International Journal of Signal Processing, Image Processing and Pattern Recognition
Vol.7, No.2 (2014), pp.69-74
http://dx.doi.org/10.14257/ijsip.2014.7.2.07

Switcher of Three Audio Source Channels in Medium Wave Transmitter Based on Microcontroller

Chang Shu[1,*], Yue Wang[1], Ying Zhang[1], Yu Song[1], Jinshuo Mei[2] and Jinghua Yin[2]

[1]*Technical School, Harbin University, 150080 Harbin, P.R. China*
[2]*Applied Sciences school, Harbin University of Science and Technology, 150080 Harbin, P.R. China*
sum157@163.com

Abstract

Based on microcontroller, an audio source switcher which can be used for medium wave transmitter is proposed in this paper. According to the default priority, the proposed switcher can correctly realize the function of switch among other signal channels when the current audio source is in transmission fault. In order to improve the stability and practical value, the switcher can correctly distinguish the statuses of speech pause and transmission fault according to default time. Moreover, the trap filter is also used in switcher to inhabit the high frequency interference of transmitting station. It is expected that this switcher has potential application in future.

Keywords: *Signal Source Switch, Microcontroller, Medium Wave Transmitter*

1. Introduction

With the development of electrical technology, Medium wave transmitters play an important role in people's daily life, and many researchers pay their attentions to protection and automation for the medium wave transmitter [1-5]. The audio sources of transmitter are always electrical signals of optical cables, satellite signals and FM signals in medium wave transmitting station. These three audio source channels provide three different ways for transmitting station to deliver audio programs to ensure the purpose of multiple backup. Three audio source channels usually have different priority and the operating status of current audio source is indicated by indicator unit [6, 7]. So far, the switch of signal sources is operated manually in many transmitting stations. In this paper, an audio source switcher using for medium wave transmitter is proposed, which can be realized with microcontroller. The proposed switcher can automatically switch the audio source according to the default priority and the operating status of current audio source. The advantages of the proposed switcher are that it can not only correctly distinguish the statuses of speech pause and transmission fault, but also can effectively inhabit the high frequency interference of transmitting station. Therefore, the switcher exhibits high stability, and has practical value in the field of medium wave transmitter.

2. System Composition and Principle

The audio source switcher is composed of microcontroller, optical signal monitoring circuit, satellite signal monitoring circuit, FM signal monitoring circuit, relay control unit and indicator unit. The structure diagram of audio source switcher is shown in

ISSN: 2005-4254 IJSIP

Figure 1. The indicator units indicate the operating statues of electrical signals of optical cable, satellite signal and FM signal by three light-emitting diodes. The three channels audio sources are monitored by corresponding signal monitoring circuit, respectively. The output of the monitoring circuit is finally transmitted to microcontroller. According to the monitoring values and the default priority of signal channels, the microcontroller can automatically close the corresponding signal relay of relay control circuit, and realize the connection of the corresponding signal with transmitter.

