THE NATIONAL INSTITUTE OF ENGINEERING
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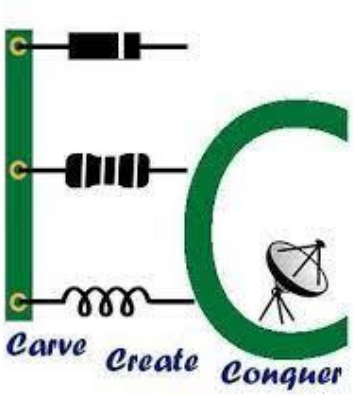
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING



EC5L01 - COMMUNICATION LABORATORY PROJECT

REPORT ON

FM RADIO RECIEVER USING TEA5767 AND ARDUINO UNO

UNDER THE GUIDANCE OF

Dr. Rajalekshmi Kishore

Submitted by

1. Satwik M Hegde – 4NI19EC091
2. Shrinidhi Kulkarni – 4NI19EC097
3. Vinayak Kulkarni – 4NI19EC115
4. Pranav N – 4NI19EC122

ABSTRACT:

FM radio was a very important source of information and entertainment before the advent of the television and the internet. A radio receiver is an electronic device that receives radio waves and converts the information carried by them to a usable form. Here we used Arduino Uno board to set up a system of FM radio receiver on breadboard. The FM module which contains TEA5767 chip helps in tuning on to any particular FM frequency. We use Nokia 5510 LCD display, to display the selected frequency and an IR receiver to change the frequency using a remote control.

Of the radio waves, FM is the most popular one. Frequency modulation is widely used for FM radio broadcasting. It is also used in telemetry, radar, seismic prospecting, two-way radio systems, and some video-transmission systems. An advantage of frequency modulation is that it has a larger signal-to-noise ratio and therefore rejects radio frequency interference better than an equal power amplitude modulation (AM) signal.

TABLE OF CONTENTS:

COMPONENTS REQUIRED:

1. **TEA5767 FM stereo module**:

   The module uses the TEA5767 radio chip. The chip uses the 12C interface, so it is straightforward to use with Arduino. It has two headphone jacks, one is for antenna, and the other one is the standard headphone output.

2. **Arduino Uno**:

   Arduino Uno is a microcontroller board based on ATmega328P. It has a 16MHz resonator, analog and digital input and output pins and everything else to support a microcontroller.

3. **HX1838 VS1838 NEC Infrared IR Remote control sensor module:** This is primarily used to achieve communication with the help of a remote to navigate through various frequencies.

4. **NOKIA 5110 LCD**:

   This is a Liquid crystal display was used in old Nokia cell phones, now widely by hobbyists to display graphics or text in their projects.

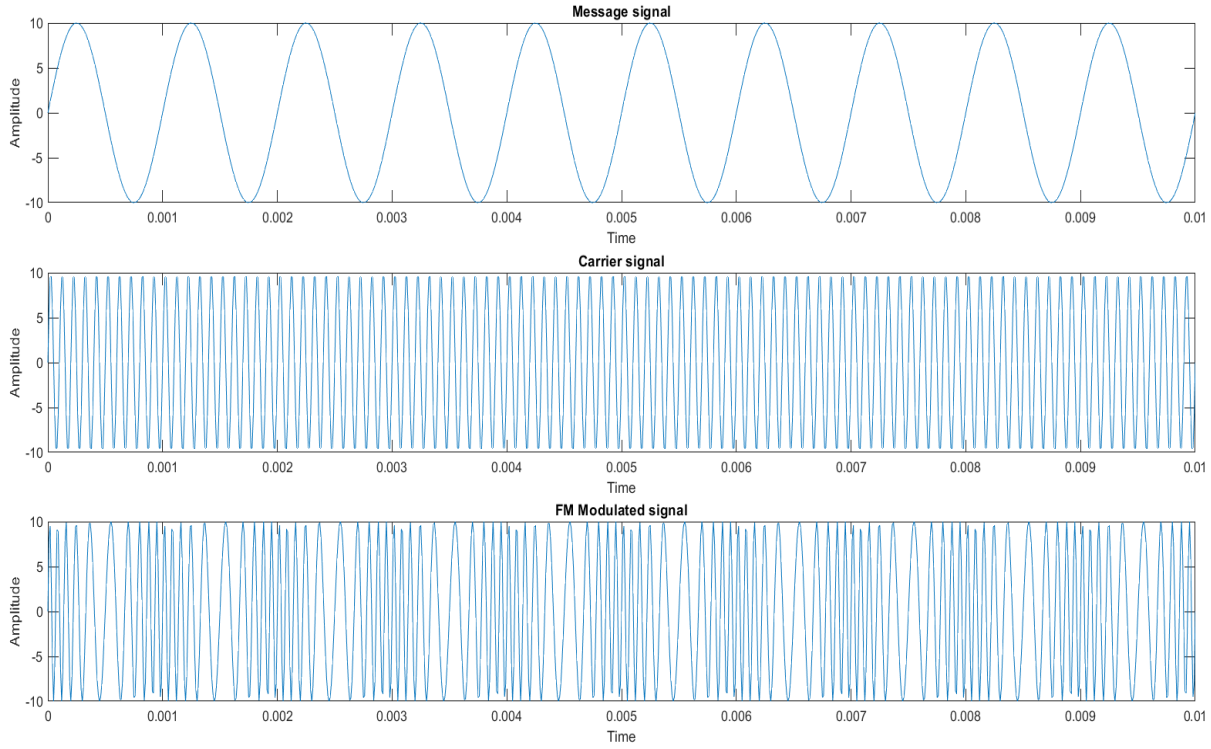
5. **Speaker :** Used to generate sound. It is connected to the standard output of FM module using a AUX cable.

