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## Adapted Digital Music Players for Individuals with Severe Impairments

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### Abstract

Portable music production devices, such as radios, cassette players and MP3 players have characteristics that make them less than ideal for teaching the cause-and-effect relationships that would enable children and adults with severe impairments to control them independently and appropriately. Even when adapted for control with adaptive switches, the relationship between switch closure and on-off operation results in contingency characteristics that can inhibit learning. Some solutions to these problems are described, and for those individuals who can learn with complex contingencies, some promising products are reviewed.

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Listening to music and stories can be an enjoyable activity for both children and adults. Often, people without the ability to reach and grasp have been limited to listening to material chosen by others. An option has been to provide radios, cassette players, or CD players that are adapted for switch use. An adaptive switch is a simple device similar to a light switch, but it usually has a flat plate. When the plate is depressed, it causes electricity to flow to the music-generating device. With the adaptive switch, the hope is that a person with severe impairments can learn that pressing the switch causes something to happen and, over time, learn to intentionally turn these devices on and off (Saunders, Questad, Kediorski, Boase, Patterson, & Cullinan, 2001; Lancioni, O'Reilly, Singh, Oliva, & Groeneweg, 2002). Moreover, learning to control devices is an important prerequisite for learning communication skills (Schweigert, 1989; Schweigert & Roland, 1992). Addressing communication deficits often is a high priority with these individuals. Educational or therapeutic interventions often begin with the introduction of switch-controlled speech generating devices or voice output communication aids.

Several problems are associated with music players, however, when adapted for control with special switches. The audio devices that are commercially available that have been constructed to accept control from an adaptive switch are set to be turned on or off with the switch. Often there is a short lag of approximately 1.5 seconds between switch closure and sound onset with cassette tape players, as the tape drives are slow to go in motion when power is applied. If the person does not hear the audiotape immediately after closing the

switch, he/she may release the switch before experiencing the sound. With adapted radios, switch closure may occur during auditory pauses, commercials, and commentaries rather than music, even when the radio is tuned to a music station. Generally, adapted radios and cassette players have less than desirable sound quality. Cassette tapes are also difficult to purchase in today's market. Adapted CD players have the disagreeable characteristic of always starting over again at the beginning of the CD each time switch closure stops and restarts playback. Commercially adapted MP3 type players have confusing protocols for controlling playback. For example, in order to engage the play function the user may need to hold the switch for a specified period of time before music will start, or they may need to press the switch in a rapid sequence to activate music. Failure to follow the above described playback protocols may lead to unintended consequences including pauses, volume changes, or shutdown of devices.

To arrange for better control of what is produced by switch closure and to improve the characteristics of the switch-device contingency, we have designed an adaptor for digital music players of the MP3 type. These players have good sound quality, can store hundreds of songs or stories, and music genres can be stored, organized and played separately. These players have the drawback, however, of being very difficult to adapt for switch control by the user without voiding the warranty. Thus, our adaptor is designed to be used with any music player that has a socket for ear phones (or speaker) without modifying the player itself in any way. The skills needed to make the adaptor include the ability to read and follow a simple electronic schematic drawing, drill holes in a plastic box, and solder wires. These skills are typically those that anyone would learn in a high school electronics course.

The adaptor costs approximately \$18.00 to make. We purchased the parts at Radio Shack. The wiring diagram and materials are listed below.

#### Parts List

1. 1/8" Stereo Panel-Mount Audio Jack (2-Pack), Radio Shack Catalog #: 274-249
2. 1/8" Mono Panel-Mount Audio Jack, Radio Shack Catalog #: 274-251
3. 1/8-Watt 10 Ohm Carbon-Film Resistors (5-Pack), Radio Shack Catalog #: 271-013
4. Project Enclosure (3×2×1"), Radio Shack Catalog #: 270-1801
5. 20-Ft. UL-Recognized Black Hookup Wire (12AWG), Radio Shack Catalog #: 278-566
6. Rosin Core Solder (8.0 oz.), Radio Shack Catalog #: 64-009

When the player is turned on and the switch, earphones (or speaker), and music player are connected to the adaptor, music can be heard as long as the switch is closed. When the switch is released, the music continues to play but cannot be heard. That is, the device interrupts sound output to the earphones or speakers, but does not interrupt operation of the player. When the switch is closed again, sound resumption is instantaneous. A drawback to this design is that speakers (instead of earphones) cannot be battery-operated. If battery-operated speakers are used, there may be a bleedover sound effect after the switch has been released.

