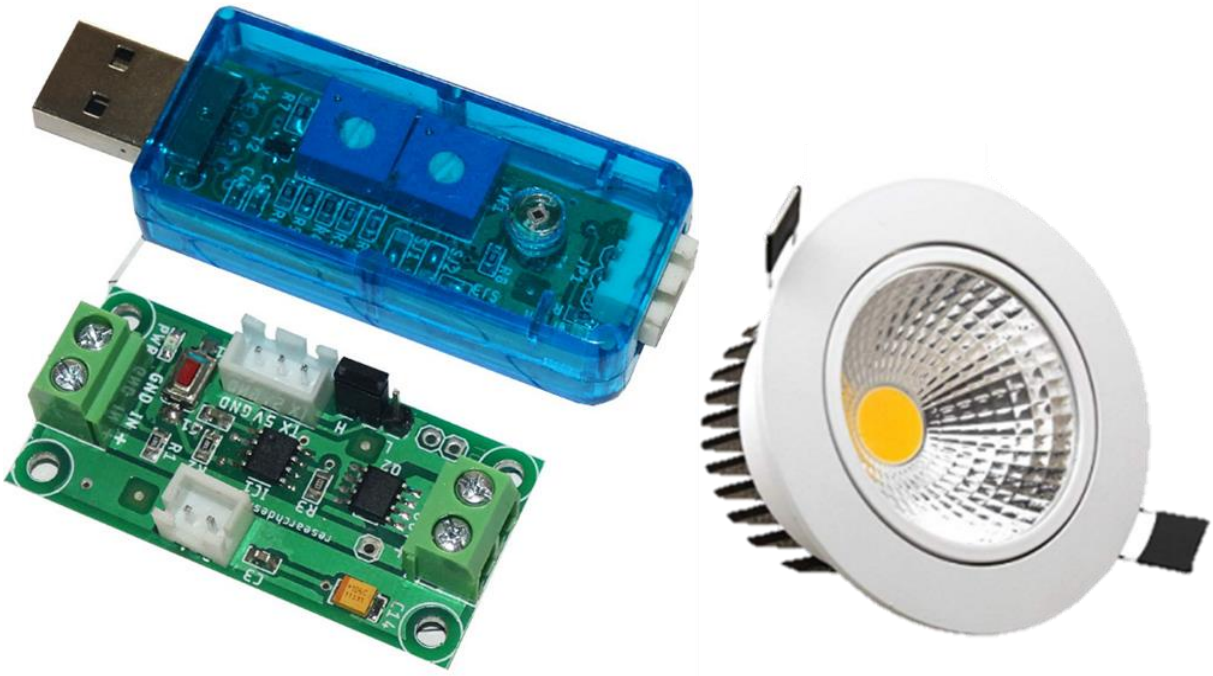
Research
Design Lab



LiFi Nano V2

ORDER CODE: RDL749

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1. Overview

R-LiFi Nano v2 is an easy-to-use, plug-and-play evaluation platform for a wide array of visible light communication applications in consumer, wearable, industrial, medical and Internet of Things (IoT) markets. LiFi Nano consists of two modules, LiFi transmit module connected to the lighting LED and LiFi receive module connected to the host communicating system.

LiFi Nano V2 transfers data from one source to another through visible light without the flickering effect. Technically, 1's (LED on) and 0's (LED off) are transmitted at very high speed where human eye cannot notice the visual flickering effect.

LiFi Nano V2 is used in such areas where radio wave transmission is strictly prohibited. LiFi Nano V2 can be used indoor navigation, under water application and location based service application.

2. Features

- Supports baud rates up to 38400 to 115200.
- Support serial(UART) communication
- Supported distance from the ceiling 6 to 15 feet max.
- Plug-and-Play with simple configuration.
- Ceiling / wall mounting LED light can be used for the communication.

Fig. 1 (Transmitter Board)

Fig. 2 (Receiver Board)

3. Application

- **Security** - Area of interest can be securely focused with higher data rates.
- **LiFi Device can be used EMI sensitive environments.**
- **Augmented reality** - In museums and galleries Li-Fi enabled lighting can provide localized information within that light.
- **Localized advertising** - Shop display lighting can be used to transmit advertising information on the goods being viewed.
- **Underwater communication –** Data can be transmitted under the water with the help of light.
- **Safety environments** - In explosion hazard environments, where the use of electrical equipment, including mobile phones, is generally greatly restricted.
- **Intelligent transportation systems** - AGV (auto guided vehicle).
- **Connectivity** - Sensor area network can be created.
- **Sensitive data** - Better deployment of secure networked medical instruments, patient records, etc.
- **Indoor navigation –** LiFi enabled lamps can be fixed in indoor places for data transmission.
- **Dense urban environments** - Dense urban environments by their nature tend to have complete artificial lighting coverage. This lighting infrastructure can provide always available high data rate access for users as they move through that environment.

4. System Requirements and Accessories

- Windows® OS (XP, 7, 8) /LINUX/MAC O.S
- USB type A to B mini cable.
- FT232 board.
- Jumper.
- Jumper wires.
- 16 Watt LED with driver.

