

MULTIDISPLAY-SYSTEM USING CC2500

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ABSTRACT

In the past, various techniques were used serial communication. Most commonly used techniques included wired networks for multiple transmissions and reception. The main disadvantage of these methods is that they were complicated and not portable. Hence, to get better accuracy, reliability, we used wireless RF module which could ease the process of multiple transmission. The developed system consists of two RF modules (minimum), a TTL converter, two Arduino Uno boards (minimum), two LCD displays (minimum) and a personal computer or laptop. The three RF modules used in this project are all CC2500. Initially, the CCs were configured using Flash Magic software in such a way that one of them acted as transmitter and the other two act as receivers. But for the purpose of cost cutting, the transmitting CC was replaced with a TTL converter which served the same purpose as of a transmitting CC. The PC is then used to give commands or transmit message signals. Before that, we interface this set up with the two Arduino boards at the receiving end along with two LCD displays. The transmitted data is received by the two CCs and then it goes to the Arduino, which serves as an intermediate between the PC and the CC. And finally, the sent signal is received at the VDU (visual display unit) and is flashed on the screens of the LCD.

Keyword: - CC2500, Visual Display Unit, RF Module

1. Introduction

Multi-display setups are very common in investment banks, particularly in market making, where they allow the simultaneous display of several screens of prices as reference data, allowing the trader to keep an eye on the market. Setups of 6 displays (2×3: 2 rows of 3) are common on interest rate trading desks, which involve many numbers, while 8 displays (2×4: 2 rows of 4) are not uncommon. Financial multi-display setups may also incorporate Bloomberg Terminals, or these may be adjunct to the main display. Now that multi-monitor setups are more budget-friendly, it is not uncommon to see a wide range of business professionals using multiple monitors to increase visual area. This advantage helps promote the concept of a paperless by increasing the quantity of simultaneous media that can be viewed digitally, although the advantage of viewing two documents simultaneously is also feasible on many larger widescreen monitors. Multi-monitor gaming/simulation is also becoming more common; however, the hardware expense can be a limiting factor. With multiple monitors present, each screen will have its own graphics buffer.

Because of its increasing popularity and the concept of paperless world, we have come up with the idea of a multiple display system using an economical and reliable RF module. CC2500 satisfies all the above mentioned requirements and works within a range as good as 25 metres with frequency of 2400-2483.5 MHz used in ISM/SRD band systems. The system will be developed to serially transmit data to multiple stations and display it on their respective screens. Ideas for further developments of this multi-display system are put forth.

2. Description

We reached the ultimate idea with the help of our project guide to design a multi-display system using an RF module. Multi-monitor, also called multi-display and multi-head, is the use of multiple physical display devices, such as monitors, televisions, and projectors, in order to increase the area available for computer programs running on a single computer system. Research studies show that, depending on the type of work, multi-head may increase the productivity by up to 50-70%.

Support for a multi-monitor setup is either achieved by installing multiple graphics cards into one computer or by special display controllers that have the ability to feed multiple monitors independently with a signal. Monitors supporting Display Port allow driving multiple monitors from only one external clock. Display Port version 1.2 supports Multi-Stream Transport; this makes it possible to drive multiple displays on one single Display Port connector using a multi-head cable or loop through.

The project is based on microcontroller board designs, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. 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++.

Here, we configure the two RF modules (CC) and interface it with LCDs and Arduino board so as to obtain desired output.

3. COMPONENTS

3.1. CC2500 (RF MODULE)

3.1.1. DESCRIPTION:

The **CC2500** is a low-cost 2.4GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band.

The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 k Baud. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication and wake-on-radio.

The main operating parameters and the 64-byte transmit/receive FIFOs of **CC2500** can be controlled via an SPI interface. In a typical system, the **CC2500** will be used together with a microcontroller and a few additional passive components.



