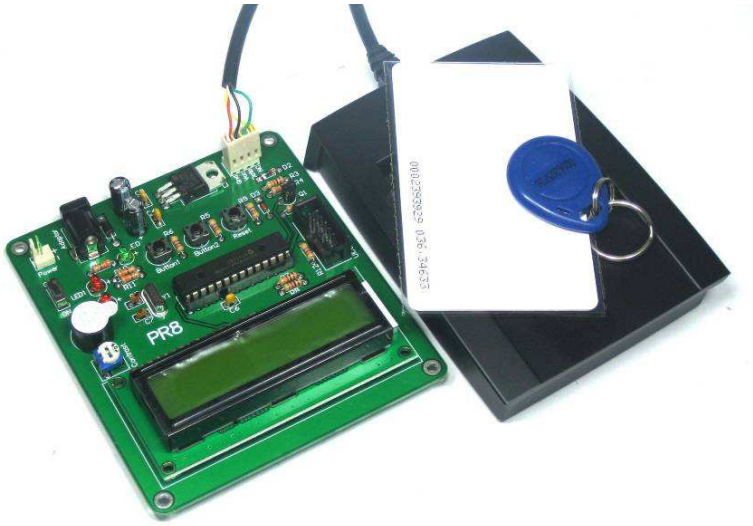
PR8-B

RFID: Read and Display V2010



Version 1.1

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Cytron Technologies Sdn. Bhd.

OVERVIEW

This document describes the development of Cytron Technologies DIY (Do It Yourself) Project No.8 (PR8-B RFID: Read and Display V2010). This project will use PIC16F876A and a RFID reader (RFID-IDR-232N) to control LCD (2x 16 characters), LED and buzzer. Circuit schematic and PIC source code will be provided.

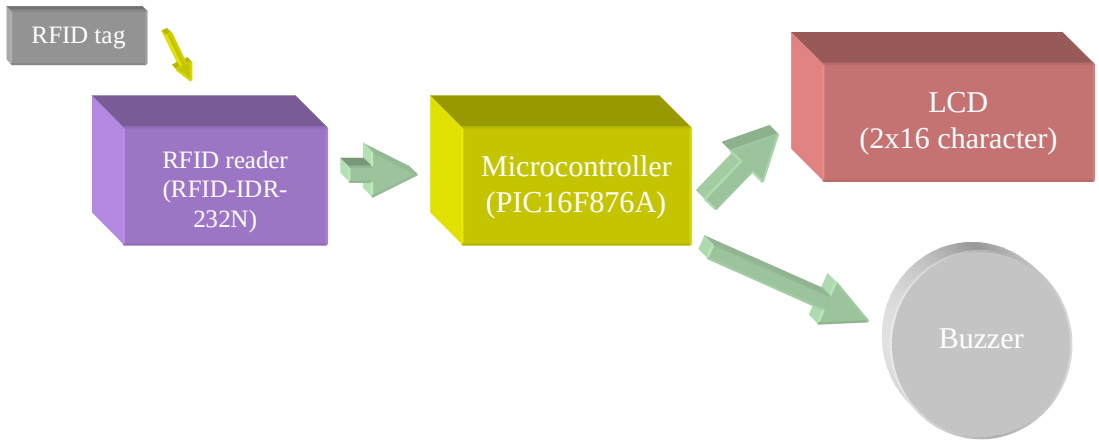
FEATURES

PIC16F876A
- 8-bit microcontroller with 22 I/O
- Operate with 5V supply
- Operating speed 20MHz

RFID reader RFID-IDR-232N
- RFID tag reader with serial UART output
- Operate with 5V supply
- Output baud rate 9600bps

LCD (2x 16 characters)
- 2x16 character display
- Operate with 5V supply
- Back light

SYSTEM OVERVIEW



When the RFID tag is place near the RFID reader, the RFID reader read the RFID tag, further sends the tag ID to the PIC microcontroller. PIC microcontroller process the tag ID, the user name and the tag ID will be display on the LCD display

GENERAL DESCRIPTION

Cytron Technologies offers several model of RFID reader. The most common and easy to use reader is RFID-IDR-232N. It read the RFID passive tag and sends the tag ID to PC or Microcontroller in serial communication.

