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Design shield of ESP8266 Nodemcu

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June 11, 2019

1 Introduction

1.1 Product Introduction

In this project, I designed a PCB shield for module ESP8266 Nodemcu to utilize the modules SIM800L, RFID, LCD and DHT11, combine together to create a complete circuit with a specified applications. My product can be used to measure the temperature and humidity in the environment, then send information through SMS or to the server. I also designed a menu and display all possible functions of the circuit on LCD for control easily.

1.2 Platform

My product is based on Arduino platform module ESP8266 Nodemcu is the main micro-controller of the system.

1.3 Function

- Read temperature and humidity from DHT11.
- Use Pin number or UID card to login/logout system.
- Send inform, sensor values to user through SMS.
- Send inform, sensor values to server through wifi.
- Add/remove UID member card.
- Store information when power off or reset the system.
- Get time from Internet and display Date/Month/Year and time.

1.4 Component

Components List					
No.	Name	Number	No.	Name	Number
1	ESP8266 Nodemcu	1	7	LM2596	1
2	RFID	1	8	Button	2
3	SIM800L	1	9	LED	1
4	LCD_I2C	1	10	Connector	1
5	DHT11	1	11	Capacitor	4
6	Resistor	5			

1.5 Overall schematic

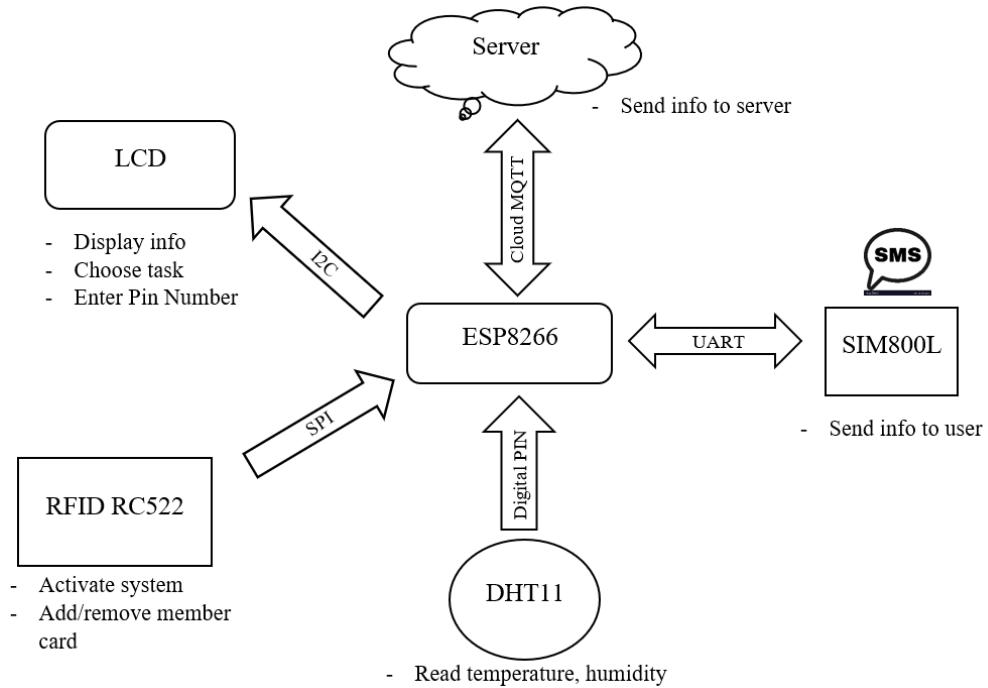


Figure 1: Overall schematic

2 Design

2.1 Power Supply

Since the system contains a large number of modules, I used a 12V DC from adapter for this circuit instead of using the power supply from USB. In addition, module SIM800L consumes up to 2A current then it needs a stable power supply. Therefore, I used module LM2596 to convert 12V DC to 4.3V DC with high current.

