**The Theremin project (Level 2)**

**Worksheet for students**

**Team:………………………………**

**Level 2: Creating a two-hand operated Theremin**

Search for information online and briefly describe what a Theremin is. Write your answer below.

Imagine a Theremin that is controlled with two hand. Sketch your Theremin and list the crafting material that you may need.

| *Area for sketches* | *List of material:* |
| --- | --- |
|  |  |

**Time for crafting!** Start working on the design of your Theremin using the available crafting materials; bear in mind that your model may be revised several times and adjustments/improvements may be introduced.

**Our aim**
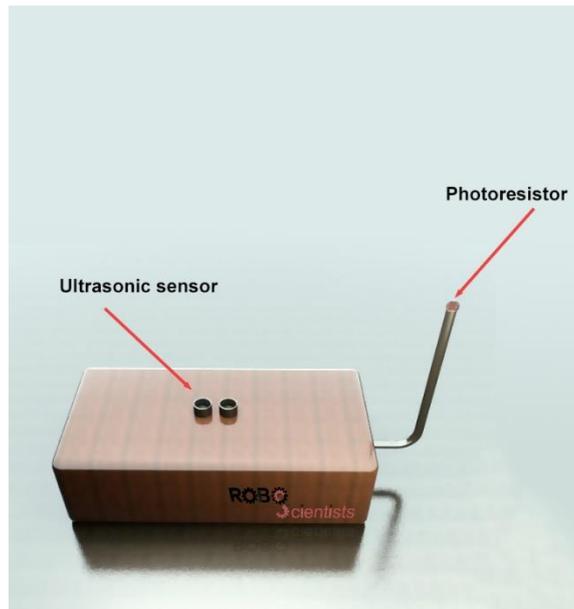


When the left hand is moving closer to the Ultrasonic Sensor and the right hand away from the photoresistor, high-pitched sounds of longer beat are produced by the PC (left), while when the right hand is moving away from the Ultrasonic Sensor and the right hand closer to the photoresistor, low-pitched sounds of shorter beat are produced (right).
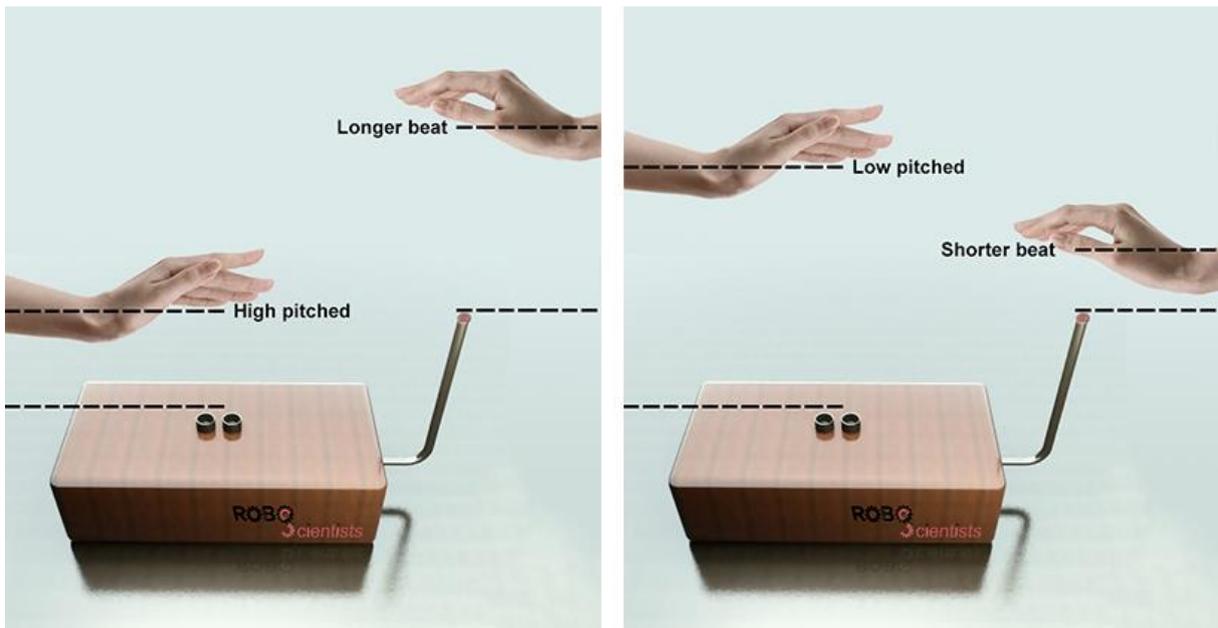
The image below depicts an already connected breadboard to the Arduino board with an Ultrasonic sensor (HC-SR04). You will also need a photoresistor and a 10 KΩ resistor. **How will you connect them?**

