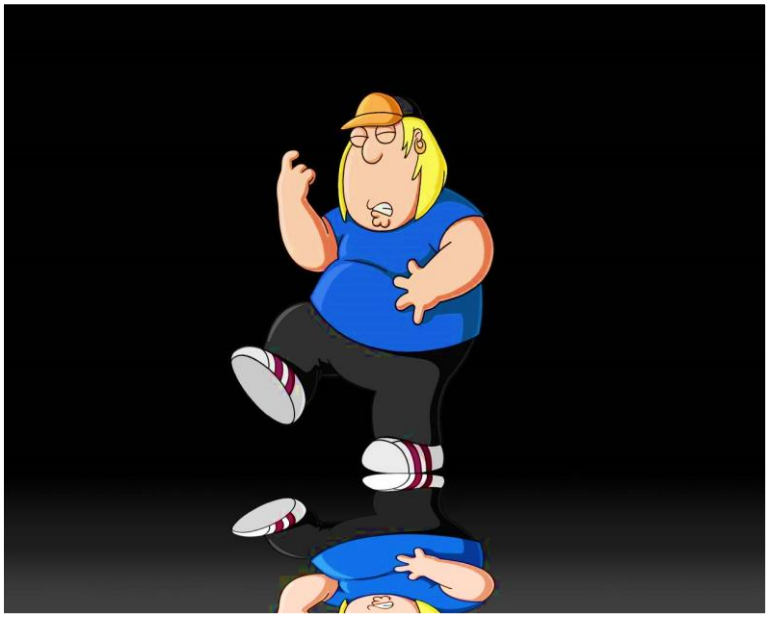
Implementing a Virtual Guitar using Ultrasonic Sensors



By
Vatsal H. Salla
(110570111018)
Mihir N. Malaviya
(110570111019)

Project Guide
Prof. Kaushal J. Doshi

Project Definition

Definition –

- Virtual guitar is a concept in which a conventional guitar is virtualized by using ultrasonic sensors

Literature survey and Motivation

Gathering information on –

- Distance measuring sensors

  -Infrared sensors.

  -Ultrasonic sensors.

- Development boards.

  -Arduino.

  -TI.

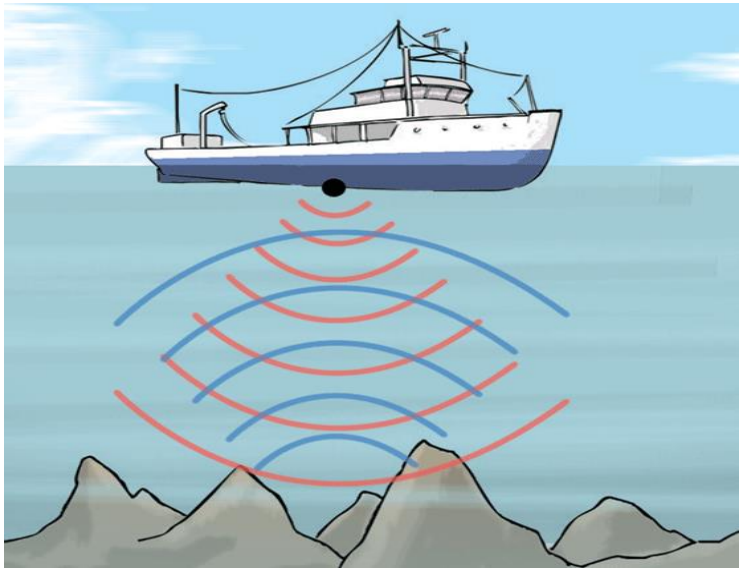
- Controllers

Ultrasonic vs Infrared sensors

Infrared sensors	Ultrasonic sensors
They depend on external entities.	Such problems are not faced.
Depends on surface.	Surface dependence is not a big problem.
Less accurate	More accurate.
Sunlight can affect the operate.	Works in any light.
Narrow beam width.	Wide beam width.
Low cost.	High cost.
No Echo problem.	Echo problem.

What is Ultrasonic sensor?

