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SKINPUT

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Abstract

Skinput is technology that appropriates the human body for acoustic transmission, allowing the skin to be used as an input surface.in particular, we identify the location of finger taps on the arm and hand by analyzing mechanical vibrations that propagates through the body. The aim of the skinput is to allow devices to become smaller without simultaneously shrinking the surface area on which input can be performed. Skinput leverages the natural acoustic conduction properties of the human body. When a finger taps the skin, several distinct forms of acoustic energy are produced. Among the acoustic energy transmitted through them, the most readily visible are transverse waves and longitudinal waves.

Introduction

The Objective of the project is to design a skin put [3] that would satisfy the requirements as specified in the overview above. Here we present a basic concept of how we could use our skin surface as providing inputs. With the huge success of touch technology in the market nowadays, we are sure this technology will be a field to be explored. Maybe touch skins or skin screens will be a common lingo in a few years. Skinput provides an exciting prospect of using our body as input surface to devices is appealing not only because we have roughly two square meters of external surface area, but also because much of it is easily accessible by our hands. Few external input devices can claim an accurate eyes-free input characteristic and provide a large interaction.

The prototype we aim to design contains three small cantilevered piezo elements configured to be highly resonant, sensitive at low frequencies. The piezo sensors are basically transducers which senses the vibrations and produces a proportional voltage. These analog values are sampled by a microcontroller like ATMEGA-8 using ADRUINO platform.

The report is organized into 6 sections. The subject dealt in each of these sections can be condensed as indicated herein.

Sensor

The LDT1-028K is a multi-purchase, piezoelectric sensor[1] for detecting physical phenomena such as vibration or impact. The piezo film element is laminate to a sheet of polyester (Mylar), and produces a useable electrical signal output when forces are applied to the sensing area. The dual wire lead attached to the sensor allows a circuit or monitoring device to process the signal.

Functional description of sensor

The LDT1-028K piezo sensor[2] acts as a cantilever-beam accelerometer. Strain in the beam is detected as a charge or voltage output across the electrodes of the sensor. The sensor may be used to detect either continuous or impulsive vibration or impacts. For excitation frequencies below the resonant frequency of the sensor, the device produces a linear output. The sensitivity at resonance is significantly higher. This is achieved by adding weight to tip of the sensor.

Electrical description of sensor

The figure shows a simplified equivalent circuit of piezo film. It consists of series capacitance with a voltage source. The series capacitance Cf represents piezo film capacitance which is proportional to the film permittivity and area and inversely proportional to film thickness. The voltage source amplitude is equal to the open circuit voltage of piezo film and varies from microvolt to 100’s of volts, depending on the excitation magnitude.

Features

- Minimum Impedance: 1MΩ
- Preferred Impedance: 10MΩ
- Output Voltage 10mV-100V depending on Force and Circuit Impedance
- Storage Temperature: -40^{o}C to +70^{o}C[-40^{o}F to 160^{o}F]
- Operating Temperature: 0^{o}C to
- +70^{o}C[32^{o}F to 160^{o}F]

Applications

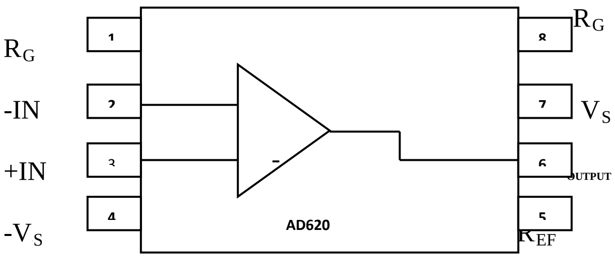
- Sensing Direct Contact Force
- Recording Time of an Event
- Counting Number of Impact Events
- Measuring Impact Related Events
- Sensing Vibration using Cantilevered Beam
- Wakeup Switch

Signal Amplification

An instrumentation (or instrumentation) amplifier is a type of differential amplifier that has been outfitted with input buffers, which eliminates the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Instrumentation amplifiers are used where great accuracy and stability of the circuit both short-and long-term are required.
Although the instrumentation amplifier is usually shown schematically identical to a standard op-amp, the electronic instrumentation amplifier is almost always internally composed of 3 op-amps. These are arranged so that there is one op-amp to buffer each input(+,-), and one to produce the desired output with adequate impedance matching for the function.

