A Directive Programmable Audio Switcher Intelligent Control System

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Abstract

The Audio switcher is high performance intelligent matrix switch equipment which is specially designed for the broadcasting of the audio signal. It is widely used in speech engineering, audio-visual teaching, and command and control center, multi-media conference room and so on and used for switching audio signal. Most of the existing audio switcher support serial control protocol and it can be controlled by the third party software. In this paper, a directive programmable audio switcher intelligent control system was realized. Any kind of audio switcher which supports serial communication protocol can be controlled by this system without any software changing. The only thing to be needed is to change the programmable command list.

Keywords: Automatic audio switch; directive programmable; Audio workstation; serial communication protocol

1. Introduction

The Audio Switching is the high-performance intelligent Matrix switch equipment which is designed for the sound signal's dynamic display. It's widely used in phonetic project, audio education programme, command control center, multimedia conference room and so on, accomplishing the switch of the Audio signal. For the commands of different industries, not only the Audio Switching Support the unbalance of RCA audio signal interface, but also support the balance of professional audio XLR interface. Audio Switching can put the multiple channel audio input signal to the output port, under the condition of the multiple input signals, any way you can switch the input signal to the output port.

2. The Research Background and the Current Situation

Generally, audio Switching could complete 1 ~ 16 road input, any switch 1 ~ 16 channel output. Possess the function of infrared ray remote control and RS232 communication terminal control, Can be additive RS485 bus interface, Users can easily complete the signal switching in the process of demonstration. Switches are widely used in radio broadcasting and broadcast monitoring [1-7]. Usually a radio switcher connection scheme is shown in Figure 1.Through the switches, Radio station staff can easily control the output signals to switch between the input signal sources.
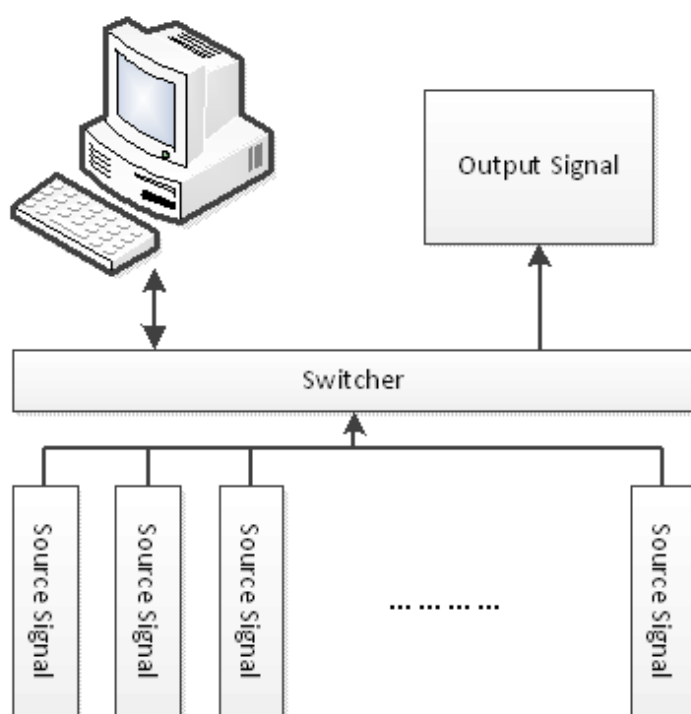
Figure 1. Radio Connection Schemes Commonly Used Switcher

Through the computer serial control signal, so we can easily by means of software, timing of the automatic control of switches shall be carried out in accordance with the setting in advance [8]. Assume that the input signal of signal source in Figure 1 is CCTV, while the radio station broadcast The CCTV news every night at seven o 'clock. After possessing switcher control software, we can advance arranging switch tasks every day. Such as automatic at 7 o 'clock every night will switch input signal to the corresponding channel. Such as automatic at 7 o 'clock every night will switch input signal to the corresponding channel, without the need for a day at 7 o 'clock in the evening when people operating switches hardware.

