

Design of Broadcast FM Radio Transceiver For Portable Application

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Abstract—In this paper we propose a system that is capable of transmitting and receiving FM Radio signals in 76MHz to 108MHz band. The FM transmission and reception is done using C-programming. The main purpose of broadcast FM radio transceiver for portable applications could be used to broadcast academic information in any of the freely available channel. Even though in India the concept is still under consideration by WPC, very low power signals can be transmitted on non-interference basis. The same device can be extending to broadcast distress signal in case of natural calamities and human emergence needs.

Keywords—Beagle bone; FM Transceiver; IC Si4721; RDS; WPC;

I. INTRODUCTION

Communication means conveying information or exchange of information between any two living creatures. The information may be voice, image, video, audio, text anything.

It is the meaningful exchange of information between two or more living creatures. A communication requires a sender, a message and a recipient. A communication requires a medium to transfer the information between sender and recipient; those mediums are radio, television, newspaper. In this radio communication is widely used because in this we don't need any physical medium. The information is sent via air so no need of physical medium like wire or other things.

In radio communication there are 3 types namely Amplitude Modulation, Frequency Modulation and Phase Modulation. In above 3 methods Frequency Modulation is widely used because of its large advantages like large area coverage, signal strength etc.

FM radio communication involves transmitter and receiver. Transmitter is at sender side and receiver is at recipient side. FM transmitter consists of frequency modulation; in this method the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. FM radio[1] can be used in various areas like news telecasting, in small college campus areas, weather forecasting and so many things.

In frequency modulation, only the frequency of the carrier wave is changed in accordance with the signal. However, the amplitude of the modulated wave remains the same i.e. carrier wave amplitude. The frequency variations of carrier wave depend upon the instantaneous amplitude of the signal.

The process of recovering the audio signal from the modulated wave is known as demodulation or detection. The

FM radio is used in large areas, such as in Mobile application, Computer, FM radio devices. The FM radio is used as a communication medium like in college campus, news telecasting, weather forecasting, etc.

At the broadcasting station, modulation is done to transmit the audio signal over larger distances to a receiver. When the modulated wave is picked up by the radio receiver, it is necessary to recover the audio signal from it. This process is accomplished in the radio receiver and is called demodulation.

II. EXISTING METHOD

In present FM radio one way method is used either transmission of signal or receiving of signal. Modulation is done at the transmission end, in this process the message signal is coupled with carrier signal and it is transmitted through antenna. The FM transmission is complex one, in this we are having carrier signal and modulator separately and for transmission we need lot of power consumption and large area needed.

Demodulation is the act of extracting the original information-bearing signal from a modulated carrier wave. A demodulator is an electronic circuit that is used to recover the information content from the modulated carrier wave. In receiver side although it is small but consists of lots of blocks.

III. PROBLEM DEFINITION

In the present days we don't have any such hardware or device which can do both FM transmitter and receiver job. To overcome this hardware designer will design a device by using IC Si4721, which will work as FM transceiver. To make work that hardware design it is mounted on development board and board is interfaced with computer. To make work this hardware the proper C-commands are used.

IV. PROPOSED WORK

In this we are building a device which can work as FM transceiver. The block diagram of the device is as shown in Figure1. The above block diagram works as FM transceiver. In this there are mainly 2 important blocks those are Beagle Bone and Si4721 IC [2]. The Si4721 IC is interfaced with Beagle Bone and using relevant C commands we will control the IC. Depending on the C commands we will make IC to work as transmitter and receiver. To write C program [4]

commands we use Linux operating system, because it is Simple and elegant and also C-programming language is portable and flexible compared to assembly language.

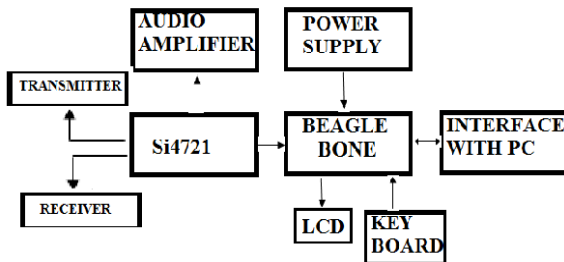


Figure 1: Block Diagram of FM Transceiver

This Si4721 IC [3] product is programmed using Linux commands and responses. To perform an action, the system controller writes a command byte and associated arguments, causing the device to execute the given command. The device will, in turn, provide a response depending on the type of command that was sent. "Commands and Responses" and "Commands and Properties" describe the procedures for using commands and responses and provide complete lists of commands, properties, and responses.