AD620

The AD620[5] is a low cost, high accuracy instrumentation amplifier that requires only one external resistor to set gains of 1 to 10,000. Furthermore, the AD620 features 8 –lead SOIC DIP packaging that is smaller than discrete designs and offers lower power (only1.3mA max supply current), making it a good fit for battery powered, portable (or remote) applications.



TOP VIEW
Fig1: pin out of AD620

THEORY OF OPERATION

The AD620 is a monolithic instrumentation amplifier based on a modification of the classic three op amp approach. Absolute value trimming allows the user to program grain accurately (to 0.15% at G=100) with only one resistor. Monolithic construction and laser wafer trimming allow the tight matching and tracking of circuit components, thus ensuring the high level of performance inherent in this circuit.

MICROCONTROLLER

ATMEGA-8

The low-power Atmel 8bit AVR RISC-based microcontroller combines 8KB of programmable flash memory, 1KB of SRAM,512K EEPROM, and 6 or 8 channel 10bit A/D converter. The device supports throughput of 16 MIPS at 16MHz and operates between 2.7-5.5 volts.

Key parameters

Parameter	value
Flash (Kbytes)	8Kbytes
Pin count	32
Operating frequency	16MHz
CPU	8bit AVR
No of Touch channels	12
Max I/O Pins	23
External Interrupts	2
USB transceiver	0
Quadrature Decoder channels	0

Arduino

Ardunio is an open-source single board microcontroller, descendant of the open source wiring platform, designed to make the process of using electronics in multi disciplinary projects more accessible. The hardware consists of a simple open hardware design for the Arduino board with an Atmel AVR processor and on-board input/output support. The software consists of a standard programming language compiler and the boot loader that runs on the board.

Programming in Arduino

Programming in Arduino has 3 sections.

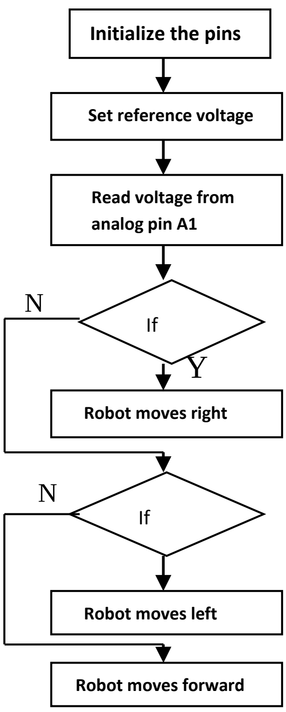
- DECLARATION where we declare pins and other variables.
- SETUP where we configure device pins and other peripherals
- LOOP which contains all the conditional logic that is going to be exectuted until the board is switched off.

Implementation Result:

Calibration of sensor:

In order to uniquely determine the finger taps on the human body and the robot to recognize it the sensors have to be calibrated. As mentioned earlier every change of 4.25mV accounts to increase in one step of the ADC. We found that voltages obtained differed from person to person depending on their body mass index (BMI) and also the placement of the sensor on the arm. The sensors used in our project have been calibrated to a certain placement and body mass index. The default position is the wrist and the test points used are the forearm and a finger snap.

Fig2: Program Flow chart



Conclusion and Future Scope.

We have presented our approach to appropriating the human body as input surface and results demonstrating other potential uses of our approach. These include single –handed gestures, taps with different parts of the finger.

Skinput could relay tapped commands to mobile devices or PCs via wireless technologies like Bluetooth. If this gadget ever becomes a commercial reality, it could redefine our perception of common gestures. Drumming our fingers nervously could actually be texting, for example, while a slap to the forehead could launch a web browser. Extrapolating from the arm device, skinput could turn the whole body into one giant quivering, jumping, dancing interface. Also, with the addition of a Pico-projector to the armband, skinput could allow users to interact with a graphical user interface displayed directly on the skin make it more convenient and easier.

We conclude with descriptions of several prototype applications that demonstrate the rich design space we believe skinput enables.

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