Therefore, there are so many types switcher products on the market, different vendors switcher usually have different control instruction, the scope of the switcher control software very stringent requirements are put forward. Common practice at the moment, which in view of the different vendors switcher hardware write different control code, through the way of pre-compiled, is to demand to generate the corresponding executable program, in order to adapt to different types of manufacturers products. This makes the same set of software can only control one type of switches, if the need to control the other hardware, usually need to recompile software, for software maintenance and update will be disadvantageous.

In this paper, using.net technology and WPF (Windows Presentation Foundation) technology to design a set of switcher intelligent control system, the most striking feature of this system is that the idea of the instruction of programmable, the switcher hardware control instruction by extensible markup language (XML), dynamically loaded at run time. Because there is no instruction curing in the software code, in the face of different switches hardware, you just need to modify the control instruction in the XML. Removes the trouble to compile software and many sets of software code to maintain.

3. System Solutions

3.1 The Basic Implementation Approach

WPF is introduced Microsoft Windows Vista based user interface framework [9-12],Part of belonging to the.net Framework 4.0. It provides a unified programming model languages and frameworks, truly a separate interface designers and developers to work; at the same time, it provides a new multimedia interactive graphics user interface.

XML is a kind of used to mark the electronic file has the structural markup language. It can be used to mark the data define the data type, which is a kind of allowing users to own markup language to define the source language. It is very suitable for the World Wide Web transmission, provides a unified method to describe and exchange of structured data independent of the application or suppliers [13-15]. Due to the serial interface of the hardware of the switcher control instruction are simple string information, such as Chongqing modern model for HS5455 switcher control instruction control commands and equipment return status of the format for the command (or state) of the ASCII character code and return characters in the ASCII code, combined with certain parsing and map processing, can satisfy the requirement of real-time configuration and dynamic loading.

The system in this paper is designed by Microsoft Visual Studio 2012 and .net Framework 4.0. It used WPF (Windows Presentation Foundation) development scheme. The business logic and data processing and user interface can be separated completely in this model. This soft kept the commands for switch action by XML file. It can be easy used for another switch only change this xml file content.

3.2 System Technology Scheme in Detail

Switcher intelligent control system is designed in this paper is mainly to realize the automatic switch of the intelligent control of the switches, the user as long as a day will have to do to switches arranged some operations into a single operation, then can realize automatic switching of switches. Users can also in schedule a task to edit Settings of the day, when to call what single operation, can automatically adjust the single and switch.

The main work flow of the switcher intelligent control system is shown in Figure 2, the system functions is the instruction of programmable thought to realize the key point.
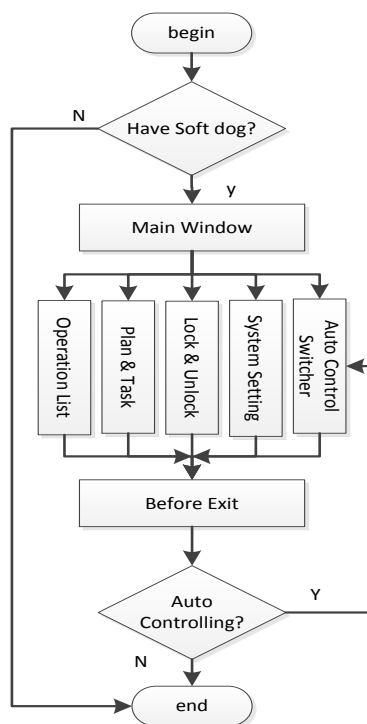
Figure 2. System Work Flow

According to the function of the system which need to implement, and user interface and data processing logic separate principles as far as possible, the system software is divided into four main module: The user interaction module, User data processing module, system data processing module and auxiliary program module, each module of user interaction through the Figure 3 describes the main functions of each module are briefly described as follows:

1) The user interaction module

User interaction module mainly completed software operating process and user interaction, including software main interface and some of the pop-up interface. Software main interface include the toolbar, entries show the regional, manual switch control, switch status bar, date and time display area, *etc*. The toolbar includes a switch to list add, delete, modify, edit, save, system setup, planning list, lock the entrance to the main interaction function, *etc*. Switch entry display area mainly shows the specific content of one day switch plans. Manual switch control area is mainly used for analog switches panel, hardware can be realized through software button switches manually switch control of each channel.

