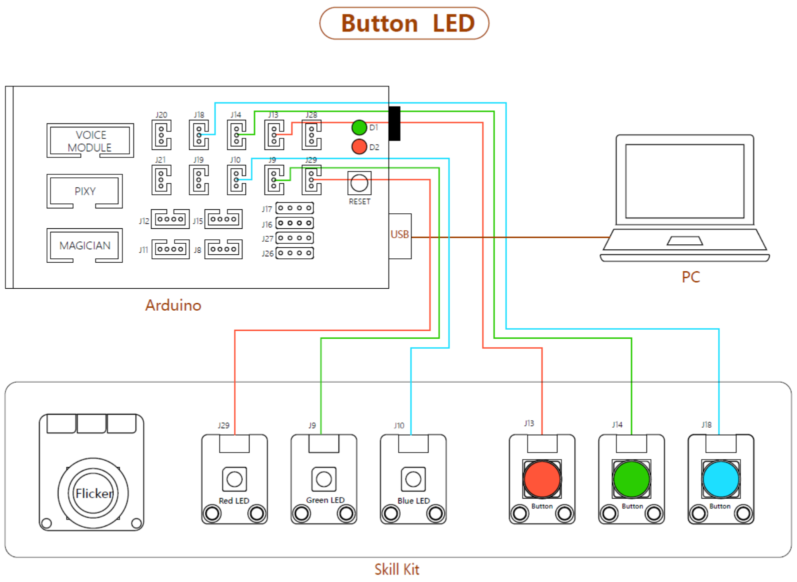

Figure 5.1 ButtonLED Connection

5.3 Realization Process

Figure 5.2 shows its realization process.

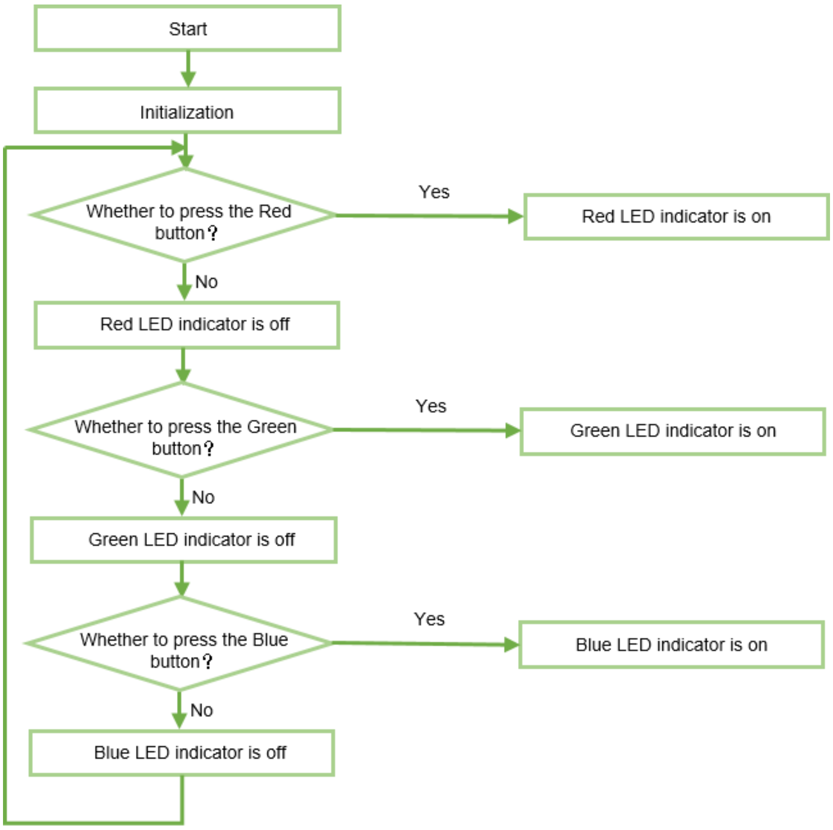

Figure 5.2 Realization process

5.4 Critical Code Description

（1） Define the pins of which LED indicators and buttons are connected to Arduino.

Program 5.1 Define the pins that LED indicators and buttons are connected

```
#define Red_LED 9                    //Red LED connects to the 9 pin
#define Green_LED A1                 //Green LED connects to the A1 pin
#define Blue_LED A3                  //Blue LED connects to the A3 pin

#define Red_button A0                // Red_button connects to the A0 pin
#define Green_button A2              //Green_button connects to the A2 pin
#define Blue_button A4               // Blue_button connects to the A4 pin
```

（2） Set the pins to **INPUT** or **OUTPUT**.

Program 5.2 Configure the pins as inputs and outputs

```
pinMode(Red_LED, OUTPUT);            // Set the 9 pin to OUTPUT
pinMode(Green_LED, OUTPUT);          // Set the A1 pin to OUTPUT
pinMode(Bule_LED, OUTPUT);           // Set the A3 pin to OUTPUT
```

```
pinMode(Red_button, INPUT);                    // Set the A0 pin to INPUT
pinMode(Green_button, INPUT);                  // Set the A2 pin to INPUT
pinMode(Blue_button, INPUT);                   // Set the A4 pin to INPUT
```

（3） Use buttons to turn on and off the LED indicators.

Program 5.3 Use buttons to turn on and off the LED indicators

```
int val1 = digitalRead(Red_button);            //Get the value of the A0 pin
int val2 = digitalRead(Green_button);          //Get the value of the A2 pin
int val3 = digitalRead(Blue_button);           //Get the value of the A4 pin
if (val1 == 1) {                               //Press the Red button
    digitalWrite(Red_LED, 1);                  // turn on the Red LED
}
else {
    digitalWrite(Red_LED, 0);                  // turn off the Red LED
}
……
…..
```

6. SeedVoiceLED Demo

6.1 Introduction

The demo uses Grove speech recognizer to turn on and off three different colored LED indicators (Red, Green, and Blue).

6.2 Hardware Connection

The speech recognizer, three LED indicators and Arduino Mega2560 are required in this demo. Figure 6.1 shows its realization process.

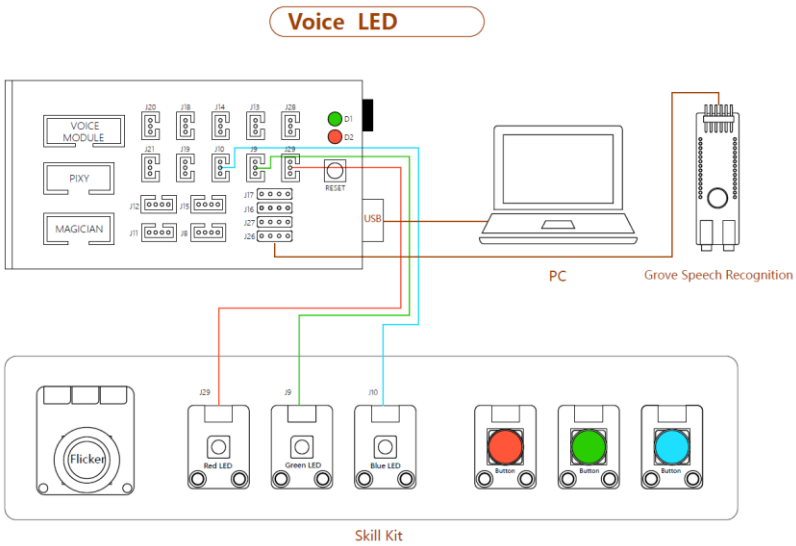

Figure 6.1 SeedVoiceLED Connection

6.3 Realization Process

Figure 6.2 shows its realization process.

📖NOTE

Please speak out the command **Hicell** to wake up the Grove speech recognizer before using it. If successful, the LED on the speech recognizer will turn red. Then, you can speak out the command word. If the command word is detected, the LED will turn blue.

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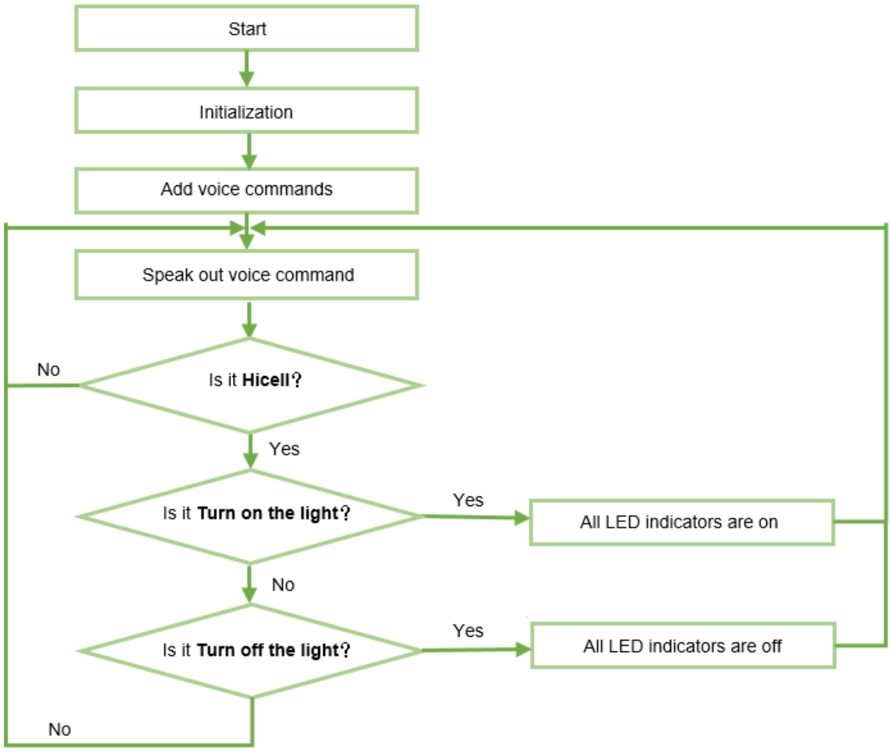

Figure 6.2 Realization process

6.4 Critical Code Description

Before debugging this demo, please select **SoftwareSerial** library on the **Sketch** > **Include Library** menu.

（1） Define the pins of which the LED indicators and the Grove speech recognizer are connected to Arduino.

Program 6.1 Define the pins that the LED indicators and Grove speech recognizer are connected

```
#define SOFTSERIAL_RX_PIN   A11                    //connect to the A11 pin
#define SOFTSERIAL_TX_PIN   14                     //connect to the 14 pin

#define Red_LED 9                                  //Red LED connects to the 9 pin
#define Green_LED A1                               //Green LED connects to the A1 pin
#define Blue_LED A3                                //Blue LED connects to the A3 pin
```

（2） Control the LED indicator by voice commands.