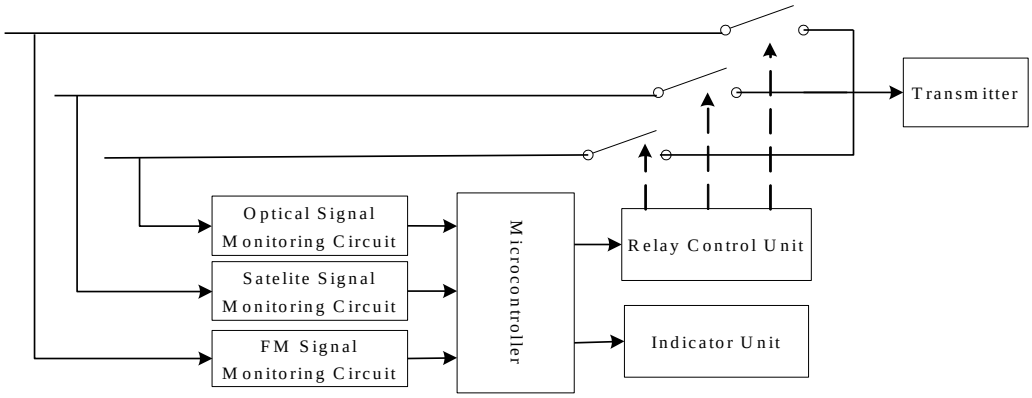

Figure 1. The Structure Diagram of Audio Source Switcher

The circuit structure of the optical signal monitoring circuit, satellite signal monitoring circuit and FM signal monitoring circuit are the same, as shown in Figure 2.The sampling circuit is used to sample the corresponding channel signal, and transmit the signal to trap filter to inhabit the high frequency interference of transmitting station. The sampled signal is amplified by amplification circuit and transmitted to comparison circuit. When the current audio source is normal, the comparison circuit output is a series of low-pulse signal. Otherwise, the output of comparison circuit is a high level value. Then the above output of comparison circuit is transmitted to monostable trigger which is designed to a type of repeatable trigger by LM555 [8]. When the input is a low-pulse in a period time the output of the trigger is high level value, and vice versa. So the monitoring circuit can effectively distinguish the statuses of speech pause and transmission fault. By the means of incessantly monitoring the output of the monostable trigger, the microcontroller can finally realize the control of the relay control unit and indicator unit.

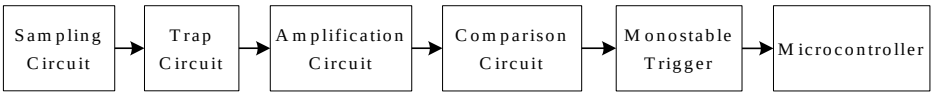

Figure 2. The Structure Diagram of Monitoring Circuit

3. System Hardware Design

According to principle of the system, the outputs of monitoring circuit of three signal channels were connected to the I/O port of microcontroller (STM32F103RBT6), respectively [9,10]. According the values of monitoring circuit, one of three relays in the relay control unit is closed to connect the corresponding single channel with the

transmitter. And the status of the current operating audio sources is indicated by the indicator unit which is composed of three light-emitting diodes and a buzzer. When all three audio sources are in the status of fault transmission, the buzzer will be ring. Figure 3 shows the monitoring circuit diagram of three single channels. In Figure 3, inductor (L3) and capacitor (C7) compose the trap filter which is a series resonant circuit, LP339MX (U5A) is used to amplify the sampling signal, and the LP339MX (U5B) is a comparator to compare the output of diode (D3) with a fixed level. The role of diode (D3) is half wave rectification of the amplification circuit output, and LM555 is used to monostable trigger which is designed to a type of repeatable trigger.

