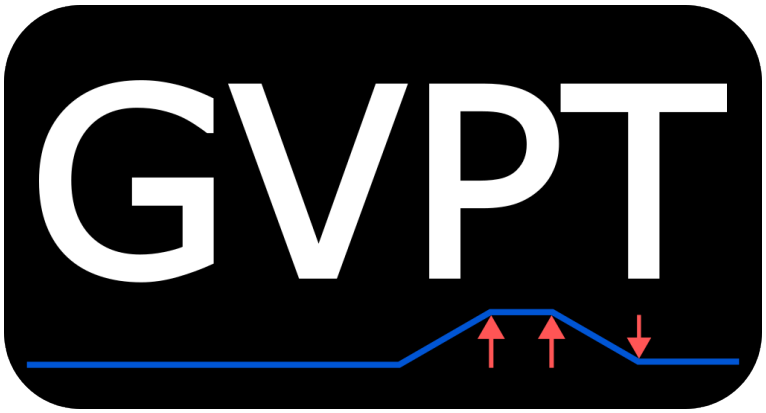

GVPT Technical User Guide

Version 1.0.0

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February 8, 2025

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Contents

1 Downloading GVPT

You can download and use GVPT in two ways:

- Download the compressed Windows executable files (.exe), which do not require installation.
- Download the C# codebase and run it through Visual Studio. **Note: Visual Studio Code is a different IDE.**

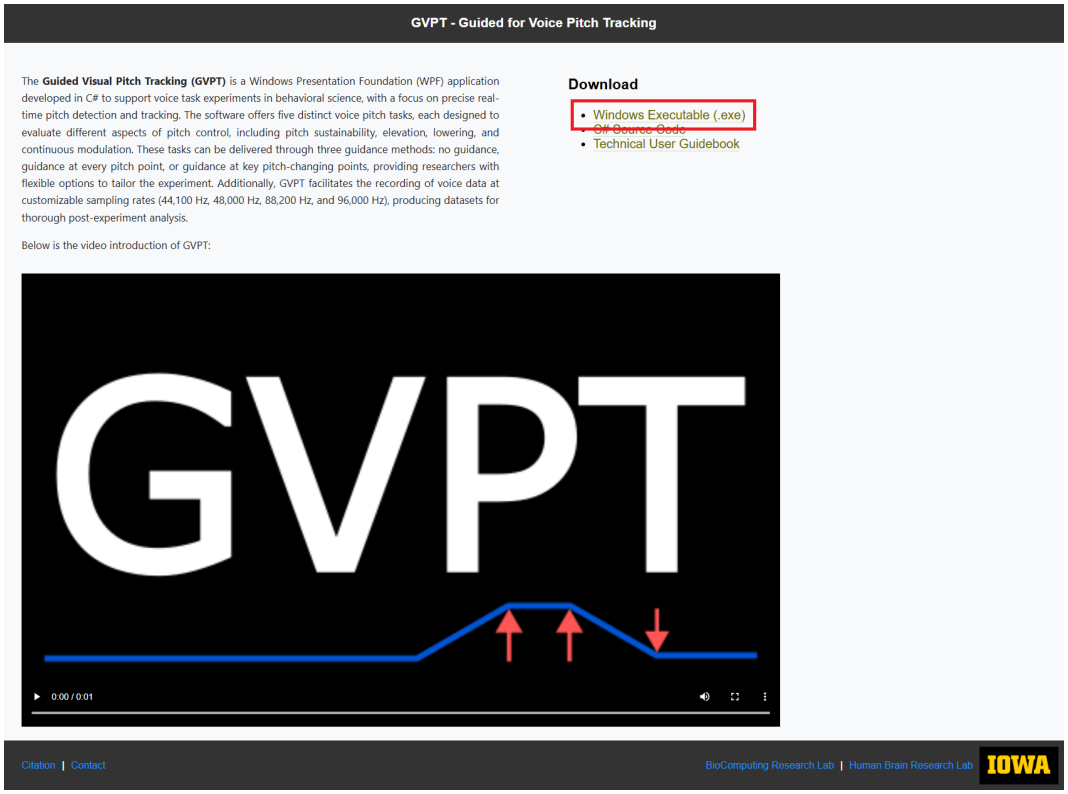
The download links can be found here on our GVPT webpage.

We welcome inquiries about GVPT, but we are unlikely to answer questions related to C# programming, Windows Presentation Foundation, or how to use Visual Studio.

1.1 Executable (.exe) File

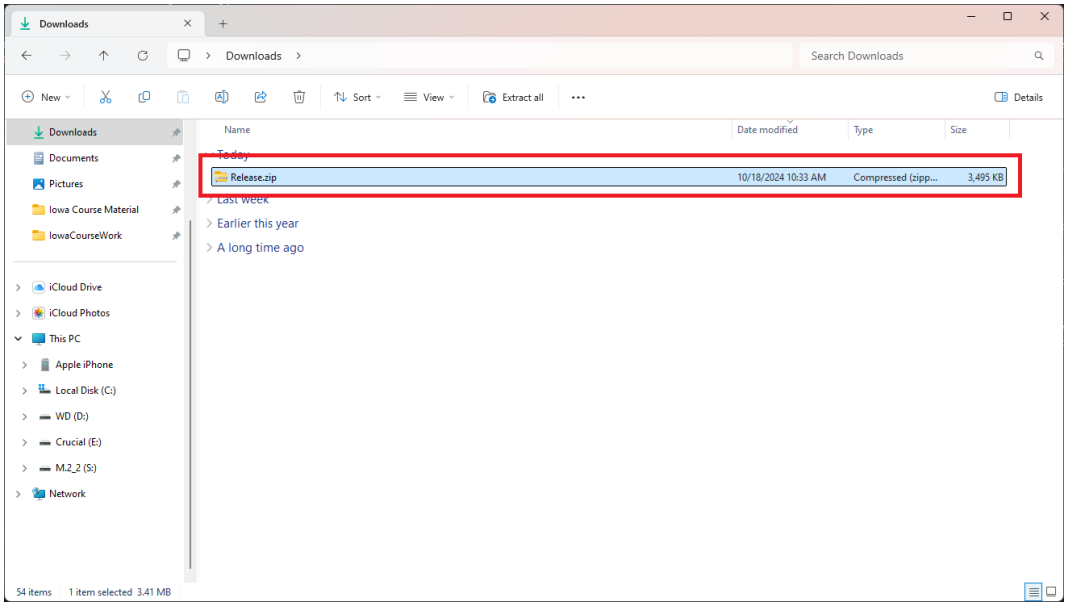
1.1.1 Download

You can find the download link to the executable files on our webpage.