RFID Reader (RFID-IDR-232N)

Figure 1

Specification:

RFID-IDR-232N is plug and play RFID reader. It has been designed with capabilities and features of:

- Low cost solution for reading passive RFID transponder tags.
- Industrial grade casing for better outlook and protection.
- Integrated RFID reader, LED, power cable and data cable.
- Every reader has been tested before it being shipped.
- **9600 baud** RS232 serial interface (output only) to PC.
- Fully operation with **5VDC** power supply.
- Buzzer as sound indication of activity.
- Red and green LED for visual indication of activity.
- Standard RS232 serial cable (female) ready to plug to desktop PC or Laptop.
- USB as power source from desktop PC.
- 2cm reading range.
- 0.1s response time.
- 12bytes of data received include start of heading, RFID ID and start of text

RFID-IDR-232N is fully working RFID tags reader and can be applied in:

- Security system.
- Car parking.
- Office.
- Hypermarket for item pricing.
- Student projects.

RFID-IDR-232N can be connected to PC or microcontroller as part of embedded system. In this project the reader will be interface to a microcontroller.

For more information, please refer http://www.cytron.com.my for RFID-IDR-232N User's Manual.

RFID-IDR-232N Protocol

RFID also known as Radio-frequency identification is an automatic identification method where the data is stored in the RFID tag. The RFID reader is a device that transmit radio frequency when powered ON. When the RFID tag is place near the RFID reader, the RDIF tag will receive the radio frequency via the antenna inside RFID tag. The radio frequency received will be converted into electrical power that is enough for the RFID tag to transmit the data back to the RFID reader. Further, the RFID reader will transmit the tag ID to PIC or PC via serial communication.

RFID-IDR-232N will read the ID from RFID tag if the tag is near enough to RFID Reader. The ID is normally 10 digit of number. RFID-IDR-232N will automatically send this ID with 1 byte of Start of heading (0x01), followed by 10 byte of ASCII character (ID) and 1 byte of Start of text (0x02). This protocol is only valid for RFID-IDR-232N. Different types of RFID reader sometimes have different protocol.

1 byte Start of heading	10 byte RFID ID	1 byte End of Text

The 1st byte will be read is "Start of heading" followed with 10 bytes of RFID Identification number. The last 1 byte is "Start of Text"

PIC16F876A

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 28-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices.

Feature of the device:

- 8 Kbytes of Flash Program Memory
- 1 Kbytes of Data Memory (RAM)
- 256 bytes of EEPROM data memory
- 5 channels of 10-bit Analog-to-Digital (A/D) converter
- 2 capture/compare/PWM functions
- MSSP (Master Synchronous Serial Port) can be configured as either 3-wire Serial Peripheral Interface(SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus
- Universal Asynchronous Receiver Transmitter (USART)

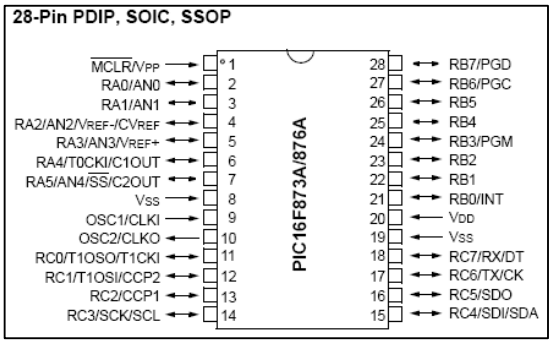


Figure 2

Figure 2 shows the pin diagram for PIC16F876A. For more information about the PIC microcontroller, please refer to the datasheet. The datasheet can be found in microchip web site at: http://www.microchip.com

HARDWARE

This project will require following hardware:

a. 1 x RFID reader, RFID-IDR-232N
b. 1 x PR8 Printed Circuit Board (PCB)
c. 1 x PIC16F876A
d. 1 x LCD (2x16 character)
e. Related electronic components

Please refer to Appendix A for the PCB layout of PR8. The PCB layout is provided free therefore Cytron Technologies will not be responsible for any further modification or improvement.

Interface RFID reader (RFID-IDR-232N) with PIC16F876A

The RFID reader comes with a cable for data communication. The cable is consist DB9 serial port for data communication to PC, RJ-11 connector to connect to RFID Reader and a USB connector to supply 5V for the reader.

For this project, user has to cut the wire of the DB9 Serial Port and connect the wire to a 2510-04 female connector. Table below is example of output wire when user cut the wire of female DB9 Serial Port.

Example of wire color output

Color	Pin function	Connection
Orange	Vcc	5V
Red	Tx	Data
Brown	Rx	NC
Black	Ground	GND

*NC = Not connected

However, user need to refer color figure 3 and table of output pin configuration for output color function. It is because different types of RFID reader sometimes have different color of output wire. Orange is not necessarily Vcc, red, brown and black also are not necessarily Tx, Rx and GND pin.