5. Module Description

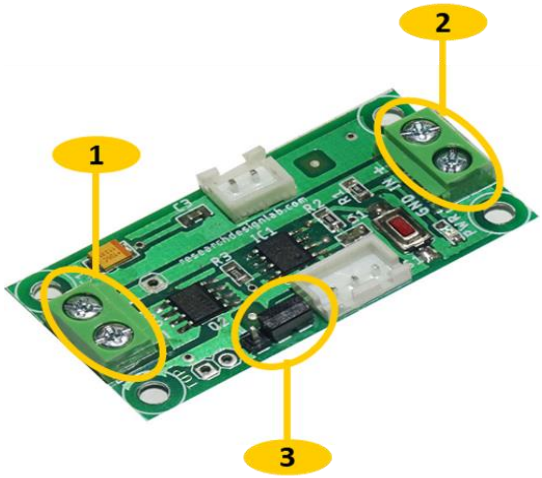


Fig. 3 Transmitter Module

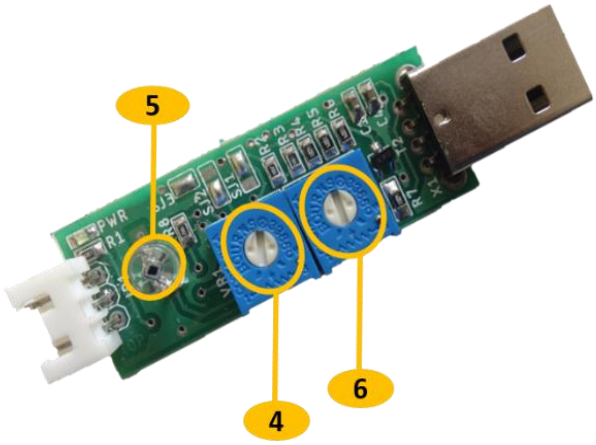
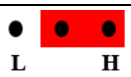


Fig. 4 Receiver Module

1. VIN
2. LED OUT
3. Jumper setting for TX to for CONFIG/RUN mode.

L	CONFIG	
H	RUN	

4. Fine tuning POT.
5. Photo diode.
6. Height adjustment POT.

6. Specification

6.1. LiFi Transmitter Specification

	Transmitter
Module Version	V2
Operating Current	50 mA
Operating Voltage	12V
Power Consumption	0.6 Watt
Communication Source LED	18 Watt
Communication Protocol	Serial
Baud Rate	38400 bps
Constant Current Power Supply for LED	18 Watt
USB	2.0
Dimension	24x48x12 mm
Weight	15 g

6.2. LiFi Receiver Specification

	Receiver
Module Version	V2
Operating Current	50 mA
Operating Voltage	5V
Power Consumption	0.25 Watt
Communication Source	Photodiode
Communication Protocol	Serial
Baud Rate	38400 bps
Dimension	23x67x19 mm
Weight	15g

7. Hardware Description

7.1. Power Supply (Transmitter)

12/24 V DC is provided through Vin pin.

7.2. Jumper

Connecting jumper on Low side (indicating ‘L’ on the transmitter module) puts the transmitter module in CONFIG mode. And connecting jumper on High side (indicating ‘H’ on the transmitter module) will put the transmitter module to RUN mode. In the receiver module the jumper setting will always be in RUN mode i.e jumper is always connected towards High (towards ‘H’ on the module).

7.3. LED

OUT + is connected to LED + and OUT – is connected to LED. Higher intensity LED leads to long communication distance.
Note: Do not reverse the LED polarity.

7.4. Potentiometer

Varying pot configures the module to correct distance and accuracy. Pot is adjusted when the transmitter is kept in configuration mode. When the transmitter is run mode, the pot should be varied.

8. Interfacing with PC

PC to PC communication is possible with LiFi Nano V2 transmitter and receiver module. Data is sent from one PC to LiFi transmitter and the same data is received in another PC from LiFi receiver. An example of this application circuit connection along with the code is shown in the following section. Fig. 5 shows the LiFi Nano transmitter connection.

8.1. Transmitter:

Transmitter Circuit Diagram:

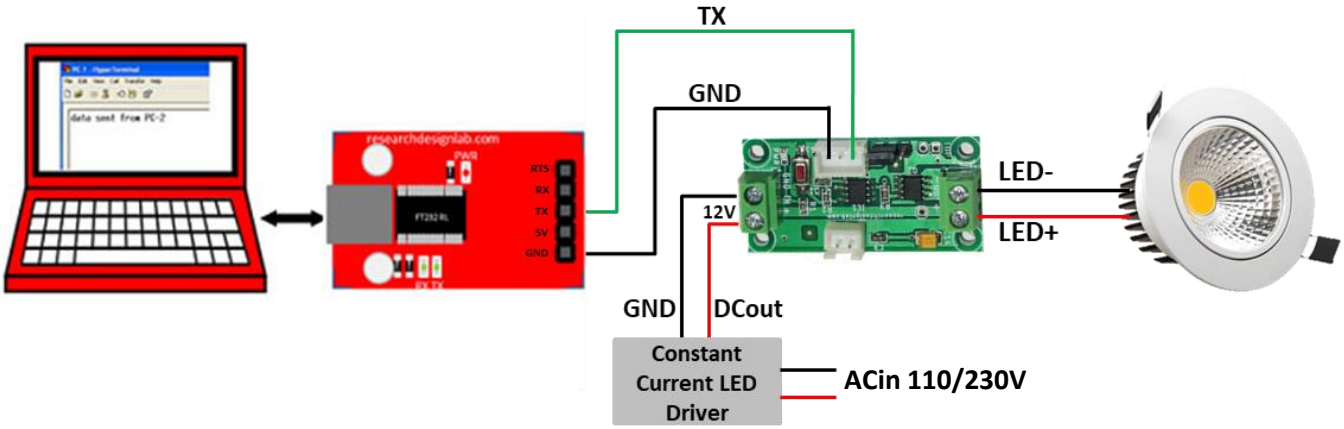


Fig. 5

8.2. Receiver:

Receiver Circuit Diagram:

Fig. 6

9. Working Steps

Step 1:

- Connect the TX, GND of Transmitter module to TX, GND of FT232 respectively.
- Connect Vin to LED driver DC out.
- Connect the receiver module to your PC.
- Please refer Fig. 5 and Fig. 6 for hardware connection.

Step 2:

- In transmitter module put the jumper toward Low(L), which will put the transmitter in CONFIG mode. Observe LED intensity going low in CONFIG mode.
- In transmitter module put the jumper toward High(H), which will put the receiver in RUN mode.

- Make sure photo sensor is open for communication.
- Open Serial terminal window in PC.
- Focus LED on receiver module.
- Keep adjusting both the pots until you find “U” displaying in serial window as shown in Fig. 7.