Program 6.2 Control the LED indicator by voice commands

```
void loop()
{
    char cmd;
    if(softSerial.available())
```

```
    {
        cmd = softSerial.read();
        switch(cmd)
        {
          case 1:
               digitalWrite(Red_LED,HIGH);                    //turn on the Red LED
               digitalWrite(Green_LED,HIGH);                  //turn on the Green LED
               digitalWrite(Blue_LED,HIGH);                   //turn on the Blue LED
               Serial.println(voiceBuffer[cmd - 1]);
               break;
          case 2:
               digitalWrite(Red_LED,LOW);                     //turn off the Red LED
               digitalWrite(Green_LED,LOW);                   //turn off the Green LED
               digitalWrite(Blue_LED,LOW);                    //turn off the Blue LED
               Serial.println(voiceBuffer[cmd - 1]);
               break;
        }
    }
}
```

⚠NOTICE

Grove speech recognizer only supports 22 voice commands without user-defined. The commands with values are as shown in Program 6.3.

Program 6.3 Command description

```
const char *voiceBuffer[] =
{
    "Turn on the light",                              //return 1
    "Turn off the light",                             //return 2
    "Play music",                                     //return 3
    "Pause",                                          //return 4
    "Next",                                           //return 5
    "Previous",                                       //return 6
    "Up",                                             //return 7
    "Down",                                           //return 8
    "Turn on the TV",                                 //return 9
```

```
    "Turn off the TV",                         //return 10
    "Increase temperature",                    //return 11
    "Decrease temperature",                    //return 12
    "What's the time",                         //return 13
    "Open the door",                           //return 14
    "Close the door",                          //return 15
    "Left",                                    //return 16
    "Right",                                   //return 17
    "Stop",                                    //return 18
    "Start",                                   //return 19
    "Mode 1",                                  //return 20
    "Mode 2",                                  //return 21
    "Go",                                      //return 22
};
```

7. MoveBlock Demo

7.1 Introduction

The demo uses Arduino to control Dobot Magician for picking and placing cubes.

7.2 Hardware Connection

Arduino Mega2560, Dobot Magician and suction cup kit are required in this demo. Figure 7.1 shows its connection process.

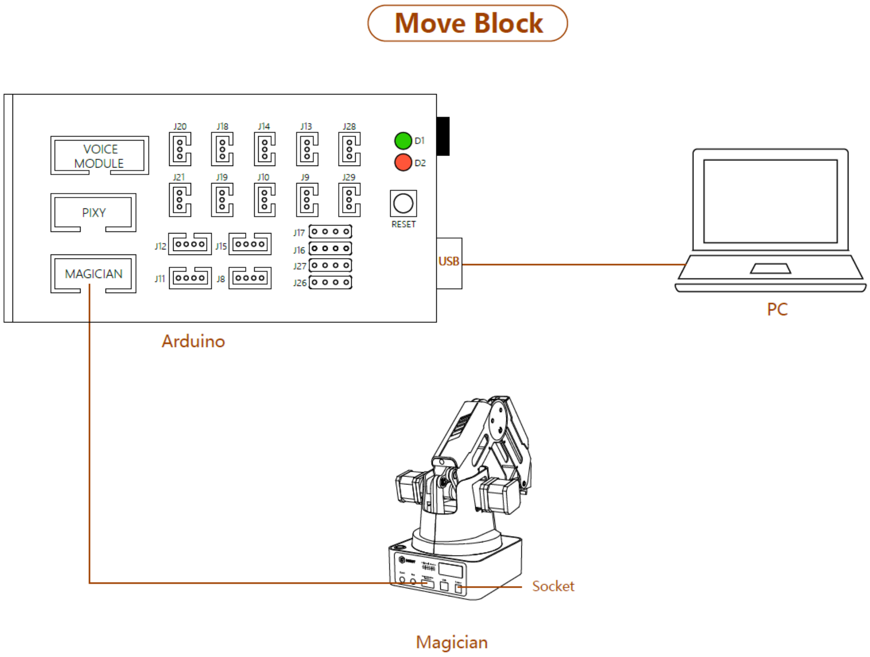

Figure 7.1 MoveBlock Connection

For details how to connect Dobot Magician and suction cup kit, please see *Appendix B Installing Suction Cup Kit.*

7.3 Realization Process

If the cube is moved from point A to point B and then from point B back to point A with multiple times. Figure 7.2 shows its realization process.

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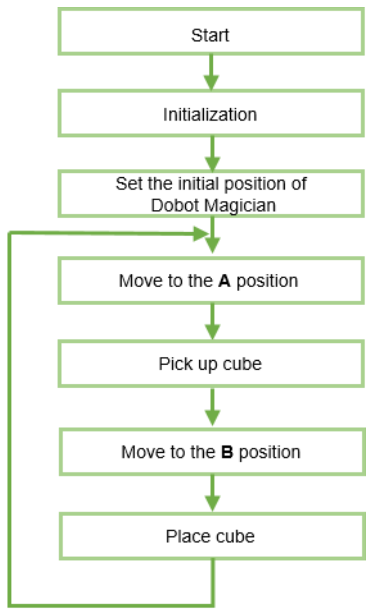

Figure 7.2 Realization process

7.4 Critical Code Demo

Dobot Magician communicates with Arduino over UART interface (10 PIN) on the base of the Dobot Magician, using the Dobot protocol. We have provided **Dobot** library which encapsulates part of the Dobot Magician APIs, being called directly to control Dobot Magician. Before debugging this Demo, please select the **Dobot** library on the **Sketch** > **Include Library** menu.

⚠NOTICE

Please long press the **Key** button on the back of base of Dobot Magician to operate homing before debugging this Demo.

Before debugging this Demo, please connect Dobot Magician and DobotStudio and operate homing. And then press the **Unlock** key on the Forearm and drag Dobot Magician to move to the positions where the cube is to be placed (A point and B point), then record their Cartesian coordinates from the **operation panel** pane of DobotStudio page to write in this demo for picking and placing cube.

Figure 7.3 Obtain Cartesian coordinates

（1） Define the coordinates of point A and point B

The coordinates can be obtained from the **Operation Panel** of DobotStudio page.

Program 7.1 Define the coordinates of point A and point B

```
//Coordinates of A point
#define block_positio_X 263                    //X-coordinate of A point
#define block_position_Y 3                     //Y-coordinate of A point
#define block_position_Z -40                   //Z-coordinate of A point
#define block_position_R 0                     //R-coordinate of A point

//Coordinates of B point
```

```
#define Des_position_X 207                        //X-coordinate of B point
#define Des_position_Y -171                       //Y-coordinate of B point
#define Des_position_Z -46                        //Z-coordinate of B point
#define Des_position_R 0                          // R-coordinate of B point
```

（2） Dobot Magician moves from point A to point B with multiple times.

Program 7.2 Dobot Magician moves from point A to point B with multiple times

```
while(count > 0)
{
  Dobot_SetPTPCmdEx(JUMP_XYZ,block_position_X, block_position_Y,
                    block_position_Z, block_position_R);            //Move to point A
  Dobot_SetEndEffectorSuctionCupEx(true);                           //Turn on air pump to pick up cube
  Dobot_SetPTPCmdEx((JUMP_XYZ,block_position_X, block_position_Y,-4, block_position_R);
                                                                    //Lift a certain height
  Dobot_SetPTPCmdEx(JUMP_XYZ, Des_position_X, Des_position_Y,
                    Des_position_Z, Des_position_R);                //Move to point B
  Dobot_SetEndEffectorSuctionCupEx(false);                          //Turn off air pump to place cube
  Dobot_SetPTPCmdEx(JUMP_XYZ, Des_position_X, Des_position_Y, -20, Des_position_R);
                                                                    //Lift a certain height
  Dobot_SetPTPCmdEx(MOVJ_XYZ, 178, -4, 40, 0);                      //Move back to the initial position
  Dobot_SetPTPCmdEx(JUMP_XYZ, Des_position_X, Des_position_Y,
                    Des_position_Z, Des_position_R);                //Move to point B
  Dobot_SetEndEffectorSuctionCupEx(true);                           //Turn on air pump to pick up cube
  Dobot_SetPTPCmdEx(MOVL_XYZ, Des_position_X, Des_position_Y, -10, Des_position_R);
                                                                    //Lift a certain height
  Dobot_SetPTPCmdEx(JUMP_XYZ,block_position_X, block_position_Y,
                    block_position_Z, block_position_R);            //Move to point A
  Dobot_SetEndEffectorSuctionCupEx(false);                          //Turn off air pump to place cube
  Dobot_SetPTPCmdEx(MOVJ_XYZ, 178, -4, 40, 0);                      //Move back to the initial position
  count--;
}
```

8. SeedVoiceDobot Demo

8.1 Introduction

This demo uses Grove speech recognizer to control the Dobot Magician movement and the air pump start-stop.

8.2 Hardware Connection

Grove speech recognizer, Dobot Magician, air pump and Arduino Mega2560 are required in this demo. The connection between Dobot Magician and Arduino is shown in Figure 8.1.

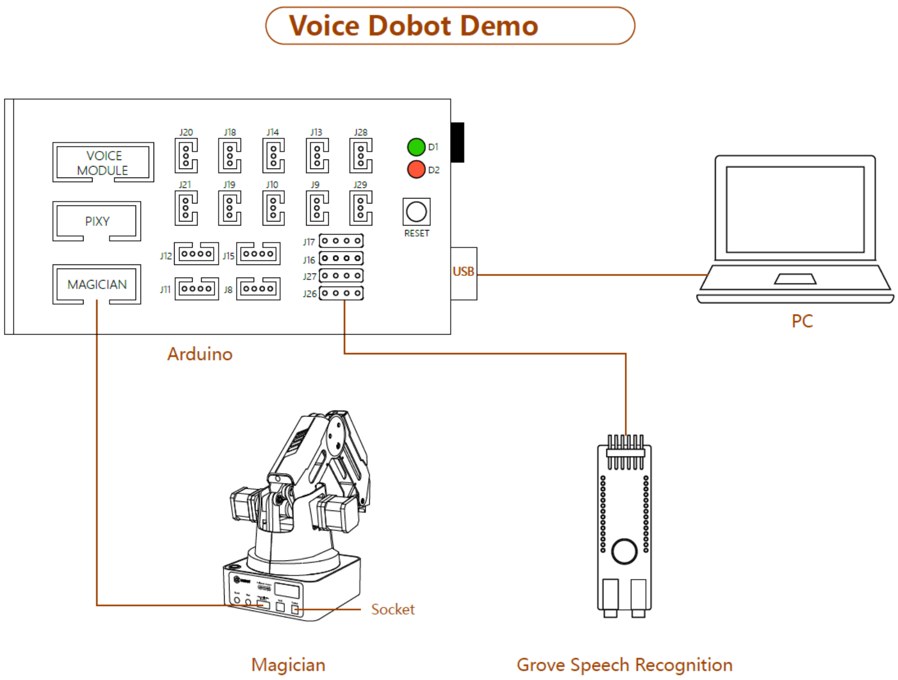

Figure 8.1 SeedVoiceDobot Connection

The connection between Dobot Magician and air pump is shown in Figure 8.2.