Fig 3.1(a). CC2500 RF module

3.1.2. FEATURES:

- ☐ **RF Performance**
 - ☐ High sensitivity (-104 dBm at 2.4 k Baud, 1% packet error rate)
 - ☐ Low current consumption (13.3 mA in RX, 250 k Baud, input well above sensitivity limit)
 - ☐ Programmable output power up to +1 dBm
 - ☐ Excellent receiver selectivity and blocking performance
 - ☐ Programmable data rate from 1.2 to 500 k Baud
 - ☐ Frequency range: 2400 - 2483.5 MHz
- ☐ **Analog Features**
 - ☐ OOK, 2-FSK, GFSK, and MSK supported
 - ☐ Suitable for frequency hopping and multichannel systems due to a fast settling frequency synthesizer with 90 us settling time
 - ☐ Automatic Frequency Compensation (AFC) can be used to align the frequency synthesizer to the received centre frequency
 - ☐ Integrated analog temperature sensor
- ☐ **Digital Features**
 - ☐ Flexible support for packet oriented systems: On-chip support for sync word detection, address check, flexible packet length, and automatic CRC handling
 - ☐ Efficient SPI interface: All registers can be programmed with one "burst" transfer
 - ☐ Digital RSSI output
 - ☐ Programmable channel filter bandwidth
 - ☐ Programmable Carrier Sense (CS) indicator

- ☐ Programmable Preamble Quality Indicator (PQI) for improved protection against false sync word detection in random noise
- ☐ Support for automatic Clear Channel Assessment (CCA) before transmitting (for listen-before-talk systems)
- ☐ Support for per-package Link Quality Indication (LQI)

- ☐ **Low-Power Features**
 - ☐ 400 nA SLEEP mode current consumption
 - ☐ Fast start-up time: 240 us from SLEEP to RX or TX mode (measured on EM design)
 - ☐ Wake-on-radio functionality for automatic low-power RX polling
 - ☐ Separate 64-byte RX and TX data FIFOs (enables burst mode data transmission)

- ☐ **General**
 - ☐ Few external components: Complete on chip frequency synthesizer, no external filters or RF switch needed
 - ☐ Green package: RoHS compliant and no antimony or bromine
 - ☐ Small size (QLP 4x4 mm package, 20 pins)
 - ☐ Suited for systems compliant with EN 300 328 and EN 300 440 class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan)
 - ☐ Support for asynchronous and synchronous serial receive/transmit mode for backwards compatibility with existing radio communication protocols

- ☐ **APPLICATIONS**
 - ☐ 2400-2483.5 MHz ISM/SRD band systems
 - ☐ Consumer Electronics
 - ☐ Wireless game controllers
 - ☐ Wireless audio
 - ☐ Wireless keyboard and mouse
 - ☐ RF enabled remote controls

3.2. ARDUINO UNO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.



Fig 3.2(a) Arduino Uno board

Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Uno is one of the more popular boards in the Arduino family and a great choice for beginners.

3.2.1 FEATURES

- ☐ ATmega328 microcontroller with Opti-boot (UNO) Boot loader
- ☐ USB Programming Facilitated by the Ubiquitous FTDI FT232RL
- ☐ Input voltage - 7-15V
- ☐ 0-5V outputs with 3.3V compatible inputs
- ☐ 14 Digital I/O Pins (6 PWM outputs)
- ☐ 6 Analog Inputs
- ☐ 32k Flash Memory
- ☐ 16MHz Clock Speed
- ☐ All SMD Construction
- ☐ R3 Shield Compatible
- ☐ Red PCB!

