Arduino Music Maker

Joshua Smith

5/6/2016

ECE 387

Dr. Rajasekhar

**Introduction**

This project consisted of making a music maker out of an Arduino Uno board and various sensors. The project was an extension of the Tilt Tone midterm project where tilting a gyroscope was used to vary the pitch or frequency of a buzzer. The Music Maker made significant use of inputs, outputs, and coded logic.

**Function**

The Music Maker took inputs from a 3-axis gyroscope, a tactile pushbutton, a photoresistor, a thermistor, and a 38 kHz Infrared receiver. The outputs of the system were a square wave driven buzzer, and one red, one green, and one yellow LED. An Arduino Uno microcontroller controlled these inputs and outputs with the appropriate logic.

The first portion of the Music Maker was the tilt tone functionality. In the first mode, tilting the gyroscope along the x-axis varied the pitch of the buzzer using notes from the western scale. The red LED was lit to indicate that the system is in the pitch mode. The second mode also tilted the gyroscope along the x-axis, but instead continuously varied the frequency of the buzzer through very integer Hz value. The green LED indicated this mode. A tactile pushbutton was used to switch back and forth between the two modes. A delay was used on inputting the pushbutton to prevent switch bounce.

The second portion of the Music Maker was the song playing capability. Three different songs could be played according to the sensory input. The photoresistor detected the amount of light in the room. When the amount of light detected dropped below a certain level by turning off the lights or covering the photoresistor, the “Halloween Theme Song” began to play. A thermistor behaved similarly by playing “Hot Cross Buns” when the temperature went above a certain value such as when a hot object was touched to the thermistor. The third song was “Crazy Train” activated by the IR receiver detecting input from a standard TV remote.

When any of these songs were being played, no other input was taken until the end of the song except for the gyroscope. Tilting the y-axis of the gyroscope while a song was playing varied the tempo of the song. Leaving the gyroscope flat played the songs at their traditional tempo. The LEDs flashed in rhythm to this tempo to provide a visual output.

**Technical Explanation**

The program running on the Arduino chip used a 10 ms clock to keep all of the songs in time while still allowing sensor updates every code cycle. Sensory input is described below.

The GY-80 is a chip that includes a gyroscope, accelerometer, magnetometer, barometer, and thermometer. However, only the gyroscope was utilized for this project leaving room for future improvement. The chip used I2C Serial Protocol to communicate with the Arduino through the analog 4 and 5 pins. Pin 4 corresponded with the SDA data pin on the GY-80 and pin 5 with the SCL clock pin. Sample code was used to read data from the chip as the GY-80 is a complicated, digital device [1]. Initial values were taken of the x and y-axes upon start-up to compare to dynamic values later in the program. This comparison enabled the pitch, frequency, and tempo to be controlled accordingly.

The tactile pushbutton is a simple, digital switch that was connected between digital input pin 4 and ground. The pull-up resistor was activated on that pin to allow the active low to be detected. The Arduino used the input to switch modes when a “0” is detected.

The photoresistor was the first sensor used to control a song and was connected between ground and 3.3 volts in series with a 1k Ohm resistor. A connection was made between analog pin 0 and the connection between the photoresistor and resistor. This allowed the analog pin to read the voltage drop over the photoresistor. As the light hitting the photoresistor diminished from the lights going out, the resistance and therefore the voltage drop increased. The pin read in an analog value from 0 to 1023 corresponding to 0 to 3.3 volts. When the Arduino detected a value above 550, the “Halloween Theme song” was played.

Similarly, the thermistor was used to control a different song. It was connected in series to two 10 Ohm resistors due to a lower nominal resistance from ground to 3.3 volts and fed to analog pin 1. At startup, an initial value was read from the thermistor. As the temperature rose, the resistance dropped and the measured voltage drop increased. This new value was compared to the initial value, and started “Hot Cross Buns” when the difference was greater than 20.

The last sensor used was a 38 kHz IR receiver. The device was digital and only responded to IR waves at a 38 kHz frequency. All other frequencies were ignored, a trait that allows background IR noise to be filtered. When a TV remote button was pressed and released a signal, the IR receiver would go from a value of 1 to 0, signaling the beginning of “Crazy Train”.

Audio output on the system was achieved using a simple buzzer connected to a PWM pin on the Arduino. The pin used the Arduino “tone()” function to generate a square wave at the prescribed frequency with the “noTone()” function silencing the buzzer for rests. Volume to this device was controlled using a 10k Ohm potentiometer.

Visual output was obtained using one green, one red, and one yellow LED. Each was connected in line with a 1k Ohm resistor to prevent too much current from being drawn. The LEDs were designed to come on and indicate the mode or to be flashed in rhythm to the music.

**Conclusion**

Overall, the Music Maker is a fairly cheap project that allows for user interaction. Customization is readily available by changing the songs in the program and by using different sensors to activate the songs. This device was a great tool for learning how to get several sensors and outputs to act synchronously using a clock and taught valuable lessons in the order of calculations in written code.

