Miniature Cost Efficient Swarm Robots

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***Abstract*—The paper speaks about how to make swarm robots in a cost efficient and more robust way by using most commonly available devices. The major device that will be described in this paper is NRF24L01 transceiver module and interfacing it to micro controller and to enable its six pipes for transmission and reception Few other components like Arduino Uno and Nano micro controllers and transferring data between the transceiver modules to make them work like swarms.**

I. INTRODUCTION

This paper gives a detailed description of how to use radio frequency module i.e., NRF24L01 to act as medium of communication between individual robots and to share information collectively among themselves. To enable NRF24L01, Arduino Nano board is used (in my case) and few more parts that are required to make a basic robot

II. NRF24L01

It is a radio frequency module which works in the band width of 2.4GHZ (free band for any transmitter). This module consists of 6-pipes which are used for transmission and reception of data the pipes numbered from 0-5. It has two antennas that have a range of maximum range of 90m the data sent from the transceiver will be in the form of packets.

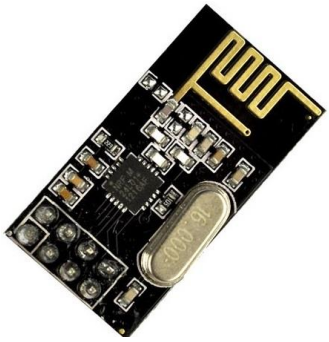

Fig.1

NRF24L01

A. *Pin Configuration*: This module has 8-pins the pin configuration is

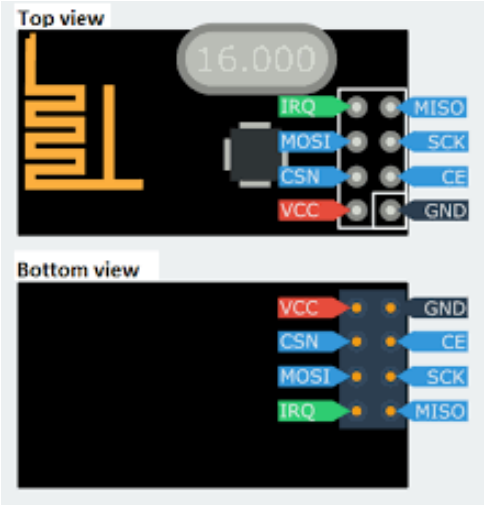

Fig.2
NRF24L01 Pin Numbers and Names

TABLE I
Pin Numbers and Names

Pin.No	**Pin name(Top View)**
1	Ground
2	Vcc(3.3-3.6)v
3	CSN(chip select not) Enables spi pins
4	CE(chip enable)
5	MOSI(master out slave in)
6	SCK(serial clock)
7	MISO(master in slave out)
8	IRQ(interrupt)

B. *Connection with Arduino Nano*: This module can be connected to different micro controllers and processers but the easiest way to do it with is

arduino

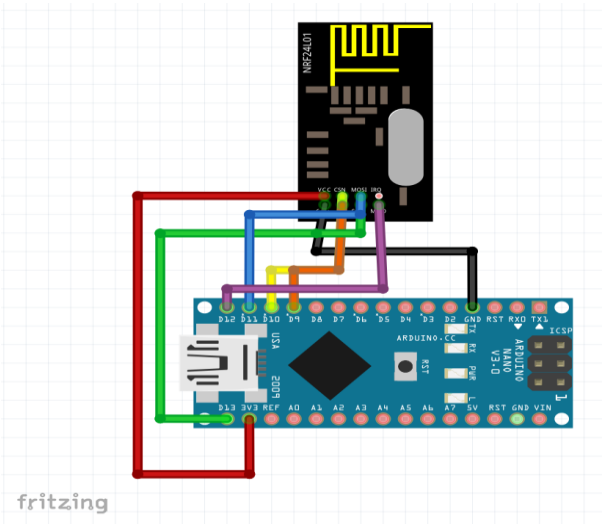

Fig.2
Circuit Diagram for Arduino Nano with NRF24l01

C. *Program*:

(Transmitter code)

```
#include<SPI.h>

#include<RF24.h>
#include<nRF24L01.h>
#include<RF24_config.h>
RF24 radio(7,8);
const byte rxAddr[6]="1180";

void setup()
{
 radio.begin();
 radio.openWritingPipe(rxAddr);
 Serial.begin(9600);
 radio.stopListening();// put your setup code here, to run
once:

}

void loop()
{ int a=analogRead(A0),b=analogRead(A1);
  Serial.println(a);
  Serial.println(b);
 if(a>400 && b<10)
 {
 const char text='1';
 radio.write(&text,sizeof(text));
 Serial.println("front");
 }
 if(a>900 && b>400)
 {
 const char text='2';
 radio.write(&text,sizeof(text));
 Serial.println("right");
 }
 if(a>400 && b>900)
 {
 const char text='3';
 radio.write(&text,sizeof(text));
 Serial.println("back");
 }
 if(a<20 && b>400)
 {
 const char text='4';
 radio.write(&text,sizeof(text));
 Serial.println("left");
 }// put your main code here, to run repeatedly:

}
```

(Receiver Code):

Here, the index in radio.openReadingpipe denotes pipe number that can be incremented and can be uploaded to 5 other devices to achieve swarm communication.

```
#include<SPI.h>

#include<RF24.h>

#include<nRF24L01.h>

#include<RF24_config.h>

RF24 radio(7,8);

const byte rxAddr[6]="1180";

void setup()

{

 radio.begin();

 radio.openReadingPipe(0,rxAddr);

 Serial.begin(9600);

 radio.startListening();

// put your setup code here, to run once:

 pinMode (1,OUTPUT);

 pinMode(2,OUTPUT);

 pinMode(3,OUTPUT);

 pinMode(4,OUTPUT);

}

void loop()
```

```
{   char text;
 radio.read(&text,sizeof(text));
 if(text=='1')
{
   Serial.println("front");

   digitalWrite(2,HIGH);
   digitalWrite(3,LOW);
   digitalWrite(4,HIGH);
   digitalWrite(5,LOW);
   }
   if(text=='2')
 {
   Serial.println("right");
   digitalWrite(2,HIGH);
   digitalWrite(3,LOW);
   digitalWrite(4,LOW);
   digitalWrite(5,HIGH);
  }
 if(text=='3')
 {
   Serial.println("back");
   digitalWrite(2,LOW);
   digitalWrite(3,HIGH);
   digitalWrite(4,LOW);
   digitalWrite(5,HIGH);
   }
   if(text=='4')
 {  Serial.println("left");
   digitalWrite(2,LOW);
   digitalWrite(3,HIGH);
   digitalWrite(4,HIGH);
   digitalWrite(5,LOW);
   }else  {
 Serial.println("stop");
   digitalWrite(2,LOW);
   digitalWrite(3,LOW);
   digitalWrite(4,LOW);
   digitalWrite(5,LOW);   }
```

Note.1: (This code is for a 4-wheeler robot) and the same method by enabling all six pipes in receiver can take information from multiple transmitters at time.

Note.2: The circuit connections are same for bot transmitter and receiver

References

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[1] https://github.com/liamjack/Arduino-NRF24L01-Thermometer

[2] http://starter-kit.nettigo.eu/2014/nrf24l01-wireless-modem/

[3] https://www.sparkfun.com/datasheets/Components/SMD/nRF24L01Pluss_Preliminary_Product_Specification_v1_0.pdf

[4] https://www.google.com/search?q=nrf+range&rlz=1C1CHBF_enIN810IN810&oq=nrf+range&aqs=chrome..69i57j0l5.2663j0j7&sourceid=chrome&ie=UTF-8