Figure 8.2 Air pump Connection

8.3 Realization Process

In this demo, we use Grove speech recognizer to control Dobot Magician and air pumps. Figure 8.3 shows the realization process.

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📖NOTE

Please speak out the command **Hicell** to wake up the speech recognizer before using it. If successful, the LED on the speech recognizer will turn red. Then, you can speak out the command word. If the command word is detected, the LED will turn blue.

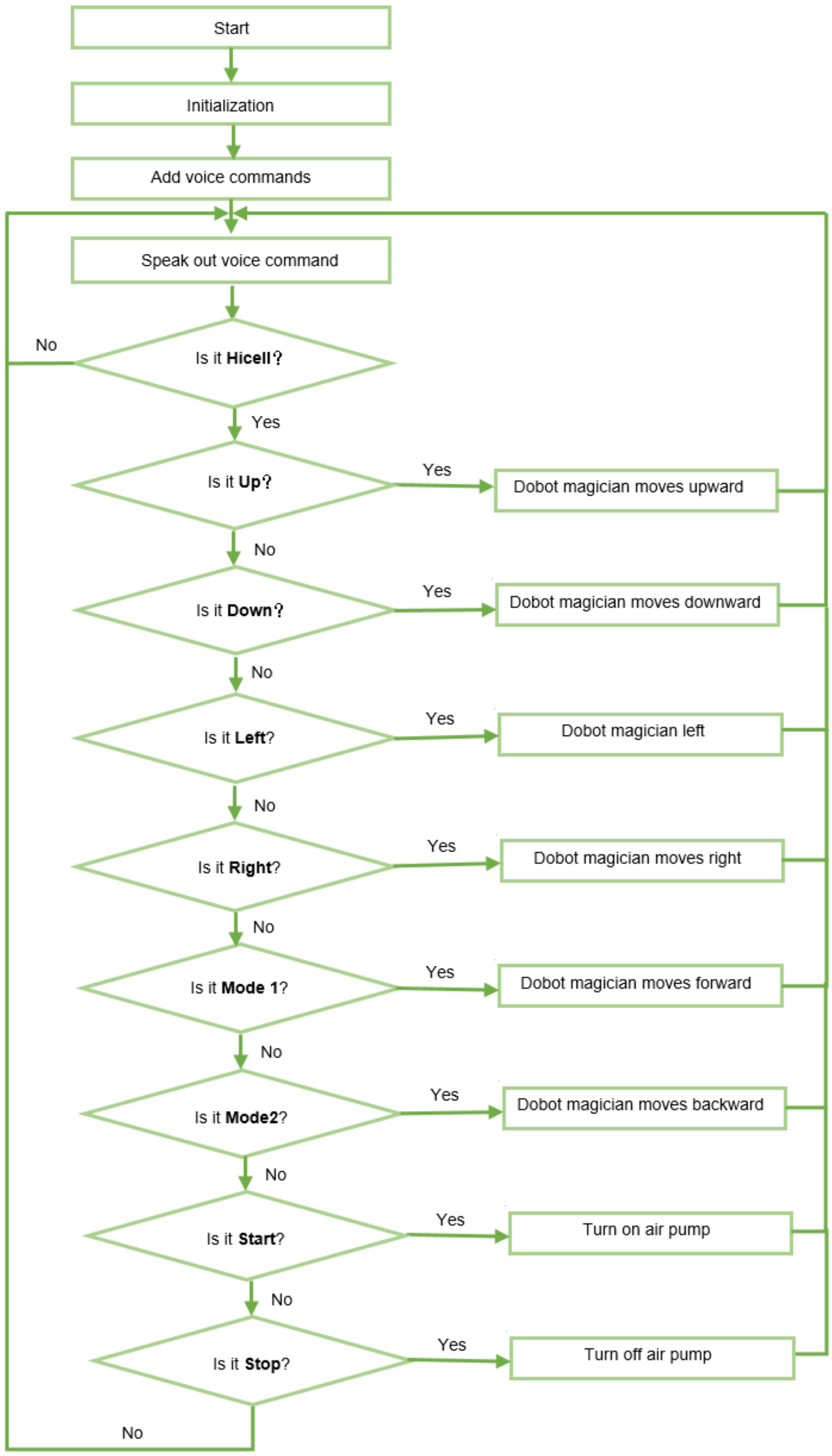

Figure 8.3 Realization process

8.4 Critical Code Description

This demo uses Grove speech recognizer to control Dobot Magician, the **Dobot** library and **SoftwareSerial** library need to be called. Before debugging this Demo, please select **Dobot and SoftwareSerial** on the **Sketch** > **Include Library** menu.

⚠NOTICE

Please long press the **Key** button on the back of base of Dobot Magician to operate homing before debugging this Demo.

（1） Define the pins of which the Grove speech recognizer is connected to Arduino.

Program 8.1 Define the pins that the Grove speech recognizer are connected

```
#define SOFTSERIAL_RX_PIN    A11                                  //connect to the A11 pin
#define SOFTSERIAL_TX_PIN    14                                   //connect to the 14 pin
```

（2） Move Dobot Magician by voice commands.

Program 8.2 Move Dobot Magician by voice commands

```
    if(softSerial.available())
    {
        cmd = softSerial.read();
        switch(cmd)
        {
          case 7:
                Dobot_SetPTPCmdEx(MOVL_INC,0,0,30,0);          //magician moves upward
                Serial.println(voiceBuffer[cmd - 1]);
                break;
          case 8:
                Dobot_SetPTPCmdEx(MOVL_INC,0,0,-30,0);         //magician moves downward
                Serial.println(voiceBuffer[cmd - 1]);
                Break;
……
……
  }
```

⚠NOTICE

Grove speech recognizer only supports 22 voice commands without user-defined. The commands and their return values are as shown in Program 8.3.

Program 8.3 Command description

```
const char *voiceBuffer[] =
{
    "Turn on the light",            //return 1
    "Turn off the light",           //return 2
    "Play music",                   //return 3
    "Pause",                        //return 4
    "Next",                         //return 5
    "Previous",                     //return 6
    "Up",                           //return 7
    "Down",                         //return 8
    "Turn on the TV",               //return 9
    "Turn off the TV",              //return 10
    "Increase temperature",         //return 11
    "Decrease temperature",         //return 12
    "What's the time",              //return 13
    "Open the door",                //return 14
    "Close the door",               //return 15
    "Left",                         //return 16
    "Right",                        //return 17
    "Stop",                         //return 18
    "Start",                        //return 19
    "Mode 1",                       //return 20
    "Mode 2",                       //return 21
    "Go",                           //return 22
};
```

9. JoyStick Demo

9.1 Introduction

This demo uses joystick and three buttons to control the Dobot Magician movement and the air pump start-stop.

9.2 Hardware Connection

Joystick module, button, Dobot Magician, air pump, and Arduino Mega2560 are required in this demo. The connections between them are shown in Figure 9.1.

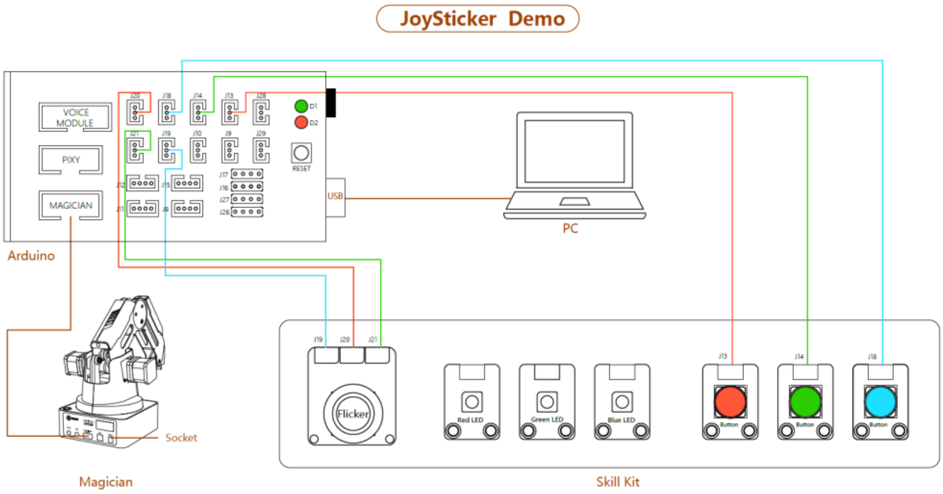

Figure 9.1 JoyStick Connection

The connection between Dobot Magician and air pump is shown in Figure 9.2.

Figure 9.2 Air pump Connection

9.3 Realization Process

In this demo, we move Dobot Magician forward, backward, left and right by moving joystick along X-axis or Y-axis, control the moving speed by joystick button, move Dobot Magician upward by red button , move Dobot Magician downward by green button and control the air pump start-stop by blue button. Figure 9.3 shows its realization process.