Pop-up interface switch includes broadcast program management interface and the interface of system setup, the system setting is closely related to the interface and the innovation of this article, which can through it for channel information configuration Settings and hardware control instructions.
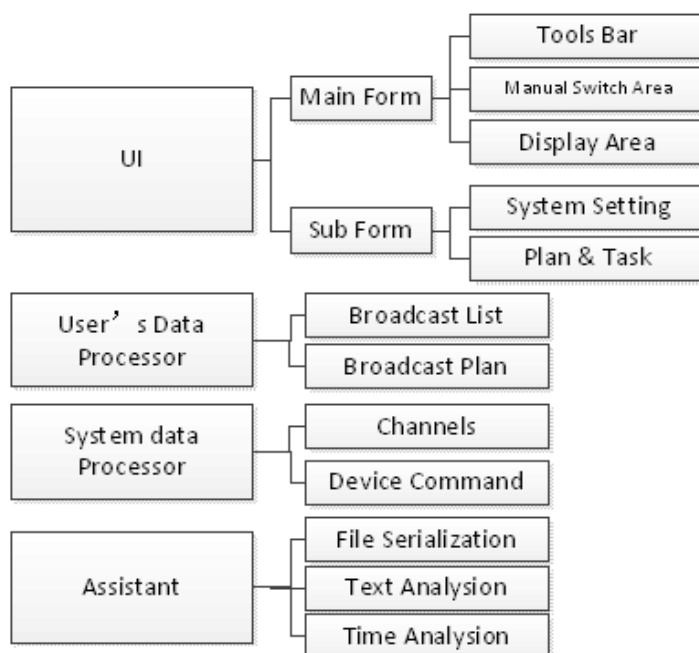
Figure 3. System Main Function Module

2) The user data processing module

User data processing module is mainly used for storage and processing in the process of the interaction of user data, such as the specific content of the broadcast table list, broadcast schedule list, *etc*. These data are usually saved in binary form.

3) The system data processing module

System data processing module is mainly used to store and process data produced in the process of interaction system, such as channel information data and hardware control instruction. These data are usually stored in XML files

4) Program Assistant module

Procedures auxiliary module is mainly used for auxiliary complete some logical processing, generally, each module of some utility function from it, for example, text string analysis, time information analysis, *etc*.

4. System Implementation

According to the above design, this article use VS2012 implements the whole system. Below will with Chongqing modern HS5455 switches as an example, detailed instructions on the system implementation process and result display.

Audio switcher intelligent control system program (hereinafter referred to as: the program) will first test whether have dongle.

If there is a dongle, you do not need to enter your user name and password can be directly into the main interface, the program is locked, will enter unlock password to unlock. Quits the program with prompt choose whether or not to quit, but the procedures are in a state of automatic operation, not allowed to exit, the purpose of this design is to prevent wrong operation and exit. The main interface as shown in Figure 4 Can be seen from the diagram, the main interface contains the mentioned in the previous section in the toolbar list and manual control, *etc*. The Settings button in the toolbar, configuring hardware instruction to the entrance.
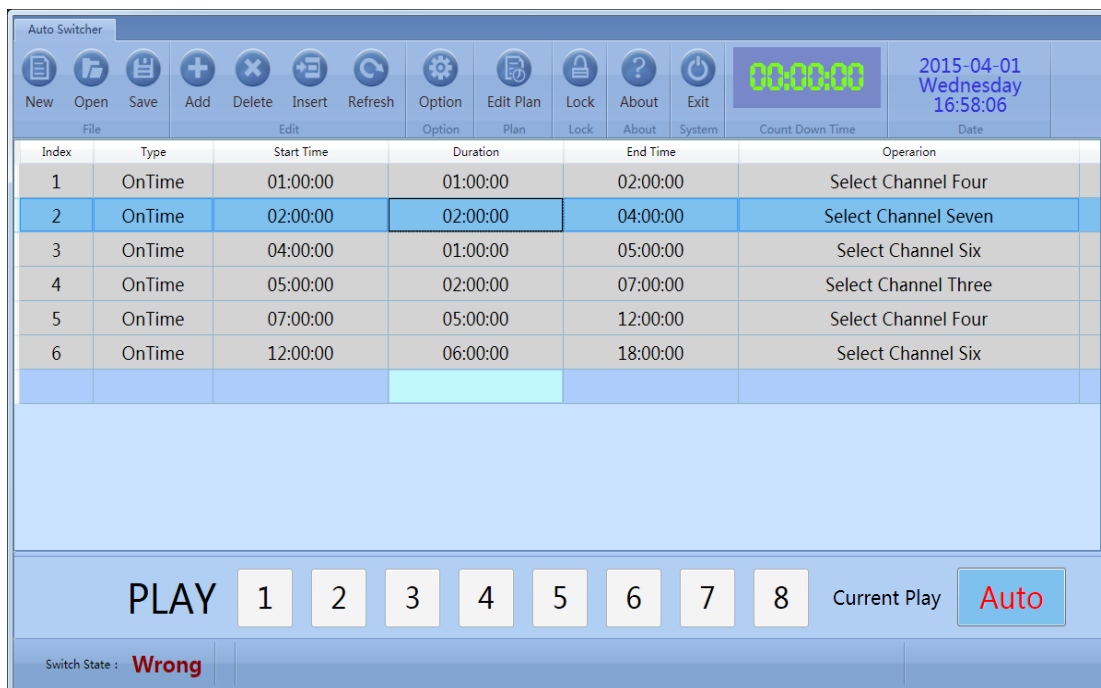
Figure 4. The Main UI of Control System

