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Smart Radio using Arduino

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Abstract: *smart radio idea is been very innovative in contemporary times making it by using Arduino Nano a cost efficient durable and economical which is portable with less power consumption makes it more efficient application which is very popular in hobby projects and readily available in the local market. For reliable data transmission and reception we use antenna and potentiometer for adjusting frequencies and also volume. Audio amplifier plays a vital role in amplifying he audio signals and giving better performance at the output end .here we consider ArduinoNano module in combination with Nokia 5110 LCD module for viewing the desired frequencies and this all are achieved some encoding scheme for reducing effect of noise. Present approaches make use of display library and library for using these modules with Arduino board. This gives an economical and reliable application which is compact, portable smart radio with no noise*

Key Words: *ArduinoNano; Nokia 5110 LCD; 10K POT; Audio Amplifier.*

1. INTRODUCTION:

A radio waves or FM receiver that receives radio waves as an input and converts the information carried by them to a usable form in the output [1]. An antenna is used to grab the desired frequency waves [2]. The destination end utilizes electronic filters to separate the desired radio frequency signals from all the other signals picked up by the antenna, an electronic amplifier is used to increase the power of the signals for further processing, and finally recovers the desired information through demodulation performed on desired output signal[3]. Among Radio waves, FM is the most popularly known one. Frequency modulation is most predominantly used for FM radio broadcasting [4]. It has an applications in telemetry, radar, seismographic prospecting about earth quakes, and monitoring newborns for seizures via EEG, two-way radio systems, music synthesis in music visualizer, magnetic tape-recording systems and some video-transmission system to maintain quality[5].An advantage of frequency modulation is that it has a larger signal-to-noise ratio and therefore rejects and reduces radio frequency interference better than an equal power amplitude modulation (AM) signal [6]. Frequency modulation is used in a radio broadcast in the 88-108MHz VHF band. This bandwidth range is nominated as FM on the band scales of radio receivers, and the devices that are able to receive such signals are called FM receivers [7].The FM radio transmitter has a 200kHz wide channel. The maximum audio frequency transmitted in FM is 15 kHz as compared to 4.5 kHz in AM [8]. This allows a wider range of frequencies that could be transferred in FM and hence the quality of FM transmission is significantly higher and efficent than that of AM transmission [9].

2. HARDWARE SYSTEM:

2.1 Arduino Nano:

This component is the brain of the whole project. This section consists of an Arduino Nano chip with an ATmega328P microcontroller. This chip is the smallest of its kind and functions according to the program fed to it. The program fed to this chip instructs it about how to control the whole system according to the given input. It consists of a power cable to which the power is given and input and output pins to which the input and output components are connected

Figure 1. Arduino Nano

3. BOARD HARDWARE RESOURCES:

Nokia 5110 LCD:

Figure 2. Nokia 5110 LCD

Features of Nokia5110 LCD module:

- Operating Voltage is 2.7V to 3.3V
- Current consumption is 6mA
- Consists of 48 rows and 84 columns (84×48) monochrome pixels
- Works using SPI interface
- Consists of Philips PCD8544 interface chip for easy interfacing
- Can be easily interfaced with Arduino
- Supports decent graphics of bitmap images
- Available in Green and Blue Backlight

Where to use Nokia 5110 Display module:

As the name itself says this module was originally developed by Nokia. Nokia 5110 mobile phone [10].So it is capable of displaying alphanumeric characters, and could draw lines and other shapes and even displays a bitmap image. All this is possible because of its (84×48) monochrome pixels [11]. The module comes with the PCD8544 interface IC which makes this module easy to use and friendly usage with low-level microcontrollers too. It communicates through SPI protocol and hence does not require much pins. The Nokia 5110 LCD module also has a readily available library for Arduino which makes it ideal even for new programmers. So for a display that is better than the standard 16*2 LCD to showcase some decent graphics or generic personalized characters then this display might be the right choice for us.

How to use Nokia 5110 Display module:

The Nokia 5110 module is basically used in combination with Arduino but it could be efficiently used with any microcontroller which supports SPI communication [12].The module activates on 3.3V and hence all the pins are only 3.3V tolerant. So if there is a need to use a 5V microcontroller then it is recommended to use a logic level shifter like a voltage divider circuit to access the SPI pins of the Nokia 5110 LCD display module [13]. The graphical Nokia 5110 LCD shown above manufactured from spark fun, and so we could find the soldering pad sets on both on above and to the below of the LCD of. However it can also find many alternatives from different vendors in the market with pads on only one side, but still, they have the same pin outs and same functionality . All outcomes have the same dimensions (1.72’ × 1.72’) with 6 input pins. Hence we can easily interface Nokia 5110 module with Arduino by using the readily available libraries.