Shown below, is the design of another adaptor that can be used with speakers that are battery-operated.

#### Parts List

1. 1/8" Stereo Panel-Mount Audio Jack (2-Pack), Radio Shack Catalog #: 274-249
2. OMRON G6H-2 Standard DPDT Relay ([www.digikey.com](http://www.digikey.com))
3. 9V Alkaline Battery Radio Shack Catalog #: 23-875
4. 1/8" Mono Panel-Mount Audio Jack, Radio Shack Catalog #: 274-251
5. 9 Volt Snap-In Battery Holder <http://www.keyelco.com/> Catalog #: 1290-79
6. Project Enclosure: Fry's Electronics web site:  
Serco Mold 253-BLACK 9 Volt Enclosure. High Impact ABS W/ Scratch Resistant Grain Finish. 3H × 5.25L × 2.25H Black  
Frys # 138294 Mfr: Chasis's Enclosures  
[http://www.frys.com/product/138294?site=sr:SEARCH:MAIN\\_RSLT\\_PG](http://www.frys.com/product/138294?site=sr:SEARCH:MAIN_RSLT_PG)
7. 20-Ft. UL-Recognized Black Hookup Wire (12AWG), Radio Shack Catalog #: 278-566
8. Rosin Core Solder (8.0 oz.), Radio Shack Catalog #: 64-009

This device works well with all types of battery-operated speakers and sound is high quality. The drawbacks are that it is a little more difficult to construct and requires a separate battery. The cost is approximately \$40. The picture, shown below, shows an adaptor (black box), a Jellybean<sup>®</sup> switch connected into one port, a music player into a second port, and the speaker (silver box) into the third port.

If the user is unable to sustain long switch closures to maintain continuous playing or wants the ability to turn on or off the music player with a switch closure, then a timer/latch control interface can be used. Such devices are sold at internet sites that sell adaptive switches. Ablenet<sup>®</sup>, for example, sells a product called a Single Switch Latch and Timer for approximately \$150. The timer mode can be set for a specified number of minutes or seconds. The music player will continue to play for the interval set following a single switch closure. Additional switch closures do not affect play. If the device is set on the latch mode, then the first closure will turn on the music player, and the second closure will turn off of the player. Our experience is that latch and timer modes require less effort and prevent interruption of the music output.

If the user has not yet learned the relationship between closing the switch and turning on or off the device, then the latch and time modes are not recommended as initial arrangements. In early phases of instruction, latch and timer modes are problematic with respect to possible contingency confusion. In the latch mode, half the switch closures turn on the device and half turn them off. In the timer mode, the first closure starts the device, but all closures during the timed interval have no effect. Thus, in both latch and timer modes, switch closures do different things at different times, and the differences occur without contingency-change signals (i.e., schedule component markers). These conditions may retard learning. Switches that work in a synchronous mode, however, in which every switch closure starts the device and every switch release stops the device, are likely to engender learning more readily. The adaptors described above provide instantaneous stimulus change in the synchronous mode and are now employed in our research in learning by persons with severe disabilities.