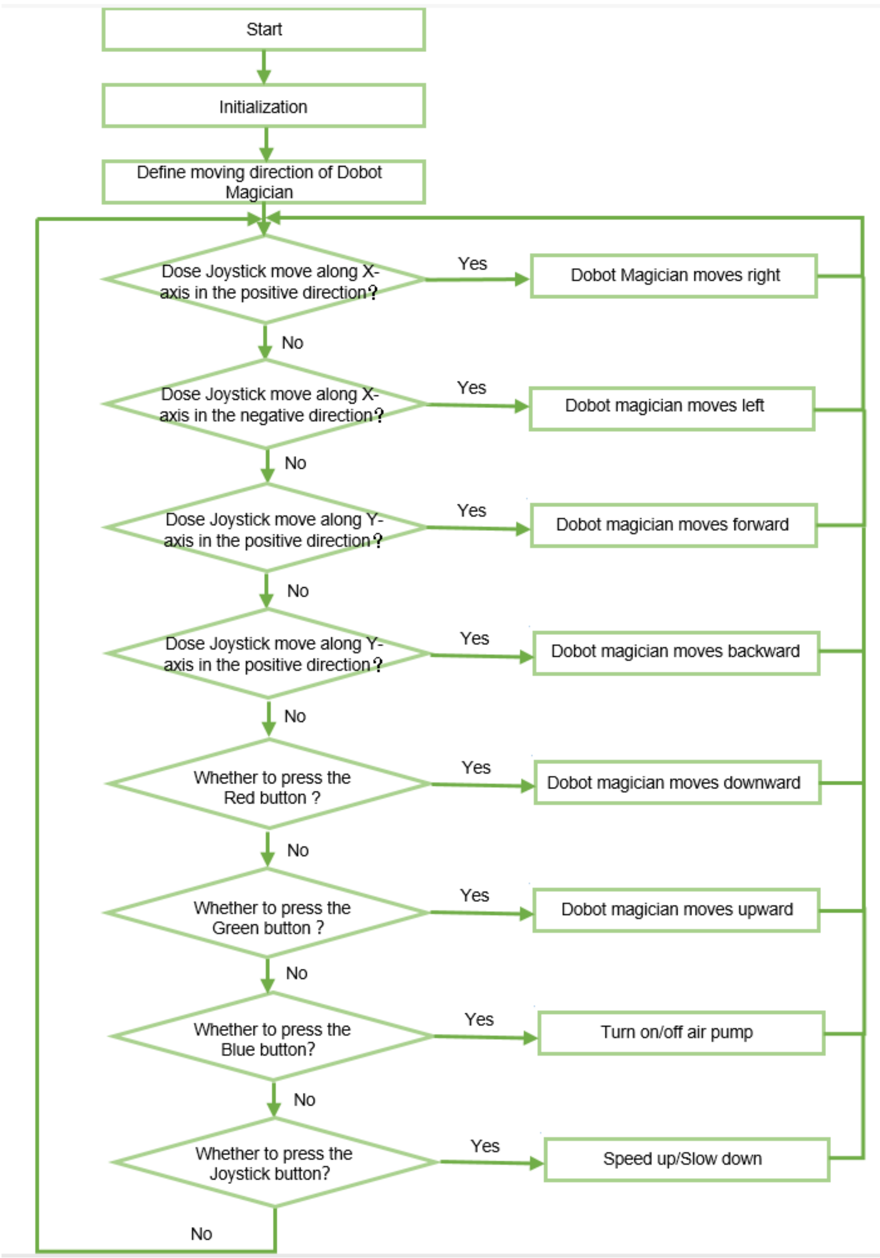

Figure 9.3 Realization process

10. DobotPixy Demo

10.1 Introduction

This demo uses Pixy vision sensor and Dobot Magician to recognize and pick-place different color cubes.

10.2 Hardware Connection

Arduino Mega2560, Pixy vision sensor, Dobot Magician and suction cup kit are required in this demo. For details about the installation and configuration of Pixy vision sensor, please see *Appendix CPixy Install and Configure Pixy*. For the installation of suction kit, please see *Appendix B Installing Suction Cup Kit*.

The connection between them is shown in Figure 10.1.

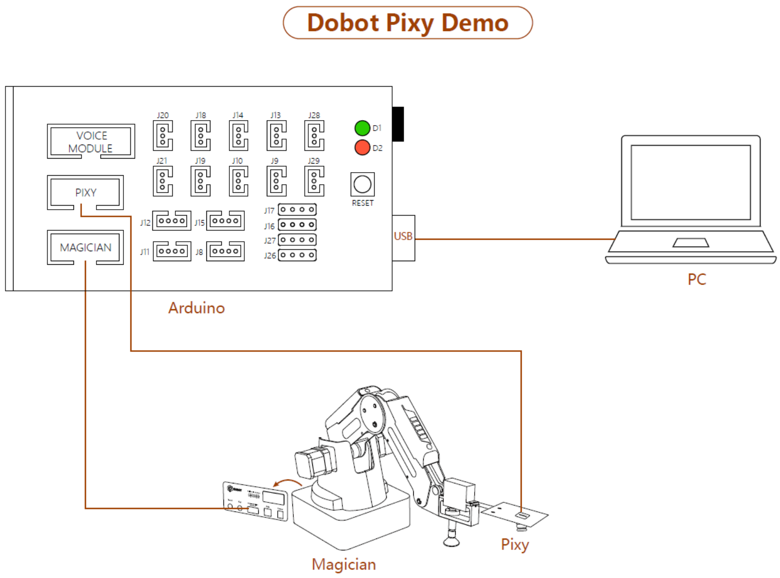

Figure 10.1 DobotPixy Connection

10.3 Critical Code Process

This demo uses joystick to control Dobot Magician, the Dobot library need to be called. Before debugging this Demo, please select the corresponding library on the **Sketch** > **Include Library** menu.

⚠NOTICE

Please long press the **Key** button on the back of base of Dobot Magician to operate homing before debugging this Demo.

（1） Define and initial the pins of which joystick and buttons are connected to Arduino.

Program 10.1 Define and initial pins

```
#define JoyStick_X    7                                //JoyStick_X connects to the A7 pin
```

```
#define JoyStick_Y    6                                   // JoyStick_Y connects to the A6 pin
#define JoyStick_Z    A5                                  // JoyStick_Z connects to the A5 pin
#define Red_button A0                                     //Red_button connects to the A0 pin
#define Green_button A2                                   // Green_button connects to the A2 pin
#define Blue_button A4                                    // Blue_button connects to the A4 pin
int flag = 0;                                             //Blue_button flag
int Zflag = 1;                                            //JoyStick_Z flag
void setup()
{
    Dobot_Init();                                         //Initial Dobot
    pinMode(JoyStick_Z, INPUT);
    pinMode(Red_button, INPUT);
    pinMode(Green_button, INPUT);
    pinMode(Blue_button, INPUT);
    Serial.begin(115200);                                 //115200 bps
    Dobot_SetPTPCmdEx(MOVJ_XYZ, 178, 0, 12, 0);           //Initial position, obtained from the
//Operatioan Panel of DobotStudio page
    Serial.println("ok");
}
```

（2） Define the moving direction of Dobot Magician and the air pump start-stop based on the moving direction of joystick and buttons.

📖NOTE

When moving joystick along X-axis or Y-axis, the analog values change from 0 to 1023, as shown Figure 10.2. The homing position of the joystick is at (x,y: 512,508).

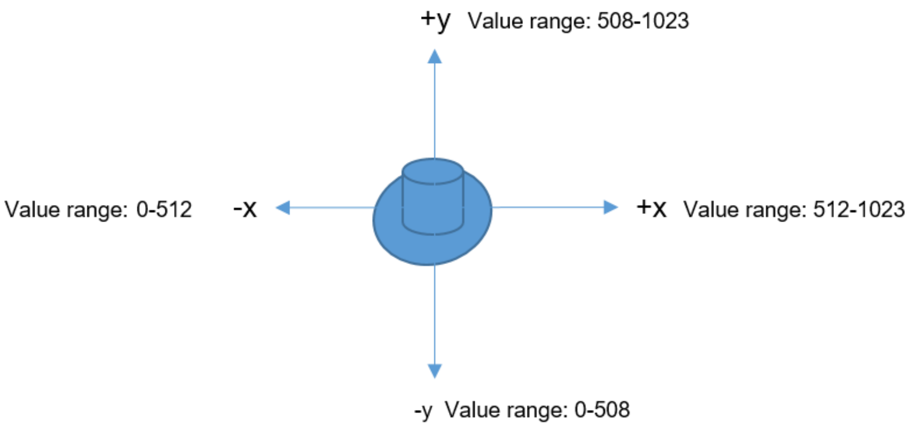

Figure 10.2 Value range

Program 10.2 Define the moving direction of Dobot Magician based on joystick and buttons

```
  int x = 0,y = 0,z = 0,b1 = 0,b2 = 0,b3 = 0;
  int direction = 0;                                    //The direction of JoyStick
  x = analogRead(JoyStick_X);
  y = analogRead(JoyStick_Y);
  z = digitalRead(JoyStick_Z);
  b1 = digitalRead(Red_button);
  b2 = digitalRead(Green_button);
  b3 = digitalRead(Blue_button);
  if(y > 600){                          //JoyStick moves alongt Y-axis in the positive direction
                                        //You can customizethe threshold. In this demo, we set to 520
    direction = 1;
  }
  else if(y < 400){                     // JoyStick moves alongt Y-axis in the negative direction
    direction = 2;
  }
…...
……
  switch(direction){
    case 1:
        Serial.println("forward");
        Dobot_SetPTPCmdEx(MOVL_INC,20,0,0,0);       //Dobot Magician moves forward
        Serial.print("x=");
        Serial.println(x);
        Serial.print("y=");
        Serial.println(y);
        break;
    case 2:
        Serial.println("backwardss");
        Dobot_SetPTPCmdEx(MOVL_INC,-20,0,0,0);            // Dobot Magician moves backward
        Serial.print("x=");
        Serial.println(x);
        Serial.print("y=");
        Serial.println(y);
        break;
……
……
```