3.3. LCD



Fig 3.3(a) LCD display

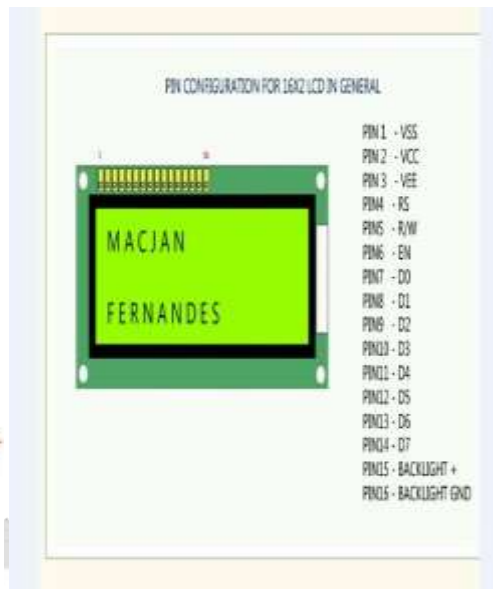


Fig 3.3(b) Pin configuration of 16*2 LCD

3.4. TTL CONVERTER

RS-232 to TTL converters make easy connections between your TTL equipment and RS-232 ports. All TTL converter models convert two channels in each direction from TTL to RS-232 or RS-422.



Fig 3.4(a) TTL converter

04. IMPLEMENTATION

4.1. SOFTWARE ASPECTS

4.1.1 Software tools

A. Flash Magic Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices. These features include

- ☐ Erasing the Flash memory (individual blocks or the whole device)
- ☐ Programming the Flash memory
- ☐ Modifying the Boot Vector and Status Byte
- ☐ Reading Flash memory
- ☐ Performing a blank check on a section of Flash memory
- ☐ Reading the signature bytes
- ☐ Reading and writing the security bits
- ☐ Direct load of a new baud rate (high speed communications)
- ☐ Sending commands to place device in Boot loader mode

Flash Magic provides a clear and simple user interface to these features. Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port.

Flash Magic only obtains access to the selected COM Port when ISP operations are being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is loaded.

To establish communication between CC2500s follow the following steps for configuring CC2500:

Step 1: Open the Flash magic Software and go to tools as shown in fig. 4.1.1(a).

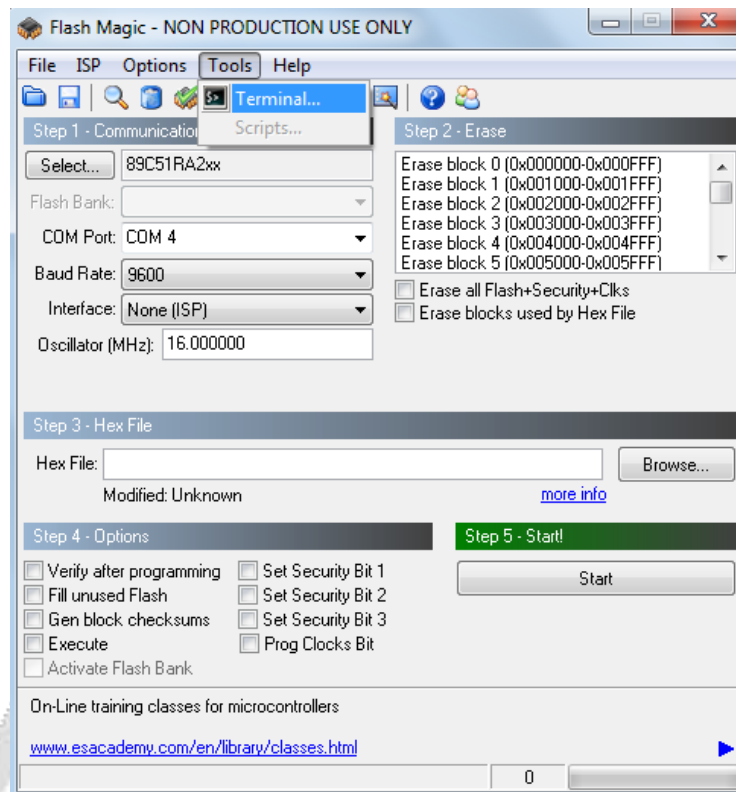


Fig 4.1.1(a) Flash magic software's window

Step 2: Open the terminal and select COM port as shown in fig 5.1.1(b)