Not all individuals with disabilities require synchronous contingencies for learning to control devices. For individuals who have demonstrated learning and stimulus control with more complex contingencies, a more versatile interface for the digital player is

commercially available from Technical Solutions Australia. This device, an iScan-MP3, and is operated by a single switch and acts as a stepper for the functions on a MP3 player. The first switch closure turns on the player. Selections are then scanned. If the Play/Pause option is scanned and the player is on, closures alternate between play and pause. Pressing the switch for more than 3 seconds turns off the player. The Track/Forward/Back allows the user to move forward or backward through the playlist, but does not allow changing albums. The Volume Up/Down option allows control of the volume. The iScan-MP3 costs \$190. Information on this device can be found at <http://www.tecsol.com/au/Switch.Pod.htm>

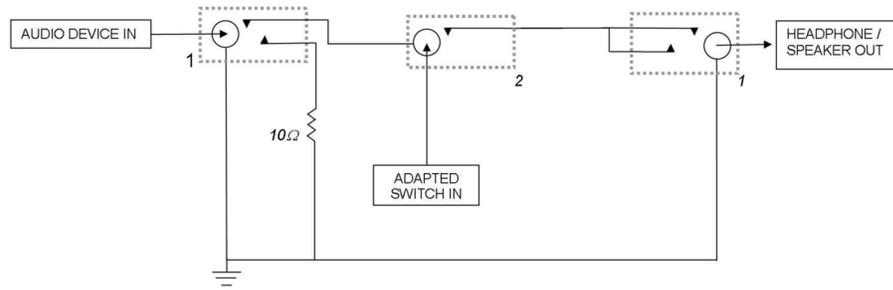
An option for those people who have some hand or finger control is the Big Button iPod Remote sold by R J Cooper (<http://www.rjcooper.com/ipod/index.html#1>). The remote control device has 5 push buttons. A 1¾ inch button works as a latch switch to either turn on or pause the music player. Smaller buttons on either side of the play/pause button control backward and forward. Two smaller buttons control volume. On the back on the remote housing are switch input slots for each button that allow, for example, a user to control play/pause with a switch closure. The remote costs \$99.

Another option for those with some hand control is the SweetPea 3 by Peapod Toys. This product is marketed for toddlers and adults with disabilities. It is large, can be held by a circular handle. And has a large built-in speaker. It also has port for a headphone jack. It has three large buttons. The button marked with a square controls start/stop and when held down turns off the device. The two buttons with triangles move through the playlist. It has a standard mini USB port and comes with power cables. It costs about \$60 and can be purchased at several internet sites.

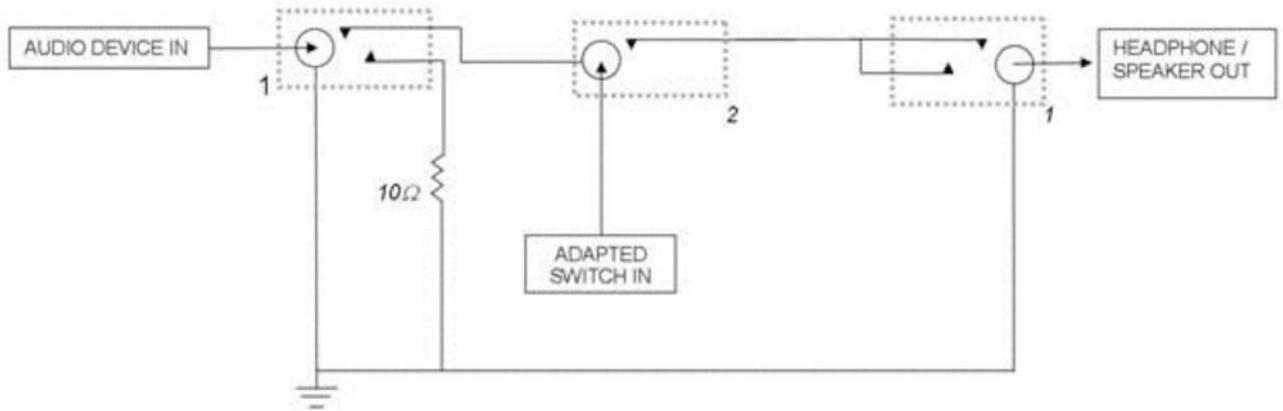
In summary, improvements have been made in the sound quality and storage capacity of portable music players. The players are difficult to adapt for use by people with severe intellectual or motor impairments. In this paper, we have described two ways of adapting MP3 type output without voiding the warranty of the player. The adaptive devices described require a few simple electronics and motor skills to replicate. The devices are versatile in that they allow switch-music contingencies in the latch, timed and synchronous modes. For those individuals who may be ready for more complex means of control of music players, we have provided a brief review of some commercially available products.