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```
}
```

10.4 Realization Process

If there are eight cubes with different colors (red, yellow, green, blue), each color has two cubes. Place these cubes in the visual range (the Pixy vision sensor is installed on the end of Dobot Magician). After a color is detected by Pixy vision sensor, Dobot Magician will pick and place the corresponding cubes. Figure 10.3 shows its realization process.

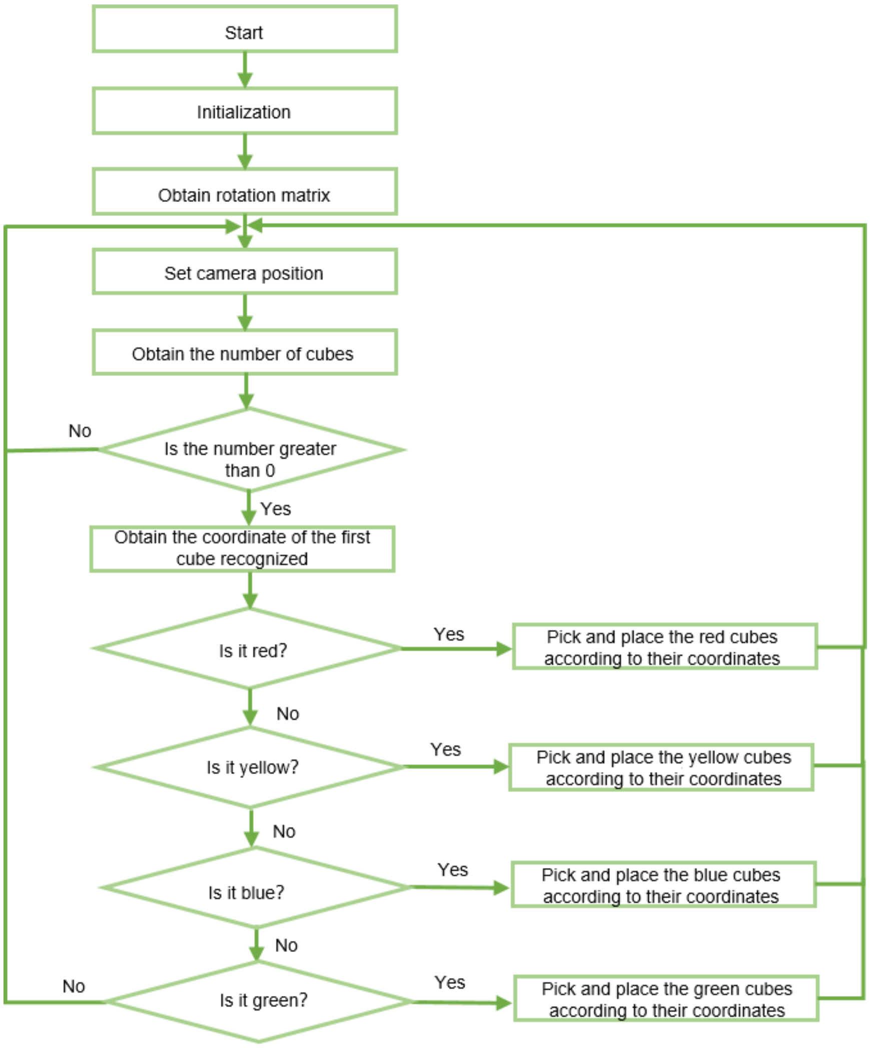

Figure 10.3 Realization process

10.5 Critical Code Description

This demo uses Pixy vision sensor and Dobot Magician to pick and place cubes. The **Dobot** library and **Pixy** library need to be called. Before debugging this Demo, please select **Dobot** and **Pixy** on the the **Sketch** > **Include Library** menu.

⚠NOTICE

Please long press the **Key** button on the back of base of Dobot Magician to operate homing before debugging this Demo.

（1） Define the coordinates of cubes that are to be placed

The coordinates can be obtained from the **Operation Panel** of DobotStudio page.

Program 10.3 Define the coordinates of point A and point B

```
//Point position coordinate
#define Red_position_X 175                    // X-coordinate of red cube that is to be placed
#define Red_position_Y -179                   // Y-coordinate of red cube that is to be placed
#define Red_position_Z -46                    // Z-coordinate of red cube that is to be placed
#define Red_position_R 0                      // R-coordinate of red cube that is to be placed

#define Yellow_position_X 50                  // X-coordinate of yellow cube that is to be placed
#define Yellow_position_Y -179                // Y-coordinate of yellow cube that is to be placed
#define Yellow_position_Z -46                 // Z-coordinate of yellowcube that is to be placed
#define Yellow_position_R 0                   / R-coordinate of yellow cube that is to be placed
……
……
```

（2） Declare a vision recognition object.

Program 10.4 Declare a vision recognition object

```
PixyI2C pixy;                                 // Pixy object
```

（3） Initial Dobot Magician.

Program 10.5 Initialization

```
Dobot_Init();
Serial.begin(115200);
Serial.print("Starting...\n");
```

（4） Obtain Rotation matrix $\mathbf{R_T}$ with the image coordinates $\mathbf{A}\begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ 1 & 1 & 1 \end{bmatrix}$ and the corresponding Cartesian coordinates $\mathbf{B}\begin{bmatrix} x_1' & x_2' & x_3' \\ y_1' & y_2' & y_3' \\ 1 & 1 & 1 \end{bmatrix}$ of three points, so that after the image coordinates of a cube are obtained by the Pixy vision sensor, the corresponding Cartesian coordinates can be calculated with the $\mathbf{R_T}$ matrix, where Dobot Magician will move to, as shown in. The formula is $\mathbf{B} = \boldsymbol{R_T A}$.

Program 10.6 Obtain Rotation matrix

```
CalcInvMat(pixyPoint, inv_pixy);
MatMultiMat(dobotPoint, inv_pixy, RT);
```

（5） Set the camera position to recognize cubes.

Program 10.7 Set the camera position

```
Dobot_SetPTPCmdEx(MOVJ_XYZ, 178, -4, 40, 0);        //Set the camera position, obtained
                                                     //from the Operation Panel of
                                                     //DobotStudio page
```

（6） Obtain the number of cubes Pixy has detected. You can then look in the pixy.blocks[] array for information about each detected object (one array member for each detected object.) Each array member (i) contains the following fields.

- pixy.blocks[i].signature： The signature number (color) of the detected cube (1-7).
- pixy.blocks[i].x： The X-coordinate of the center of the detected object (0-319).
- pixy.blocks[i].y： The Y-coordinate of the center of the detected object (0-319).
- pixy.blocks[i].width： The width of the detected cube (1-320).
- pixy.blocks[i].height： The height of the detected cube (1-200).

Program 10.8 Obtain the number of cubes and their data

```
blocks = pixy.getBlocks();
```

（7） Obtain the corresponding Cartesian coordinates where Dobobt Magician will move to, for picking and placing this cube, based on the image coordinates of the first cube and the rotation matrix.

Program 10.9 corresponding Cartesian coordinates

```
transForm(pixy.blocks[0].x,pixy.blocks[0].y);
```

（8） Pick and place cubes. If there are multiple cubes in the same color, these cubes will be piled when placing.

When setting the placement of the cubes, please connect Dobot Magician and DobotStudio. And press the **Unlock** key on the Forearm and drag Dobot Magician to move to the positions where the cube is to be placed, then record their Cartesian coordinates from sssssssthe **operation panel** pane of DobotStudio page to write in this demo for picking and placing cube.

Program 10.10 Pick and place cubes

```
Dobot_SetPTPCmdEx(JUMP_XYZ, Coordinate[0], Coordinate[1], -46, 0);
Dobot_SetEndEffectorSuctionCupEx(true);                    //Turn on air pump
```

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```
    Dobot_SetPTPCmdEx(MOVL_XYZ, Coordinate[0], Coordinate[1], 50, 0);
//place Point
    if(gRed == 0){
        Dobot_SetPTPCmdEx(JUMP_XYZ, Red_position_X, Red_position_Y, Red_position_Z, Red_position_R);
                                                                    //Move to the setting position
    }
    else{
Dobot_SetPTPCmdEx(JUMP_XYZ, Red_position_X, Red_position_Y,
                    Red_position_Z+25*gRed, Red_position_R);    // Multiple cubes are piled when placing
    }
    Dobot_SetEndEffectorSuctionCupEx(false);                    //Turn off air pump
    Dobot_SetPTPCmdEx(JUMP_XYZ, Red_position_X, Red_position_Y, 50, 0);    //Lift to a certain height
    gRed++;
```

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Appendix A Common Function Description

Common Function of Arduino

Arduino demo is developed based on Arduino Mega2560 and the Arduino APIs need to be called. This topic describes the common functions that are used in Arduino demo.

Attached table 1 Set the specified pin to INPUT or OUTPUT

Prototype	void pinMode(uint8_t pin, uint8_t mode)
Description	Set the specified digital pin to **INPUT** or **OUTPUT**
Parameter	pin: Pin number of the pin mode: INPUT or OUTPUT
Return	None

Attached table 2 Set the specified digital pin to HIGH or LOW

Prototype	void digitalWrite(uint8_t pin, uint8_t value)
Description	Set the specified digital pin to **HIGH** or **LOW**
Parameter	pin: Pin number of the pin mode: HIGH or LOW
Return	None

Attached table 3 Read the specified digital pin

Prototype	int digitalRead(uint8_t pin)
Description	Read the specified digital pin
Parameter	pin: Pin number of the pin
Return	HIGH or LOW

Attached table 4 Write the specified analog pin

Prototype	void analogWrite(uint8_t pin, int value)
Description	Write the specified analog pin for controlling the brightness of LED indicator or the motor speed
Parameter	pin: Pin number of the pin value: 0-255. 0: OFF; 255: ON

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Return	None

Attached table 5 Read the specified analog pin

Prototype	int analogRead(uint8_t pin)
Description	Read the specified analog pin
Parameter	pin: Pin number of the pin
Return	0-1023

Pixy Common Function of Pixy

When the Pixy vision sensor is used in Arduino demo, the Pixy APIs need to be called. This topic describes the common functions in Arduino demo.

Attached table 6 Return the number of cubes Pixy has detected

Prototype	uint16_t getBlocks()
Description	Obtain the number of cubes Pixy has detected. You can then look in the pixy.blocks[] array for information about each detected object (one array member for each detected object.) Each array member (i) contains the following fields • pixy.blocks[i].signature: The signature number (color) of the detected cube (1-7) • pixy.blocks[i].x: The X-coordinate of the center of the detected object (0-319) • pixy.blocks[i].y: The Y-coordinate of the center of the detected object (0-319) • pixy.blocks[i].width: The width of the detected cube (1-320) • pixy.blocks[i].height: The height of the detected cube (1-200)
Parameter	None
Return	Return the number of cubes Pixy has detected

Common Function of Dobot Magician

Dobot Magician communicates with Arduino over UART interface (10 PIN) on the base of the Dobot Magician, using the Dobot protocol. We have provided Dobot library which encapsulates part of the Dobot Magician API, being called directly to control Dobot Magician. This topic describes the common functions that are used in Arduino demo. For details about Dobot Magician API, please see *Dobot Magician API Description*.