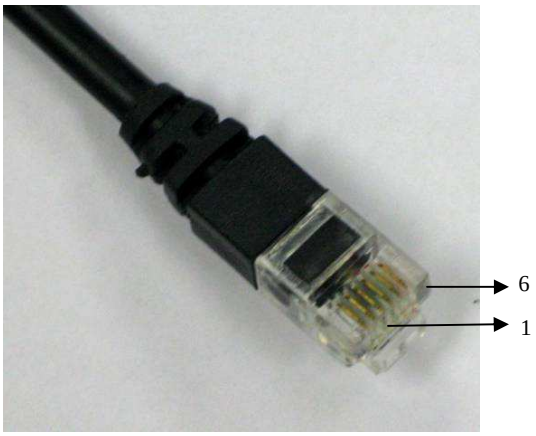


Figure 3

Pin	Pin function
1	**5V**
2	NC
3	NC
4	**Tx**
5	**Rx**
6	**GND**

Output pin configuration

After cut the female DB9 Serial Port, connect four of the wire to 2510-04 female connector according to the color of the wire on figure 3 and pin configuration. For example, from figure 3 pin 1 which is orange color will connect to Vcc of PR8, pin 4 which is red color will connect to data pin of PR8.

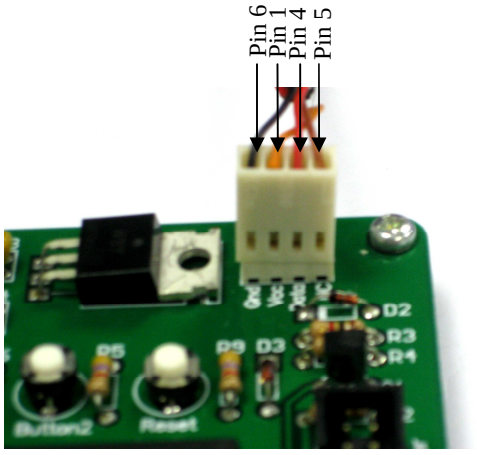


Figure 4

For more information about how to connect the wire to 2510-04 connector, please refer to getting start section.

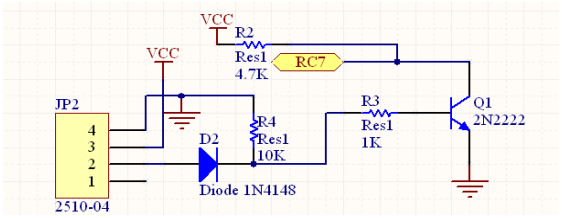


Figure 5

The output of the RFID reader is serial UART in logic +10V/-10V, and the baud rate is 9600bps. The Figure 5 shown is used to convert +10V/-10V logic to +5V/0V logic for PIC microcontroller.

Interface LCD (2x16 Character) with PIC16F876A

To use the LCD, user has to solder 16 pin header pin to it. LCD used in this project is JHD162A, for other type of LCD, please refer to its data sheet.

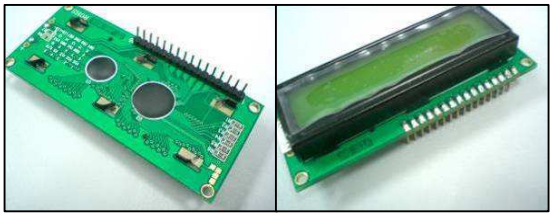


Figure 6

Figure 6 is a 2x16 character LCD. Figure 7 shows the connection of LCD to PIC microcontroller. LCD connection pin and function of each pin is shown:

Pin	Name	Pin function	Connection
1	VSS	Ground	GND
2	VCC	Positive supply for LCD	5V
3	VEE	Brightness adjust	Connected to a preset to adjust brightness
4	RS	Select register, select instruction or data register	RC3
5	R/W	Select read or write	RC2
6	E	Start data read or write	RC4
7	DB0	Data bus pin	RB0
8	DB1	Data bus pin	RB1
9	DB2	Data bus pin	RB2
10	DB3	Data bus pin	RB3
11	DB4	Data bus pin	RB4
12	DB5	Data bus pin	RB5
13	DB6	Data bus pin	RB6
14	DB7	Data bus pin	RB7