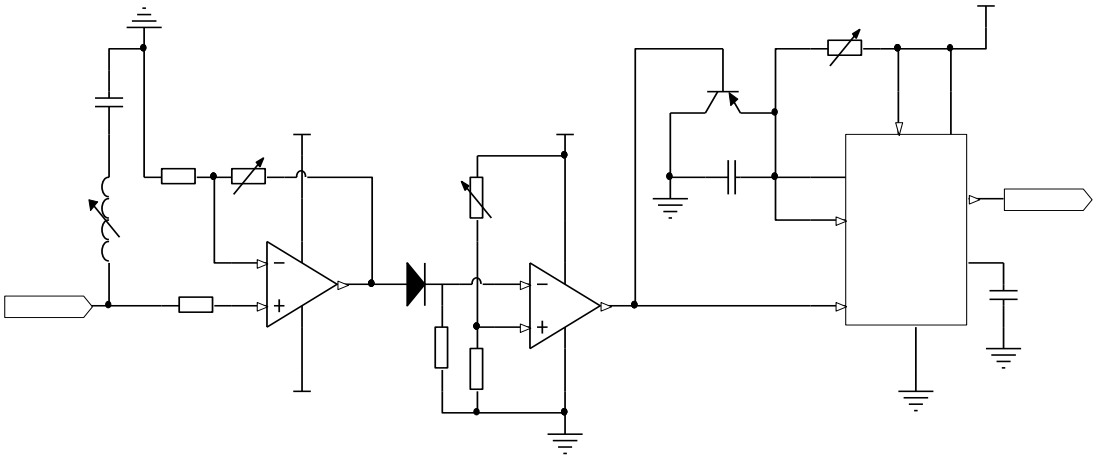

Figure 3. The Circuit Diagram of Monitoring Circuit

4. System Software Design

In this section, the software design for the above hardware system is presented and the flow chart of procedure is shown in Figure 4. In the initialization process, the microcontroller can light the diodes and close the relay 1. According to the scanning values of three monitoring circuits, the operating status of three signal channels could be indicated by the corresponding diodes. When the three signal channels are all in normal status, the signal channel exhibiting the highest priority (default optical signal) firstly selected. In other words, the relay 1 was closed, and the electrical signal of optical channel was connected to the transmitter. If the optical signal is in transmission fault, the signal channel exhibiting higher priority (default satellite signal) is selected and the corresponding relay 2 was closed. When both optical signal and satellite signal are in transmission fault, the relay 3 controlling the lowest priority signal channel (default FM signal) is closed. If all three signals channels are in error, the buzzer will ring to alarm operator.

5. Testing and Analysis

To validate the functionality of above design, the performance of the monitoring circuit is simulated, as shown in Figure 5.