1. Commands

The C-commands [5] are used to control the hardware some of the important commands are,

- A. `si47xxFMTX_initialize ()`: It is used to initialize the hardware set up this command is used. To initialize IC some other commands are used like.
 - a) `si47xx_reset ()`: This command is used to reset the device.
 - b) `si47xxFMTX_powerup ()`: This command is used to give power to the device.
 - c) `si47xxFMTX_configure ()`: In this the device is configured, like setting interrupt, clock, GPO, etc.
- B. `si47xxFMTX_tune (8750)`: set the transmit frequency of 87.50M.Hz.
- C. `si47xxFMTX_tunePower (115)`: for setting the transmit tune power of 115 db μ V this command is used. The transmit tune power for IC is predefined as 115 db μ V.
- D. `TxRdsPs (0, 0x41, 0x4C, 0x50, 0x48); //ALPHA`: The command gives the RDS data information; to transmit RDS information first the characters are converted to ASCII value and transmitted.
- E. `si47xxFMTX_hardware_cfg ()`: For hardware configuration.
- F. `si47xxFMRX_CLK_cfg ()`: For generating a clock signal this command is used. The clock frequency is 32.768M.Hz.

2. Flow Chart

The device is interfaced with computer and using simple commands the device is controlled. The above Figure 2 shows

Flow chart of FM transmitter, the commands for FM transmitting are as below.

- Power up device b using command `Si47xxFMTx_powerup ()`.
- Check for chip components.
- Use all default settings like interrupt, GPO.
- Set Tx frequency using command `Si47xxFMTx_tune(Freq)`, the freq range is 76M.Hz to 108M.Hz.
- After freq is set the modulation or pre emphasis is done.
- Set audio deviation using command `Si47xx_set_property (Tx_audio_deviation)`.

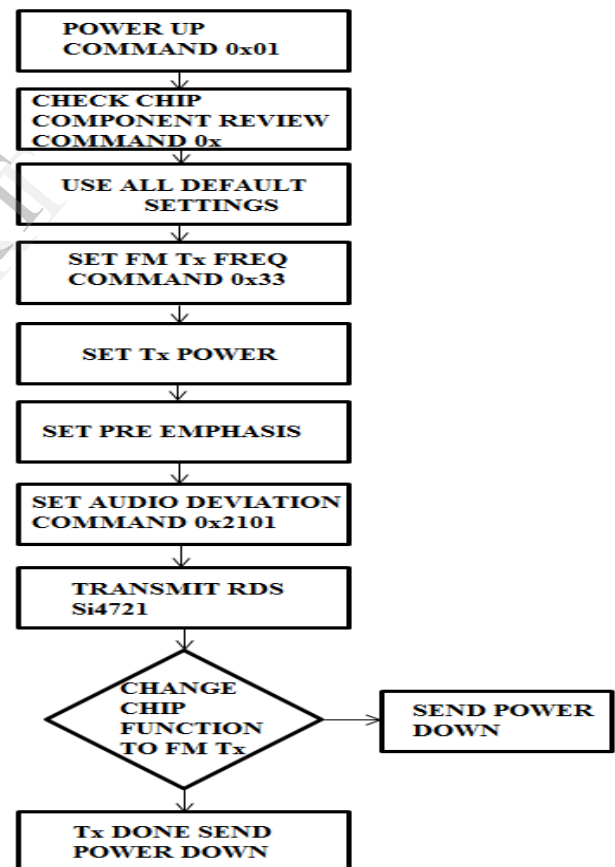


Figure 2: Flow Chart of FM Transmitter

- Transmit the Radio Data Service information by `TxRDSbuff (0, 0x00, 0x00)`, the 0x00 is the ASCII value of the character Ex: AIR is written as 0x41, 0x49, 0x52.

- After RDS and freq is set the programmer need to decide whether the IC work as transmitter or receiver. If transmit is done then the device goes to power down using command `Si47xxFMTx_powerdown()`.

The flow diagram for FM receiver is as in Figure 3, the commands for receiver are as below.