15	LED+	Backlight positive input	RC1
16	LED-	Backlight negative input	GND

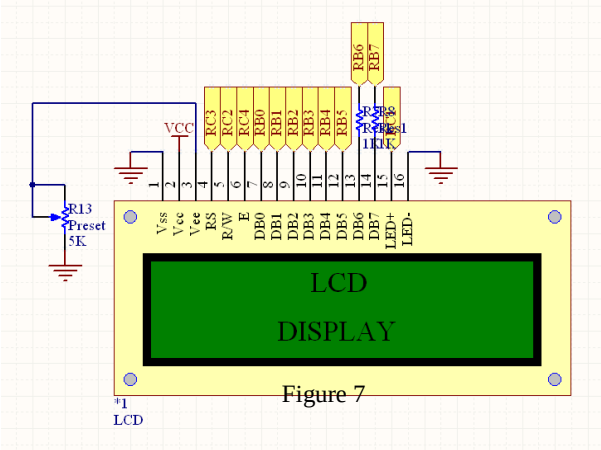


Figure 7

Power Supply for Board

User can choose either AC to DC adaptor (not included in the DIY project set) or 9V-12V battery (not included in the DIY project set) to power up the circuit. Higher input voltage will produce more heat at LM7805 voltage regulator. Typical voltage is 12V. Anyhow, LM7805 will still generate some heat at 12V. There are two types of power connector for the circuit, DC plug (J1) and 2510-02 (Power Connector). Normally AC to DC adaptor can be plugged to J1 type connector.

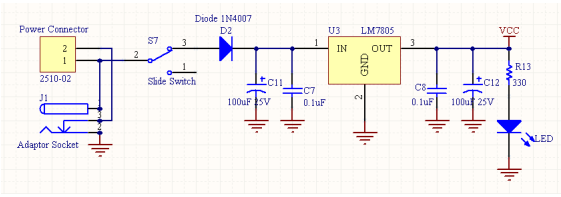


Figure 8

As Figure 8 shown, the D2 is use to protect the circuit from wrong polarity supply. C7 and C11 is use to stabilize the voltage at the input side of the LM7805 voltage regulator, while the C8 and C12 is use to stabilize the voltage at the output side of the LM7805 voltage supply. The LED is a green LED to indicate the power status of the circuit. R13 is resistor to protect LED from over current that will burn the LED.

Push Button as Digital Input

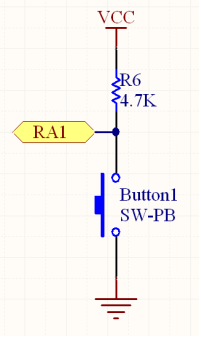


Figure 9

One I/O pin is designated for a push button as input of PIC microcontroller. The connection of the push button to the I/O pin is shown in Figure 9. The I/O pin should be pull up to 5V using a resistor (with value range 1K-10K) and this configuration will result an active-low input. When the button is being pressed, reading of I/O pin will be in logic 0, while when the button is not pressed, reading of that I/O pin will be logic 1.

LED as output for PIC microcontroller

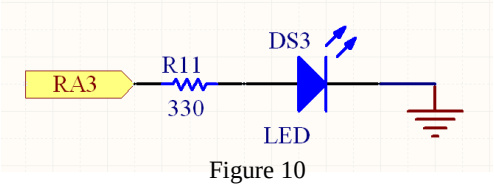


Figure 10

One I/O pin is designated for a LED as output of PIC microcontroller. The connection for a LED to I/O pin is shown in Figure 10. The function of R11 is to protect the LED from over current that will burn the LED. When the output is in logic 1, the LED will ON, while when the output is in logic 0, the LED will OFF.

Buzzer as output of PIC microcontroller

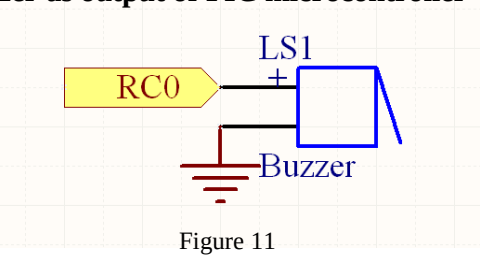


Figure 11

When the output is in logic 1, the buzzer will activate (beep), while when the output is in logic 0, the buzzer will deactivate.

In Circuit Serial Programming (ICSP)

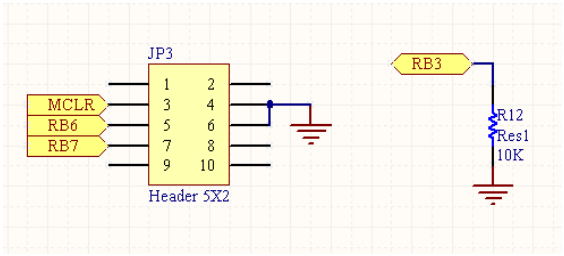


Figure 12

MCLR, RB6 and RB7 need to be connected to the USB In Circuit Programmer (UIC00A) to program the PIC microcontroller. At the same time, RB3 need to be pull low to 0V to disable low voltage programming, because the programmer is using high voltage programming. The programmer (UIC00A) is not included in DIY project set since it can be used several time for different project set. User can also choose other type of PIC programmer to load the program.