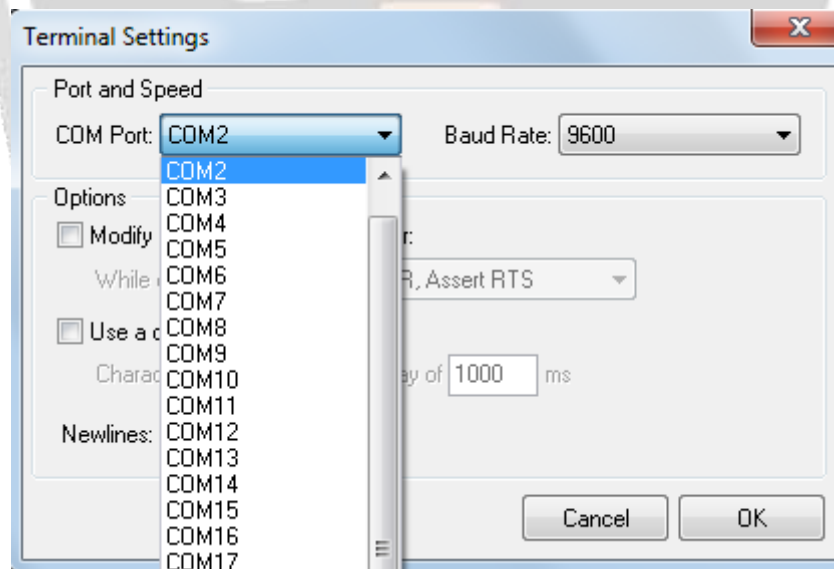


Fig. 4.1.1(b) Flash magic software's window for selecting the COM port

Step 3: Select the COM port accordingly and open the terminal window as shown in fig 4.1.1(c)

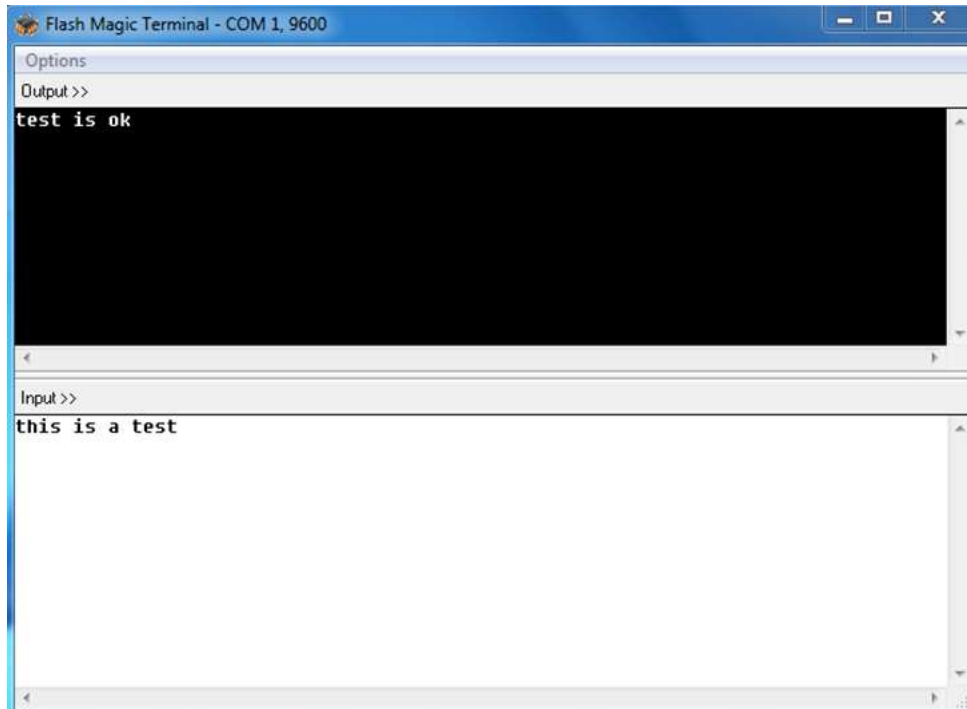


Fig 4.1.1(c) Flash magic software's terminal window(CC2500(1) as transceiver)