- Power up device by using command `Si47xxFMRx_powerup()`.
- Check for chip components.
- Set clock frequency by using command `Si47xxFMRx_clk_cfg()`.
- Set FM tune frequency using command `Si47xxFMRx_tune_freq(freq)`.
- After signal received it has to demodulate or de-emphasis is made.
- Receive RDS information and scan for valid channel.
- Check for chip function if it is transmit function the power down signal is sent or the signal is received and power down signal.

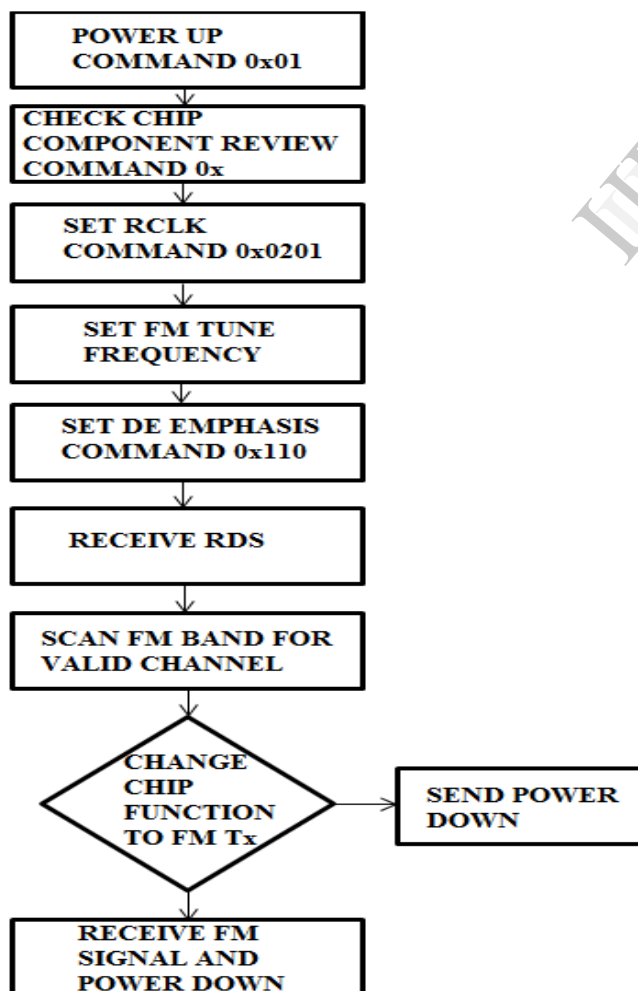


Figure 3: Flow Chart of FM Receiver

V. PERFORMANCE ANALYSIS

The hardware designer will design a device which will work as FM transceiver. The board is connected to the development board to communicate with IC. The development board may Beagle board or Microcontroller board. After proper connection of input/output ports to the FM board, the set up for FM transceiver is made.



Figure 4: Snap Shot of FM Transmit Frequency and RDS Information

We connect the development board to the PC to give proper commands and take response from the board, the board and PC is connected via USB device. After connecting to PC, by using proper commands like `Si47xxFMTx_tune(freq)` the radio station is set. The above command states that the IC is transmitting a FM signal of some frequency and we can set any frequency in between range 76MHz to 108MHz. The frequency and signal power need to be set. The signal power is set by command `Si47xxFMTx_tunepower(dbμV)`, for this IC the signal power is 115 dbμV. then the Radio Data Service (RDS) information is set by command `TxRdsPs(0, 0x00, 0x00, 0x00, 0x00)` the 0x00 is a hexadecimal number. The hexadecimal number for proper character is put in the command and the board is made to run.

The setup will now transmits the RDS information on which the frequency is set and this can be seen in a mobile or a device which consists of RDS information as shown in Figure 4. To make the device to operate as receive the FM signal, the receiver commands are used instead of transmitter command. And we need to set the proper frequency for the reception of the FM signal.

VI. CONCLUSION

In this paper we proposed software method of design for FM transceiver using C language. The programming language was used as an interface between hardware modules. The proposed method is capable of transmitting and Receiving FM Radio signals in 76MHz to 108MHz band. System could be used to broadcast academic information in any of the freely available channel. It used in various other portable applications. The same device can be extended to broadcast distress signal in case of natural calamities and human emergence needs. The scope of the work can be extended by adding external frequency converters and there by the operating band can be extend as desired.

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