6. **Some other components used to facilitate necessary circuit connections:**

   - Jumper Wires
   - Resistors (1K)
   - Breadboard

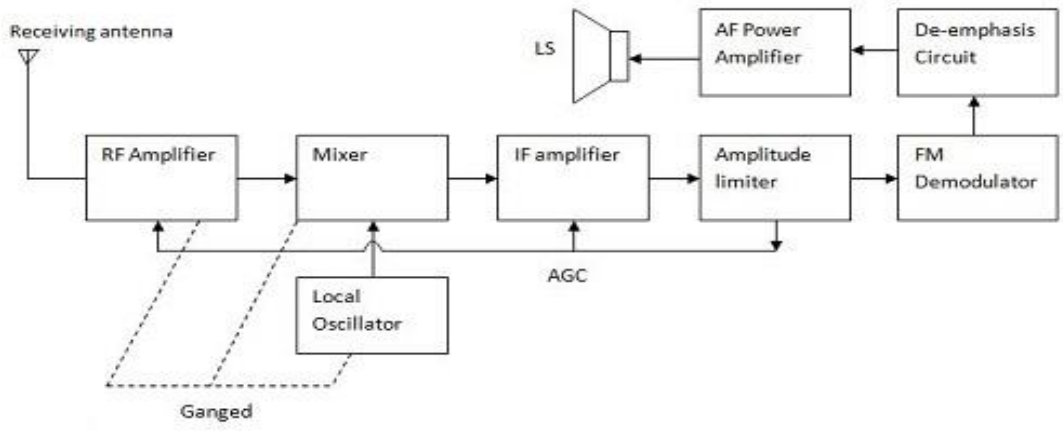
THEORY:

Modulation is the process by which information is encoded from a message source in order to facilitate it for transmission. Frequency Modulation (FM) is the encoding the information in a carrier wave by changing the instantaneous frequency of the wave. The figure below depicts frequency modulation.



Standard broadcast for FM is 88-108MHz. The maximum permissible deviation is 200kHz and intermediate frequency is 10.7MHz. It is mainly used in FM radio broadcasting, magnetic tape-recording systems, RADAR, seismic prospecting and many more.

The FM receiver circuits are mainly used in broadcast receiver stations. High bandwidth, low noise, less interference are some of the characteristics of a good FM receiver. The block diagram of a simple FM receiver is given below.



The first section is the RF section, which is tuneable circuit connected to the antenna terminals. It is used to select only the desired RF signal out of a number of frequencies at the receiver. The RF amplifier is a tuned voltage amplifier and it contains a parallel LC tuning circuit.

In the mixer the incoming signal frequency is mixed with the frequency generated by a local oscillator to convert it into a lower fixed frequency called intermediate frequency. It is 10.7 MHz in FM receivers. The local oscillator will be a high frequency oscillator. The RF amplifiers and the local oscillator are tunes together, so that difference frequency at the output of the mixer will be equal to the intermediate frequency. The local oscillator frequency always kept above the signal frequency by an amount equal to IF.

