Force Based Sound Generator by Interfacing Force Sensor with Arduino Microcontroller

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***Abstract*—Stress has become a part of daily routine for millions of people, and if not dealt with correctly, it can cause serious health problems. Stress produces the fight-or-flight response. When it becomes hard to find your way out of the descending twisting caused by irresistible stress and anxiety, try turning to music. Music has the ability to quickly shift our attitude, affecting our subconscious awareness where pesky negative thoughts feed on our fears and fuel the fires of stress. Researchers now know that playing a musical instrument can switch off the stress response, improving physical and emotional health. Playing music is a relatively inexpensive, quick-acting solution that's almost always available, and it could just save your life. Playing music is like a mega-vitamin, engaging more areas of the human brain than any other activity. Music is a greathealing tool to aid you get through difficult times. A morning walk or run, or even yoga or stretching, waiting in traffic, overtime office hours, late hour exam studies can become easier and more enjoyable if you have music as your personal coach and companion. Drum pants that helps you de-stress, release tension, or lift your spirits. Drum pants can be used to reduce stress, Eases anxiety, Decreases depression, Promotes relaxation, Increase focus, Increases immune system, Reduces blood pressure, Elevates mood, Alleviates pain. The drum pant is flexible wearable that can be attached to any type of pant, The drum pant has number of sensors which when tapped produces the corresponding music in the android mobile to which the sensors are interfaced via the Bluetooth.**

***Keywords* — Wearable sensors, Music, Android.**

I. INTRODUCTION

Stress is a burst of energy that basically advises you on what to do. In small doses, stress has many Advantages - it can help you meet daily challenges, motivate you to reach your goals and help you Accomplish tasks more efficiently giving you a memory boost. Stress is also a vital warning system, producing the fight-or-flight response. When the brain perceives some kind of stress, it starts flooding the body with chemicals like epinephrine, norepinephrine and cortisol. There are two types of stress - good stress and bad stress. While stress affects everyone in different ways, there are two major types of stress: stress that's beneficial and motivating — good stress — and stress that causes anxiety and even health problems — bad stress Unfortunately, our nervous system is bad at distinguishing between good and bad stress, making us more vulnerable and less equipped to fight stress on a daily basis. When it becomes hard to find your way out of the downward spiral caused by overwhelming stress and Anxiety, try turning to music. Music has the ability to quickly shift our mood, affecting our subconscious mind where pesky negative thoughts feed on our fears and fuel the fires of stress. Listening to music is a relatively inexpensive, quick-acting solution that's almost always available, and it could just save your life. Whether you are a well-versed musician or just beginning to learn how to play an instrument, spend a few minutes in the morning playing music. It can be simple scales or rudimentary exercises, a favorite song, or something improvisational. Playing music is like a mega-vitamin, engaging more areas of the human brain than any other activity. Music's ability to help us shift thought patterns and moods, and even improve our physical well-being, is quite remarkable. There is a reason they call it "playing" music and not "working" music. The point is to connect to your instrument in a positive, relaxed, and joyful way, and then let the vibration of the music do its magic. The more you can be present and truly enjoy the experience, the more it will help keep the stress at bay. The stress persons has pretty basic requirements for this project. The project should have a long battery life, be physically robust, not inhibit movement, be washable, be audible, have a good response time to user stimulus, and the components that make up Drum Pants should be hidden from view. Specifically, the components should be somewhere inside the pants, and their existence should not be obvious to the casual observer. The microcontroller and its power source should also be hidden in a similar manner. In order for Drum Pants to be successful, there will need to be a way to detect the user's drumming and a way to produce the drum sound. The drumming detection will be done with some kind of sensor, and the customer has expressed interest in

having the drum sounds be created by an Android application as he owns an Android phone. This means that the signals from the sensors have to be processed by a microcontroller and sent wirelessly using a protocol that an Android phone could receive. The goal of our project is to create wearable electronics, specifically for pants, that simulate playing drums.