Try to draw the circuit below or create the simulation on TinkerCAD.
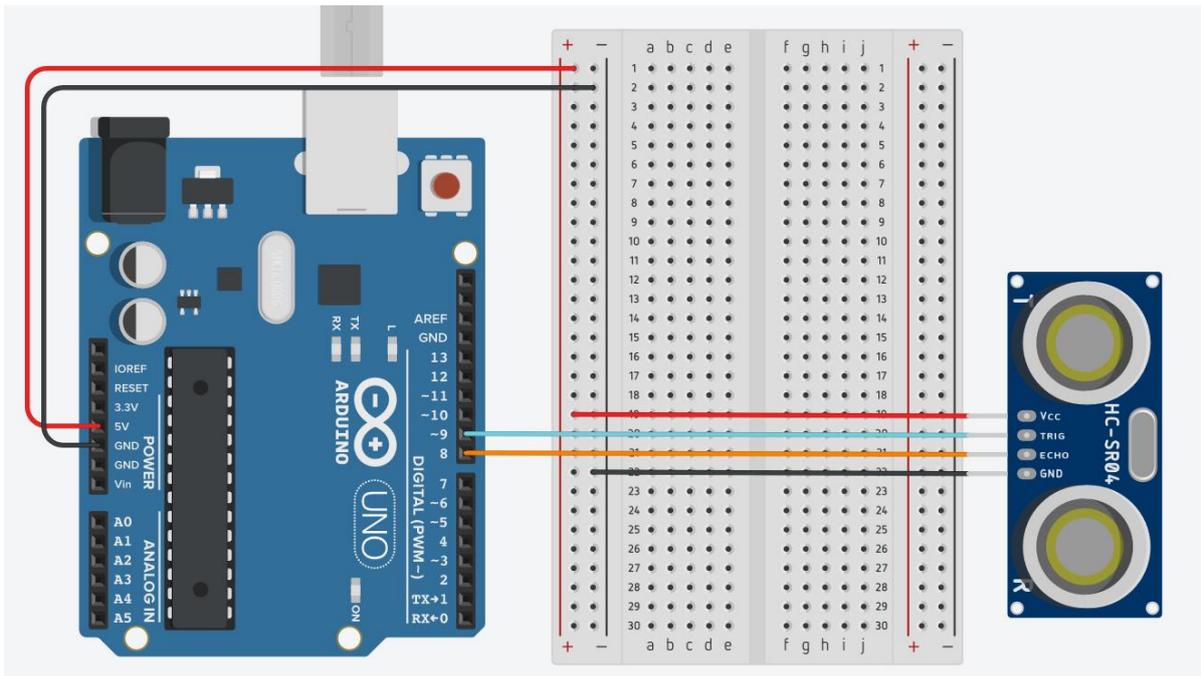


**What does the Ultrasonic sensor do?**

**Why the Ultrasonic sensor does not need a resistor?**

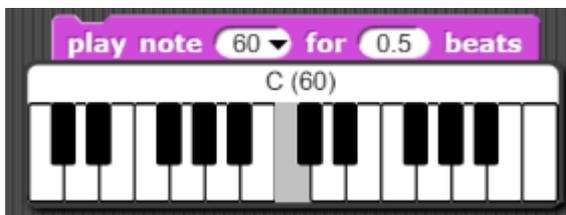**Why are we using digital instead of analog pins to connect the Ultrasonic Sensor?**

A script in Snap4Arduino (and in most of the block-based programming environments) is assembled by dragging blocks from a palette into the scripting area in the middle part of the window in Snap4Arduino.
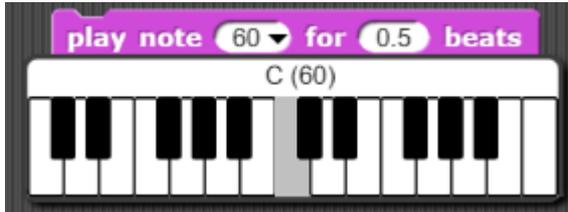
Before you continue experiment with the following block:



**What does the number 60 represent? What will happen if you change it to 50? What will happen is you change it to 63?**

**What does the beat represent? What will happen is we change 0.5 to 5? What will happen if we change 0.5 to 0.1?**

**Having done the experiments above do you agree with the following explanation?**



The selected note is notated with number 60. Even though the drop-down keyboard shows only two octaves of notes (48 to 72), a number can be put in manually to get any note using operators. To change octaves, we can simply add or subtract 12. The duration of each note is defined by the value addressed to beats**.**

- o   Yes, I agree
- o   No, this is not true
- o   Additional comment: …………………………………………………………………………………………………..

**Wave your hand across the Ultrasonic sensor. What values does the ultrasound sensor return? Identify the range and write your answers below.**
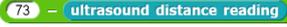
**Lower value:  ………………………**

**Higher value: ………………………**

In order to play the piano by waving your hand across the Ultrasonic sensor, you need to replace note with the following operator:
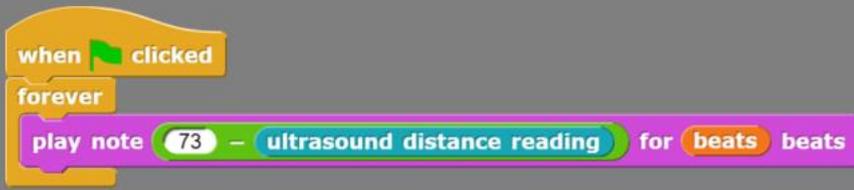


Use the following script to observe the values that this operator returns.