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Attached table 7 Set the motion mode and the target coordinates

Prototype	void Dobot_SetPTPCmdEx(uint8_t Model, float x, float y, float z, float r)
Description	Set the motion mode and the target coordinates

Parameter	Details for Model:
	enum {
	JUMP_XYZ, //JUMP mode, (x,y,z,r) is the target point in Cartesian coordinate system
	MOVJ_XYZ, //MOVJ mode, (x,y,z,r) is the target point in Cartesian coordinate system
	MOVL_XYZ, //MOVL mode, (x,y,z,r) is the target point in Cartesian coordinate system
	JUMP_ANGLE, //JUMP mode, (x,y,z,r) is the target point in Joint coordinate system
	MOVJ_ANGLE, //MOVJ mode, (x,y,z,r) is the target point in Joint coordinate system
	MOVL_ANGLE, //MOVL mode, (x,y,z,r) is the target point in Joint coordinate system
	MOVJ_INC, //MOVJ mode, (x,y,z,r) is the angle increment in Joint coordinate system
	MOVL_INC, //MOVL mode, (x,y,z,r) is the Cartesian coordinate increment in Joint coordinate system
	MOVJ_XYZ_INC, //MOVJ mode, (x,y,z,r) is the Cartesian coordinate increment in Cartesian coordinate system
	JUMP_MOVL_XYZ, //JUMP mode, (x,y,z,r) is the Cartesian coordinate increment in Cartesian coordinate system
	};
	x、y、z、r : Coordinate parameters in PTP mode. (x,y,z,r) can be set to Cartesian coordinate, joints angle, or increment of them

Return	None

Attached table 8 Control the start-stop of air pump

Prototype	void Dobot_SetEndEffectorSuctionCupEx(bool issuck)
Description	Control the start-stop of the air pump
Parameter	Issuck: Whether to turn on the air pump. true: Turn on; false: Turn off
Return	None

Attached table 9 Set the speed ratio and acceleration ratio of Dobot Magician

Prototype	void Dobot_SetJOGCommonParamsEx(float velocityRatio, float accelerationRatio)
Description	Set the speed ratio and acceleration ratio of Dobot Magician
Parameter	velocityRatio: Speed ratio accelerationRatio: Acceleration ratio
Return	None

Attached table 10 Get the real-time pose of Dobot

Prototype	float Dobot_GetPoseEx(uint8_t temp)
Description	Get the real-time pose of Dobot

Parameter	temp: Cartesian coordinate system axis
	Details for temp:
	enum{
	X,……//X axis
	Y,……//Y axis
	Z,……//Z axis
	R,……//R axis
	JOINT1,……//joint axis 1
	JOINT2,……//joint axis 2
	JOINT3,……//joint axis 3
	JOINT4,……//joint axis 4
	};

Return	Return the value of axis or joint angle

Attached table 11 Get the device clock

Prototype	uint32_t Dobot_GetDeviceTimeEx(void)
Description	Get the device clock
Parameter	None
Return	Return the device clock

Attached table 12 Set the sliding rail status

Prototype	void Dobot_SetDeviceWIthLEx(bool isWithL)
Description	Set the Sliding rail status
Parameter	isWithL: 0:Disabled, 1:Enabled
Return	None

Attached table 13 Execute the homing function

Prototype	Void Dobot_SetHOMECmdEx(void)
Description	Execute the homing function
Parameter	None
Return	None

Attached table 14 Set the offset of end-effector

Prototype	void Dobot_SetEndEffectorParamsEx(float x,float y, float z)
Description	Set the offset of the end-effector. If the end-effector is installed, this API is required
Parameter	x: the X-axis offset of end-effector y: the Y-axis offset of end-effector z: the Z-axis offset of end-effector
Return	None

Attached table 15 Enable laser

Prototype	void Dobot_SetEndEffectorLaserEx (uint8_t isEnable, float power)
Description	Enable laser
Parameter	isEnable: Control laser. 0: Disabled, 1: Enabled power: PWM duty cycle:0-100
Return	None

Attached table 16 Set gripper status

Prototype	void Dobot_SetEndEffectorGripperEx(bool isEnable,bool isGriped)
Description	Set gripper status

Parameter	isEnable: Control end-effector. 0: Disabled, 1: Enabled isGriped: Control the gripper to grab or release. 0:Released, 1: Grabbed
Return	None

Attached table 17 Set the velocity and acceleration of the joints coordinate axis in jogging mode

Prototype	void Dobot_SetJOGJointParamsEx(float velocityJ1,float accelerationJ1,float velocityJ2,float accelerationJ2,float velocityJ3,float accelerationJ3,float velocityJ4,float accelerationJ4)
Description	Set the velocity and acceleration of the joints coordinate axis in jogging mode
Parameter	velocityJ1、velocityJ2、velocityJ3、velocityJ4: joints velocity in jogging mode accelerationJ1、accelerationJ2、accelerationJ3、accelerationJ4: joints acceleration in jogging mode
Return	None

Attached table 18 Execute the jogging command

Prototype	void Dobot_SetJOGCmdEx(uint8_t model)
Description	Execute the Jogging command. Please call this API after setting the related parameters of jogging

Parameter	model : Jogging command
	Details for model:
	enum {
	AP_DOWN, ……//X+/Joint1+
	AN_DOWN, ……//X-/Joint1-
	BP_DOWN, …… //Y+/Joint2+
	BN_DOWN, …… //Y-/Joint2-
	CP_DOWN, …… //Z+/Joint3+
	CN_DOWN, …… //Z-/Joint3-
	DP_DOWN, ……//R+/Joint4+
	DN_DOWN, …… //R-/Joint4-
	LP_DOWN, ……//L+
	LN_DOWN ……//L-
	};

Return	None

Attached table 19 Set the velocity ratio and the acceleration ratio in PTP mode

Prototype	void Dobot_SetPTPCommonParamsEx(float velocityRatio,float accelerationRatio)
Description	Set the velocity ratio and the acceleration ratio in PTP mode
Parameter	velocityRatio: velocity ratio in PTP mode accelerationRatio: velocity acceleration in PTP mode
Return	None

Attached table 20 Set the velocity and acceleration of the joint coordinate axis in PTP mode

Prototype	void Dobot_SetPTPJointParamsEx(float velocityJ1,float accelerationJ1,float velocityJ2,float accelerationJ2,float velocityJ3,float accelerationJ3,float velocityJ4,float accelerationJ4)
Description	Set the velocity and acceleration of the joint coordinate axis in PTP mode
Parameter	velocityJ1、velocityJ2、velocityJ3、velocityJ4: Joint velocity in PTP mode accelerationJ1、accelerationJ2、accelerationJ3、accelerationJ4: Joint acceleration in PTP mode
Return	None

Attached table 21 Set the velocity and acceleration of sliding rail in PTP mode

Prototype	void Dobot_SetPTPLParamsEx(float velocityRatio, float accelerationRatio)
Description	Set the velocity and acceleration of sliding rail in PTP mode
Parameter	velocityRatio: Sliding rail velocity in PTP mode accelerationRatio: Sliding rail acceleration in PTP mode
Return	None

Attached table 22 Set the lifting height in JUMP mode

Prototype	void Dobot_SetPTPJumpParamsEx(float jumpHeight)
Description	Set the lifting height in JUMP mode
Parameter	jumpHeight: The lifting height
Return	None

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Attached table 23 Execute a PTP command with the sliding rail

Prototype	void Dobot_SetPTPWithLCmdEx(uint8_t Model,float x,float y,float z,float r,float l)
Description	Execute a PTP command with the sliding rail

Parameter	Model: PTP mode
	Details for Model:
	enum {
	JUMP_XYZ, //JUMP mode, (x,y,z,r) is the target point in Cartesian coordinate system
	MOVJ_XYZ, //MOVJ mode, (x,y,z,r) is the target point in Cartesian coordinate system
	MOVL_XYZ, //MOVL mode, (x,y,z,r) is the target point in Cartesian coordinate system
	JUMP_ANGLE, //JUMP mode, (x,y,z,r) is the target point in Joint coordinate system
	MOVJ_ANGLE, //MOVJ mode, (x,y,z,r) is the target point in Joint coordinate system
	MOVL_ANGLE, //MOVL mode, (x,y,z,r) is the target point in Joint coordinate system
	MOVJ_INC, //MOVJ mode, (x,y,z,r) is the angle increment in Joint coordinate system
	MOVL_INC, //MOVL mode, (x,y,z,r) is the Cartesian coordinate increment in Joint coordinate system
	MOVJ_XYZ_INC, //MOVJ mode, (x,y,z,r) is the Cartesian coordinate increment in Cartesian coordinate system
	UMP_MOVL_XYZ, //JUMP mode, (x,y,z,r) is the Cartesian coordinate increment in Cartesian
	};
	x、y、z、r: Coordinate parameters in PTP mode.(x,y,z,r) can be set to Cartesian coordinate, joints angle, or increment of them
	l: The distance that sliding rail moves

Return	None

Attached table 24 Set the I/O multiplexing

Prototype	void Dobot_SetIOMultiplexingEx(uint8_t address,uint8_t function)
Description	Set the I/O multiplexing
Parameter	address: I/O address(1~20),please refer to *Appendix D Multiplexed I/O Interface*

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	Description for details
	function: I/O multiplexing function
	Details for function:
	typedef enum {
	IOFunctionDummy; //Invalid
	IOFunctionDO; // I/O output
	IOFunctionPWM; // PWM output
	IOFunctionDI; //I/O input
	IOFunctionADC; //A/D input
	IOFunctionDIPU; //Pull-up input
	IOFunctionDIPD //Pull-down input
	}

Return	None

Attached table 25 Set I/O output

Prototype	void Dobot_SetIODOEx(uint8_t address,uint8_t value)
Description	Set I/O output
Parameter	address: /O address(1~20) value: Low level(0), High level(1)
Return	None

Attached table 26 Set PWM output

Prototype	void Dobot_SetIOPWMEx(uint8_t address, float freq, float duty)
Description	Set PWM output
Parameter	address: I/O address(1~20) freq: PWM frequency(10HZ~1MHz) duty: PWM duty circle(0~100)
Return	None

Attached table 27 Get I/O input

Prototype	uint8_t Dobot_GetIODIEx(uint8_t address)
Description	Get I/O input

Parameter	address: I/O address(1~20)
Return	return I/O input

Attached table 28 Get A/D input

Prototype	uint16_t Dobot_GetIOADCEx(uint8_t address)
Description	Get A/D input
Parameter	address: I/O address(1~20)
Return	Return A/D input