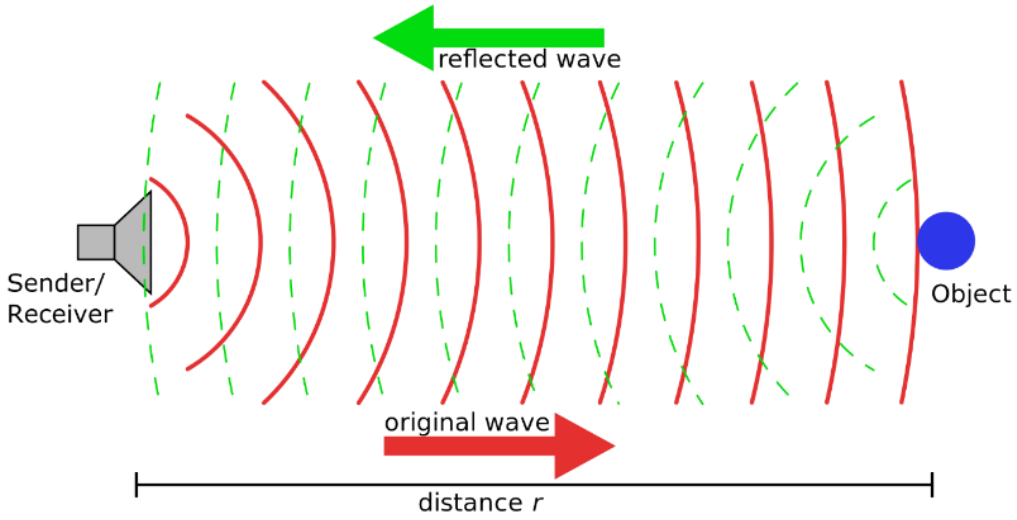
Basic understanding of ultrasonic sensor using SONAR –



Working Principle of Ultrasonic sensor

Flow –

- Generate high frequency sound waves.
- Echo detection.
- Distance measurement.
- Frequency generation.



Arduino and TI boards

Arduino Vs TI

Area of concern –

- I/O pins
- Cost
- Programming
- Facility

Arduino family

Controller family

Available controllers (Familiar)–

- ARM(RISC)
- PIC(RISC)
- AVR(RISC) – ATMEGA
- 8051(CISC)
- MSP430(RISC)

RISC Vs CISC

RISC vs. CISC

CISC	RISC
Emphasis on hardware	Emphasis on software
Multiple instruction sizes and formats	Instructions of same set with few formats
Less registers	Uses more registers
More addressing modes	Fewer addressing modes
Extensive use of microprogramming	Complexity in compiler
Instructions take a varying amount of cycle time	Instructions take one cycle time
Pipelining is difficult	Pipelining is easy

Controller selected

AVR better than other controllers

AVR comparison with other other controllers.	
ARM	High end controller.
8051	8051 are CISC controllers.
PIC	PIC are not widely used, not an open source, free C compiler.
MSP430	More expensive compared to AVR.

Development environment

Selection on the basis of boards

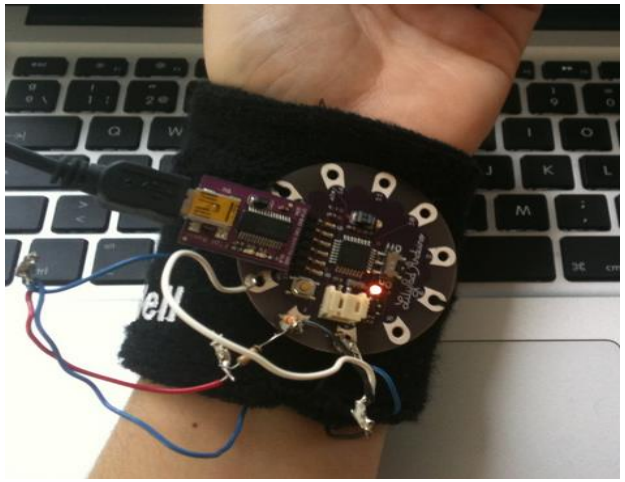
- Software provided by Arduino.
- Energia.
- CCS.

Identification of major components…

- Arduino :
  - Arduino UNO.
  - Arduino Lilypad.
- Ultrasonic Sensor HC-SR04.
- Controller – ATMEGAxx
- A loudspeaker

Arduino UNO Vs Arduino Lilypad

ARDUINO boards selected –



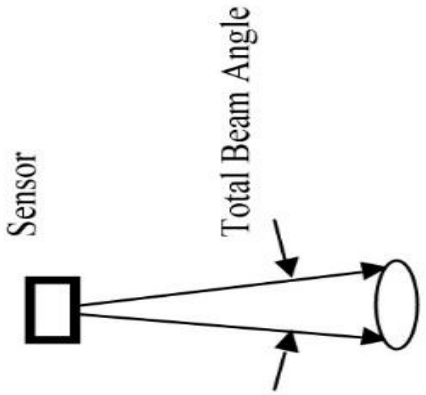
Arduino Lilypad

Arduino UNO

Selected Ultrasonic sensor : HC-SR04

Specifications

- **Working Voltage :** 5V(DC)
- **Static current:** Less than 2mA.
- **Output signal :** Electric frequency signal, high level 5V, low level 0V.
- **Sensor angle :** Not more than 15 degrees.
- **Detection distance :** 2cm-450cm.
- **High precision :** Up to 2mm.
- **Input trigger signal :** 10us TTL impulse.
- **Echo signal :** output TTL PWL signal.