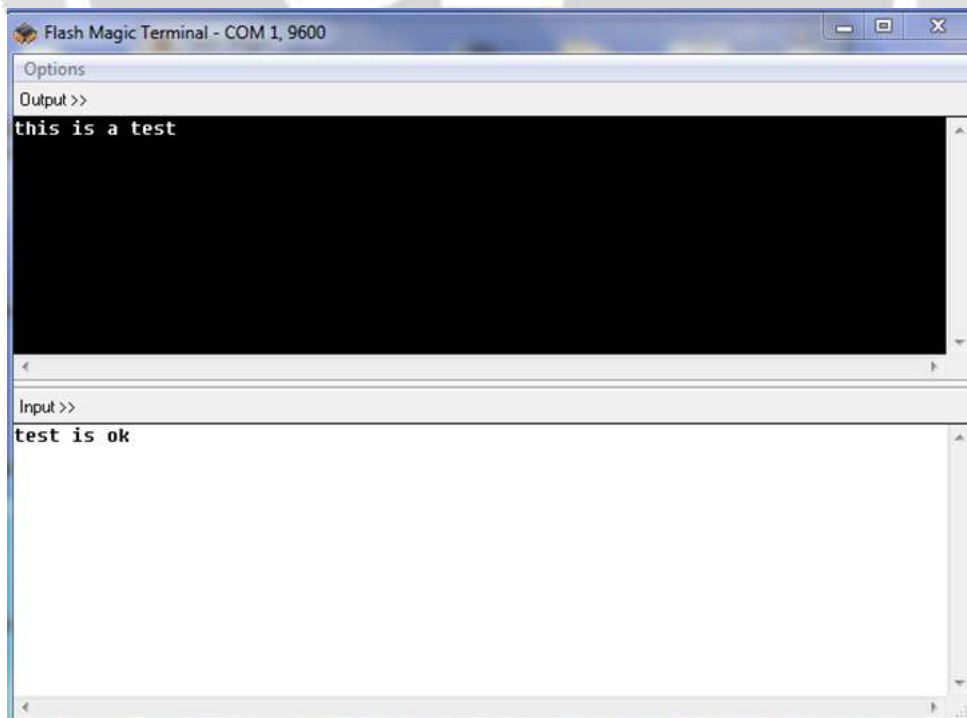
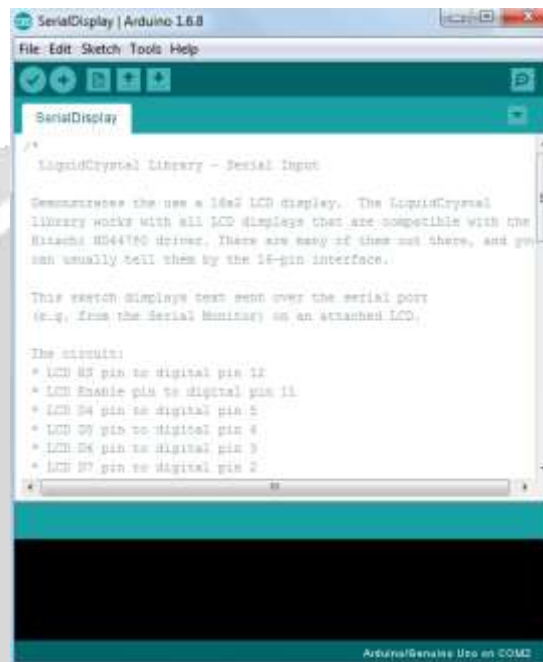


Fig 4.1.1(d) Flash magic software's terminal window(CC2500(2) as transceiver)

B. Arduino(IDE)

Arduino is an open-source prototyping platform based on easy to use hardware and software. Arduino boards are able to read inputs- light on a sensor, a finger on a button or a Twitter message- and turn it into an output-activating a motor, turning ON and LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language(based on wring) and the Arduino Software(IDE) based on processing.