Applications:

- used to display alphanumeric characters and bitmap images (BMI)
- Used in applications where fancy graphics are required
- Requires maximum of 5 pins to efficiently operate hence I/O friendly
- Comes with a backlight and hence can be used even in darker environment contrast.
- used to create retro games in combination with microcontrollers.
- Graphics are decent enough to create a basic GUI

10K POT:

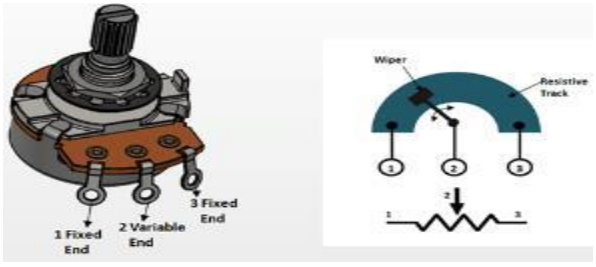


Figure 3. POT Pin diagram

Features:

- Type: Rotary a.k.a Radio POT
- Available in different resistance values like 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.
- Power Rating: 0.3W
- Maximum Input Voltage: 200Vdc
- Rotational Life: 2000K cycles

Selecting a Potentiometer:

Potentiometers also well known as POT, or variable resistors. They can provide a variable resistance by simply varying the knob on top of its head [14]. It can be classified based on two main parameters. first is their Resistance (R-ohms) itself and the second is its Power (P-Watts) rating. The value or resistance value decides how much resistivity it provides to the flow of current. The greater the resistor value the smaller the current will flow and vice versa. Some standard values for a potentiometer are 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1M. Resistors are also categorized based on how much amount of current it can allow; this is called Power (wattage) rating. The higher the power rating the bigger the resistor gets and it can also more current [15]. For potentiometers the power rating is generally 0.3W and hence can be used only for low current circuits effectively.

How to Use a Potentiometer:

As far as we know resistors should always have two terminals but, why a potentiometer has three terminals and how to we use these terminals. It is very easy to understand the purpose of these terminals by looking at the diagram below.

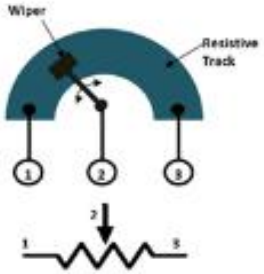


Figure 4. Working of POT

The above working diagram shows the parts present inside a potentiometer. We have a resistive track whose complete resistance will be equal to the rated resistance value of the POT. As the symbol itself suggests a potentiometer is nothing but a variable resistor with one variable end. Let us assume a 20k potentiometer, here if we measure the resistance between terminal 1 and terminal 3 we will get a value of 20k because both the terminals are fixed ends of the potentiometer. Now, let us place the wiper exactly at 50% from terminal 1 as shown above and if we measure the resistance between 1 and 2 we will get 50% of 20k which is 5.0K and measuring across terminal 2 and 3 will give a resistance of 15K. So the terminals 1 and 2 or terminals 2 and 3 can be used to obtain the variable resistance and the knob can be used to vary the resistance and set the required values.

Applications:

- Voltage and Current Control Circuits
- Used as volume control knobs in radios
- Tuning or controlling circuits
- Analog input control knobs

AUDIO AMPLIFER:

Figure 5. Audio Amplifier

An audio amplifier (amp) is an well choosed electronic amplifier which amplifies low-frequency electronic audio signals such as the signal from radio receiver or electric guitar pickup to a level that is high enough for driving loudspeakers or headphones [16]. Audio amplifiers which are found in many of the applications are of sound systems including sound reinforcement, public address and home audio systems and musical instrument amplifiers like guitar amplifiers. It is the final electronic stage in a typical audio playback chain before the signal is sent to the loudspeakers [17].