The output of the mixer is applied to the IF amplifier stages. The intermediate frequency and the bandwidth required in FM are higher than that in AM receivers. Typical bandwidth for a receiver operating in 88-108 MHz and IF of 10.7 MHz is 200 KHz. Two IF amplifier stages are often provided.

FM demodulation is totally different from AM demodulation. Balanced slope detector, Foster-Seeley discriminator and Ratio detectors are common types of demodulators used for FM detection. De-emphasis circuit is used to attenuate the high frequencies in order to compensate the boosting at the transmitter.

The amplitude of the FM signal remains constant. But by traveling from the transmitter to the receiver antenna, external sources produce unwanted variations in the signal amplitudes. These variations are easy to detect because the amplitude of the original FM signal remains constant. The limiter is a form of clipping device that does not produce an output, when the positive or negative amplitude of the FM signal exceeds a pre-determined level. So FM receivers can be integrated with amplitude limiters to take away the amplitude variation caused by noise. Hence FM reception is more immune to noise than AM reception.

There are different methods of obtain AGC in an FM receiver. The limiter user has leak type bias; this bias voltage changes proportional to the input voltage and is thus used for Automatic Gain Control. Occasionally a further Automatic Gain Control detector is used which takes positive output of the final IF amplifier and it rectifies and filters in the common manner.

IMPLEMENTATION:

The most important component of this project is the TEA5767 FM stereo module. This consists of Philips Semiconductors' digitally tuned TEA5767FM stereo receiver IC which simplifies radio design by significantly reducing the number of external components with on board silicon. This IC is ideal for integration in a wide range of applications. It does not need an external FM discriminator and handles IF selectivity entirely on-chip.

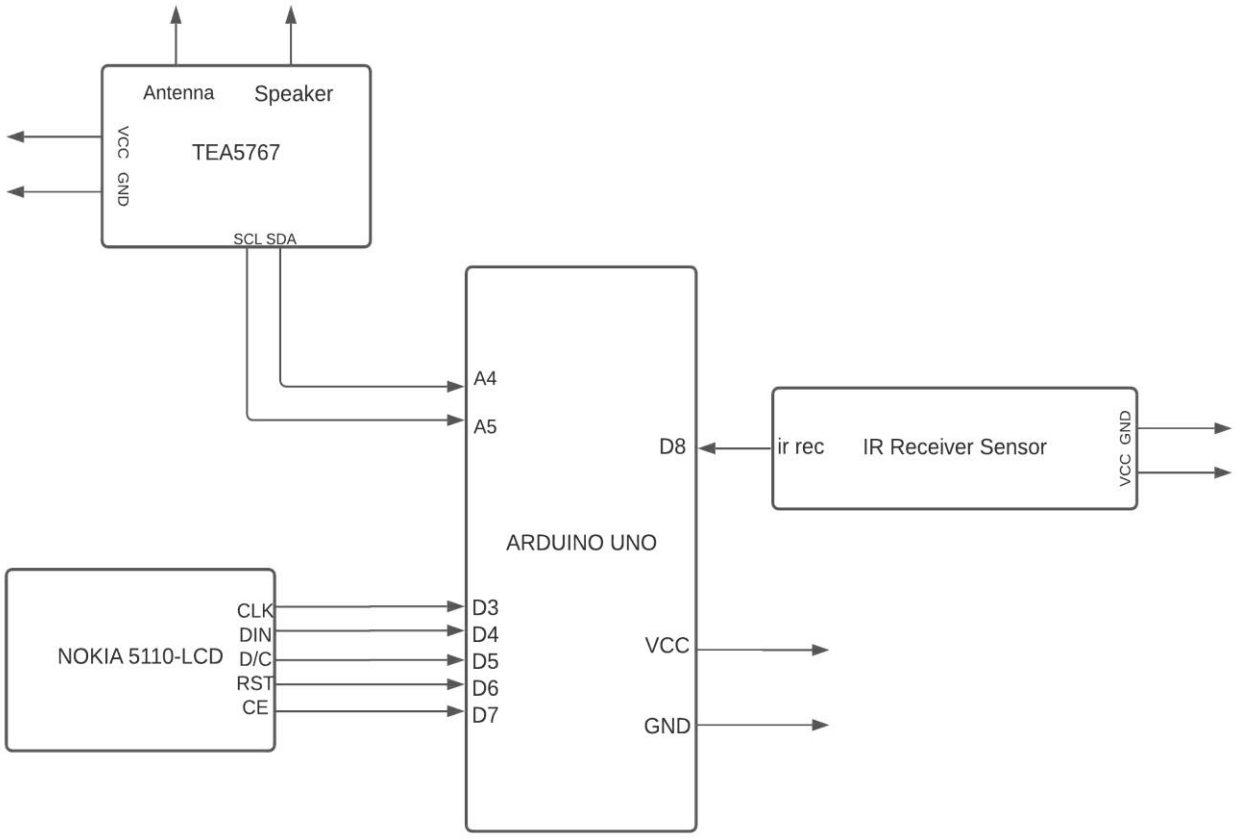
The stereo module uses I2C bus communication. The module has a reverse polarity protection diode and power output filtering sensor. It can be directly plugged to antenna interface. It has a frequency range of 76MHz to 108MHz. There is also a 3.5mm onboard audio interface.