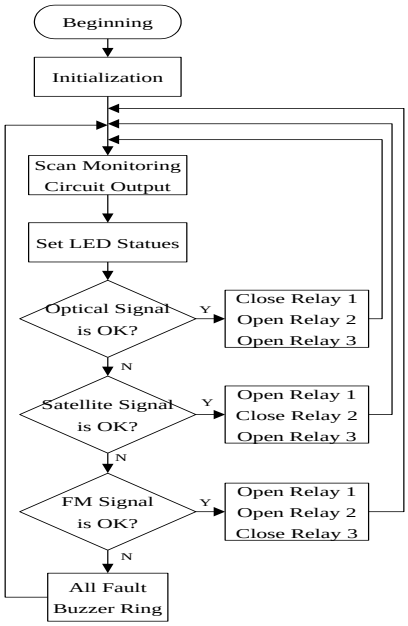

Figure 4. The Flow Chart of Procedure

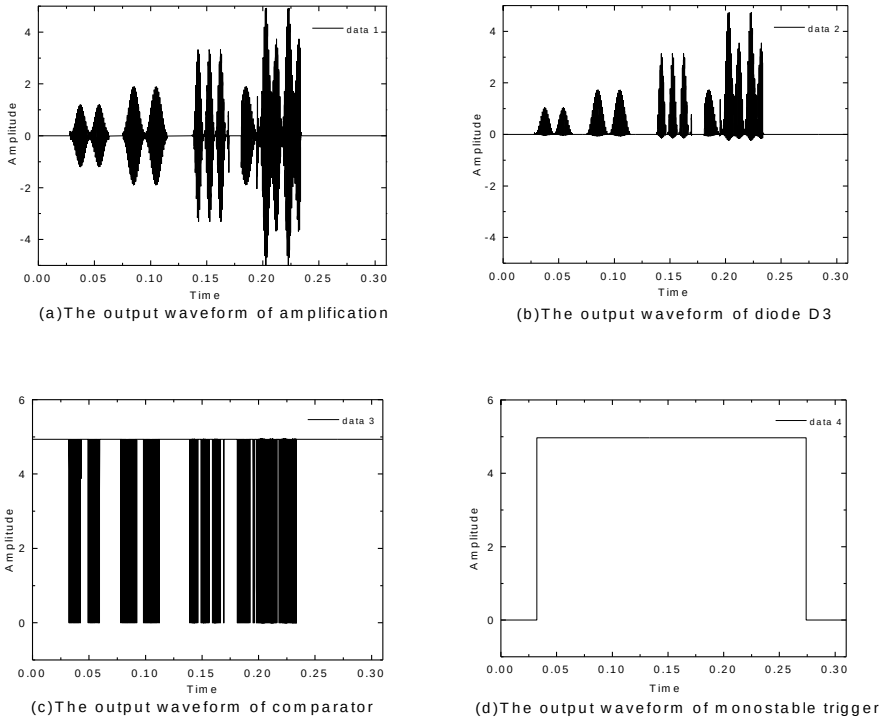

Figure 5. The Output Waveform of Monitoring Circuit

The input audio signal is amplified by the amplification circuit, as shown in Figure 5 (a). Figure 5 (b) shows the output waveform of diode D3 with the input of the amplified signal. Compared Figure 5 (a) with (b), we can see that the amplified signal is half

wave rectified. Figure 5 (c) shows the output waveform of comparator with the input of the above half wave rectified signal. Figure 5 (d) shows the output waveform of monostable trigger. Compared Figure 5 (c) with (d), we can see that the output of trigger is keeping high level when the signal with normal pauses is input. While the output is turned into low level value when the input is no audio signal over a period time, which mean the signal line is in transmission fault. At this time, the microcontroller can correctly switch the audio source according to the default priority to ensure the regular work of the station.

6. Conclusions

In this paper, an audio source switcher using for medium wave transmitter is proposed. The proposed switcher can realize the purpose of automatic switching among three channels audio source. To ensure the switching of audio source correctly, the proposed switcher can distinguish the statuses of speech pause and transmission fault according to the default time, and automatically choose one of three channels as audio source for the medium wave transmitter according to the default priority and the operating status of current audio source. In addition, the operating status of audio source can be indicated by indicator unit. When three signal channels are in error, the buzzer will ring to alarm operator. In order to improve the stability and practical value of the proposed switcher, the trap filter is also used in switcher to inhabit the high frequency interference of transmitting station. The proposed can be realized with microcontroller, therefore it is expected that this switcher may have potential application in the field of medium wave transmitting.

Acknowledgements

This work is supported by the project of College Student Innovation and Entrepreneurship Training Foundation of Heilongjiang Province (201310234015).

References

[1] S. Liang, G. F. Pan and S. P. Zeng, “Design and Implementation of Environmental Monitoring System Based on Bus”, Advanced Materials Research, vol. 712, **(2013)**, pp. 1999-2002.
[2] L. K. Hu and S. P. Xi, “Multi-serial-port Card-Based Monitoring and Controlling System for A Middle-Wave Transmitter”, Computer Measurement & Control, vol.18, **(2010)**, pp. 85-87.
[3] K. Wakai, N. Moribe, Y. Nasu, H. Ikeda and J. Z. Li, “Measurement of AM to PM Conversion in Medium Wave AM Transmitter”, IEEE Transactions on Instrumentation and Measurement, vol. 39, no. 6, **(2009)**, pp. 910-913.
[4] D. kazuaki Wakai, “Narrow-band surge protector for medium-wave digital transmitter with comprehensive monitoring system”, International Instrumentation and Measurement Technology Conference, Singapore, **(2009)** May 5-7.
[5] J. Wu, A. Lai and S. F. Yu, “Supervision System for Medium-frequency Wave Transmitter Based on Ican System”, Journal of Jiangxi University of Science and Technology, vol. 31, no. 1, **(2010)**, pp. 55-58.
[6] X. H. Xi, “Design and Application of Automatic System of DX-200kW Medium Wave Transmitter”, Computer Knowledge and Technology, vol. 9, **(2013)**, pp. 3885-3888.
[7] X. Gao, “Improvement System Design of Radio Transmitter Station”, Audio Engineering, vol. 9, **(2011)**, pp. 79-82.
[8] J. Y. Ren, “Design of 555 monostable flip-flop based on state diagram”, Journal of Zhe Jiang University (Science Edition), vol. 2, **(2011)**, pp. 177-181.
[9] ARM Limited. Cortex-M3 Technical Reference Manual, **(2006)**.
[10] ARM Limited. Cortex Microcontroller Software Interface Standard, **(2009)**.