**What do we achieve by using this operator**  **? Document your thoughts below:**



Are you ready to become a Theremin performer? Let's play the Theremin by waving your left hand across the Ultrasonic sensor and the other across the photorestistor. The solution is composed by 2 scripts (see below). Script 1 is ready. Script 2 is semi-structured. In Script 2 the value of the variable *beats* changes according to the "analog reading" input value and this is how Script 1 is informed. You are a performer and you can adjust the duration of a note by waving you hand across the photoresistor.

Compose the blocks and place them in the correct order into the scripting area, in the middle part of the window, in Snap4Arduino, in order to control the Theremin with your 2 hands.



Script 1 - Script for controlling the ultrasonic sensor and reproducing a specific note (1st hand)
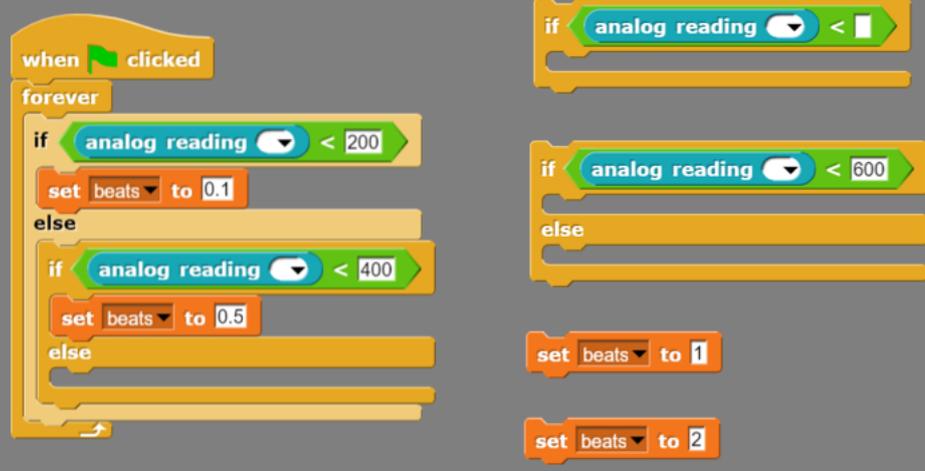


Script 2 – Semi-structured script for controlling the photoresistor and setting the beats (2nd hand)

Optionally you can use the script at your right-hand side to observe which notes (notated with numbers are reproduced).



**Enjoy playing the Theremin!**

## Tips zone

### Programming blocks



This is a *hat* block that indicates that the script should be carried out when the green flag will be clicked.



This is a *C*-block. The slot inside the *C* shape is a special kind of input slot that accepts a *script* as the input. Any script placed in there will be carried out forever in a circle.
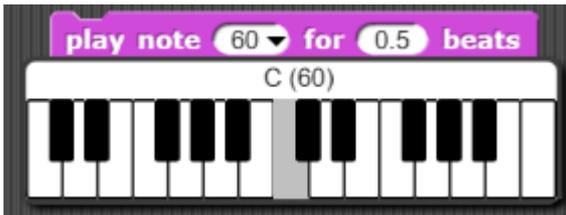


The if-else block runs its if-input script if (and only if) the expression in its hexagonal input reports true.

If it reports false the else-input is executed.

This block comes from the Variables palette and sets the variable '***beats***' to a specific value. This value can be inserted manually or can be linked to the analog readings of specific sensors (i.e. a photoresistor).



The Play Note () for () Beats block is a music block and a stack block. The block will play the specified note with a set MIDI instrument for the specified amount of beats. The notes are notated with numbers, unlike sheet music. In example, the selected Note is notated with number 60. Even though the drop-down keyboard shows only two octaves of notes (48 to 72), a number can be put in manually to get any note. To change octaves, simply add or subtract 12.



Identifying a note from 48 to 72

Basic time unit in music

**Explanation:** As our hand approaches the ultrasound sensor (we get low values), we get high tones. For this reason, we use the subtraction operator. We subtract from the highest tone (72+1) the current ultrasound distance reading. In this way we get values from 48 (low-pitched) to 72 (high pitched) that corresponds to specific notes (see also the piano above). The "duration" of each note is defined by the value of the variable ***beats***.

## Electrical components

The following table is an index containing all the components that need to be implemented for accomplishing the present activity.

| | |
|---|---|
|  | **photoresistor** |
|  | **10 kΩ resistor** |
|  | **Ultrasonic sensor** |

**ROBOSCIENTISTS PROJECT**

Motivating secondary school students towards STEM careers through robotic artefact making

**Erasmus+ KA2 2018-1PL01-KA201-051129**

## Creators

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## Declaration

This report has been prepared in the context of the ROBOSCIENTISTS project. Where other published and unpublished source materials have been used, these have been acknowledged.

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