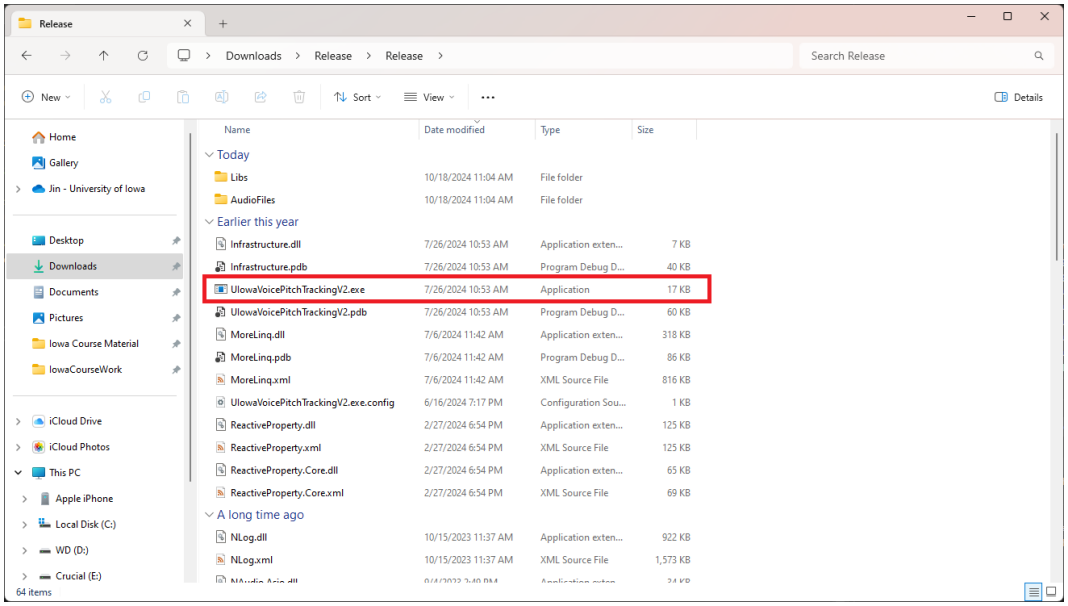
1.1.2 Extract

Right-click the downloaded zip file and choose "Extract All" (or use any compression software to decompress the files).



1.1.3 Run UIowaVoicePitchTrackingV2.exe

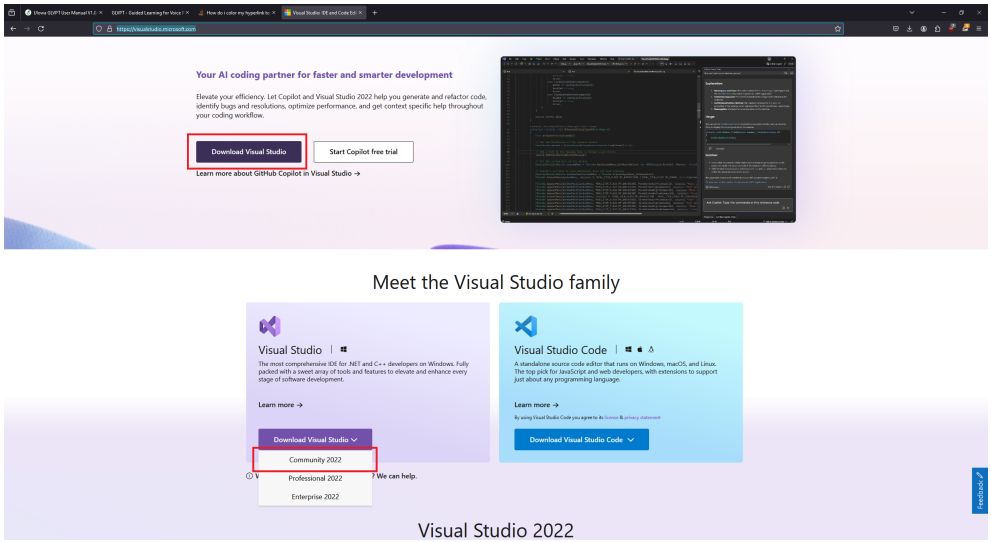
Double-click the UIowaVoicePitchTrackingV2.exe file, and the application will launch.



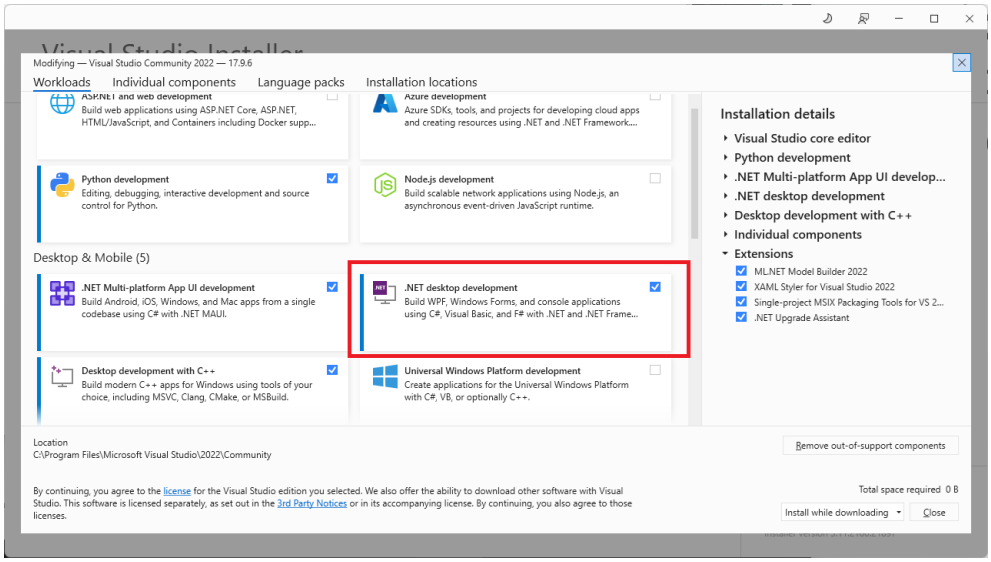
1.2 C# Codebase on Visual Studio

1.2.1 Install Visual Studio

Download and install Visual Studio from the official Microsoft website. The Community version is free. (Compatible with Visual Studio 2022, 2019, or 2017.)