Through the Settings button in the toolbar, can enter the Settings interface, as shown in Figure 5
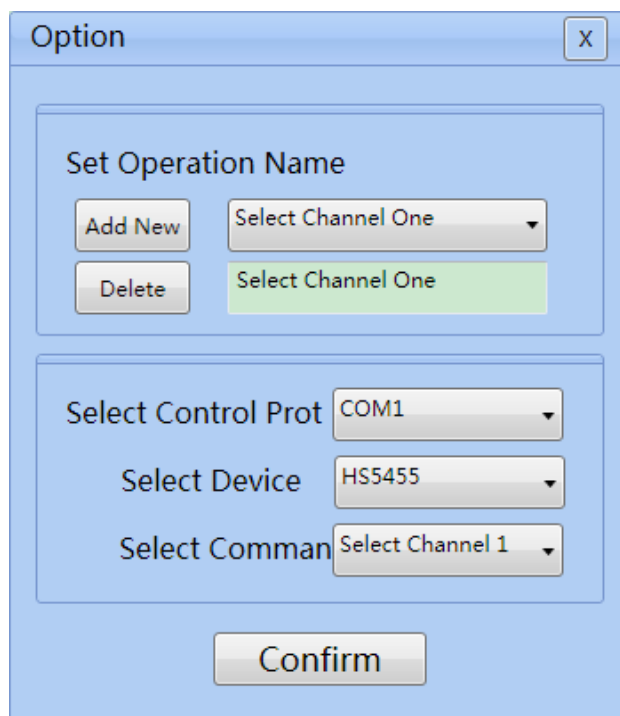