Attached table 29 Set the velocity of extended motor

Prototype	void Dobot_SetEMotorEx(uint8_t address, uint8_t enable, uint32_t speed)
Description	Set the velocity of extended motor
Parameter	address: Motor index. 0:Stepper1, 1:Stepper2 enable: Control motor. 0:Disabled, 1:Enabled speed: Motor velocity（Pulse number per second）
Return	None

Attached table 30 Set the velocity and movement distance of extended motor

Prototype	void Dobot_SetEMotorSEx(uint8_t address, uint8_t enable, uint32_t speed, uint32_t deltaPulse)
Description	Set the velocity and movement distance of extended motor, The Dobot will move for some distance at a constant velocity after calling this API
Parameter	address: Motor index. 0:Stepper1, 1:Stepper2 enable: Control motor.。 0:Disabled, 1:Enabled speed: Control motor（Pulse number per second） deltaPulse: The distance that motor moves(Pulse number)
Return	None

Attached table 31 Enable the color sensor

Prototype	void Dobot_SetColorSensorEx(uint8_t enable, uint8_t port)

Description	Enable the color sensor

Parameter	enable: 0:Disabled, 1:Enabled
	port: the Dobot interface that the color sensor is connected to. Please select the corresponding interface
	Details for port:
	enum {
	IF_PORT_GP1;
	IF_PORT_GP2;
	IF_PORT_GP4;
	IF_PORT_GP5;
	};

Return	None

Attached table 32 Get the color sensor value

Prototype	uint8_t Dobot_GetColorSensorEx(uint8_t color)
Description	Get the color sensor value
Parameter	color: 0:Red, 1:Green, 2:Blue
Return	Retun the color sensor value

Attached table 33 Set the losing-step threshold

Prototype	void Dobot_SetLostStepSetEx(float lostStepValue)
Description	Set the losing-step threshold. If you do not call this API, the default threshold is 5
Parameter	lostStepValue: losing-step threshold
Return	None

Attached table 34 Execute losing-step command

Prototype	void Dobot_SetLostStepCmdEx(void)
Description	Execute losing-step command
Parameter	None
Return	None

Attached table 35 Set the IR sensor

Prototype	void Dobot_SetIRSwitchEx(uint8_t enable, uint8_t port)
Description	Set the IR sensor

Parameter	enable: 0:Disabled, 1:Enabled
	port: the Dobot interface that the IR sensor is connected to. Please select the corresponding interface
	Details for port:
	enum {
	IF_PORT_GP1;
	IF_PORT_GP2;
	IF_PORT_GP4;
	IF_PORT_GP5;
	};

Return	None

Attached table 36 Get the IR sensor value

Prototype	uint8_t GetIRSwitchEx(uint8_t port)
Description	Get the IR sensor value

Parameter	port: the Dobot interface that the IR sensor is connected to. Please select the corresponding interface
	Details for port:
	enum {
	IF_PORT_GP1;
	IF_PORT_GP2;
	IF_PORT_GP4;
	IF_PORT_GP5;
	};

Return	Return the IR sensor value

Appendix B Installing Suction Cup Kit

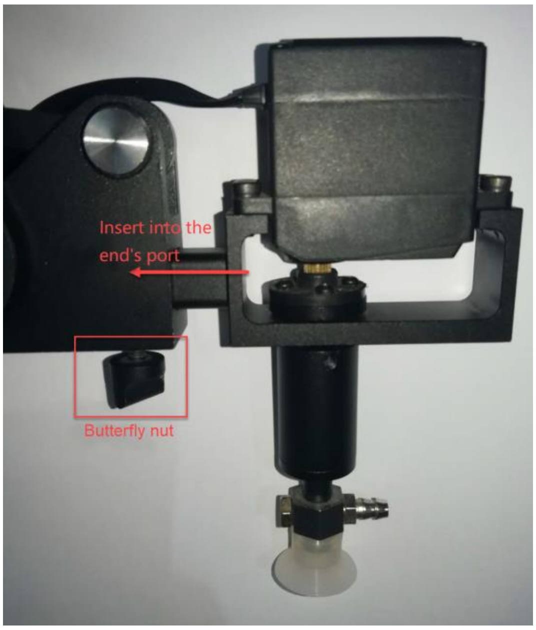
Procedure

When picking and placing cubes with Dobot Magician, the suction cup kit should be installed on the end of the Dobot Magician

Step 1 Connect the air pump's power cable **SW1** to the **SW1** connector on the Dobot Magician base' rear panel and the signal cable **GP1** to the **GP1** connector, as shown in Attached figure 1.

Attached figure 1 Connect the air pump to the Dobot Magician

Step 2 Insert a suction cup kit into the end's port, and fasten it with a butterfly nut, as shown in Attached figure 2.



Attached figure 2 Install a suction cup kit

Step 3 Connect the air pump's air tube to the air tube connector of the suction cup kit, as shown in Attached figure 3.

Attached figure 3 Install an air tube

Step 4 Connect the servo's **GP3** cable to the **GP3** connector on the Forearm, as shown in Attached figure 4.

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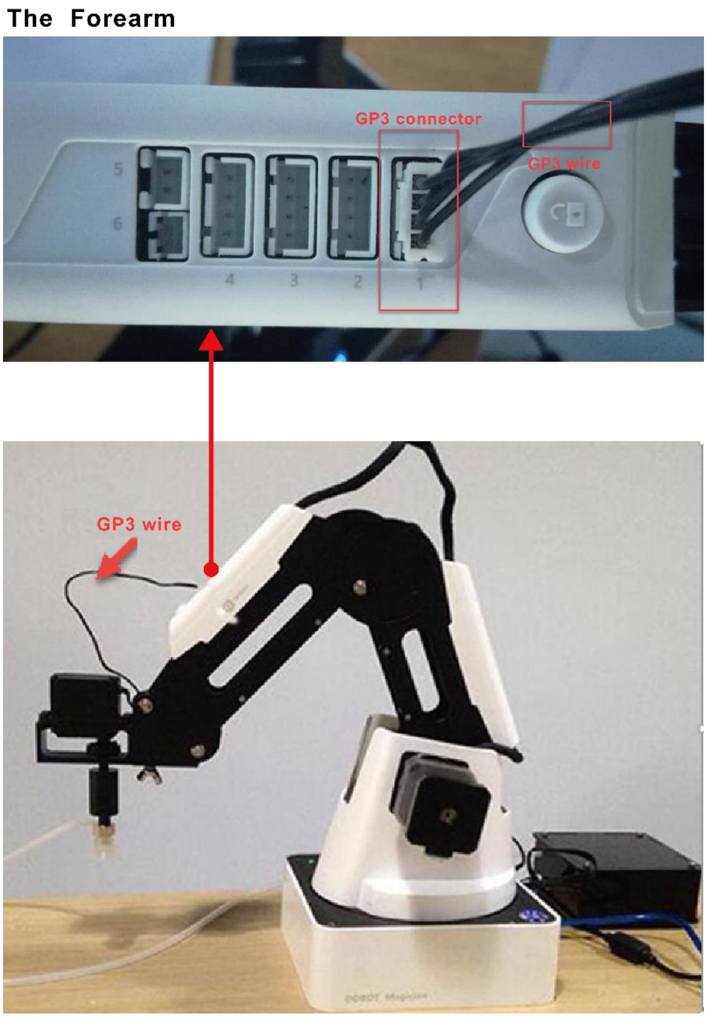

Attached figure 4 Connect the servo’s GP3 cable to the GP3 connector

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Appendix C Pixy Install and Configure Pixy

Before debugging the DobotPixy Demo, you need to install and configure the Pixy vision sensor.

Prerequisites

- The PixyMon has been installed, which is obtained from **arduino kit/PixyMon**.
- The suction kit has been installed on the end of Dobot Magician.
- The cubes have been obtained.

Procedure

Step 1 Loosen the two M3*8 hexagon socket head cap screws on the servo, as shown in Attached figure 5.

Attached figure 5 loosen the screws

Step 2 Install the Pixy vision sensor on the servo with a connecting board and fix it with two M3*8 hexagon socket head cap screws, as shown in Attached figure 6.

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Attached figure 6 Install Pixy vision sensor

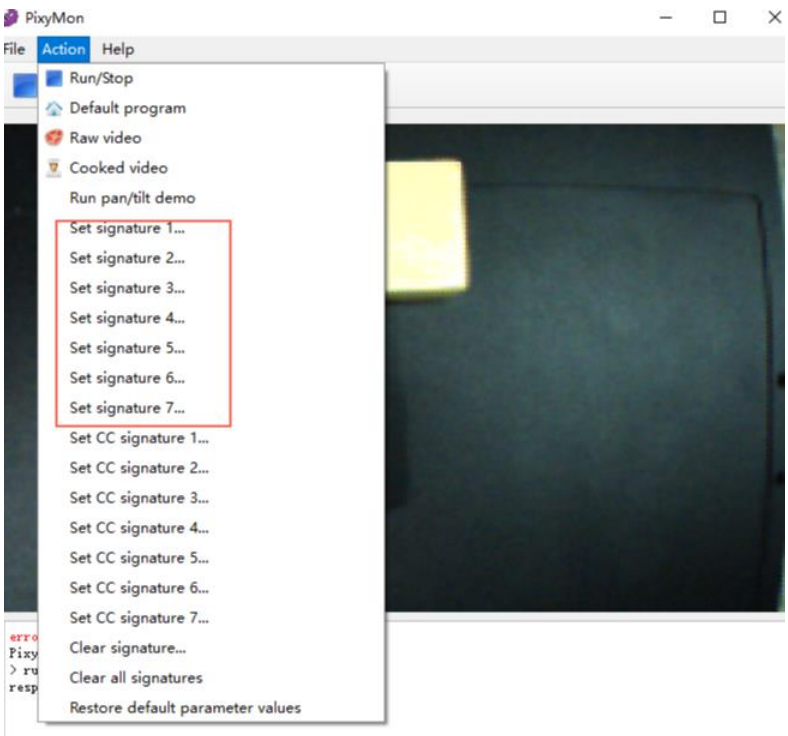
Step 3 Connect the Pixy vision sensor and PC with USB cable.

Step 4 Place cubes on the vision range.

Step 5 Rotate around the focal length of the camera on the Pixy vision sensor to adjust the camera view to the optimum state, until the cubes can be appeared clearly on the **PixyMon** page.