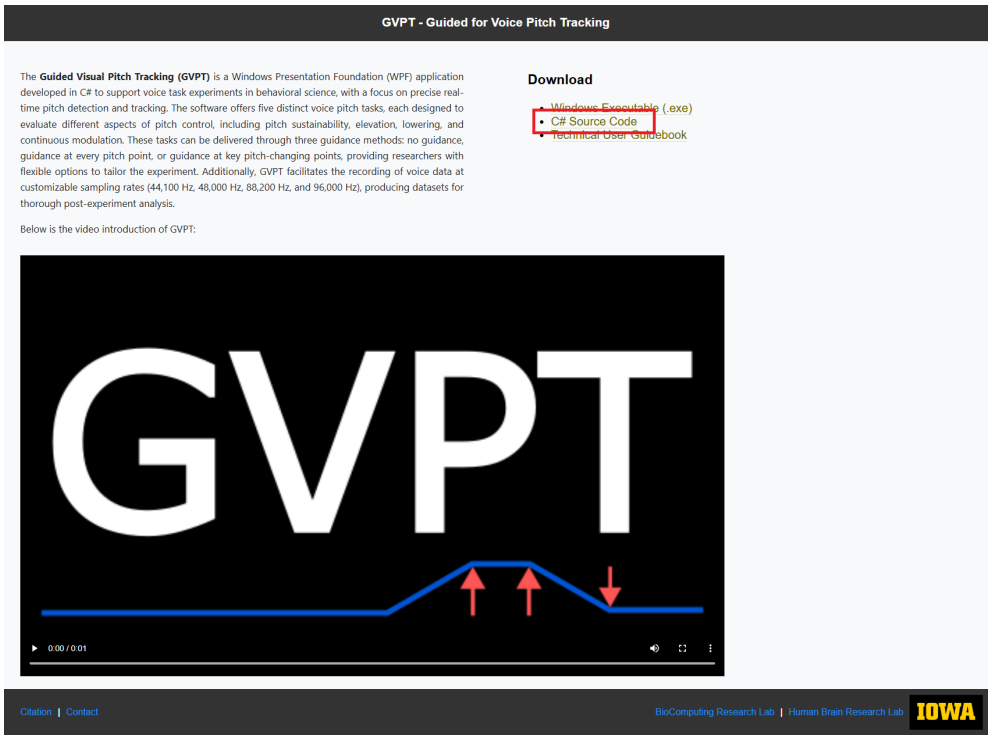


During installation, select the ".NET desktop development" workload to ensure you can run GVPT from the C# codebase.

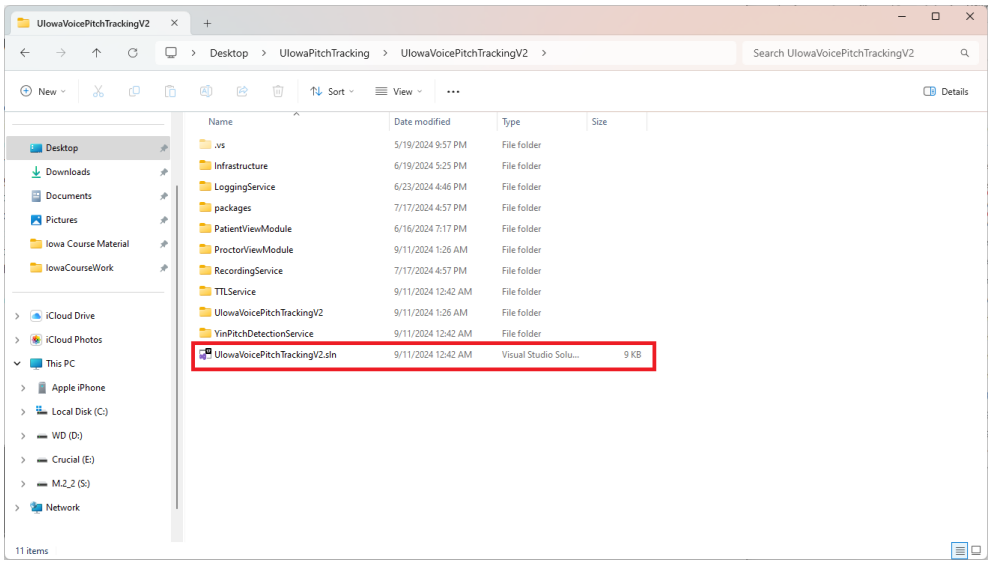


1.2.2 Download and Run Visual Studio Solution (.sln) File

You can download the C# codebase from our GVPT webpage.

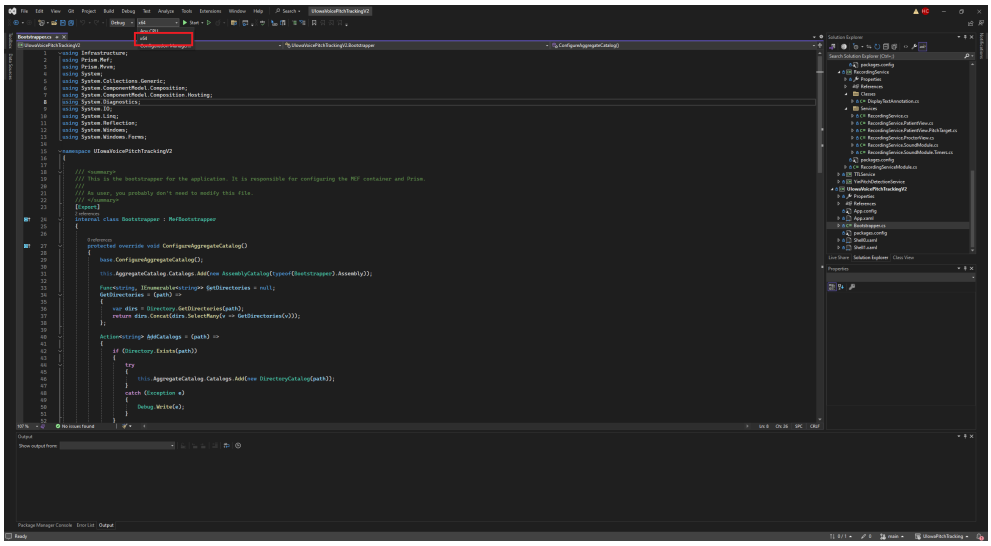


After extracting the zip file, locate UIowaVoicePitchTrackingV2.sln. Double-click the solution file to open it in Visual Studio.



