Western Washington University
ETec 471
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Drum Pad MIDI Controller

I propose to design an electronic drum pad, and the associated hardware and software to control a MIDI compatible sound source.

In 2003, the Musical Instrument Digital Interface (MIDI) turned twenty. MIDI is a communication standard for electronic instruments, allowing the remote control of MIDI compatible devices by other MIDI equipment. Initially an electronic keyboard interface, MIDI has been applied to a wide range of musical instruments, as well as to computers and recording equipment. A significant contributor to MIDI's success is its inherent flexibility and simplicity. Control signals are sent by asynchronous serial transmission over shielded cable. An electronic drum pad can be used to control a digital sampler, sequencer, drum machine, or other electronic sound source equipped with a MIDI port. Compatibility is assured by standards specified by the MIDI Manufacturer's Association. The control signals are sent by asynchronous serial transmission over a five-pin DIN connector.

An electronic drum pad would be relatively simple to build and, with appropriate hardware and software, could control a digital sampler, sequencer, drum machine, or other electronic sound source equipped with a MIDI port.

Project Description

MIDI specifications are developed by the MIDI Manufacturers Association (http://www.midi.org). These standards provide compatibility among MIDI devices. MIDI addresses physical and electrical connectivity, message format and interpretation, data rate, and transmission scheme. Since not all MIDI messages are practical in a percussion controller, the project's scope shall be limited to Program Change (two bytes), Note On, and Note Off (three bytes each).

The proposed system consists of two major units (see Figure 1). The bulk of the electronics is contained in the controller. Program and note numbers are selectable by the user, and visually displayed. A transducer connected to the drum pad sends an analog signal to the controller when the pad is struck, which uses these inputs to generate standard MIDI messages.

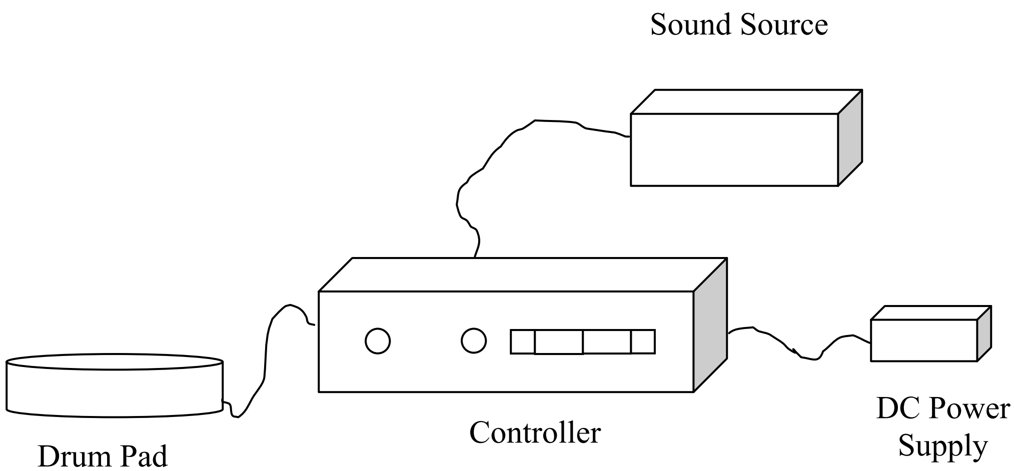

Figure 1

The first part of a MIDI message is the status byte, and contains a 1 in the most significant bit. The status byte indicates the message function. This is followed by one or two data bytes representing the parameters of the function in a range of 0 to 127 each. For the project, one data byte is either a program number or a note number. The third byte, if required, conveys velocity information corresponding to how hard the drum pad is struck. Messages are output serially, employing standard asynchronous communications protocol with one stop bit and no parity. The transmission rate is 31,250 bits per second.

Users select program and note numbers by means of three-position rocker switches. Note Off messages are initiated by a push-button switch. The input levels associated with these switches are fed to the control logic function as shown in Figure 2. The control logic outputs control signals to the LED display which, in turn, indicates the program and note numbers selected.