Figure 5. Settings Interface

Settings interface is divided into operation Settings and control instruction settings two parts. Operation is set mainly includes adding , deleting and modify the operation name three Settings, the purpose of adding operation is to add a new operation, Parameters (control, port equipment ,command) may choose from the drop-down list. Delete operation is to delete the selected operation. Modifies the operation name is mainly used for choosing the name of the operation, to facilitate a better understanding of the purpose of a switching action, such as switching to CCTV1.Control instruction part setting is to complete the control port, switcher mapping, hardware and control command name three Settings as shown said switcher HS5455 COM1 port corresponding to the command name is selected to channel 1. Here the configuration of the results will be stored in an XML file, and the relevant sections of the XML file format is shown in Figure 6.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<Config>
  <Operates>
    <Operate CommandName="Select Channel 1"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 1"/>
    <Operate CommandName="Select Channel 2"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 2"/>
    <Operate CommandName="Select Channel 3"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 3"/>
    <Operate CommandName="Select Channel 4"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 4"/>
    <Operate CommandName="Select Channel 5"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 5"/>
    <Operate CommandName="Select Channel 6"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 6"/>
    <Operate CommandName="Select Channel 7"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 7"/>
    <Operate CommandName="Select Channel 8"
        DeviceName="HS5455" PortName="COM1"
        Name="Select Channel 8"/>
    <Operate CommandName="Get Current Selected
        Channel" DeviceName="HS5455"
        PortName="COM1" Name="Get Current Selected
        Channel"/>
  </Operates>
  <Devices>
    <Device Name="HS5455" IsSort="True"/>
  </Devices>
  <Ports>
    <Port Name="COM1" IsSort="True"/>
  </Ports>
  <LockPassWord Value="123456"/>
</Config>
```

Figure 6. The Format of Configuration

Configuration information in Figure 5 to 6 format to XML file. One of the < Operate > < / Operate > to describe a COM port Settings. The Name field said the Name of the channel, Port Name said the current corresponding to the Name of the port, Device Name switcher said the current hardware, usually switcher hardware have multiple ports.

Command Name field represents the corresponding operation name.

To be sure, the CommandName field only as described in the configuration file is used, corresponding to the specific hardware control instruction, also need a XML format of the configuration file to described, in order to control the name into a specific control instruction, the format as shown in Figure 7.
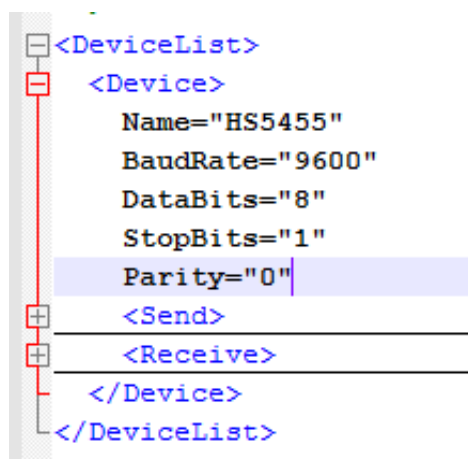
```xml
<DeviceList>
    <Device>
        Name="HS5455"
        BaudRate="9600"
        DataBits="8"
        StopBits="1"
        Parity="0"
        <Send>
        <Receive>
    </Device>
</DeviceList>
```

Figure 7. Switcher Instruction Format

In Figure 7, the "DeviceList" node is used to describe supportable hardware device list, node information would make a detailed description of various hardware. Device node describes switcher Device basic information, including equipment name, baud rate, data bits, *etc*. Send child nodes described sent via a serial port to control command content, its content is actually set in Figure 6 "CommandName" and the mapping relationship between actual Send commands "CommandString". If you want to perform operations Selected channel 1, then the actual need to send instruction to the corresponding the COM 49, 13 in the same way, the Receive child node set via a serial port receives the data, the significance of its content is set to Receive "CommandString" represent actual significance. If the received information from the corresponding the COM is 79, 75, 13, indicates that the command received correctly.

```xml
<Send>
    <Data CommandName="Select Channel 1" CommandString="49,13"/>
    <Data CommandName="Select Channel 2" CommandString="50,13"/>
    <Data CommandName="Select Channel 3" CommandString="51,13"/>
    <Data CommandName="Select Channel 4" CommandString="52,13"/>
    <Data CommandName="Select Channel 5" CommandString="53,13"/>
    <Data CommandName="Select Channel 6" CommandString="54,13"/>
    <Data CommandName="Select Channel 7" CommandString="55,13"/>
    <Data CommandName="Select Channel 8" CommandString="56,13"/>
    <Data CommandName="Read Selected Channel" CommandString="82,13"/>
</Send>
```

Figure 8. Send Instructions Paragraph Format