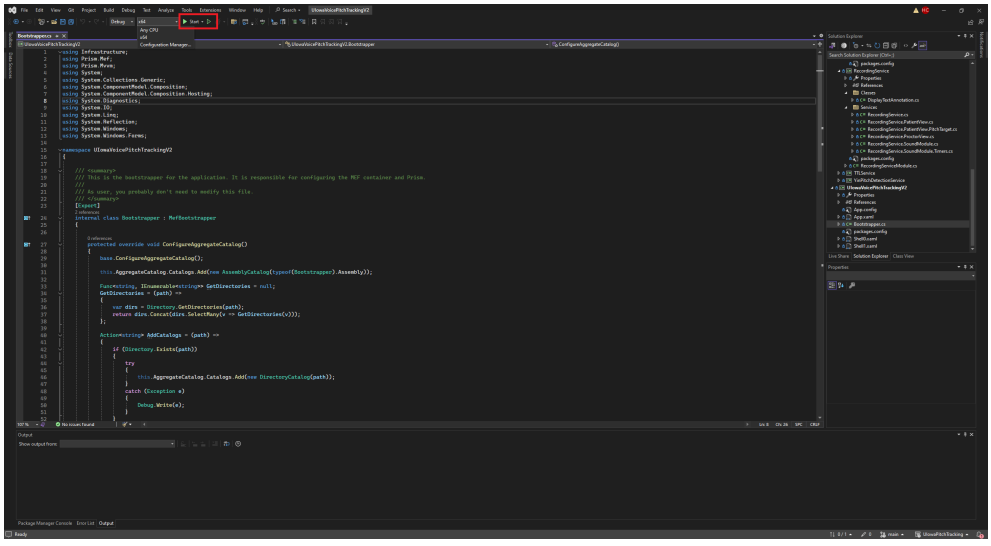
1.2.3 Setup Build Configuration

Once Visual Studio is open, change the build configuration to **x64**.



1.2.4 Run Through Visual Studio

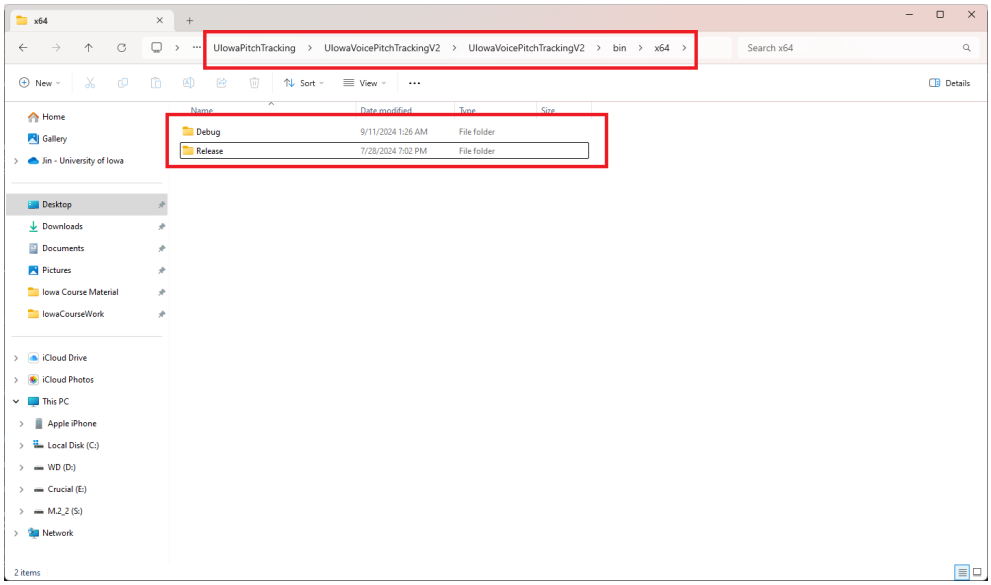
To run the GVPT application, press **F5** for debug mode or **Ctrl + F5** for release mode. You can also use the play buttons at the top of the window (hover over them for descriptions of each button).



1.2.5 Distribute Modified Executable Files

To distribute a modified version of GVPT built in Visual Studio, navigate to the Solution Directory (where UIowaVoicePitchTrackingV2.sln is located), then go to:

(SolutionDirectory)/UIowaVoicePitchTrackingV2/bin/x64/(Debug or Release folder - depending on your build settings)

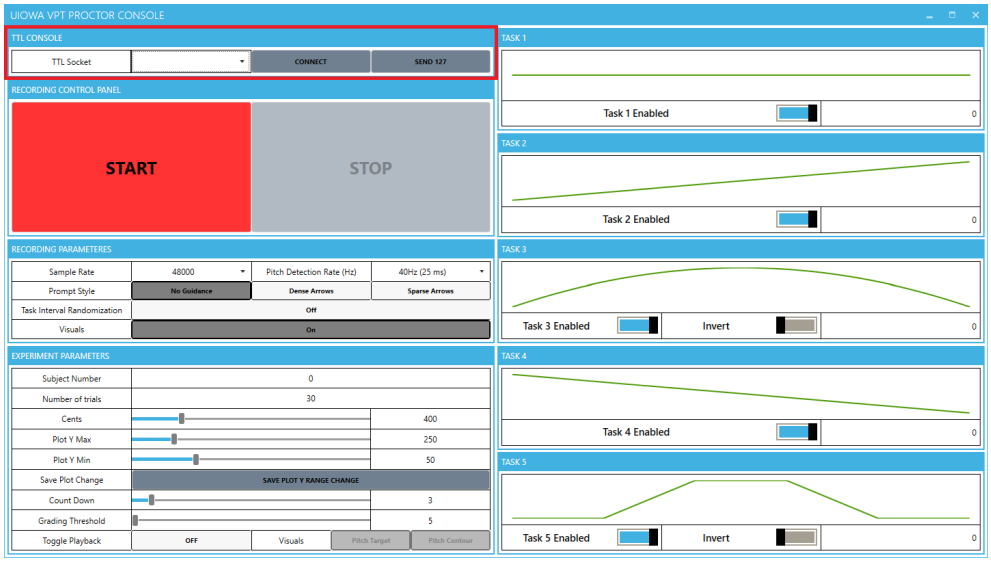


2 GVPT Software User Interface

GVPT launches with two windows: one for the proctor to set up the experiment and another for interacting with the subject. In this section, we cover how to work with each window and what files are generated for post-experiment data processing.