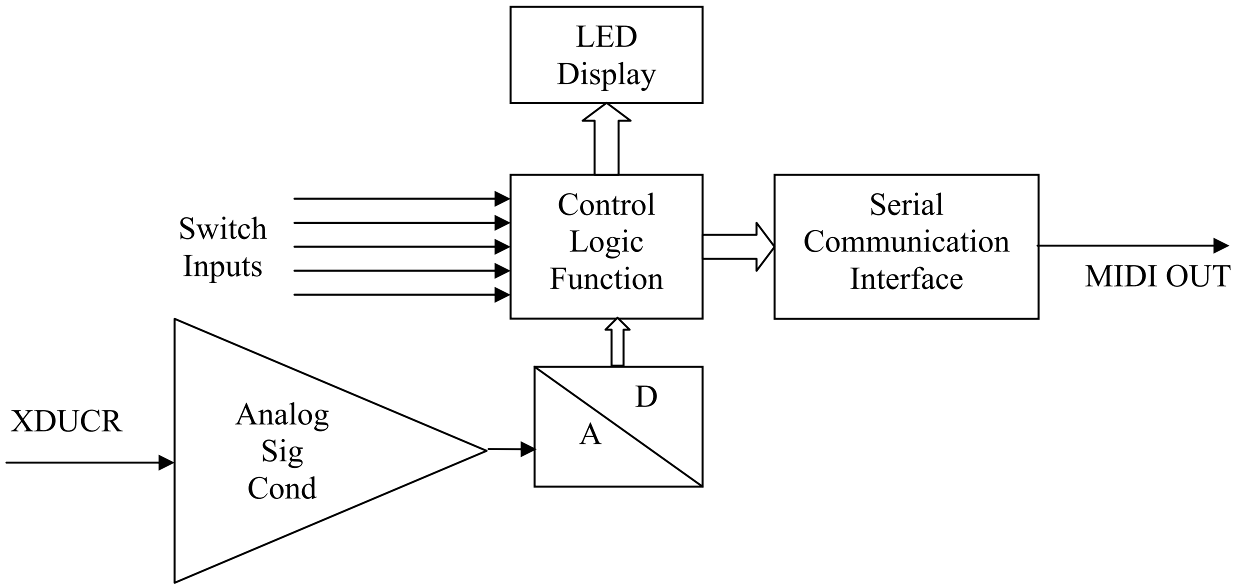

Figure 2

Signals generated by the drum pad transducer are appropriately scaled and shaped by the analog signal conditioning section, and then sent to the analog-to-digital converter. MIDI messages are assembled by the control logic function based upon its inputs. Finally, the messages are output via the serial communication interface.

Benefits

The Musical Instrument Digital Interface standard is widely used in electronic instruments. MIDI allows one instrument to control another by means of standardized digital messages. Any sound accessible from a MIDI compatible source can be controlled with these messages. Depending on the source used, anything from pristine digital samples of acoustic instruments to vintage video game noises can be triggered from the same pad.

Comparison / Advantages

From a commercial standpoint, this is not highly competitive. Percussion controllers such as the drumKAT have multiple pads assigned to different note numbers, allowing drummers to play virtual drum kits. By limiting myself to one pad, I would need to create sequenced loops in order to achieve the same effect. Additionally, a lone pad can be effectively utilized for trigger sounds not generally associated with a common drum set.

While researching sound sources, I discovered an unexpected advantage. Some low-end drum machines generate a lower range of velocity values when triggered by their built-in pads then when controlled via MIDI. Since dynamics are among the most expressive elements of drumming, this is an important, albeit subtle feature.

Project Development

As indicated above, dynamic range is among my major concerns. When the drum pad is struck with a greater force, the sound produced should be louder. In standard terminology, the pad must be velocity sensitive. A web search produced plans for such a drum pad using a piezoelectric transducer. I modified those plans, utilizing a piezoelectric film sensor from Measurement Specialties, Inc.

The transducer produces a small analog signal. This must be amplified, and processed so that its peak amplitude is converted to a digital word. Program and note numbers are also represented by digital words. The controller uses this information to construct a MIDI message.

The microprocessor unit will assemble the MIDI message, and transmit it serially. The transmission rate is limited to 31,250bps by the MIDI standard. The sound source has an additional delay; shorter delays generally corresponding to higher price tags. I can not afford the top-of-the-line sound sources, so it is imperative that the message be compiled quickly to avoid annoying time delays. Realistically though, the processor speed is the least of my concerns. I plan to use the Motorola 68HC12 and development software available in ET340.

Power supply requirements are not fully developed at this time. I have a small, switched type 5V DC power supply available. I do not expect to exploit its 5.0A rated output, but it should work admirably.

Demonstration

The Korg 05R/W AI^2 synthesis module will be used as a sound source for testing and demonstration. This unit features an extensive sound library (including164 drum sounds), digital synthesis and processing, and a host of features I will probably never learn to use. It is also equipped with a serial computer interface. Space requirements should be modest.