Fig 4.1.1(e) Arduino(IDE) Software window



4.1.2 Design steps

```
#include <LiquidCrystal.h> LiquidCrystal  
lcd(12, 11, 5, 4, 3, 2); void setup()
```

```
{  
  
    lcd.begin(16,          2);  
    Serial.begin(9600);  
    pinMode(9,OUTPUT);  
    digitalWrite(9,HIGH);  
    pinMode(8,OUTPUT);  
    digitalWrite(8,LOW);  
    pinMode(13,OUTPUT);  
    digitalWrite(13,LOW);  
  
}  
  
void loop()  
{  
  
    if (Serial.available())  
    {  
  
        delay(100);  
        lcd.clear();  
        while (Serial.available() > 0)  
        {  
  
            lcd.write(Serial.read());  
  
        }  
  
    }  
  
}
```

4.2. Flowchart

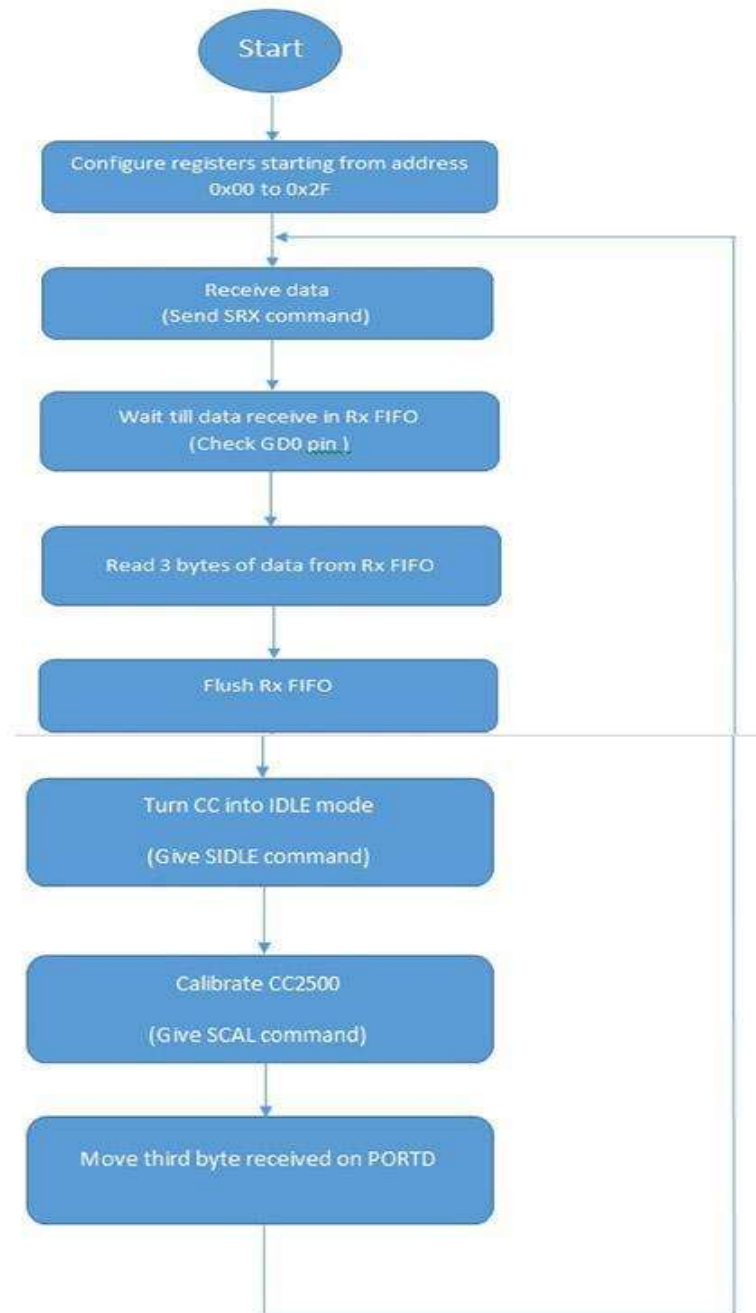


Fig 4.2(a) Flow chart for communication of CC2500s

4.3. Configuring the CC2500

To establish communication between CC2500s, we have to configure each CC2500 by giving following AT commands:

+++ - Go to command mode, the RF module will return “ok, starting cmd mode”.

COMMAND	PARAMETER	SPECIFICATION	DEFAULT	TYPE
AC	0-2	Address Check: determines whether the RF module checks the incoming packet address against its own address or not. If broadcast is enabled both its own address and the broadcast 0 address will be considered valid. 0: No address check.	0	r/w
MA	0-255	My address: set the RF module's own.	0	r/w
DA	0-255	Destination address: set address of the	0	r/w
CF	0-3	Config: select wireless transmission data rate. 0: 500kbaud	0	r/w
BD	0-2	Baud rate: set UART baud rate of the RF. 0: 9600bps 1: 19200bps	0	r/w
TH	0-32	Threshold: set threshold in bytes that will	1	r/w

OF	0-3	0: payload only. 1: source, dest, payload. 2: payload len, source, dest, payload, rssi, lqi.	0	r/w
MD	0-2	Mode: set working mode of the RF. 0: Transceive 1: Transmit only	0	r/w
O	0	Online: return to data mode.		w
CL	0-255	To select device channel ID.	0	r/w
RS	-	Restore: restore the configuration to	-	-