2.1 Proctor Console

2.1.1 TTL Console

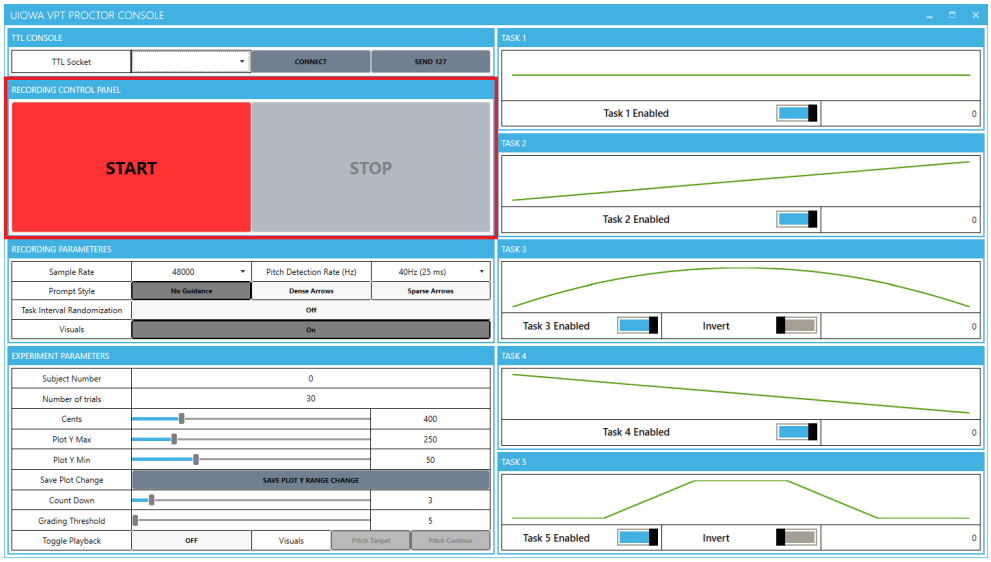


The TTL Console is used to establish a TTL connection with another system (we use the NeuraLynx system to log our experiment as a backup). By using a USB2TTL8 Adapter, you can send a byte (from 1 to 255—0 is discarded by the adapter) from GVPT to the NeuraLynx system, timestamping the recording with a latency of under 1 millisecond.

The details about connecting the adapter are explained in the Peripherals section.

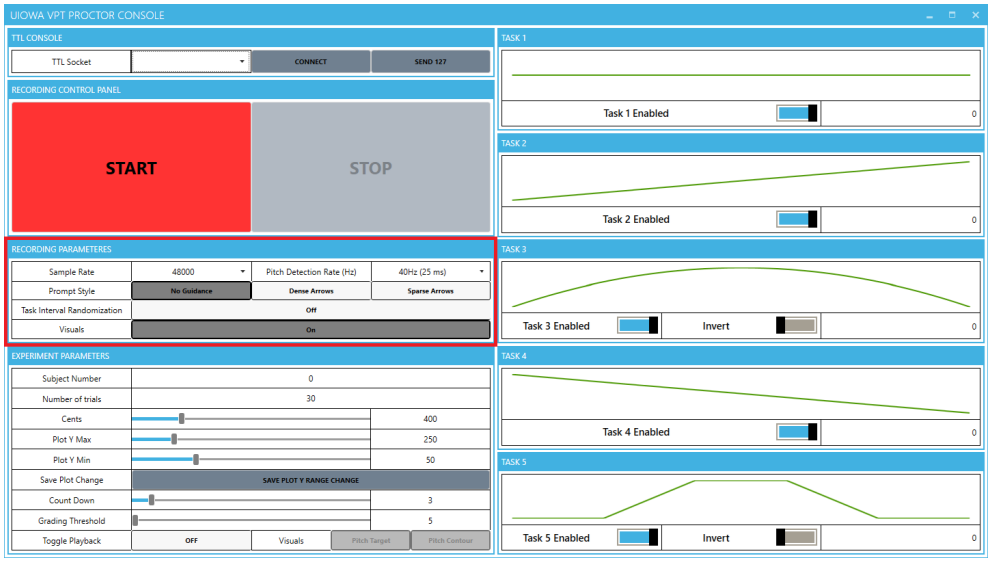
Send 127 button is provided for connection check.

2.1.2 Recording Control Panel



The Recording Panel contains the start and stop buttons for the experiment recording.

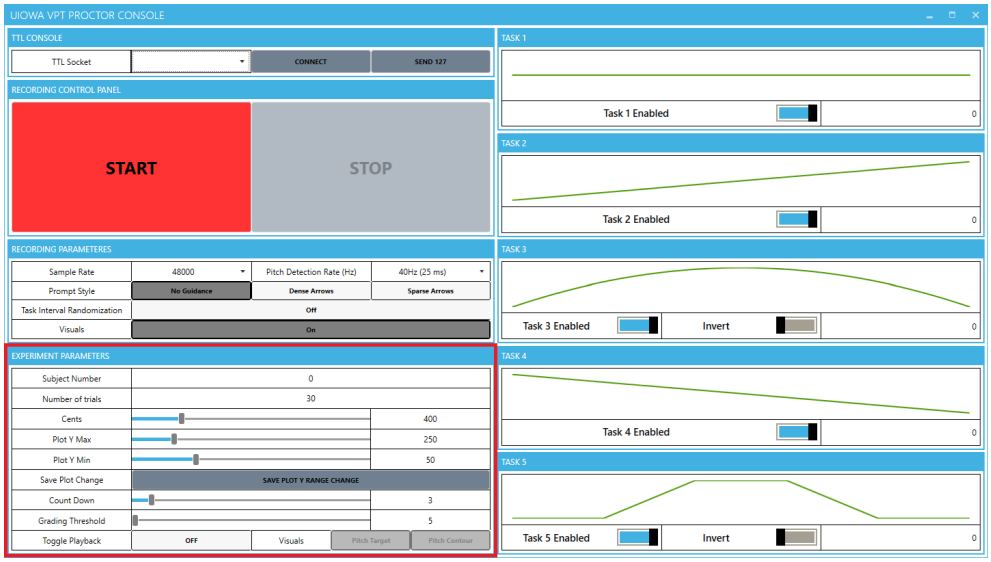
2.1.3 Recording Parameters



The Recording Parameters box includes controls for:

- Audio Sampling Rate (44.2 kHz, 48 kHz, 88.4 kHz, 96 kHz)
- Pitch Detection Rate (40Hz—once every 25ms, or 20Hz—once every 50ms)
- Prompt Style—configures the level of "guidance arrows" to indicate pitch deviation from the target. Refer to 2.2.3.
- Task Interval Randomization—randomly delays tasks by an additional 4–9 seconds. If the Playback option is enabled, it also randomizes the post-playback interval. Without randomization, tasks typically last 13–15 seconds, but with randomization, they can last around 30 seconds per task. Refer to 3.4
- Visual Toggle—turns visual elements (target line, grading thresholds, and detected pitch points) on or off. Countdown is still provided.