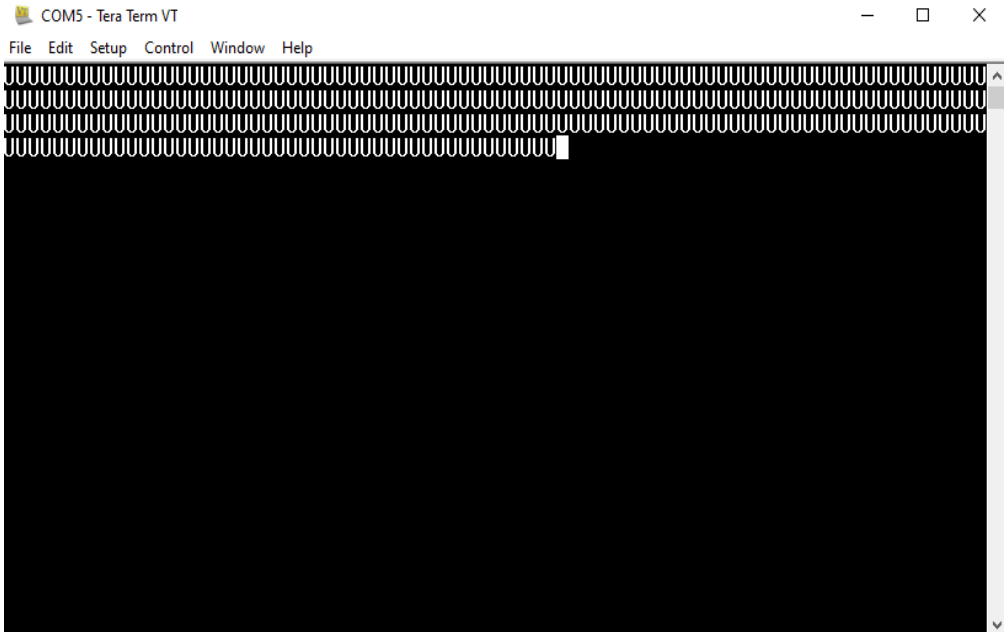


Fig. 7

- Also notice that the communication happens only when the LED is focused on the receiver module.

Step 3:

- In transmitter module put back the jumper towards High, which configures transmitter in run mode.
- Focus LED on receiver module.
- Notice that the serial monitor will receive text “researchdesignlab.com” when light is fallen on the hardware as shown in Fig. 8.

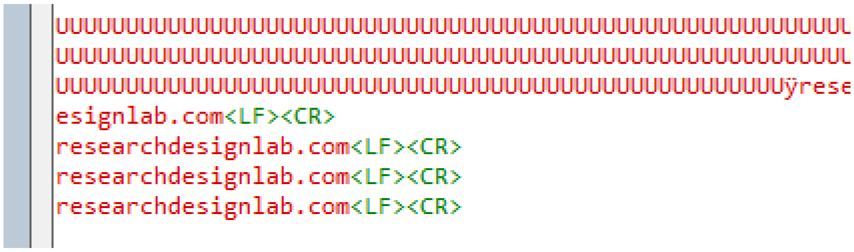


Fig. 8

Step 4:

- Send data through transmitter serial window.
- Data sent from transmitter window is displayed in receiver window.

10. Interfacing with Arduino

In this section an example circuit connection along with the code is shown for interfacing the LiFi Nano with the Arduino UNO. Fig. 7 shows the transmitter hardware connection for LiFi Nano interface with Arduino UNO and Fig.8 shows the receiver hardware connection for LiFi Nano interface with Arduino UNO

10.1. Transmitter:

Transmitter Circuit Diagram:

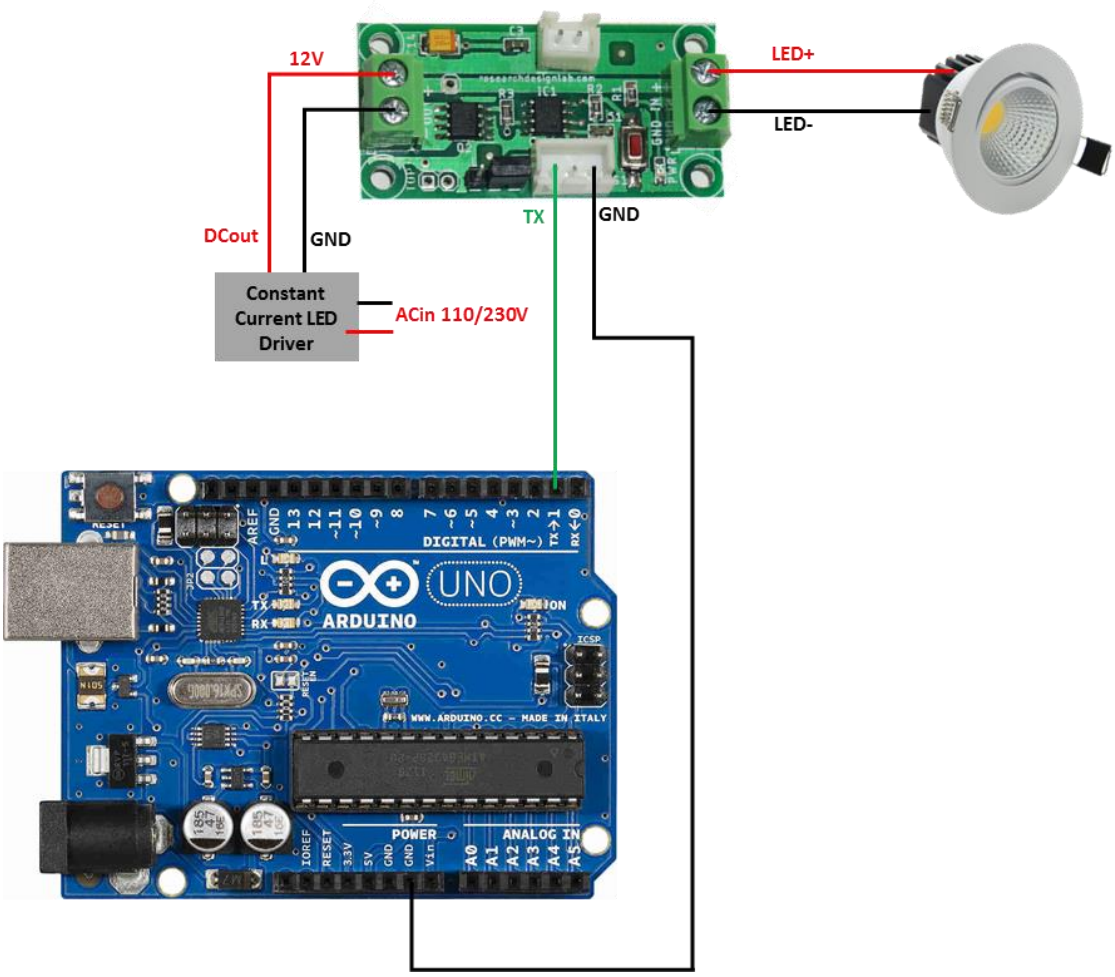


Fig. 9

Transmitter Code:

```
void setup()
{
  // Open serial communications and wait for port to open:
  Serial.begin(38400);
  while (!Serial) {
    ; // wait for serial port to connect. Needed for Leonardo only
  }

}

void loop() // run over and over
{
  if (Serial.available())
  Serial.write(Serial.read());
}
```

10.2. Receiver:

Receiver Circuit Diagram:

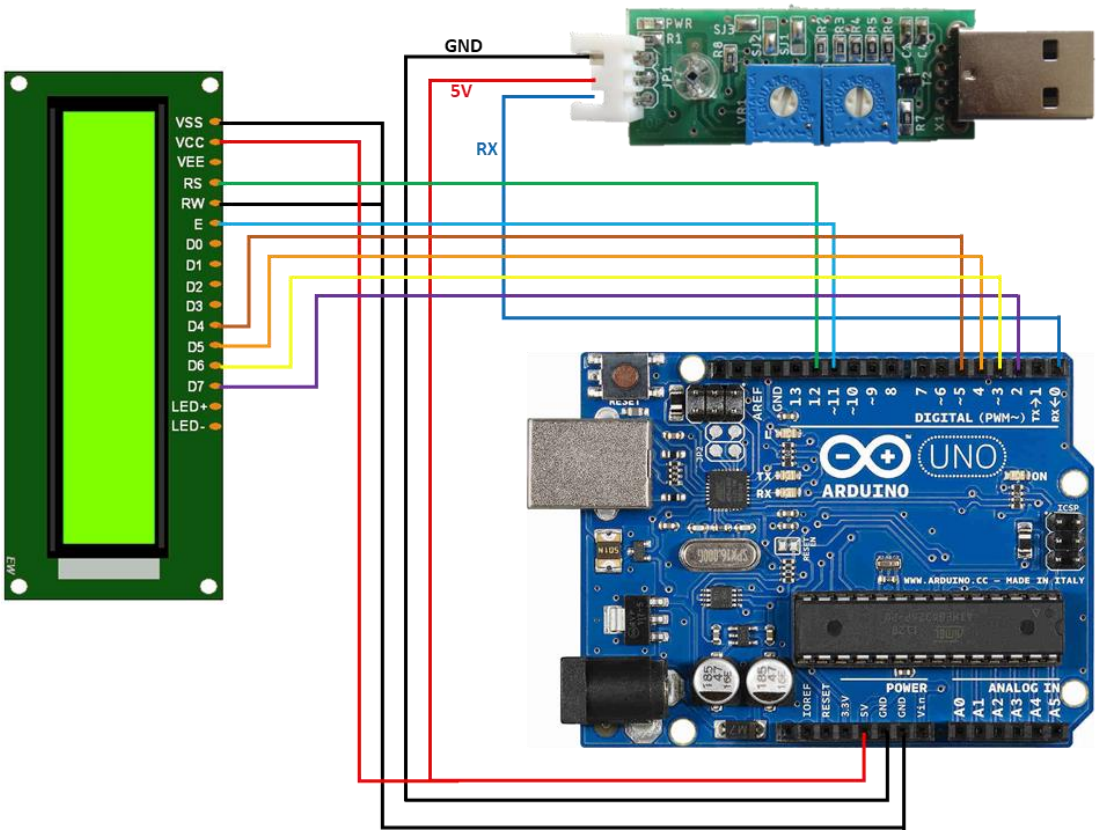


Fig.10

Receiver Code:

```
// include the library code:
#include <LiquidCrystal.h>

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  // initialize the serial communications:
  Serial.begin(9600);
}

void loop() {
  // when characters arrive over the serial port...
  if (Serial.available()) {
    // wait a bit for the entire message to arrive
    delay(100);
    // clear the screen
    lcd.clear();
    // read all the available characters
    while (Serial.available() > 0) {
      // display each character to the LCD
      lcd.write(Serial.read());
    }
  }
}
```

11. Interfacing with Raspberry Pi

By remote Login via SSH data can be sent from Raspberry Pi 3 to LiFi Nano transmitter. By using another Raspberry Pi the data can be received from LiFi Nano receiver. Fig. 11 shows the transmitter circuit connection for LiFi Nano with Raspberry Pi. And Fig. 12 and Fig. 13 shows the receiver circuit connection for LiFi Nano with Raspberry Pi.