II. TECHNIQUES

System Overview

The goal of our project is to create wearable electronics, specifically for pants, that simulate playing drums. The force sensors can be placed anywhere in our clothes based on user convenience. The Drum pant uses force sensors for sensing the taps by user. The sensors are connected to the Arduino, when the taps are sensed by the force sensors the data is processed by the Arduino and the processed data is sent to the android device by using Bluetooth. The Bluetooth is connected to the android device which the application has developed using java and the application produces corresponding drums sound based on the data of various forces sensed by force sensor. Figure 1 shows the architecture of the whole system

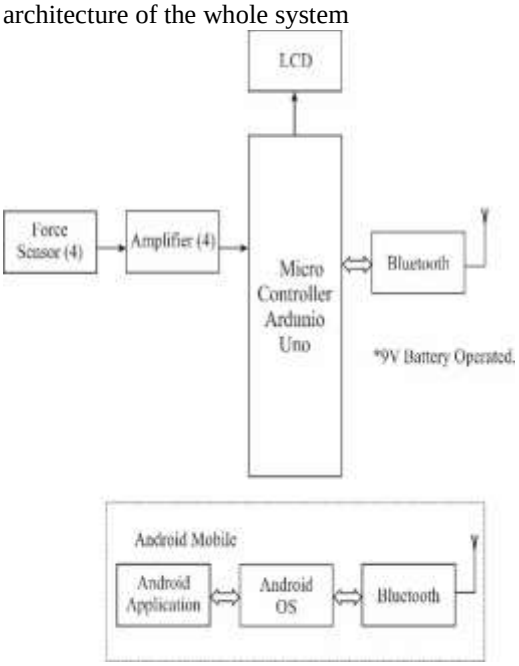

Figure 1. The architecture of the system.

Wearable force sensors

FSRs are sensors that allow you to detect physical pressure, squeezing and weight. They are simple to use and low cost. This is a photo of an FSR, specifically the Interlink 402 model. The 1/2" diameter round part is the sensitive bit. FSRs are basically a resistor that changes its resistive value (in ohms Ω) depending on how much it is pressed. These sensors are fairly low cost, and easy to use but they're rarely accurate. They also vary some from sensor to sensor perhaps 10%. So basically when you use FSRs you should only expect to get ranges of response. While FSRs can detect weight, they're a bad choice for detecting exactly how many pounds of weight are on them.

Figure 2. Wearable force sensors

Force Identification Algorithm

The force identification algorithm is used to detect whether the force applied on the force sensor is due to the normal movement of the wearer or by the tap of the wearer and send only the data that corresponds to the tap of the user to the android device using Bluetooth.

/* FSR testing sketch.

Connect one end of FSR to 5V, the other end to Analog 0. Then connect one end of a 10K resistor from Analog 0 to ground Connect LED from pin 11 through a resistor to ground

```
intfsrAnalogPin = 0; // FSR is connected to analog 0
intLEDpin = 11;       // connect Red LED to pin 11 (PWM pin)
intfsrReading;        // the analog reading from the FSR resistor divider
intLEDbrightness;
void setup(void) {
Serial.begin(9600);   // We'll send debugging information via the Serial monitor
pinMode(LEDpin, OUTPUT);
 }
void loop(void) {
fsrReading = analogRead(fsrAnalogPin);
Serial.print("Analog reading = ");
Serial.println(fsrReading);
  // we'll need to change the range from the analog reading (0-1023) down to the range
  // used by analogWrite (0-255) with map!
LEDbrightness = map(fsrReading, 0, 1023, 0, 255);
// LED gets brighter the harder you press
analogWrite(LEDpin, LEDbrightness);
delay(100);
 }
```


Data Handling Program

The data handling program includes two parts. One is the data aggregation program and one is the data checking program. The data is sent through Bluetooth to the android device from the Arduino. Thus on the android device side, the data aggregation program includes a socket to get the data through Bluetooth. The data is sampled and the accumulated data is used by the program in real-time. It is saved in a .txt file for further usage the data checking program includes a Decision Tree classifier to check whether the user is performing the task. The classifier has two classification results: one is playing drums, and the other is resting.

The Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the boot loader); It has also 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library). Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP).figure:2 The Arduino Uno is a microcontroller board

Figure 3 The Arduino Uno is a microcontroller board

Android Code Block

Drum sound refers to what will happen when the Android application plays a sound file. The details of how exactly the data of the chosen sound file gets played through the speakers of the Android device is not necessarily under the programmers control. There is, however, the media player class which allows the programmer to easily stream a sound file. User input describes user input from the GUI. The different buttons on the GUI will be assigned to different functions in this code block. When a button in an Android GUI is pressed, it creates an onClick event for that particular button. If that button has a function assigned to its onClick event, that function will be called. The initBluetooth () and sensor Select() functions will be assigned to buttons that the user can use to connect to a Bluetooth device or to change the sounds assigned to the pants sensors.figure:3 Android Code Block

