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433 MHz (Wireless RF) Communication between Two Arduino UNO

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ABSTRACT: *Radio frequency (RF) is any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz, which include those frequencies used for communications or radar signals. RF usually refers to electrical rather than mechanical oscillations. However, mechanical RF systems do exist. Although radio frequency is a rate of oscillation, the term "radio frequency" or its abbreviation "RF" are used as a synonym for radio – i.e., to describe the use of wireless communication, as opposed to communication via electric wires. To receive radio signals an antenna must be used. However, since the antenna will pick up thousands of radio signals at a time, a radio tuner is necessary to tune into a particular frequency (or frequency range). This is typically done via a resonator – in its simplest form, a circuit with a capacitor and an inductor form a tuned circuit. The resonator amplifies oscillations within a particular frequency band, while reducing oscillations at other frequencies outside the band. Another method to isolate a particular radio frequency is by oversampling (which gets a wide range of frequencies) and picking out the frequencies of interest, as done in software defined radio. The distance over which radio communications is useful depends significantly on things other than wavelength, such as transmitter power, receiver quality, type, size, and height of antenna, mode of transmission, noise, and interfering signals. Ground waves, tropospheric scatter and sky waves can all achieve greater ranges than line-of-sight propagation. The study of radio propagation allows estimates of useful range to be made. Our aim is design & implementation a communication bus bar is show communication between transmitter and receiver via Arduino.*

Keywords: *Arduino Uno, RF, Module, Baud, Serial Bus.*

I. INTRODUCTION

Arduino is a hardware and software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed *shields*) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers [1]. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named *Processing*, which also supports the languages C and C++ [2]. The first Arduino was introduced in 2005, aiming to provide a low cost, easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be produced by anyone. Adafruit Industries estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced and in 2013 that 700,000 official boards were in users' hands.

II. RF(TRANSMITTER & RECEIVER) MODULE

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK) [3].

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter [5]. The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

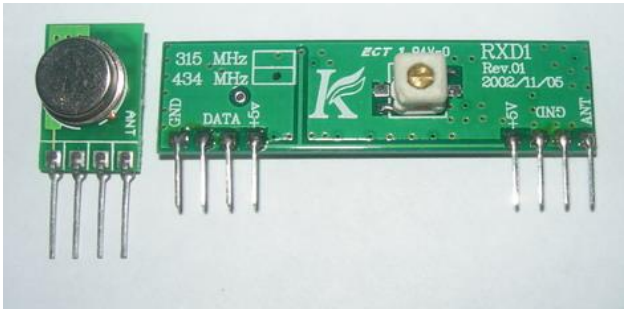

Fig 1: RF Module

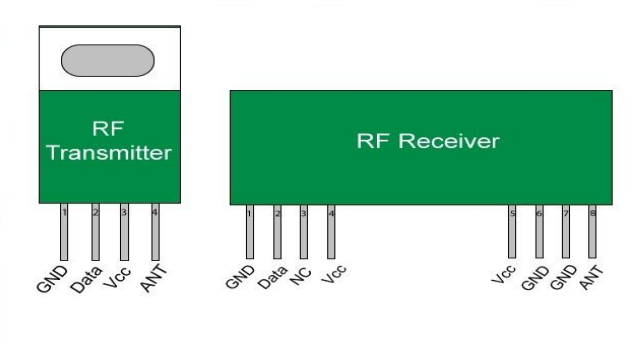

Fig 2: PIN diagram of RF Module

III. SPECIFICATIONS

Transmitter:
Working voltage: 3V - 12V for max. power use 12V
Working current: max Less than 40mA max , and min 9mA
Resonance mode: (SAW)
Modulation mode: ASK
Working frequency: Eve 315MHz Or 433MHz
Transmission power: 25mW (315MHz at 12V)
Frequency error: +150kHz (max)
Velocity : less than 10Kbps
So this module will transmit up to 90m in open area .

Receiver:
Working voltage: 5.0VDC +0.5V
Working current:≤5.5mA max
Working method: OOK/ASK
Working frequency: 315MHz-433.92MHz
Bandwidth: 2MHz
Sensitivity: excel –100dBm (50Ω)
Transmitting velocity: <9.6Kbps (at 315MHz and -95dBm)
the use of an optional antenna will increase the effectiveness of your wireless communication. A simple wire will do the trick.

Materials:
at first let's take a look for what we need:
1) 2 Arduino Board "I used Uno"
2) RF 315MHz or 433MHz transmitter-receiver module.
3) Jumper wire.
4) Breadboard.
5) External Power supply (9V Battery *2) "Optional".