IR or infrared communication is one of the most common methods of wireless communication due to being easy to use. Infrared light, with a wavelength longer than visible light, is not within the range of human vision. That's why it's a good option for wireless communications. When we press a button on remote control, an LED on your control turns on and off continuously and causes a modulated infrared signal to be sent from the control to circuit. The command will execute after the signal is demodulated. Here the command is nothing but a change in frequency from one to another. IR receiver modules are used to receive IR signals. These modules work in 3.8KHz frequency.

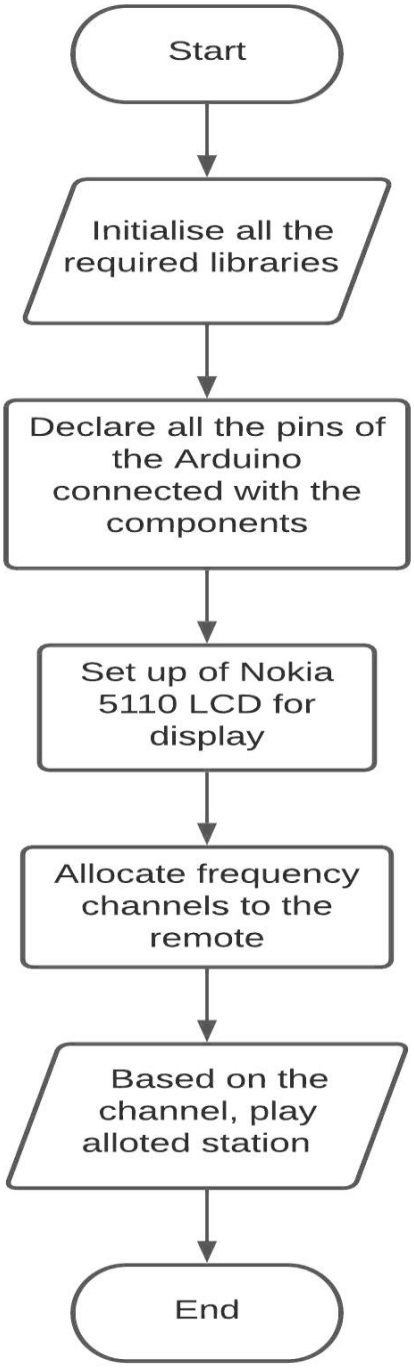
The Nokia 5110 display is basically a graphic LCD display useful for a lot of applications. This display uses a low powered CMOS LCD driver PCD8544, which drives the graphic display of size 84×48. The Nokia 5110 LCD can display text, graphics as well as bitmaps. When this display is fully lit, it draws about 10mA but with the backlight off, it draws as low as 0.4mA. In our project, it is used to display the selected frequency and to display some texts.

The brain of the project is Arduino Uno. It is an open-source microcontroller board based on the microchip ATmega328P microcontroller. The board is equipped with set of digital and analog input/output pins. The Nokia display, IR receiver sensor module and FM module are connected to Arduino board using jumper wires. The board is powered using a source (power bank / adaptor).