For the instruction of using PIC programmer, please refer to the particular PIC programmer user's manual.

For the instruction of using UIC00A/B, please refer to its user's manual at: www.cytron.com.my

The Function of Component on PCB

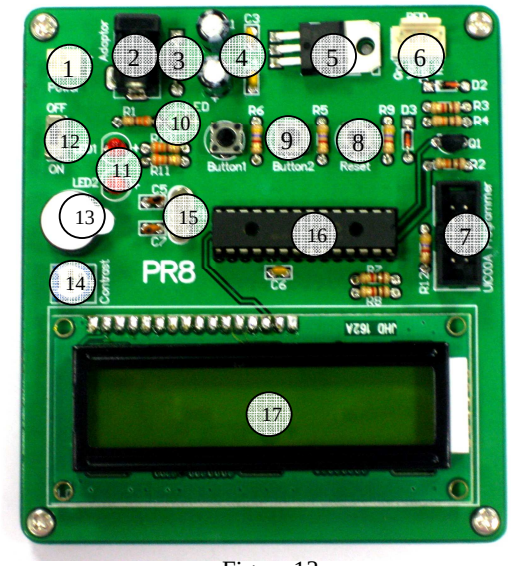


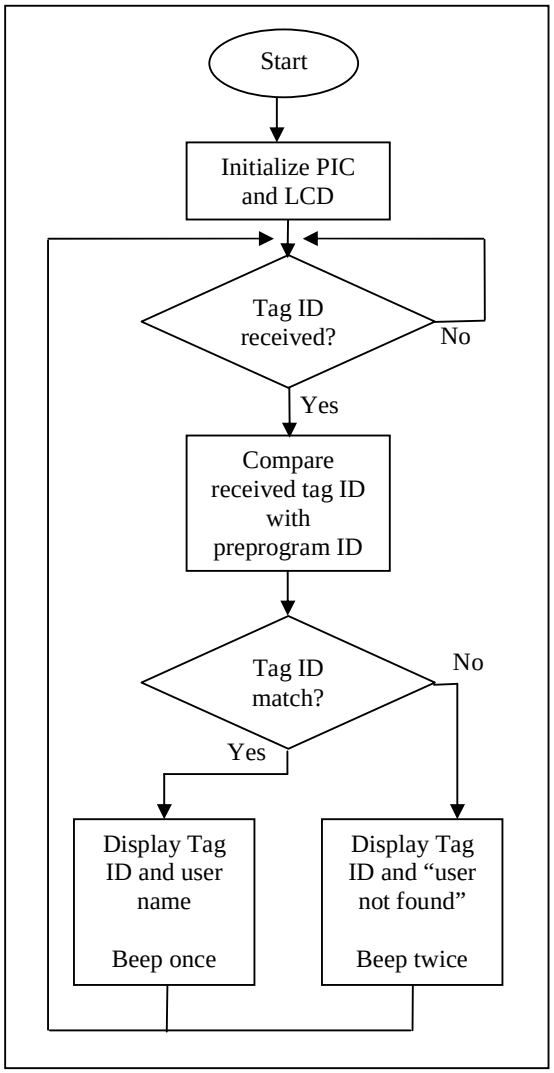
Figure 13

Component:

1. 2510-02 connector, (to use either 9V battery or 12V battery to power up the circuit).
2. AC-DC adaptor socket (to use power supply from AC-DC adaptor).
3. Diode (to protect the circuit from wrong polarity power input).
4. Capacitor (to stabilize the input and output voltage of the LM7805 voltage regulator).
5. LM7805 (voltage regulator, supply 5V for PIC).
6. 2510-04 connector for RFID reader.
7. ICSP box header (to connect to PIC programmer for loading program).
8. Reset button (to reset the microcontroller).
9. Push button.
10. Power indicator LED (to indicate the power status of the circuit).
11. LED status indicator.
12. Slide switch (to ON or OFF the circuit).
13. Buzzer.
14. Preset (to adjust the brightness of the LCD).
15. Crystal (20MHz).
16. PIC 16F876A (the main brain of the system).
17. LCD.

SOFTWARE

Flow Chart:



For more information about the software of this system, please refer to the source code provided. The explanation of each instruction is provided in the source code as the comment of each line.

The source code is provided free and Cytron Technologies will not be responsible for any further modification or improvement.

GETTING STARTED

User can obtain the hardware set for this project (PR8-B RFID: Read and Display V2010) either by online purchasing (www.cytron.com.my) or purchase it in Cytron Technologies Shop.