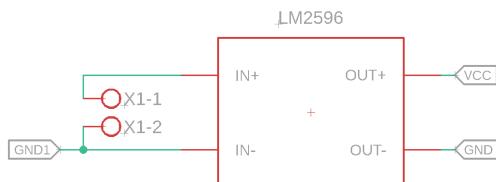


Figure 2: Power supply

2.2 LCD Display

In this system, to display value and menu, I chose the LCD display with the I2C converter to reduce the number of connecting pins. The ESP8266 Nodemcu interacts with LCD through I2C connection where the Nodemcu is master and LCD is slave.



Figure 3: LCD Display

2.3 Button

To control the system including choose method to login, switch menu, select tasks, ..., I used two buttons for two different functions. The first is for move the cursor (to scroll the menu, move up, move down) and the second is for select tasks. Two buttons are connected to analog Pin A0. By choosing different values of resistor, when we press, each button has different voltage level corresponding to analog value the microcontroller read from A0. Then it can detect which button is pressed and do the proper function.

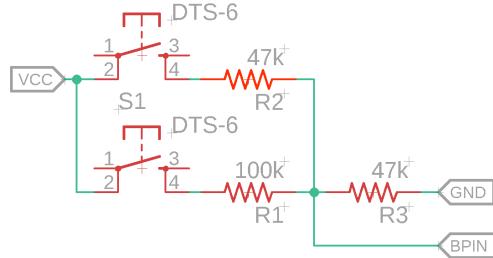


Figure 4: Button

2.4 Sensor DHT11

With the support of DHT11 library, we can read the value of temperature and humidity directly through a digital Pin.

2.5 RFID RC552

Module RFID interacts with Nodemcu through SPI. It is used to check the present of UID card, read or overwrite UID code. In this system, I used it to check master card and member card to login/logout system as well as add/remove member.

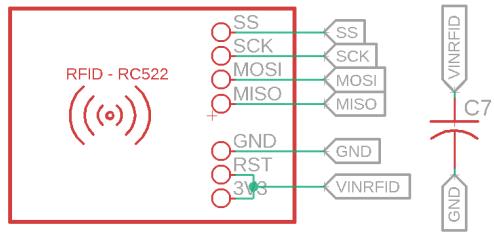


Figure 5: RFID RC552

2.6 SIM800L

To interact with this module, I used SoftwareSerial library to create virtual Serial port and connect through Serial Communication using TX and RX pins. Then we send AT commands to control this module.

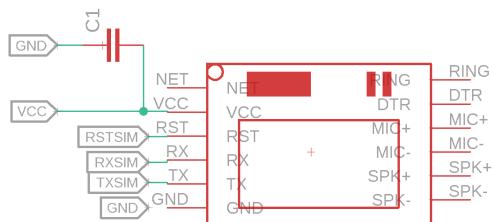


Figure 6: SIM800L

2.7 ESP8266 Nodemcu

I used this module as the main microcontroller that connects all other modules together, send commands to control the system. Moreover, with this module, we can access wifi and connect to the Internet. Based on this, I can send the data to the server (in details, I used the API Cloud MQTT) along with sending SMS to user.