```xml
<Receive>
  <Data CommandString="79,75,13" Message="Receive Command Success"/>
  <Data CommandString="69,82,13" Message="Receive Command Wrong"/>
  <Data CommandString="49,13" Message="Current Selected Channel 1"/>
  <Data CommandString="50,13" Message="Current Selected Channel 2"/>
  <Data CommandString="51,13" Message="Current Selected Channel 3"/>
  <Data CommandString="52,13" Message="Current Selected Channel 4"/>
  <Data CommandString="53,13" Message="Current Selected Channel 5"/>
  <Data CommandString="54,13" Message="Current Selected Channel 6"/>
  <Data CommandString="55,13" Message="Current Selected Channel 7"/>
  <Data CommandString="56,13" Message="Current Selected Channel 8"/>
</Receive>
```

Figure 9. Receive Instruction Format

Figure 7 listed equipment configuration information only HS5455 a switcher, if you need to use other types of switches, only need in the DeviceList configuration drawn up in accordance with the format to add or modify the corresponding instructions and mapping relationship The Figure 7 DeviceList paragraph there is a lot of a Device in the subtotal, respectively corresponding to different types of switches hardware .Thus, when changes in equipment, only need to add a Device in the configuration file configuration section, described in the configuration section switches the name of the hardware Information such as baud rate, and the format can send and receive instructions and to the configuration file do corresponding adjustment , without the need to recompile the entire software.

5. Conclusions

Switcher centralized control system has been widely used in the radio, but the universality of most products currently on the market are quite limited. With this kind of situation, the author of this paper designs an instruction of programmable intelligent switcher control system, the system can under the condition of which without recompiling code, which better adapt to a variety of different types of switches. The research achievements of this paper have applied for the computer software copyright, registration number is 2014 sr080932. In spite of this, this article mentioned the plan is still in need of improvement, one of them is the safety protection of configuration information that still not doing enough, due to the direct preserved by XML format plain code, users can even directly through a third party software to directly modify the XML, easy to produce wrong operation Considering appropriate configuration information encryption and then save, it can avoid this problem.

References

[1] Z. Qijian and B. Jianguo, "An Intelligent Controller of Novel Design", Proceedings of A Multi-National Instrumentation Conference, Part 1, **(1983)**.

[2] L. Y. Wing and W. Y. Ping, "An orthogonal genetic algorithm with quantization for global numerical optimization", IEEE Transactions on Evolutionary Computation, **(2001)**.

[3] M. K. Valiev, M. I. Dekhtyar and A. Y. Dikovsky, "Systems of agents controlled by logical programs: Complexity of verification", Programming and Computer Software, vol. 35, no. 5, **(2009)**.

[4] J. Luo and H. Ni, "Programmable- logical- controllers Synthesis for Automated- guided- vehicle Systems Using Ordinary Petri Nets", Asian J Control, vol.16,   **(2014)**, pp. 6.

[5] B. Jim, "Programmable Tool Setting System", American Machinist, vol. 153, **(2009)**, pp. 8.

[6] R. Stefano, B. Enrico, G. Francesco, M. Tiziano and T. Piero, "A programmable real-time system for development and test of new ultrasound investigation methods", IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control, vol. 53, no. 10, **(2006)**, pp. 1813-9.

[7]   "Anonymous. Business Software and Service Companies; Unify Team Developer 6.0 .NET Delivers Highly Productive Development of WPF Applications", Information Technology Newsweekly, **(2011)**.

[8]   "Anonymous Data Management; Three WPF Scheduling Controls in One - dbiCalendarWPF Released", Information Technology Newsweekly, **(2011)**.

[9]   "Anonymous Ticketsoft, LLC; Ticketsoft Adds Digital Signage with Microsoft WPF Technology for Movie Theatre Operators", Computer Business Week, **(2008)**.

[10] B. C. Tsen, J. Larry and B. Jeanne, "WPF study", Journal of Occupational and Environmental Hygiene, vol. 4, **(2007)**, pp. 9.

[11] S. Y. Lin and B. C. Xi, "Research and Analysis of Image Processing Technologies Based on DotNet Framework", Physics Proceeding, vol. 25, **(2012)**, pp. 2131-2137.

[12] D. Naugler, "Review of "Pro WPF in C# 2008: Windows Presentation Foundation with, NET 3.5 (2nd ed.)", ACM Queue, vol. 6, **(2008)**.

[13] K. Bob, "Technology Shines at InfoComm 2014", Government Video, vol. 25, no. 8, **(2014)**, pp. 6,8.

[14] W. Chris, "Broadcast Tools ACS 4.1. Radio", The Radio Technology Leader, vol. 20, no. 6, **(2014)**, pp. 32.

[15] C. W. Lee, "Efficient bit rate control method for distributed video coding system", EURASIP Journal on Advances in Signal Processing, vol. 2012, no. 1, **(2012)**.

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