1. Once user has the hardware set, component arrangement and soldering can be started. Please solder the electronic components one by one according to overlay label (white color) on PCB surface. Ensure the component value and polarity is correctly mounted. Please refer to board layout in Appendix A.

Caution: Make sure all the connectors (2510) are soldered in proper side. Electronic components which have polarity such as capacitor, diode, PIC, LM293D, and LED should be soldered in proper orientation else it will cause component failure further board failure.

Warning: Before the battery (Power) is plugged in, make sure the polarity of critical component is correctly soldered to prevent any explosion. Wrong polarity of electrolytic capacitor may cause explosion.

2. Connect the RFID reader to 2510-04 connector.

Connect the wire to 2510-04 connector:

The wire have to be soldered to the 2510 iron pin and plug the soldered iron pin into 2510-04 connector according to the color shown in Figure 13.

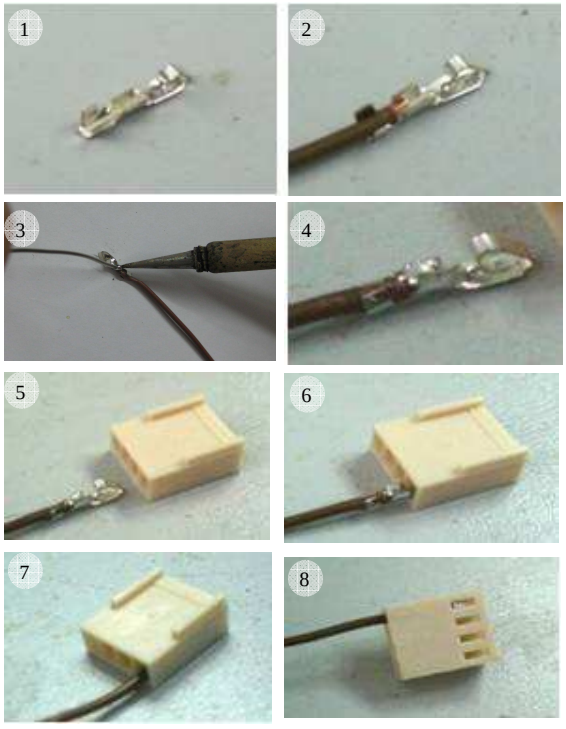


Figure 14

3. Please download the necessary files from Cytron Technologies website, www.cytron.com.my. These include Details Description (this file), sample source code, schematic and necessary software.

4. The next step is to install MPLAB IDE and HI-TECC C PRO (operating in Lite mode) into computer. The MPLAB IDE and HI-TECC C PRO can be downloaded from www.cytron.com.my . Please refer MPLAB IDE installation step document to install the software. The documents can be used for any version of MPLAB IDE software.

5. After the installation complete, open the project file provided using MPLAB IDE. Please refer MPLAB Open Project document to open the sample program.

6. **Please modify the tag ID in the program same as the tag ID that you want to read.** This step is to allow the system to remember the ID.

7. Plug in power supply for the circuit. User can choose to use battery or AC to DC adaptor.

AC to DC adaptor:

Figure 15 (Not included in DIY project set)

9V battery connector:

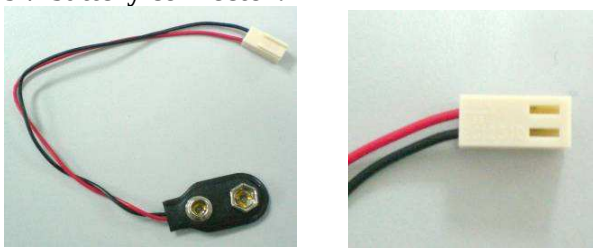


Figure 16

Connection to the PCB board:

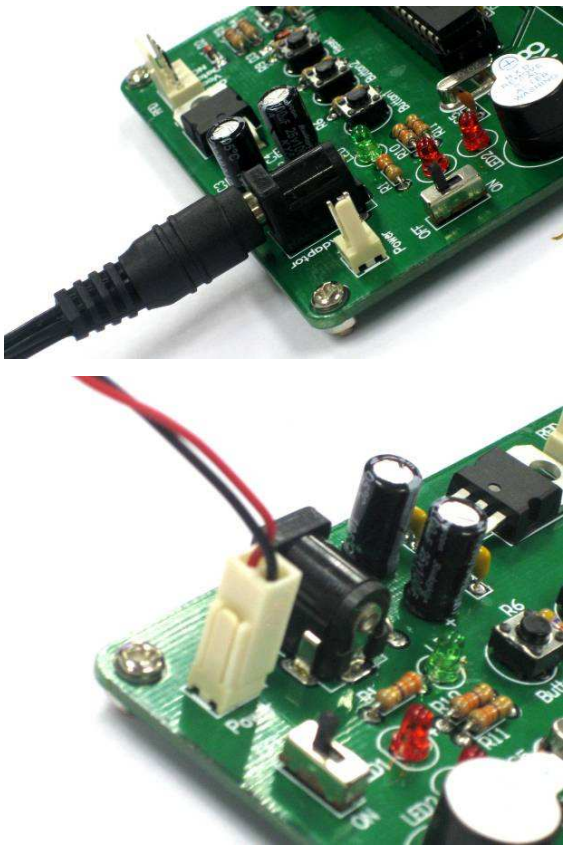


Figure 17

8. Build the project and load the hex file into the PIC microcontroller using the USB In Circuit Programmer (UIC00A). When user build the project, MPLAB IDE will generate hex file. The hex file generated from MPLAB IDE will be named according to project name, not C file name. Cytron Technologies also provide hex file for user. Do not forget to switch ON the power. The programmer is not included in the hardware set but it can be found at Cytron website. (User manual is provided at website).

9. Test the functionality of the PCB board.

10. Modify the program.

11. Have fun!

TEST METHOD

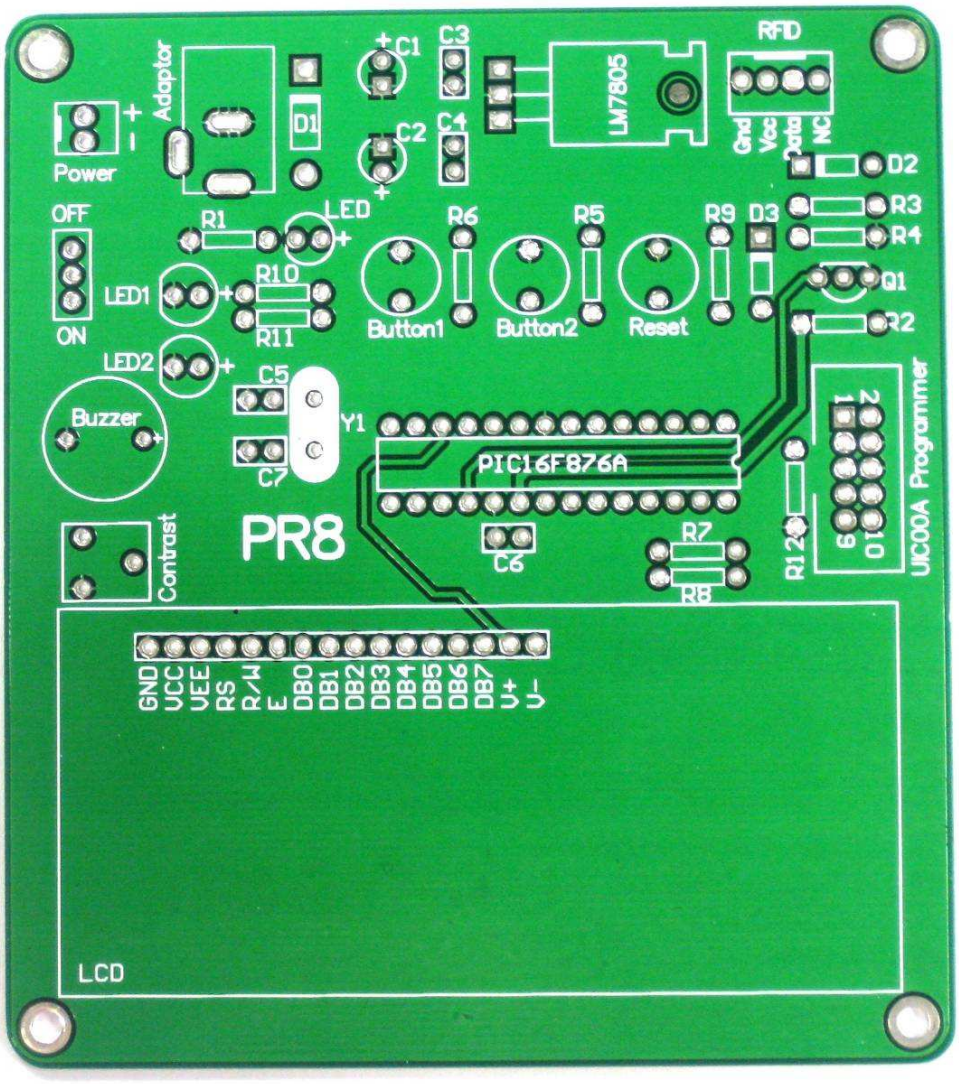
1. Switch ON the power
   - Power Led (Green) will turn ON.
   - LCD will show “RFID door security”
   - After a few second it will change to “Place your ID on the reader”
2. Place the card on RFID
   - LCD will show “ID : _ _ _ _ _ _ _ _ user not found”
   - After a few second it will change again to “Place your ID on the reader”
3. If all steps mention above can be executed, your project is done successfully. Congratulations!!