4.4. Circuit diagram

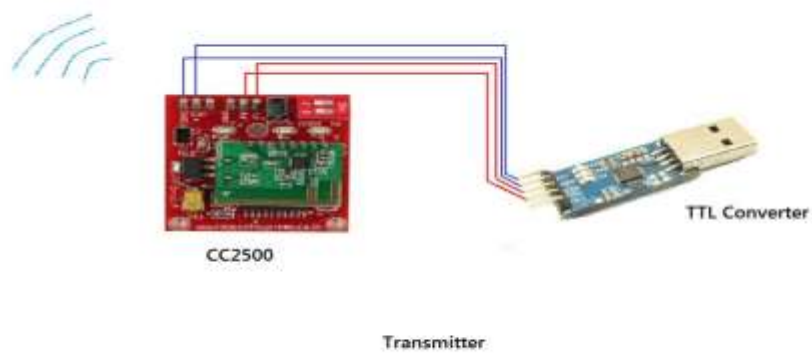


Fig 4.4(a) Circuit diagram for Transmitter

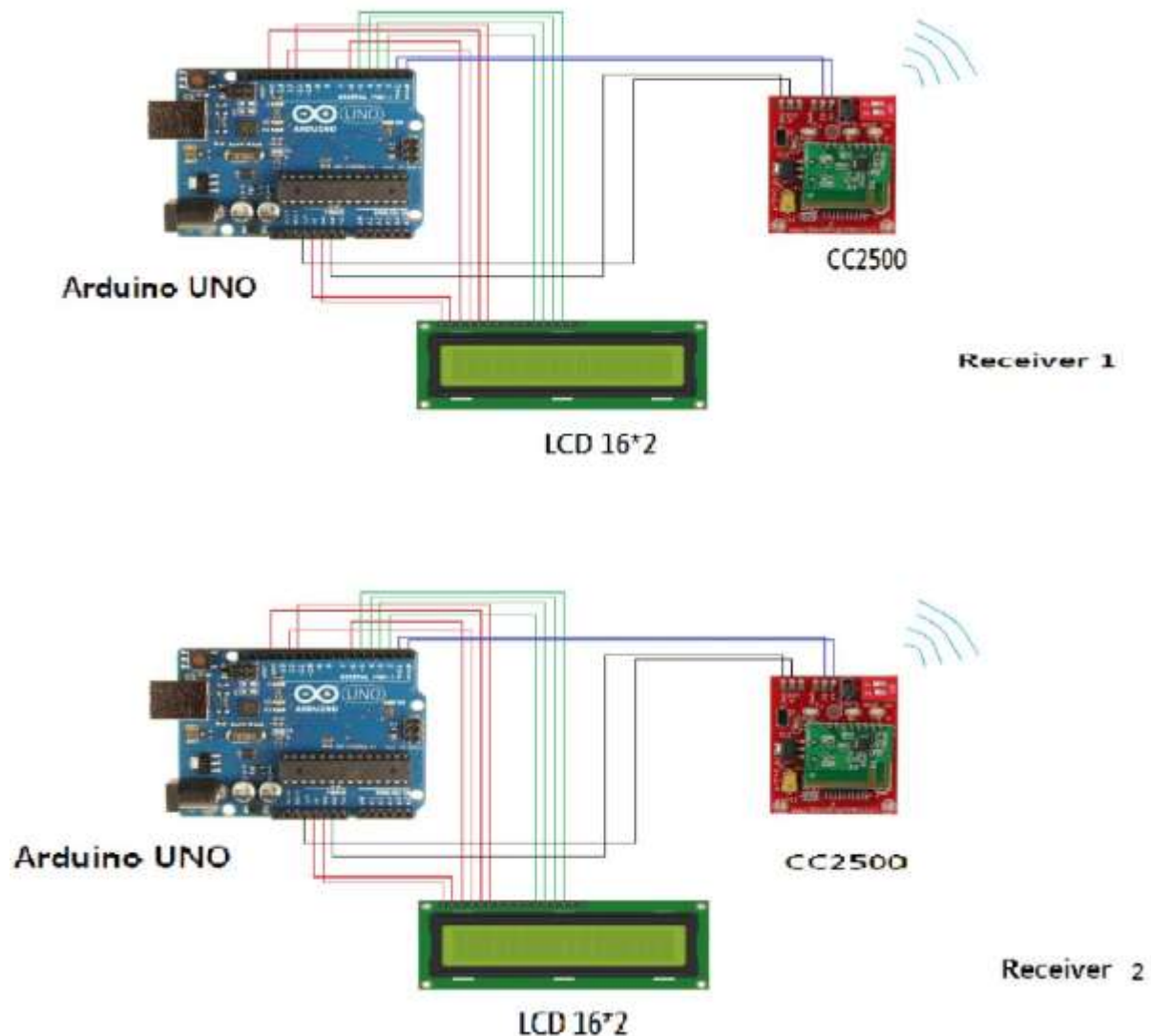


Fig 4.4(b) Circuit diagram for Receiver

5. RESULT

The study regarding the project in every aspect is done and the expected output from the device has been generated. We have successfully designed a working circuit which displays received data that has been transmitted by the one CC2500 in transmitter mode at multiple destinations where other CC2500s in receiver mode are present i.e. one transmitter and multiple receivers.

The information you want to share with your friends or for office stuff is sent from the transmitter and received at multiple receivers i.e. parallel communication, thus satisfying the objective of our project.

6. CONCLUSION

The main objective of this project was to design an economical and reliable trans-receiving system using RF technology which could be easily incorporated in the limited premises of an office or educational building. Other methods used for serial communication are costly and have lesser range. In comparison, the use of CC2500 gives more promising results as it is highly reliable for serial communication

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