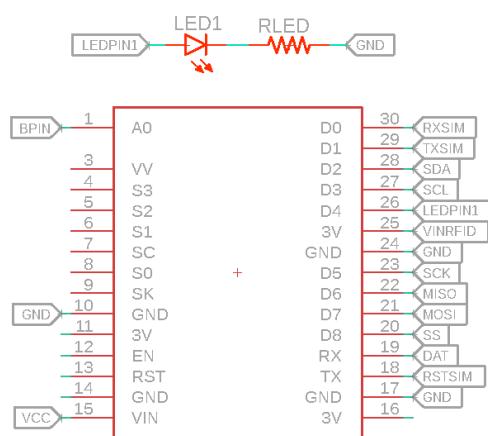


Figure 7: ESP8266 Nodemcu: microcontroller

3 Operation

3.1 Main system

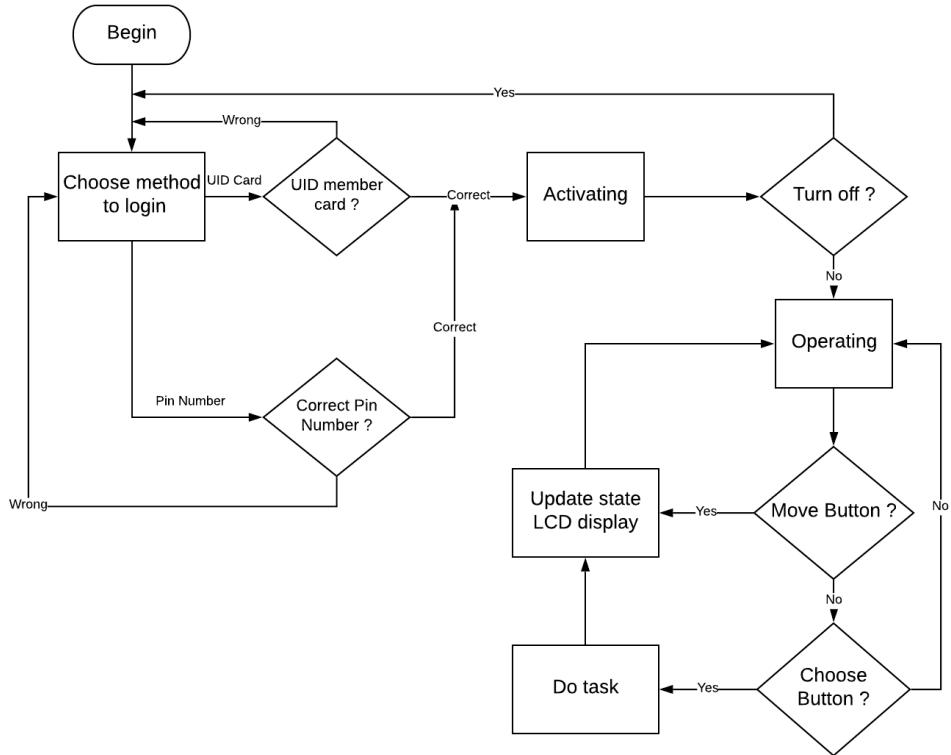


Figure 8: Main system flowchart

3.2 Finite State Machine model

I designed this system following the model of a finite state machine because it is easy to implement, control, extend or add new features. I divided into three main states:

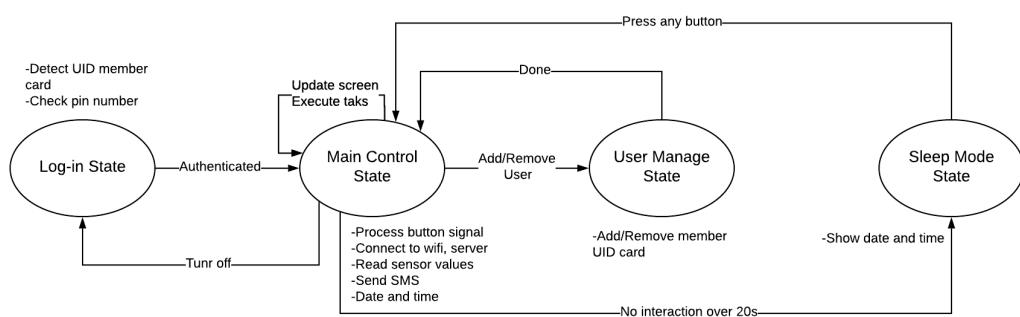


Figure 9: Finite State Machine model

4 Results

4.1 Schematic

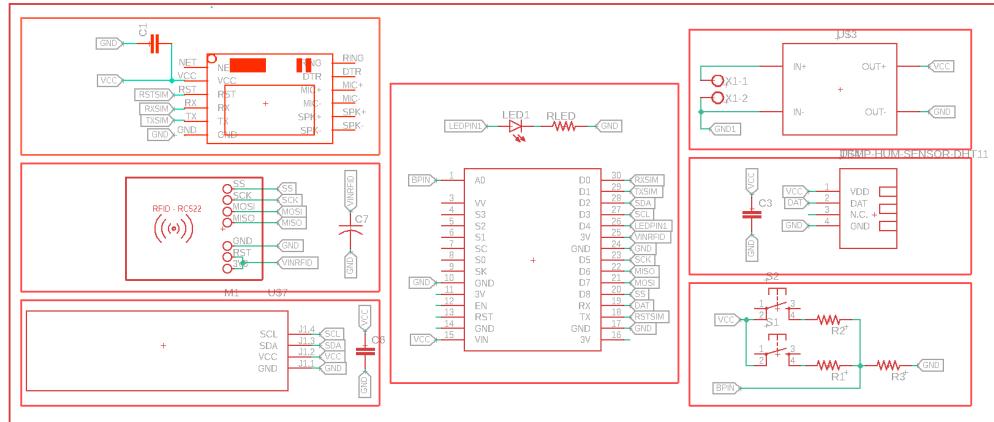


Figure 10: Schematic

4.2 PCB layout

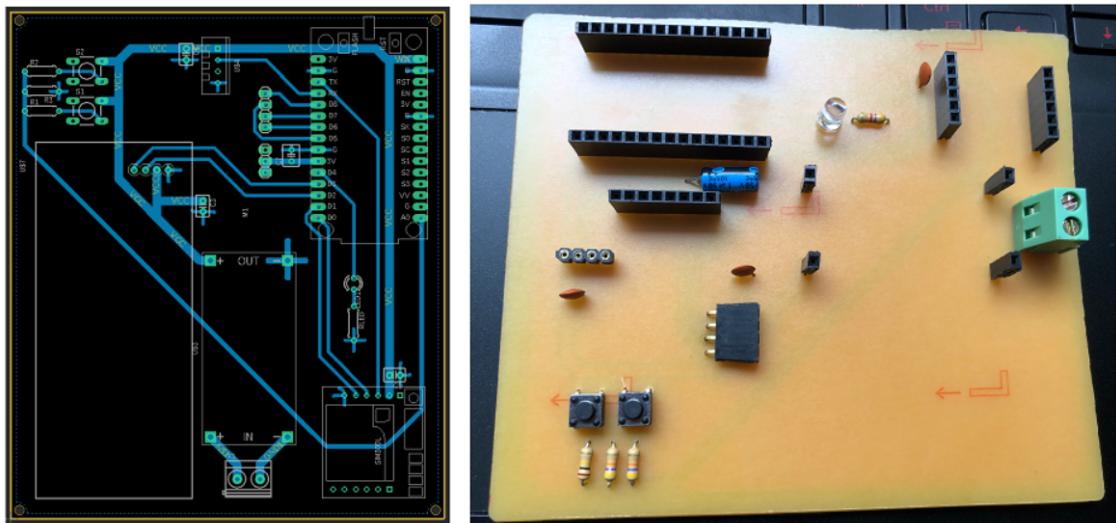


Figure 11: PCB layout

4.3 Product

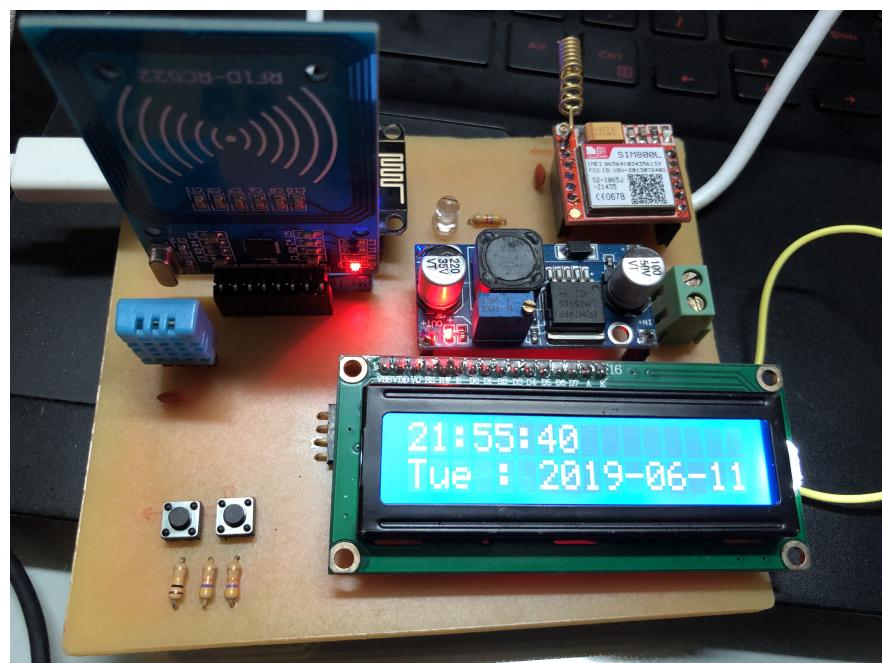


Figure 12: Product

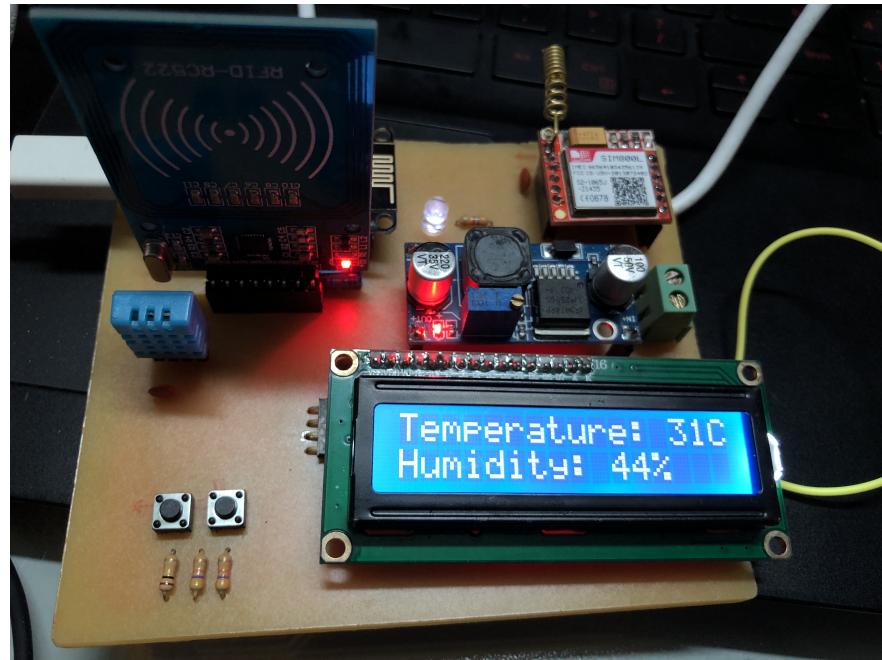


Figure 13: Product

5 Instruction manual

1. To power on system, press two buttons simultaneously, the LCD will bright and request user to authenticate to log-in.
2. To authenticate, insert valid UID card or enter Pin number.
3. Use two buttons to control the menu and choose the corresponding task: display temperature and humidity, send message to MQTT or to user by SMS, add / remove member card, display time and date.
4. To add/remove card, verify by using master card and User Control menu will occur in LCD.
5. To turn off the system, user can choose on menu, insert proper card to the RFID module or press two buttons.
6. If the system do not receive any command in 20 seconds, it will turn to sleep mode, LCD will display date and time, if any button is pressed, it will turn back to main menu.