**Bill of Materials**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item # | Item | Quantity | Price per Quantity | Total Price |
| 1 | IR TSOP 382 38 kHz receiver [2] | 1 | $1.95 | $1.95 |
| 2 | 1000 Ohm Resistor [3] | 4 | $0.10 | $0.40 |
| 3 | 10 Ohm Resistor [4] | 2 | $0.06 | $0.12 |
| 4 | Tactile Push Button [5] | 4 | $1.63 (for 100) | $1.63 |
| 5 | Potentiometer [6] | 1 | $0.89 | $0.89 |
| 6 | Ardunio Uno [7] | 1 | $5.97 | $5.97 |
| 7 | Wires [8] | 1 | $0.46 | $0.46 |
| 8 | Breadboard [9] | 1 | $4.00 | $4.00 |
| 9 | LEDs [10] | 3 | $0.21 | $0.63 |
| 10 | Photoresistor [11] | 1 | $0.95 | $0.95 |
| 11 | Thermistor [12] | 1 | $1.79 | $1.79 |
| 12 | Buzzer [13] | 1 | $0.99 | $0.99 |
| 13 | GY-80 3-Axis Gyroscope [14] | 1 | $19.34 | $19.34 |
|  | Total |  |  | $39.12 |

**References**

1. "L3G4200D Tripple Axis Gyroscope + Arduino." Bildr.org. Bildr, 15 June 2011. Web. 02 May 2016. <http://bildr.org/2011/06/l3g4200d-arduino/>.
2. "IR Receiver Diode - TSOP38238." Robot Shop. Robot Shop Inc., 2016. Web. 3 Mar. 2016. <http://www.robotshop.com/en/ir-receiver-diode-tsop38238.html?gclid=CLqQq\_vNo8sCFcskhgodx9kD7w>.
3. "1/4W 1K OHM Resistor." *Opentip.com*. Opentip, 2016. Web. 01 May. 2016. <http://www.opentip.com/product\_info.php?products\_id=1886114>.
4. "1/4W 10 OHM Resistor." *Opentip.com*. Opentip, 2016. Web. 01 May. 2016. <http://www.opentip.com/product\_info.php?products\_id=4160943>.
5. "100pcs Tactile Push Button Switch Momentary Tact 6x6x5mm DIP Through Hole 4pin | EBay." *EBay*. EBay, 2016. Web. 03 Mar. 2016. <http://www.ebay.com/itm/like/261851293559?ul\_noapp=true&chn=ps&lpid=82>.
6. "Arduino UNO R3 Development Board Microcontroller." Newegg.com. New Egg, 2016. Web. 03 Mar. 2016. <http://www.newegg.com/Product/Product.aspx?Item=9SIA7BF2K19064&nm\_mc=KNC-GoogleMKP-PC&cm\_mmc=KNC-GoogleMKP-PC-\_-pla-\_-Gadgets-\_-9SIA7BF2K19064&gclid=CLyhidmIpcsCFZNZhgoddX8OIg&gclsrc=aw.ds>.
7. "920-0008-01 (per Piece) SchmartBoard | Mouser." Mouser.com. Mouser Electronics, 2016. Web. 03 Mar. 2016. <http://www.mouser.com/ProductDetail/SchmartBoard/920-0008-01-per-piece/?qs=A6MsUmktA0ybBJjOmChibA%3D%3D&gclid=CN-4qr6JpcsCFcNehgodr\_YLqQ>.
8. "Tiny Breadboard." Adafruit.com. Adafruit, n.d. Web. 03 Mar. 2016. <https://www.adafruit.com/products/65?gclid=CIiWnYeKpcsCFQ9Zhgod5dMJKw>.
9. "B10K Linear Potentiometer (Breadboard Friendly)." OddWires.com. OddWires, 2016. Web. 01 May 2016. <http://www.oddwires.com/b10k-linear-potentiometer-breadboard-friendly/?gclid=CLLB7NzPucwCFQUFaQodoscNbg>.
10. "Standard LEDs - Through Hole Blue Round LED." Mouser.com. Mouser Electronics, 2016. Web. 01 May 2016. <http://www.mouser.com/ProductDetail/Cree-Inc/C503B-BCS-CV0Z0461/?qs=UHyCXFkX5Ex3pZZMTHReQQ%3D%3D&gclid=CLLK673QucwCFQgxaQod6hoOGg>.
11. "Photo Cell (CdS Photoresistor)." Adafruit.com. Adafruit, n.d. Web. 01 May 2016. <https://www.adafruit.com/products/161?gclid=CMWH593RucwCFY-DaQodJqkJ5w>.
12. "NTC 10D-11 Copper Manganese Thermistors." Miniinthebox.com. Mini in the Box, 2016. Web. 01 May 2016. <http://www.miniinthebox.com/ntc-10d-11-copper-manganese-thermistors-10-pcs\_p1942048.html?currency=USD&litb\_from=paid\_adwords\_shopping&utm\_source=google\_shopping&utm\_medium=cpc&adword\_mt=&adword\_ct=94710053401&adword\_kw=&adword\_pos=1o5&adword\_pl=&adword\_net=g&adword\_tar=&adw\_src\_id=1364803665\_328601281\_21739983481\_pla-146295410698&gclid=CJH6qp\_YucwCFYSAaQodGnQO2Q>.
13. "Piezo Transducer 85dB 5Vp-p." Jameco.com. Jameco Electronics, 2016. Web. 01 May 2016. <http://www.jameco.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10001&productId=2210968&catalogId=10001&langId=-1&CID=GOOG&gclid=CPidwabbucwCFYM2aQodck8NRA>.
14. "GY-80 - Multi Sensor Board." Selfbuilt.net. Selfbuilt, n.d. Web. 01 May 2016. <http://selfbuilt.net/shop/gy-80-inertial-management-unit>.