IV. HARDWARE & CODEING

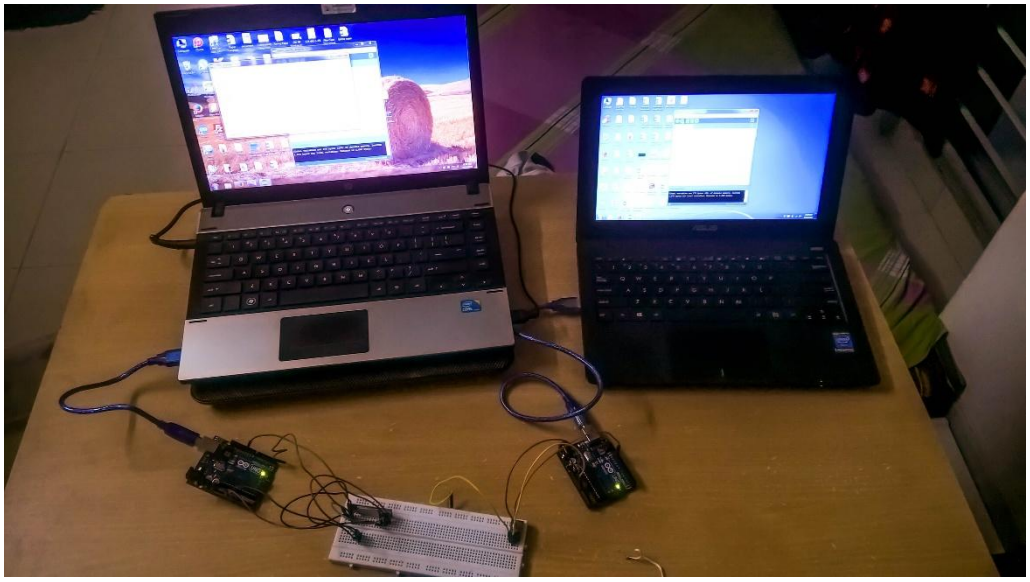

Fig 3: Hardware Setup

Transmitter coding:

```
#include <VirtualWire.h>

const int led_pin = 13;
const int transmit_pin = 12;
const int receive_pin = 2;
const int transmit_en_pin = 3;

void setup()
{
   // Initialise the IO and ISR
   //Arduino Works
   vw_set_tx_pin(transmit_pin);
   vw_set_rx_pin(receive_pin);
   vw_set_ptt_pin(transmit_en_pin);
   vw_set_ptt_inverted(true); // Required for DR3100
   vw_setup(2000);       // Bits per sec
   pinMode(led_pin, OUTPUT);
}

int count = 65;

void loop()
{
  char msg[8] = {'h','e','l','l','o',' ',' ','#'};
  //RF Module 433 MHz
  msg[6] = char(count);
  digitalWrite(led_pin, HIGH); // Flash a light to show transmitting
  vw_send((uint8_t *)msg, 8);
```

```
  vw_wait_tx(); // Wait until the whole message is gone
  digitalWrite(led_pin, LOW);
  delay(1000);
  if(count>90)
    count=65;//Reset Counter Variable
  count = count + 1;
}
```

Receiver coding:

```
#include <VirtualWire.h>

const int led_pin = 13;
const int transmit_pin = 12;
const int receive_pin = 11;
const int transmit_en_pin = 3;

void setup()
{
   delay(1000);
   Serial.begin(9600); // Debugging only
   Serial.println("setup");

   // Initialise the IO and ISR
   vw_set_tx_pin(transmit_pin);
   vw_set_rx_pin(receive_pin);
   vw_set_ptt_pin(transmit_en_pin);
   vw_set_ptt_inverted(true); // Required for DR3100
   vw_setup(2000);  // Bits per sec

   vw_rx_start();       // Start the receiver PLL running

   pinMode(led_pin, OUTPUT);
}

void loop()
{
   // RF 433 MHz Module
   uint8_t buf[VW_MAX_MESSAGE_LEN];
   uint8_t buflen = VW_MAX_MESSAGE_LEN;

   if (vw_get_message(buf, &buflen)) // Non-blocking
   {
      int i;
    digitalWrite(led_pin, HIGH); // Flash a light to show received good message
      // Message with a good checksum received, dump it.
      Serial.print("Got: ");
      for (i = 0; i < buflen; i++)
      {
        Serial.print(buf[i], HEX);
        Serial.print(' ');
      }
    Serial.println();
    Serial.println("Got TEXT: ");
    for (i = 0; i < buflen; i++)
    {
      Serial.print((char)buf[i]);
    }
    Serial.println();
```

```
      Serial.println();
    digitalWrite(led_pin, LOW);
  }
}
```

V. CONCLUSION

RF 433 MHz Modules are popularly used in remote control system. In Quad copter, Robot remote control, Industrial remote control, telemetry and remote sensing etc. RF Module means Wireless Radio Frequency Module .RF module consists of two units. One Transmitter unit and another is Receiver unit. Basically RF modules are used to build wireless connection between two points. We can easily communicate over 300-500m distance through RF module. In this tutorial we are using RF Module at 433 MHz frequency and it supports baud rate 9600. Although didn't try this. In this tutorial i will use baud rate 2400. Baud Rate .We will use USART to interface RF Module with microcontroller. The transmitter module seems to have a range of several meters without an antenna. If you require more range, you can add an external antenna by soldering a length of insulated wire to the "ANT" via on the transmitter. Recommended length is 1/4 wavelength, which is approx. 17cm @ 433MHz.

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