3. SYSTEM ARCHITECTURE AND MODULE INTERFACE

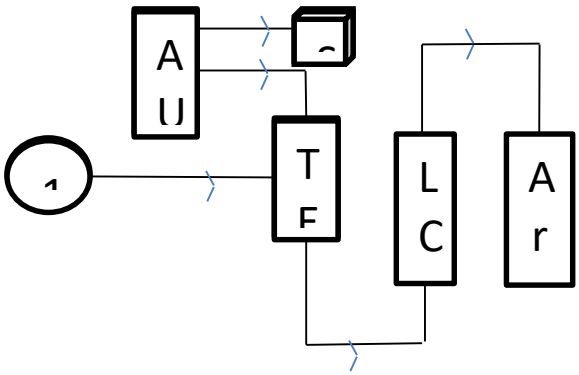


Figure 6: Block Diagram

Radio waves, part of electromagnetic waves, are present all around the globe. We generally use FM radio in our phones using these radio waves. When we think deeper, we availing these radio waves even during natural calamities to pass information from one point to another. This shows the strength of radio signals. Now the main motto of our project is to introduce Arduino into music with the help of radio signals. As shown in figure we supplied 5v of of power supply to the project. Here Audio amplifier, FM radio module, 10K potentiometer as being used as inputs. Nokia LCD screen, Speakers is employed as input. These control the actions of the amplifier according to the input given. Arduino gives out the output signals to these components based on the program written. Initially when the power supply is provided the LCD screen starts to glow. Now using potentiometer we adjust the frequency as of our requirement. Thus, the antenna captures the the required frequency and sends it into FM radio module. Then the module receives the radio waves and convert it into usable form. Later using audio amplifier we amplify the signals so that we hear stable sound without any disturbance.

4. SOFTWARE DESIGN:

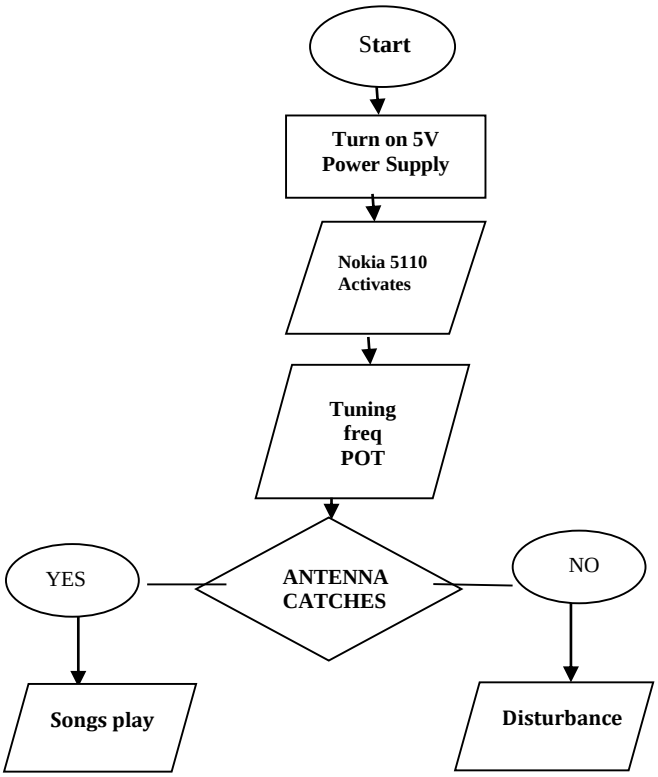


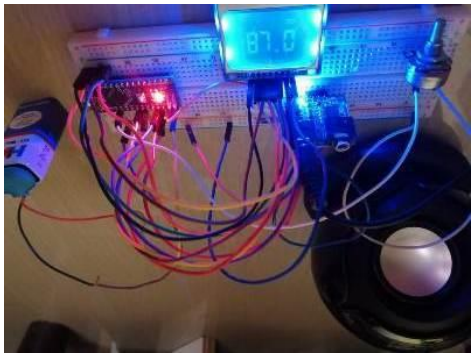
Figure 7: Flow Chart

5. RESULT:

Fig shows the received frequency through antenna on Nokia 5110. The screen of Nokia 5110 LCD is shown as a series of frequencies depending on tuning of potentiometer The setup is tested for distances of 10 to 50 meters with same results. Results obtained are without using any specific error detection and correction over the air received signal. Also there isn't any acknowledgment scheme has been used between either Transmitter or Receiver, Hence rate of transmission is also best.The transmitter and receiver side codes are much simple.

6. CONCLUSION AND FUTURE SCOPE:

Smart radio application are certainly most cheap solutions for hobby wireless projects and low end industrial applications. Here we have some process to deal with noise interference and tools to increase the scope of them. We observed that noise is interfered so that we have done noise isolation mechanism. Here we made use of inherent communication protocol of the Software adafruit library .Yet it works for distances upto 50 meters which is sufficient for low end applications.



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