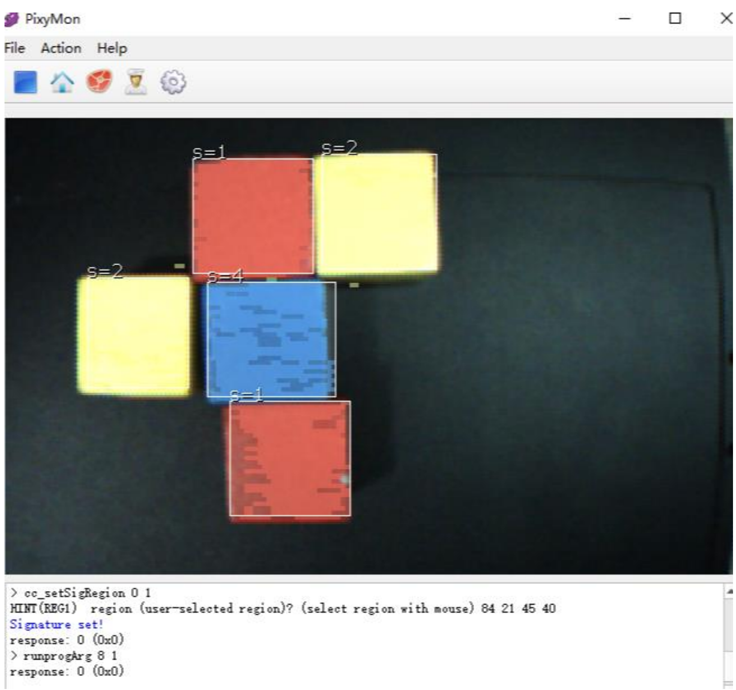
Step 6 Select **Action** > **Set signature** ***x*** on the **PixyMon** page and select an area on a cube image to set signature number, as shown in Attached figure 7.

For each color, set signature once. Pixy can only set 7 signature labels.



Attached figure 7 Set signature number

Attached figure 8 shows the setting result.

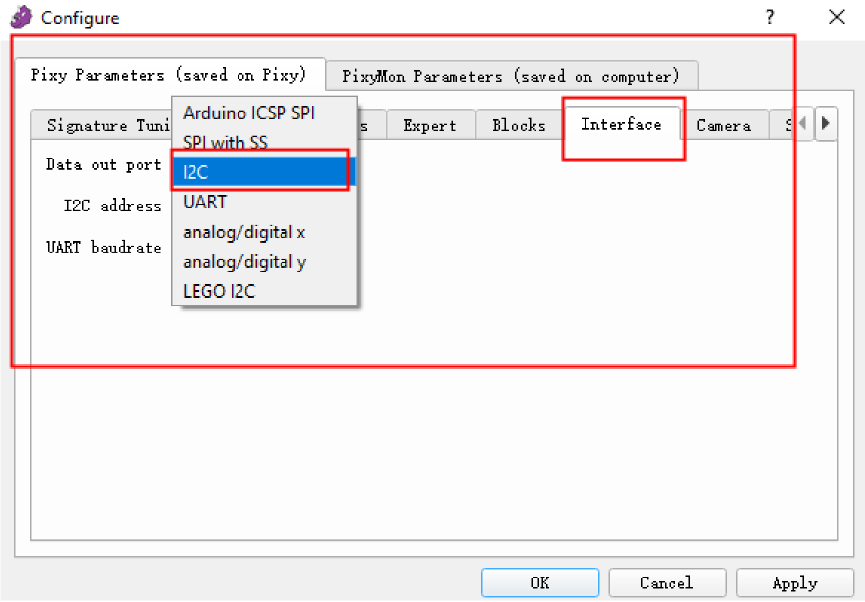


Attached figure 8 Setting result

Step 7 Click  on the **PixyMon** page.

The **Configure** page is displayed.

Step 8 Set **Data out port** to **I2C** on the **Pixy Parameters (saved on Pixy) > Interface** tab of the **Configure** page, as shown in Attached figure 9.



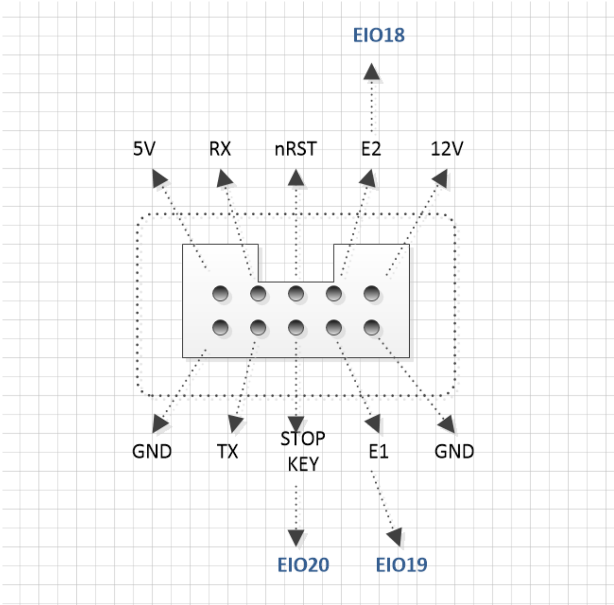
Attached figure 9 Set Data out port

Step 9 Remove the USB connection between the Pixy and PC.

Appendix D Multiplexed I/O Interface Description

Multiplexed UART Interface Description

Attached figure 10 shows the UART interface on the base, Attached table 37 lists the multiplexed I/O description.



Attached figure 10 UART interface

Attached table 37 Multiplex I/O Description

I/O addressing	Voltage	Level Output	PWM	Level Input	ADC
18	3.3V	√	-	√	-
19	3.3V	√	-	√	-
20	3.3V	√	-	√	-

Multiplexed Peripheral Interface Description

Attached figure 11 shows the peripheral interface on the base, and Attached table 38 lists the multiplexed I/O description.

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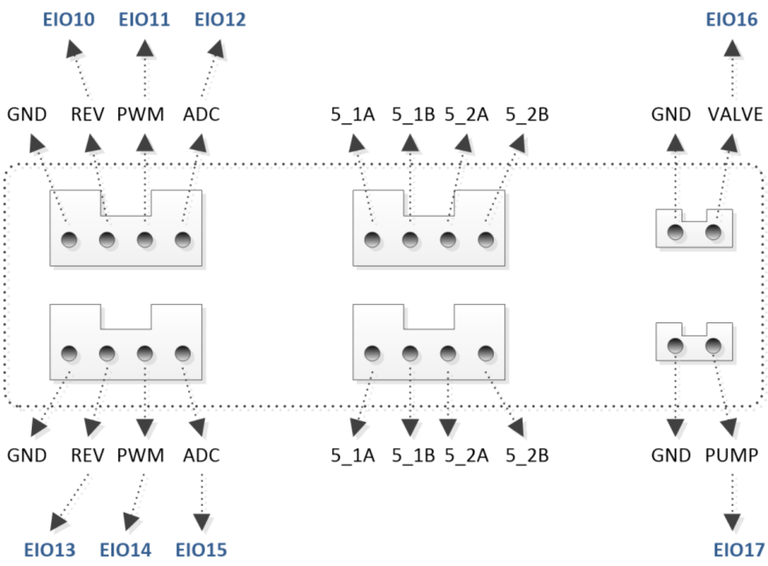


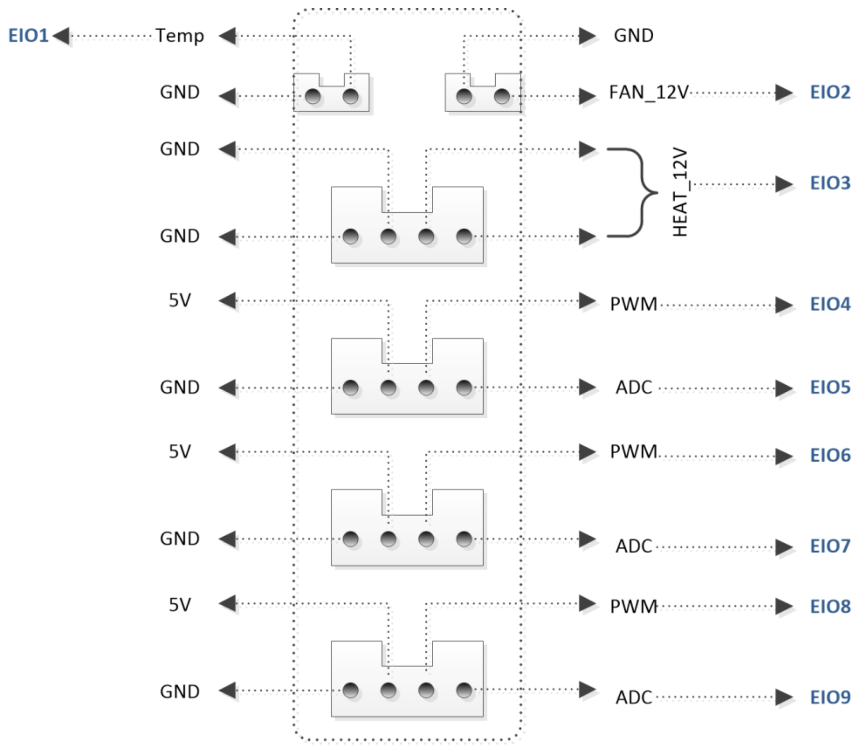
Attached figure 11 Peripheral Interface

Attached table 38 Multiplexed I/O Description

I/O addressing	Voltage	Level Output	PWM	Level Input	ADC
10	5V	√	-	-	-
11	3.3V	√	√	√	-
12	3.3V	√	-	√	√
13	5V	√	-	-	-
14	3.3V	√	√	√	-
15	3.3V	√	-	√	√
16	12V	√	-	-	-
17	12V	√	-	-	-

Multiplexed Forearm I/O Interface Description

Attached figure 12 shows the peripheral interface on the Forearm, Attached table 39 lists the multiplexed I/O description.



Attached figure 12 Peripheral interface in the Forearm

Attached table 39 Multiplexed I/O description

I/O addressing	Voltage	Level Output	PWM	Level Input	ADC
1	3.3V	√	-	√	√
2	12V	√	-	-	-
3	12V	√	-	-	-
4	3.3V	√	√	√	-
5	3.3V	√	-	√	√
6	3.3V	√	√	√	-
7	3.3V	√	-	√	√
8	3.3V	√	√	√	-
9	3.3V	√	-	√	√