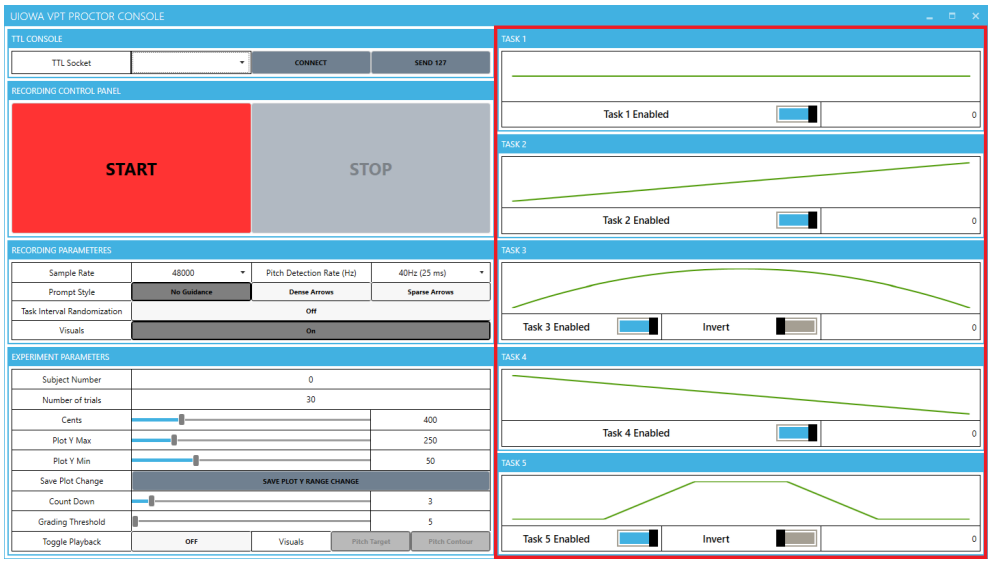
2.1.4 Experiment Parameters



The Experiment Parameters box controls variables for the voice pitch tasks:

- Subject Number—organizes the data into folders. **Note: The subject number cannot be 0.**
- Number of Trials—specifies how many times tasks will be repeated.
- Cents—adjusts pitch changes by default to 400 cents (4 semitones), which can be modified by 100-cent (1 semitone) increments using the slider.
- Plot Y Max—sets the maximum value on the Y-axis of the subject view.
- Plot Y Min—sets the minimum value on the Y-axis of the subject view. **Changes to both sliders take effect only after the button below is clicked.**
- Save Plot Changes—saves any adjustments to the Y-axis sliders.
- Countdown—default countdown is 3 seconds, adjustable based on prompt speed.
- Grading Threshold—sets the acceptable deviation from the target pitch.
- Playback—enables playback of the subject's previous voice pitch task. The proctor may choose to play the playback without the visuals or display the pitch target and subject pitch contour.

2.1.5 Task Control



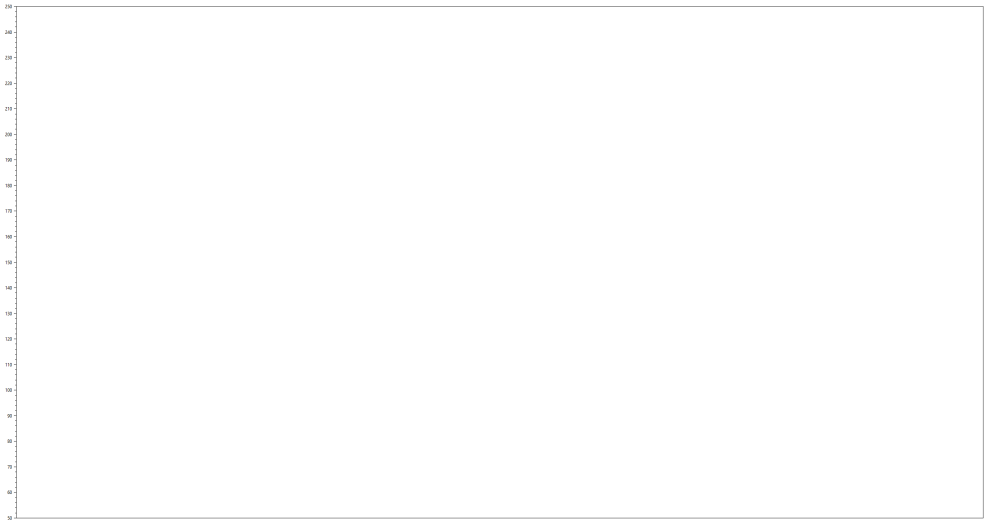
GVPT provides five pitch tasks:

- Task 1 (Flat Task)—the subject must maintain a steady base pitch.
- Task 2 (Up Task)—the subject must raise the pitch by the specified amount (set in the Experiment Parameters) within 1 second.
- Task 3 (Down-U Task)—the subject must raise and lower the pitch in a "down-U" shape, with the peak matching the value set in the Experiment Parameters, within 1 second up and 1 second down. The proctor has the option to invert this task to an up U contour.
- Task 4 (Down Task)—the subject must lower the pitch by the specified amount within 1 second.
- Task 5 (Plateau Task)—the subject must raise the pitch within 1 second, hold steady for 0.5 seconds, and then lower it back to the base pitch within 1 second. The proctor has the option to invert this task to a down-up contour.

Tasks can be added or dropped based on the subject's performance by clicking the corresponding buttons. The bottom-right corner of the screen shows how many times each task has been prompted during the current recording session.