Ultrasonic signal detector
US 5432755 A (Patent 1)

Abstract –

- Ultrasonic sensor
- Frequency generation
- Filters

Publication number	US5432755 A
Publication type	Grant
Application number	US 08/208,536
Publication date	Jul 11, 1995
Filing date	Mar 8, 1994
Priority date ⓘ	Mar 8, 1994
Fee status ⓘ	Paid
Inventors	Nikolaos I. Komninos
Original Assignee	Komninos; Nikolaos I.
Export Citation	BiBTeX, EndNote, RefMan

Description on **US 5432755 A**

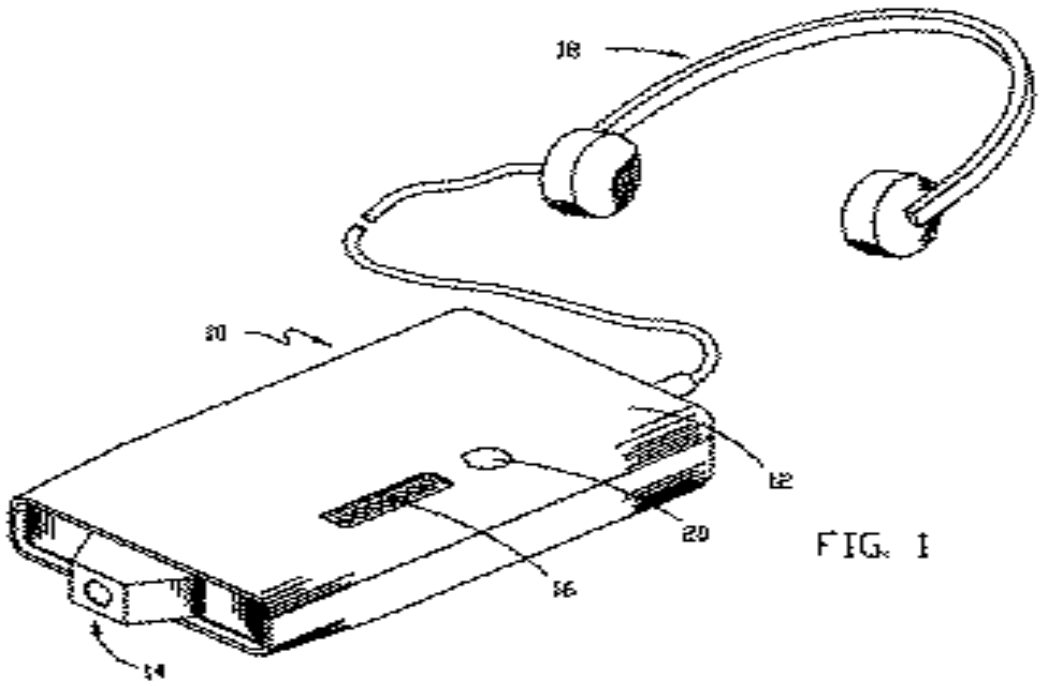


FIG. 1

Position-based controller for electronic musical instrument
US 5541358 A (Patent 2)

Abstract –

- Object
- Position detection
- Position signal generation
- Musical tone generation

Publication number	US5541358 A
Publication type	Grant
Application number	US 08/037,924
Publication date	Jul 30, 1996
Filing date	Mar 26, 1993
Priority date ⓘ	Mar 26, 1993
Fee status ⓘ	Paid
Inventors	James A. Wheaton, Erling Wold, Andrew J. Sutter
Original Assignee	Yamaha Corporation
Export Citation	BiBTeX, EndNote, RefMan

Patent Citations (8), Non-Patent Citations (6), Referenced by (25), Classifications (8), Legal Events (4)