## References

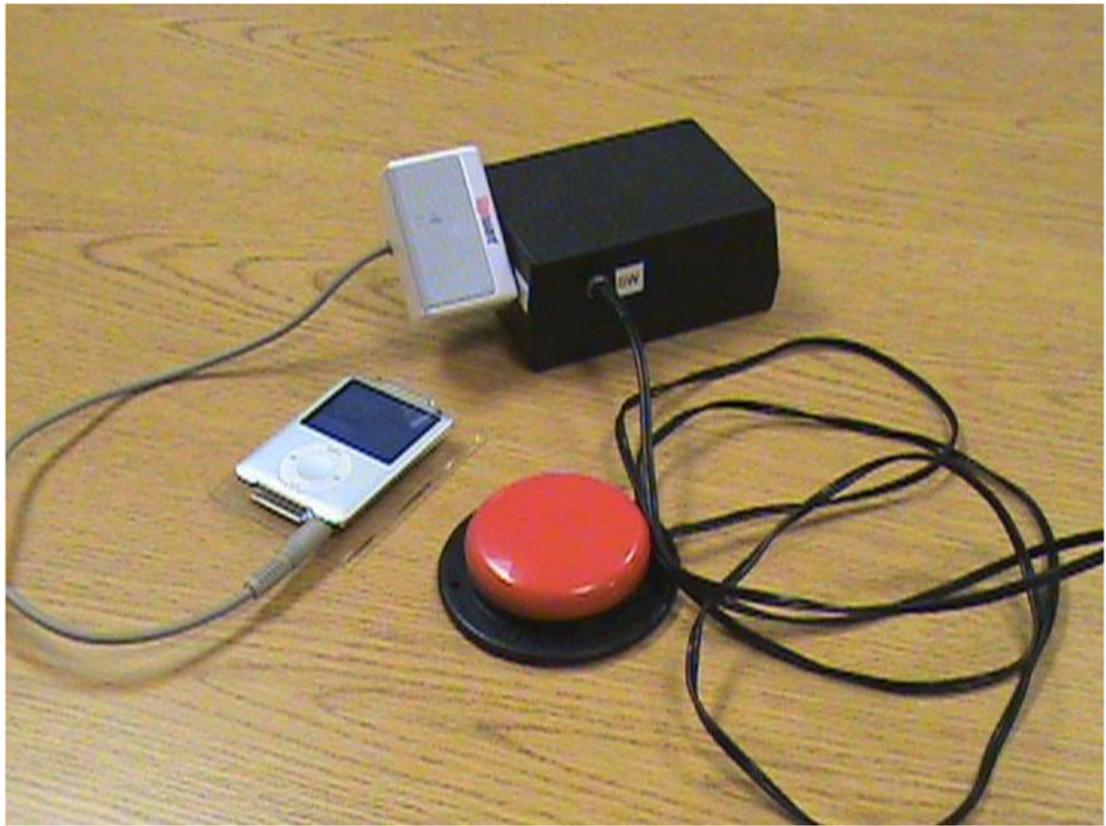
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**Figure 1.** Schematic of the electrical components and wiring for the adaptive interface for digital music players.



**Figure 2.** Schematic of the electrical components and wiring for the adaptive interface for digital music players when battery operated speakers are used as the output device.



**Figure 3.** Photo of the adaptive interface connected to a speaker, adaptive switch and digital music player.