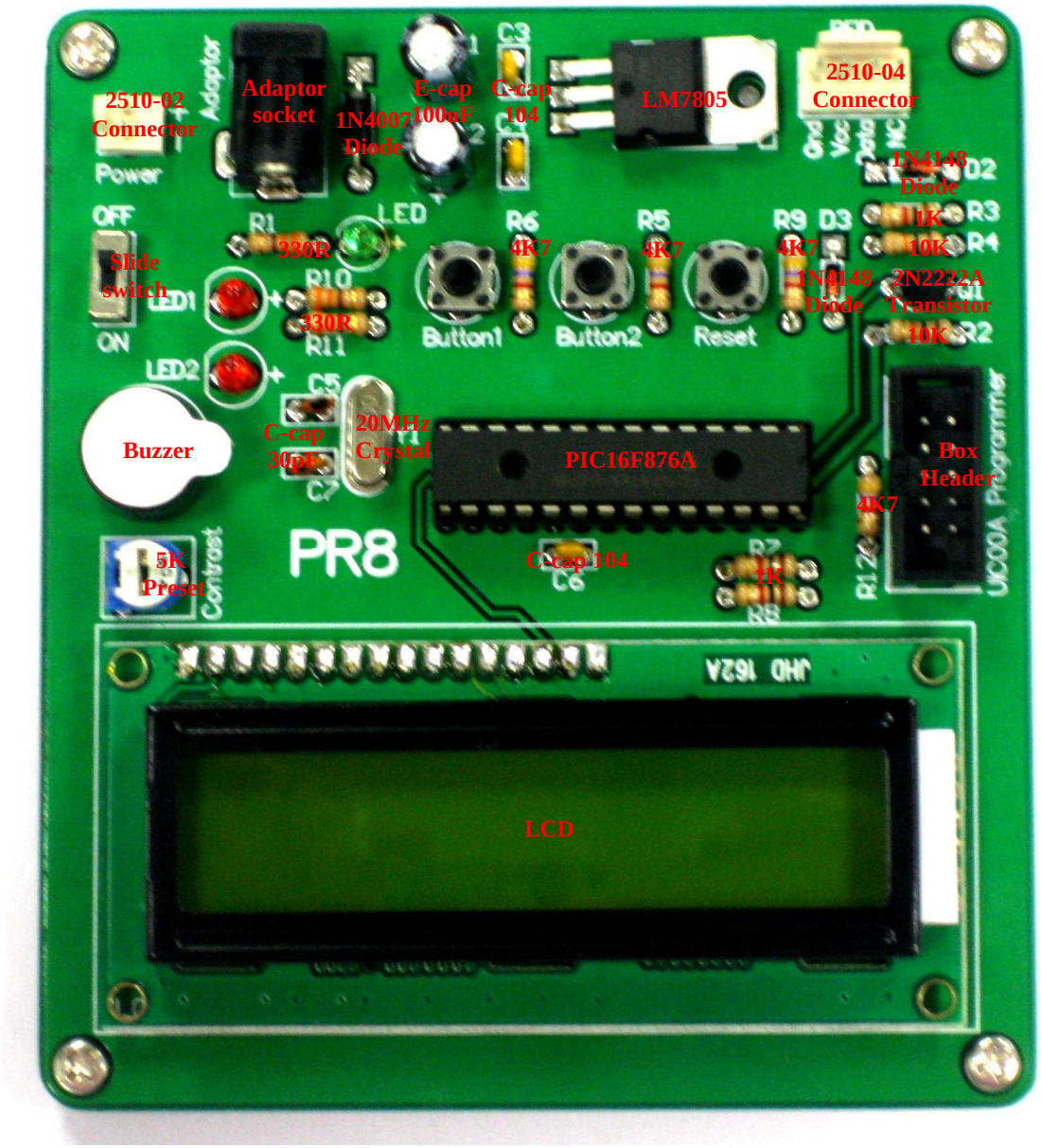
WARRANTY

No warranty will be provided as this is DIY project. Thus, user is advice to check the polarity of each electronic component before soldering it to board

Appendix A

Board Layout:





*** Cytron Technologies reserved the right to replace the component in the list with component of the same functionality without prior notice.**

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