11.1. Transmitter:

Transmitter Circuit Diagram:

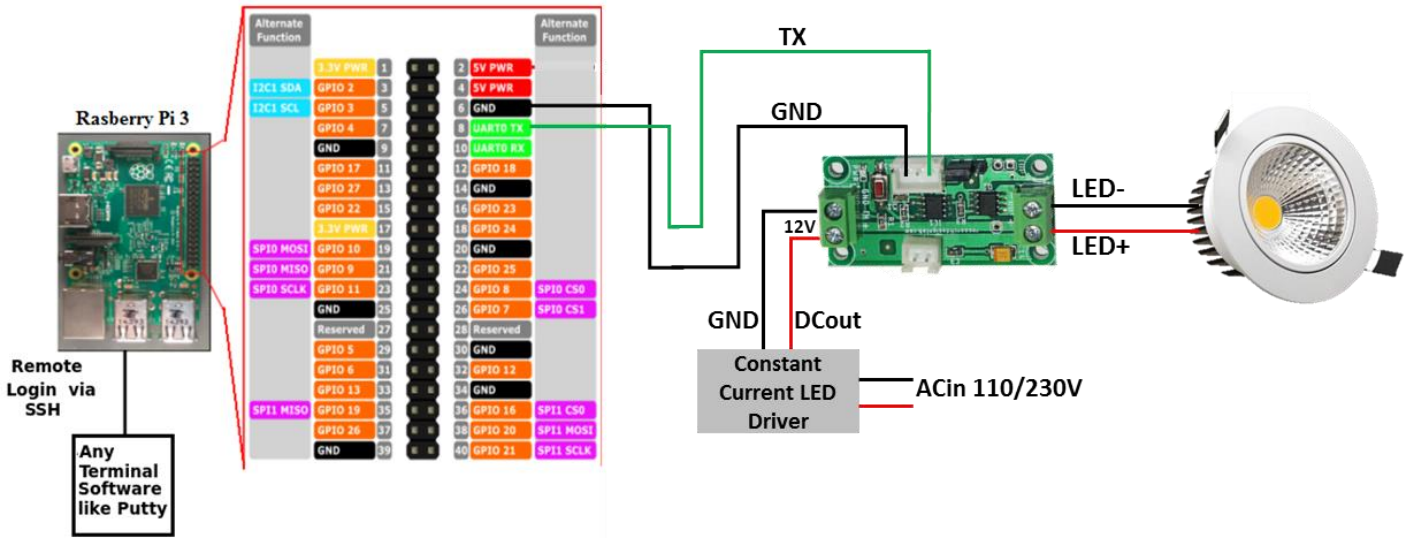


Fig. 11

Transmitter Code:

```
import time
import serial

ser = serial.Serial('/dev/ttyS0',38400)

while 1:

  input_var = raw_input("Enter the data to transmit: ")
  ser.write(input_var)
  time.sleep(1)
```

11.2. Receiver:

It is possible to interface the module with Raspberry Pi in two methods

i. Interfacing using USB, as shown in Fig. 12
ii. Interfacing through Serial, as shown in Fig. 13

Receiver Circuit Diagram:

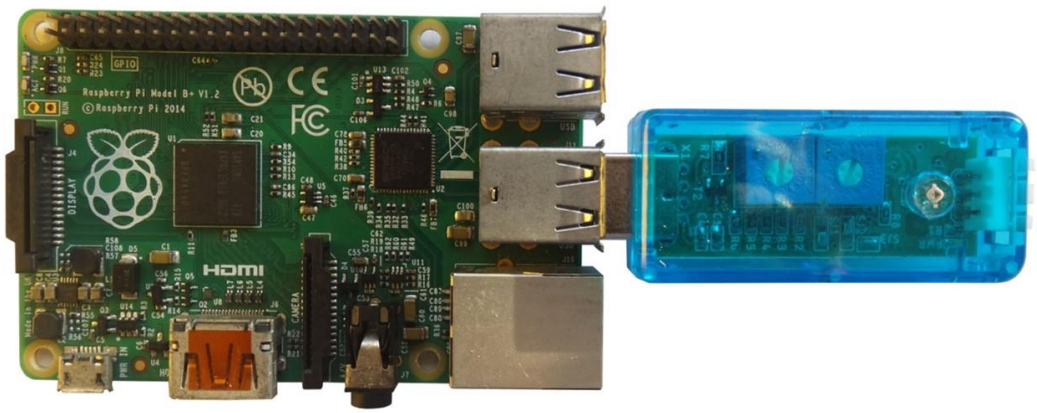


Fig. 12

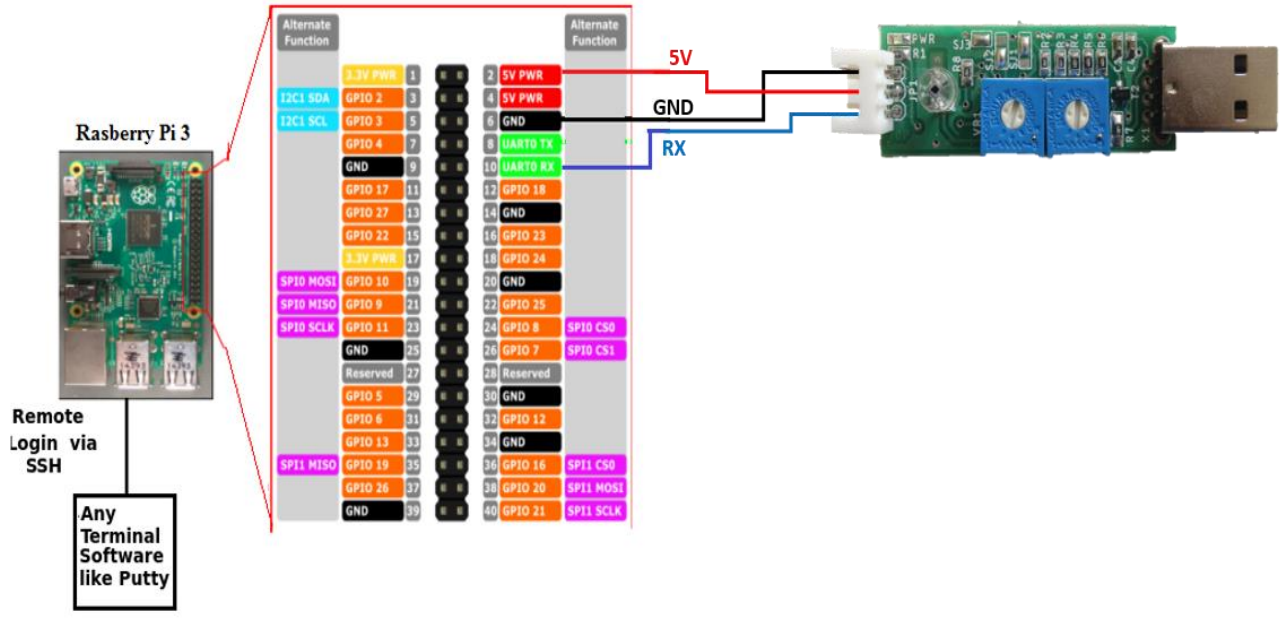


Fig. 13

Receiver Code:

```
#!/usr/bin/env python
import time
import serial

ser = serial.Serial(
        port='/dev/ttyS0',
        baudrate = 38400,
        parity=serial.PARITY_NONE,
        stopbits=serial.STOPBITS_ONE,
        bytesize=serial.EIGHTBITS,
        timeout=1
)
ser.write('Hello World\r\n')
ser.write('Serial Communication Using Raspberry Pi\r\n')

while 1:
   x=ser.readline()
   print x
```

Step 1:

- Before working on it Copy the code given below in Raspberry Pi terminal

```
sudo systemctl stop serial-getty@ttyS0.service
sudo systemctl disable serial-getty@ttyS0.service
```

12. Data Transmission over RS485 Bus

Transmit the data over RS485 bus to the multiple Slave/LiFi nodes by selecting the address.

Wiring Diagram:

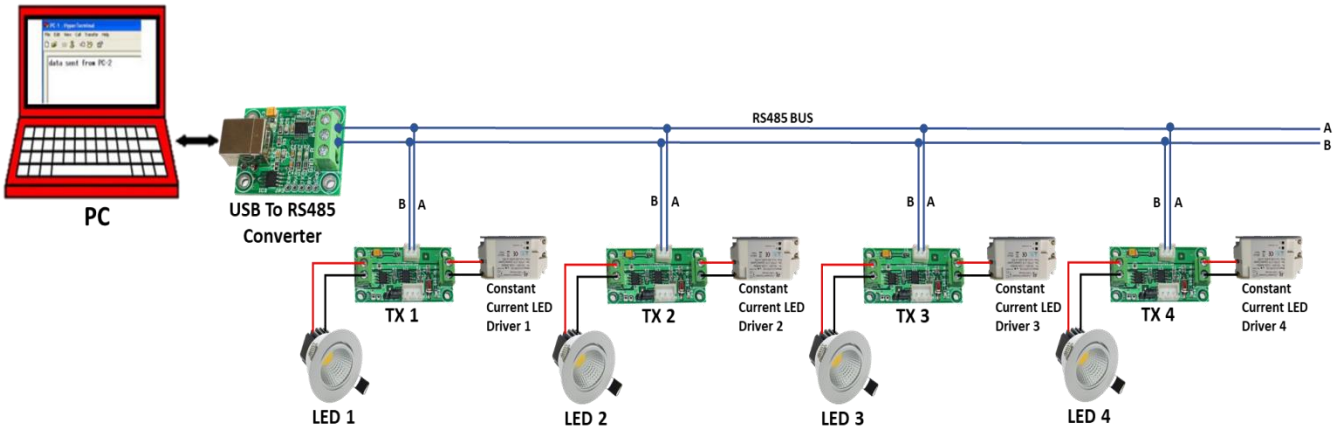


Fig. 14

13. LiFi Navigation

In LiFi navigation mode, each transmitter node can be set for predetermine location proof broadcasting at set intervals.

Wiring Diagram:

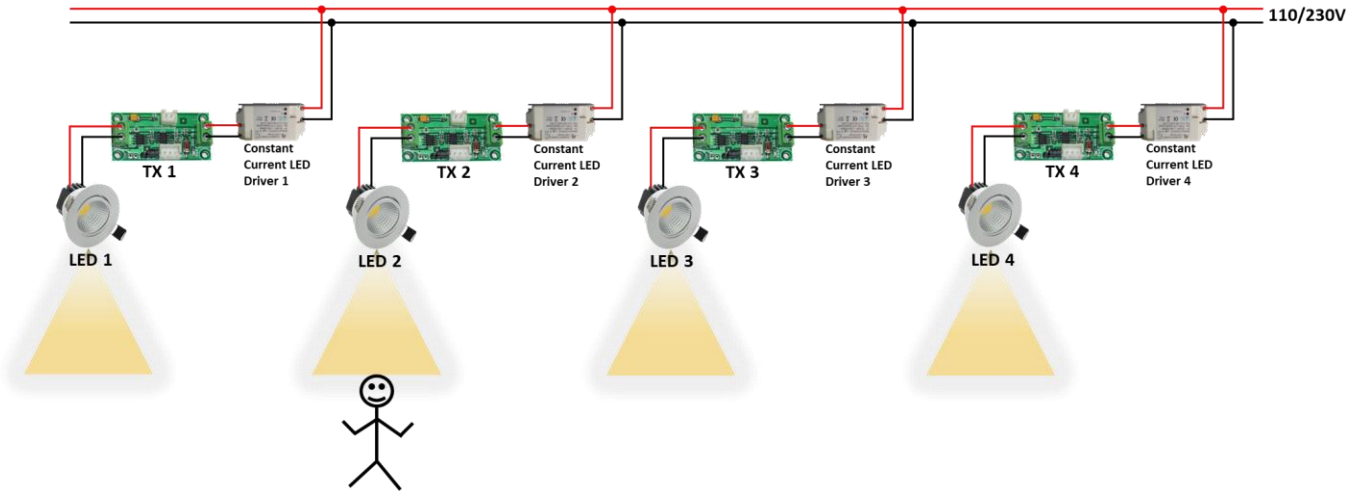


Fig. 15

14.1. Application of LiFi Navigation

- Auto guided vehicle.
- Blind navigation.
- Location based safety alerting system.
- Location based advertisement.
- Location based task reminding system.
- Indoor route navigation.
- Location based activity monitoring.