Description on **US 5541358 A**

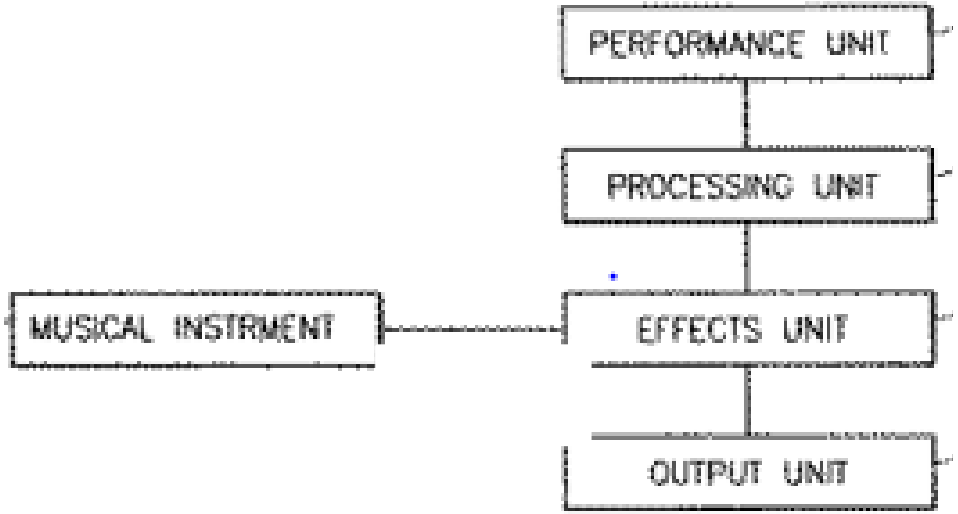
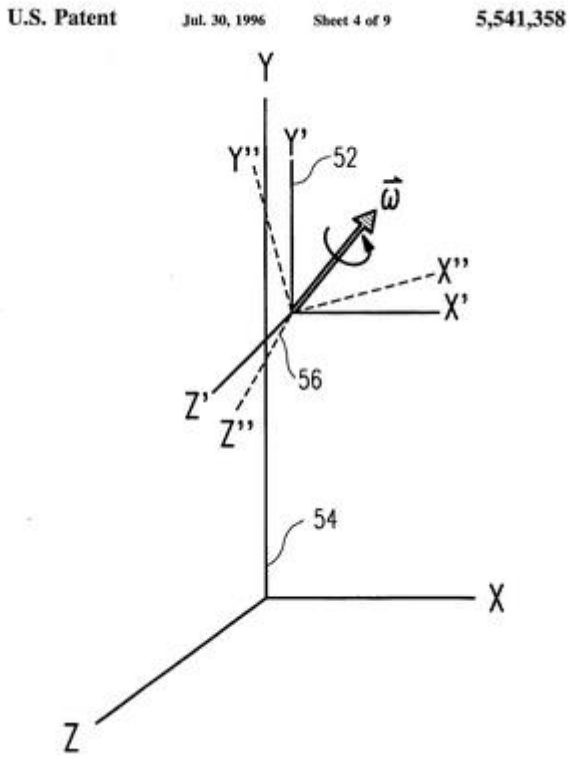


FIG. 2



Virtual music system
US 5393926 A (Patent 3)

Abstract :

- Lead storage
- Musical tone storage
- Connection with the device
- Plays the stored notes w.r.t. the music generated by the user automatically

Description on **US 5393926 A**

Publication number	US5393926 A
Publication type	Grant
Application number	US 08/073,128
Publication date	Feb 28, 1995
Filing date	Jun 7, 1993
Priority date ?	Jun 7, 1993
Fee status ?	Paid
Also published as	CA2164602A1, 6 More »
Inventors	Charles L. Johnson
Original Assignee	Ahead, Inc.
Export Citation	BiBTeX, EndNote, RefMan

Tentative plan

WORK	DURATION
Information gathering	September end 2014
Hardware & Software Development	December End 2014
Combining	By January End 2015
Testing	
Debugging	Mid – February 2015
Report generation	March 2015

GANTT CHART

Reference

- [1] (2014) Instructables website Online
  Available at http://www.instructables.com/id/Use-Arduino-code-on-a-TI-Launchpad-MSP430/
- [2] (2014) Engineer's garage website Online
  Available at http://www.engineersgarage.com/insight/how-ultrasonic-sensors-work
- [3] (2014) teacher's engineering website Online
  Available at http://www.teachengineering.org/view_lesson.php?url=collection/umo_/lessons/umo_sensorswork/umo_sensorswork_lesson06.xml
- [4] (2014) Spark fun website Online
  Available at https://learn.sparkfun.com/tutorials/arduino-comparison-guide

Reference

- [5] (2014) Stanford website Online Available at http://cs.stanford.edu/people/eroberts/courses/soco/projects/risc/risccisc/
- [6] (2014) Instructables website Online Available at http://en.wikipedia.org/wiki/Guitar_Center
- [7] (2014) Sewelectric website [Online] Available at http://sewelectric.org/diy-projects
- [8] (2014) Arduino main website [Online] Available at http://arduino.cc/en/Main/arduinoBoardLilyPad

Thank You