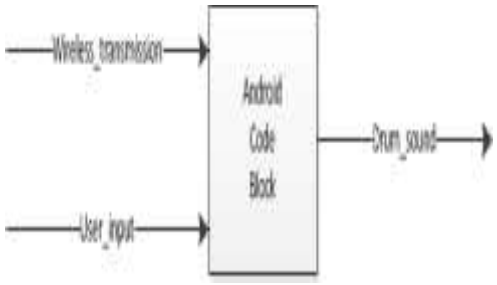

Figure 4 Android Code Block

Pseudo code:

```
//MainActivity is created when the application starts
MainActivity class
onCreate()
create "Connect" button
create list of sensors
load all the stored user preferences
//called when a sensor is selected
//the onClick event for the sensor list is a part of the User_input interface definition
sensorSelect()
sensor = user selected sensor
open file browser
newSound = chosen file
sensor.sound = newSound
//this function is called after an onClick event happens for the "Connect" button
//the onClick event for the "Connect" button is a part of the User_input interface definition
initBluetooth()
adapter = default Bluetooth adapter
if adapter == NULL
report to user that the device does not have Bluetooth
exit
enable Bluetooth
```



```
deviceWindow = window to display devices
deviceWindow.add(button to scan for devices)
pairedDevices = list of paired devices
if (pairedDevices)
deviceWindow.add(pairedDevices)
device = user selection from deviceWindow
create a socket for the selected device
request connection with selected device
if connection is accepted
connection = accepted connection
manageConnection(connection)
else
close the socket
report to the user that connection was denied
//called when the user chooses to scan for devices
deviceDiscovery()
run device discovery
discoveredDevices = list of discovered devices
if (discoveredDevices)
deviceWindow.add(discoverdDevices)
else
report to user that there are no devices in range
//called by initBluetooth()
manageConnection(connection)
inputStream = connection.inputStream

while(True)
bluetoothData = inputStream.read()
manageData(bluetoothData)

//this functions tells the Android device to play the sound associated with a sensor
//telling the device to play a sound is a part of the Drum_sound interface definition
//this function also manages the data received from a remote Bluetooth device
//receiving data from a Bluetooth device is a part of the Wireless_transmission interface definition
manageData(bluetoothData)
whilebluetoothData != NULL
pop off first byte of bluetoothData
for sensor in listOfSensors
if byte == sensor.id
playsensor.sound
```

Bluetooth Transmitter

We ended up using the Bluetooth module in the schematics below; it has a voltage regulator that steps the 5v down to the 3.3v of the Bluetooth Transceiver**.** In figure: 4 Bluetooth transmitter

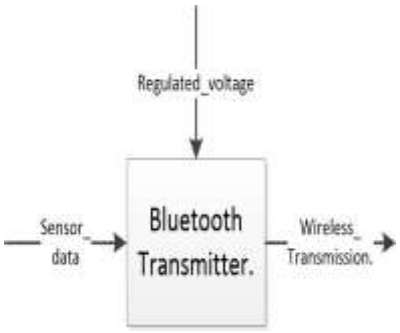

Figure 5 Bluetooth transmitter

The best block level design that I can find of the RS232 serial converter Bluetooth Module. We will be able to use this in order to integrate the Bluetooth transceiver chip into the PCB holding the micro-controller if we need to combine the Bluetooth module and the micro-controller onto one PCB board. This would make the total size of the drum pants approximately half.

Power supply A battery is a device in which chemical energy is directly converted to electrical energy. It consists of one or more voltaic cells, each of which is composed of two half cells connected in series by the conductive electrolyte. In the figure 5, the battery consists of one or more voltaic cells in series. (The conventional symbol does not necessarily represent the true number of voltaic cells.) Each cell has a positive terminal, shown by a long horizontal line, and a negative terminal, shown by the shorter horizontal line. These do not touch each other but are immersed in a solid or liquid electrolyte. In a practical cell the materials are enclosed in a container, and a separator between the electrodes prevents them from touching.

III. CONCLUSION AND DISCUSSIONS

In this paper, we proposed a novel drum pant for controlling stress. The system is minimum obtrusive and can provide entertainment for the users. The system can run in real time and has a high accuracy of identification of the force by sensors. The stress affects the persons both physically and mentally to the great extent. The drum pant reduces the stress by engaging the users in music. It also helps increase the productivity of the users by inducing the more parts of the brain using music. We plan to listen to their suggestions to gain knowledge about how to improve the system.

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