15. Underwater Communication Prototype Demo Setup

15.1. Circuit Diagram

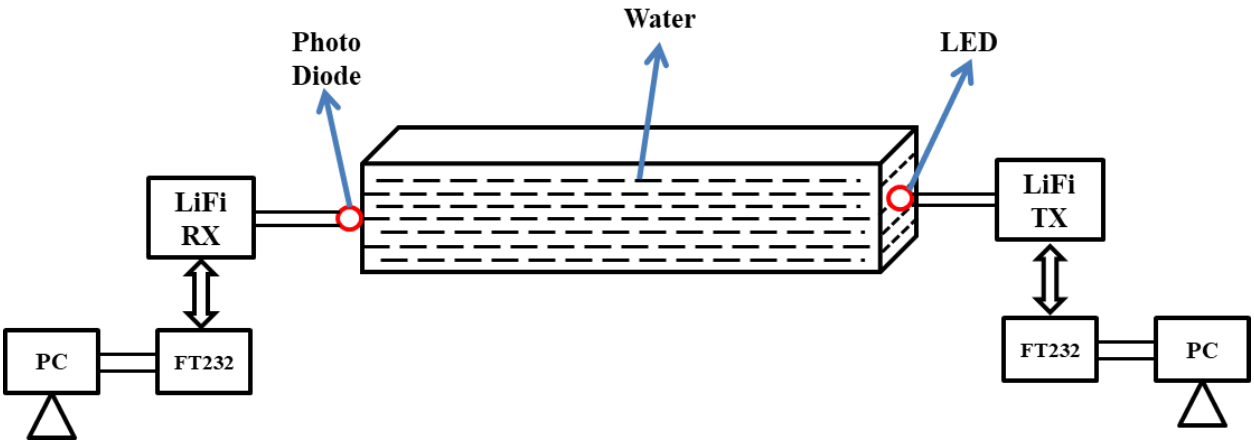


Fig. 16

15.2. Demo Setup

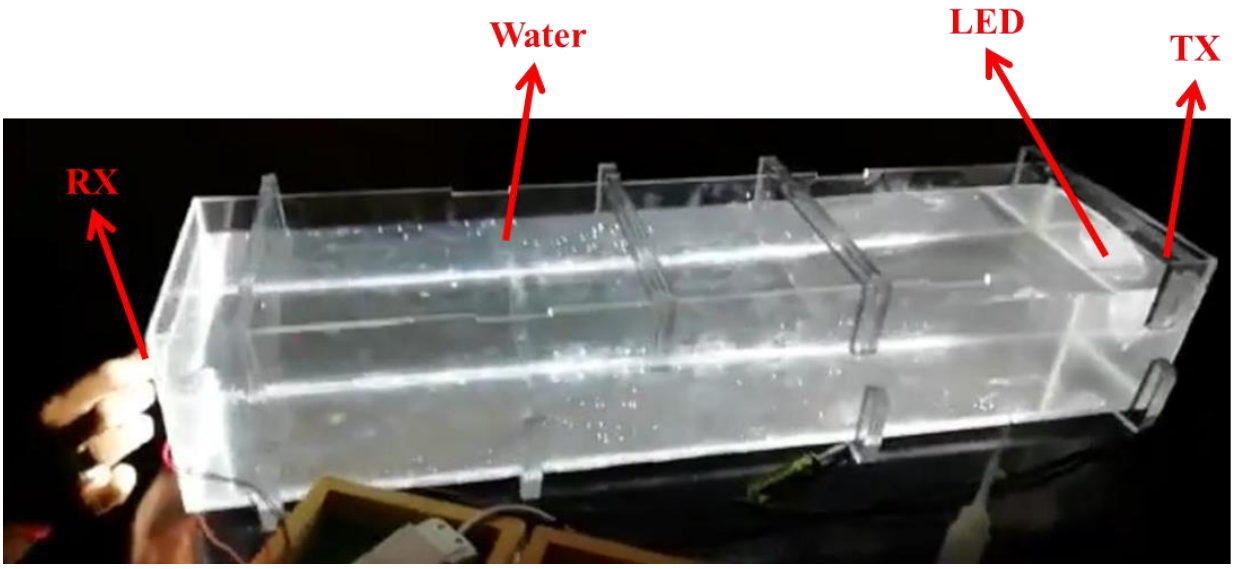


Fig. 17

Transmitter Setup:

Step 1: Open **Tera Terminal**

Step 2: Set the baud rate to 38400

Step 3: Transfer the data.

Receiver Setup:

Step 1: Open **Tera Terminal**

Step 2: Set the baud rate to 38400

Step 3: You will receive the transmitted data.