2.2 Subject Screen

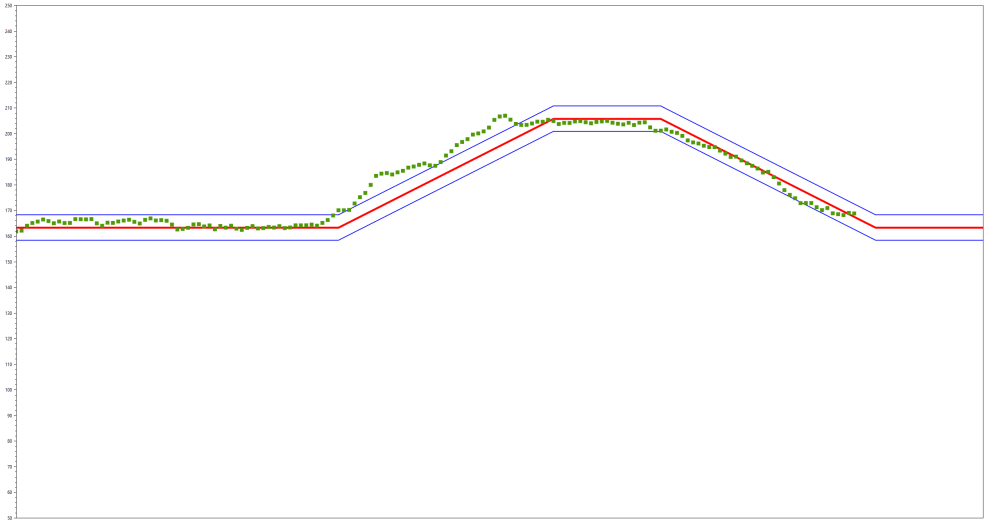
2.2.1 Overview



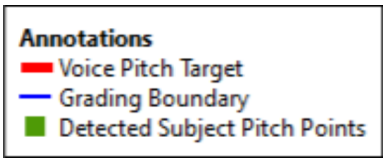
The Subject's screen is designed to have the minimum distraction to suit its neuroscience research project origin and contains the only essential items that need to be presented to the subject.

- The Y axis is the pitch frequency
- The X axis represents time from 0 to 5.5 second which is the duration of the visual pitch tasks.

2.2.2 During Tasks

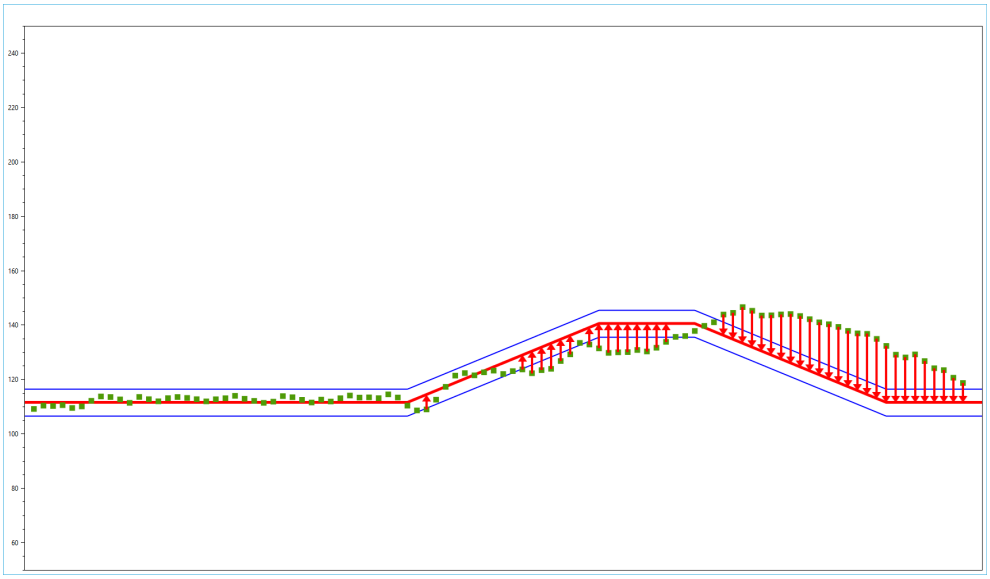


During tasks, the subject screen displays 3 items:



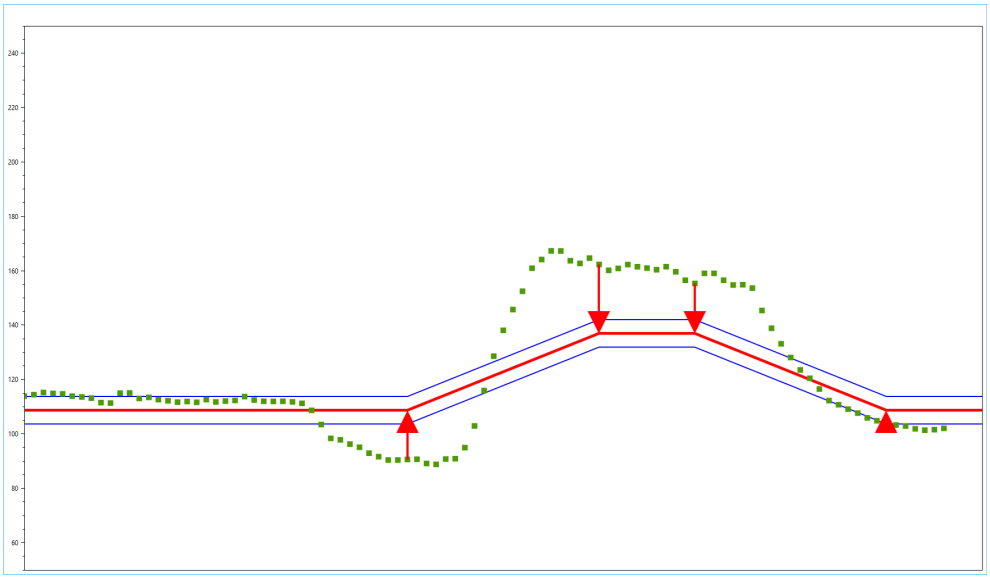
The red line is the voice pitch target that the subjects' should match, the blue lines represents the decision boundary for detected pitch points and the green squares represents the detected pitch of the subject.

2.2.3 Guidance Prompts - Dense Arrows



The 'Dense Arrow' guidance prompt will draw a red arrow from the pitch points that deviated from the grading boundary to the visual pitch target.

2.2.4 Guidance Prompts - Sparse Arrows

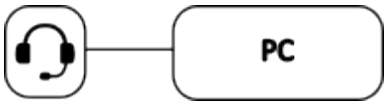


The 'Sparse Arrow' guidance prompt only draws a red arrow if the subject pitch point is when the target is moving.