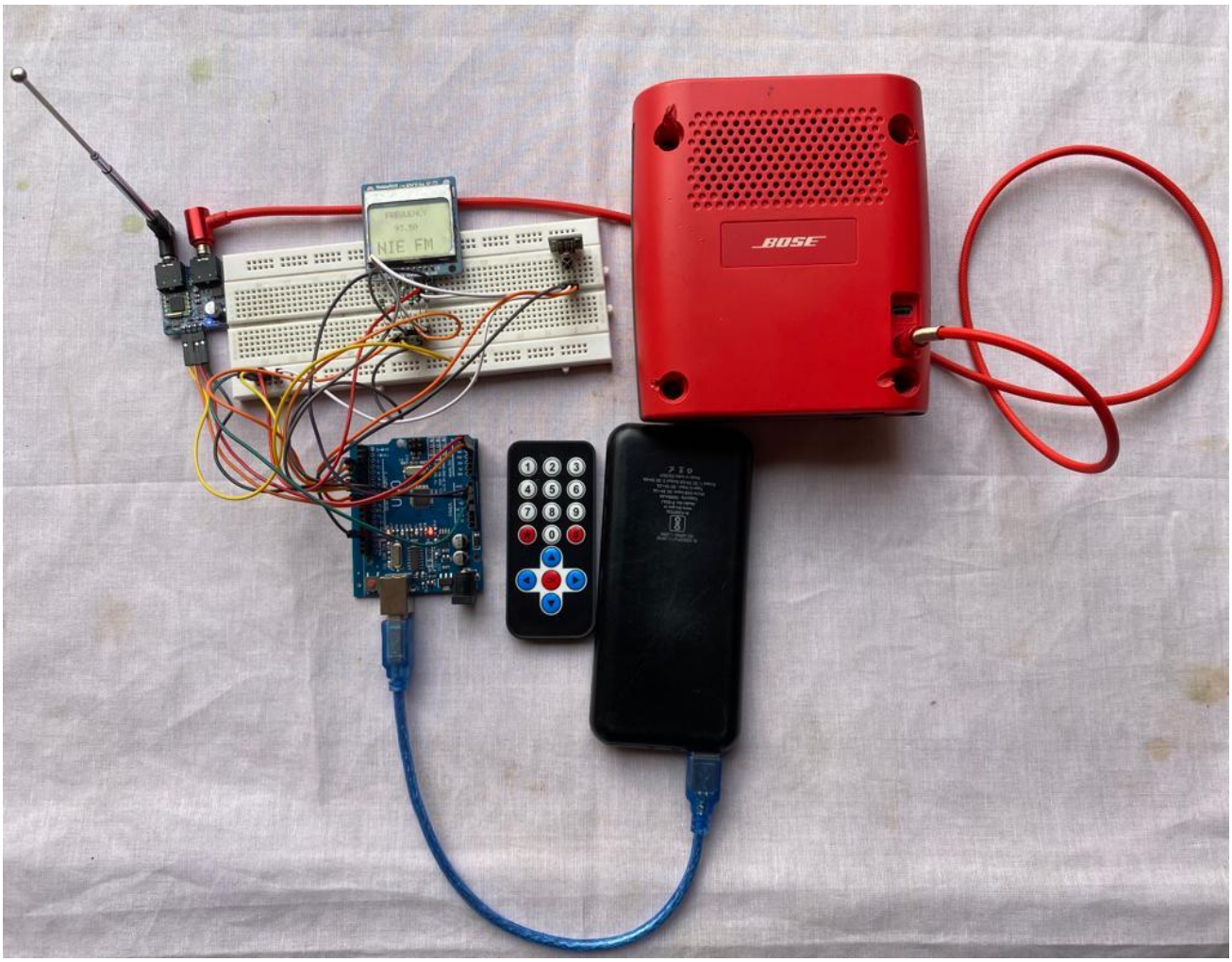
CIRCUIT DIAGRAM:



PROGRAMMING FLOW:



SETUP:



CONCLUSION:

We therefore conclude that this project was indeed helpful for us as students we explored new things and implemented our academics into practice. At very beginning we faced some problems like catching particular frequency, showing frequencies on LCD display. After many experiments, we obtained a good output. We have seen an exact application of our lessons such as FM modulation, demodulation, microcontrollers and also wireless communication.

We can here the received sound signal in the FM receiver module through a speaker. The quality of sound of the receiver is good and there was less noise that can be observed in some frequency range. ***Being able to receive sounds signals like a radio device by means of wireless FM communication is indeed fascinating.***

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