16. Voice Over LiFi

16.1. Transmitter Voice Over LiFi

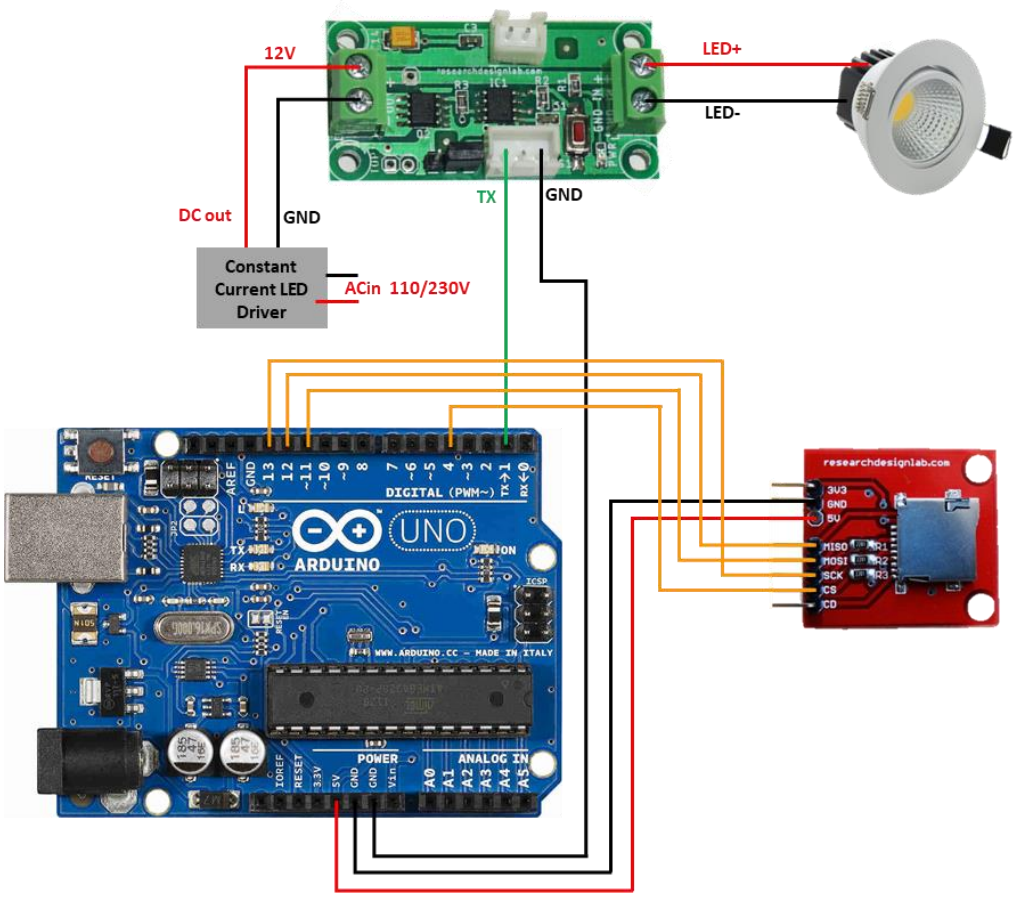


Fig. 18

LiFi Voice Over Transmitter Code

https://researchdesignlab.com/projects/LiFiVOTC.ino

16.2. Receiver Voice Over LiFi

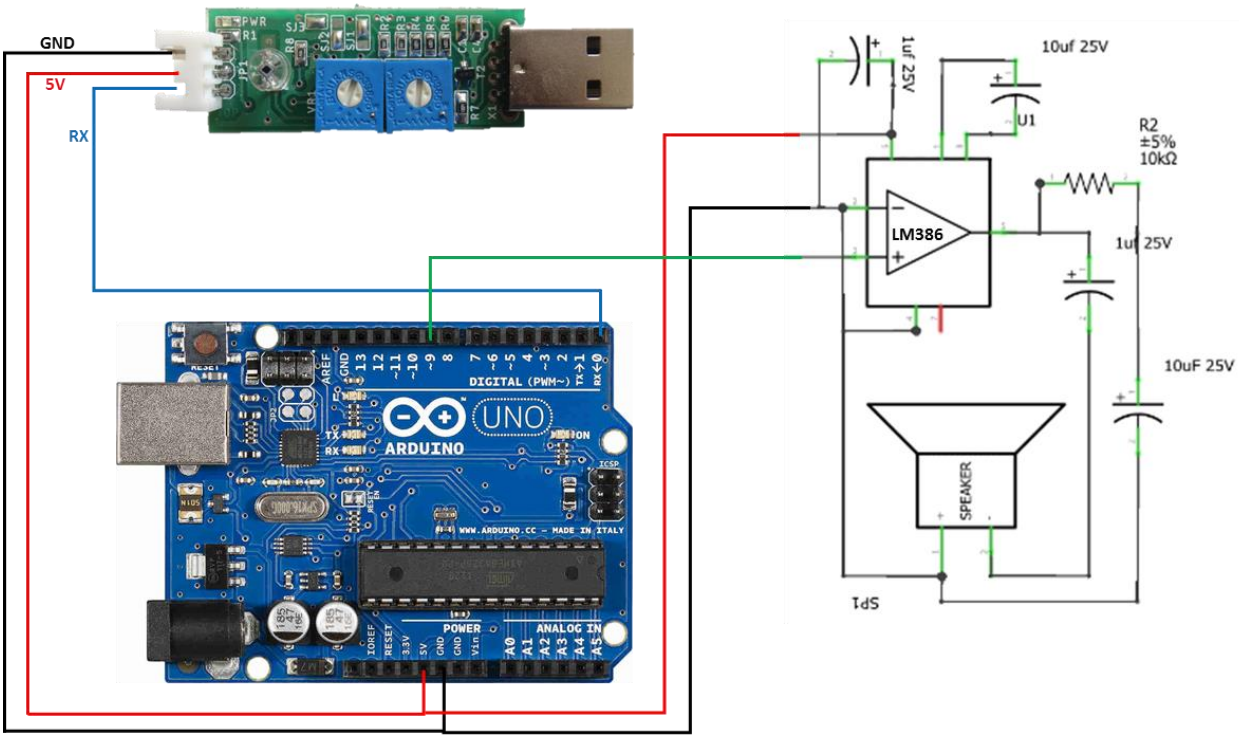


Fig. 19

LiFi Voice Over Receiver Code

https://researchdesignlab.com/projects/LiFiVORC.ino

17. References and Datasheets

- https://researchdesignlab.com/lifi-nano-v2.html
- https://researchdesignlab.com/ft232-shield.html
- https://researchdesignlab.com/projects/UNO%20MANUAL.pdf

18. Product Buying Link

- https://researchdesignlab.com/wireless/li-fi/lifi-nano-v2.html