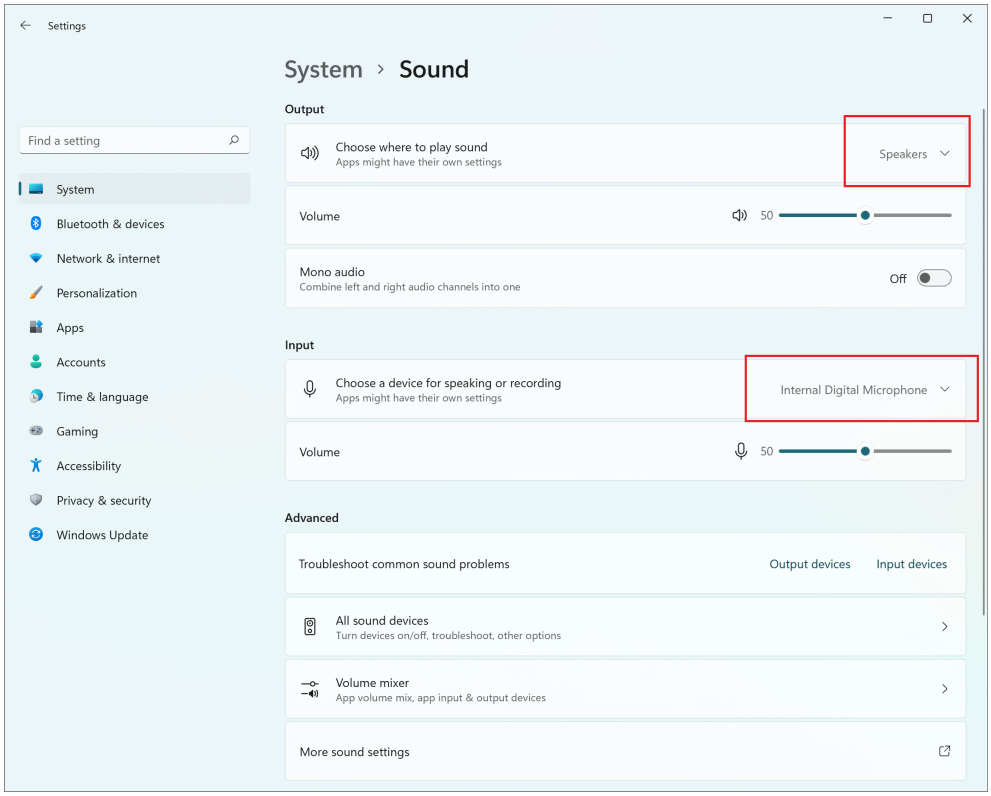
3 Experiment Setup

3.1 The Simplest Setup

The simplest setup is to connect a headset with microphone to the experiment PC.

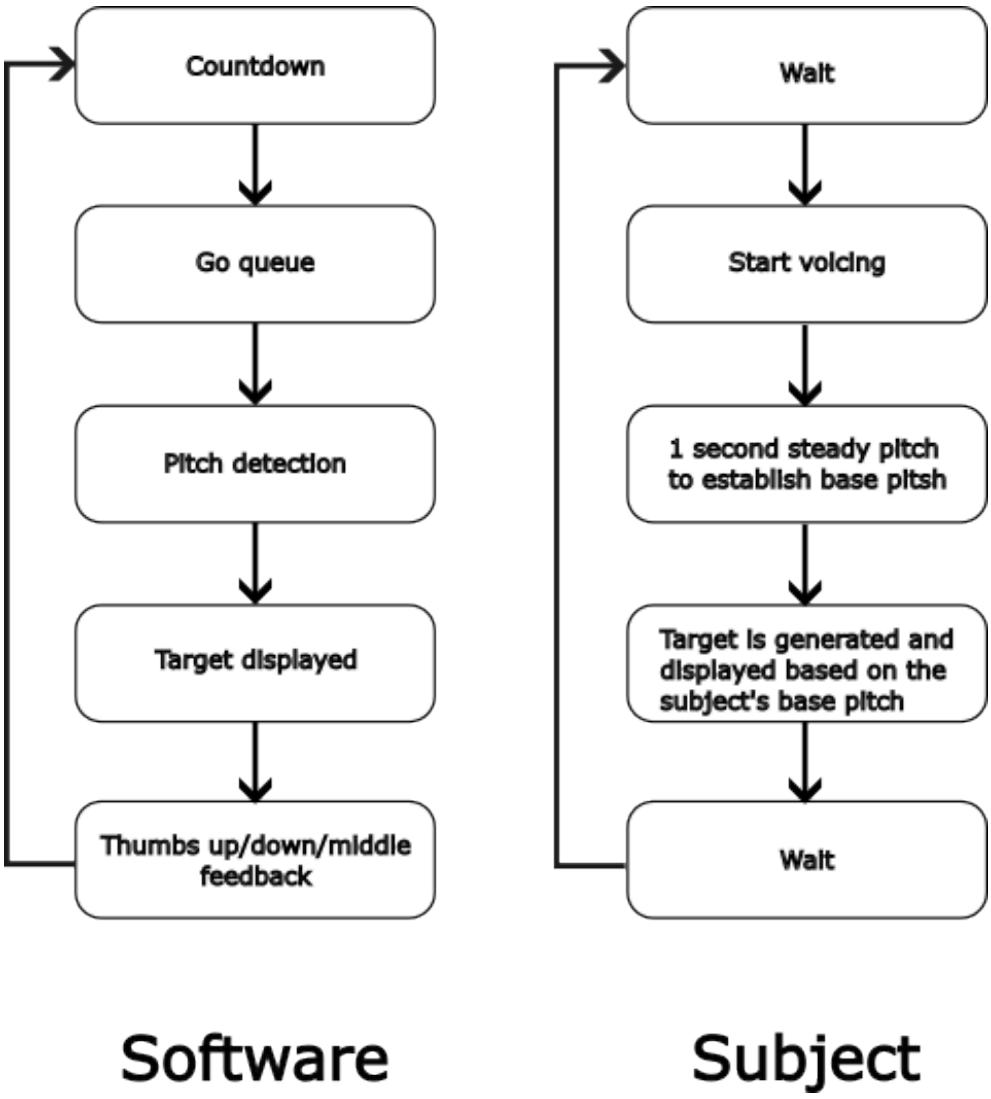


Please make sure that the sound channels are properly selected and volume adjusted in the Windows Settings.



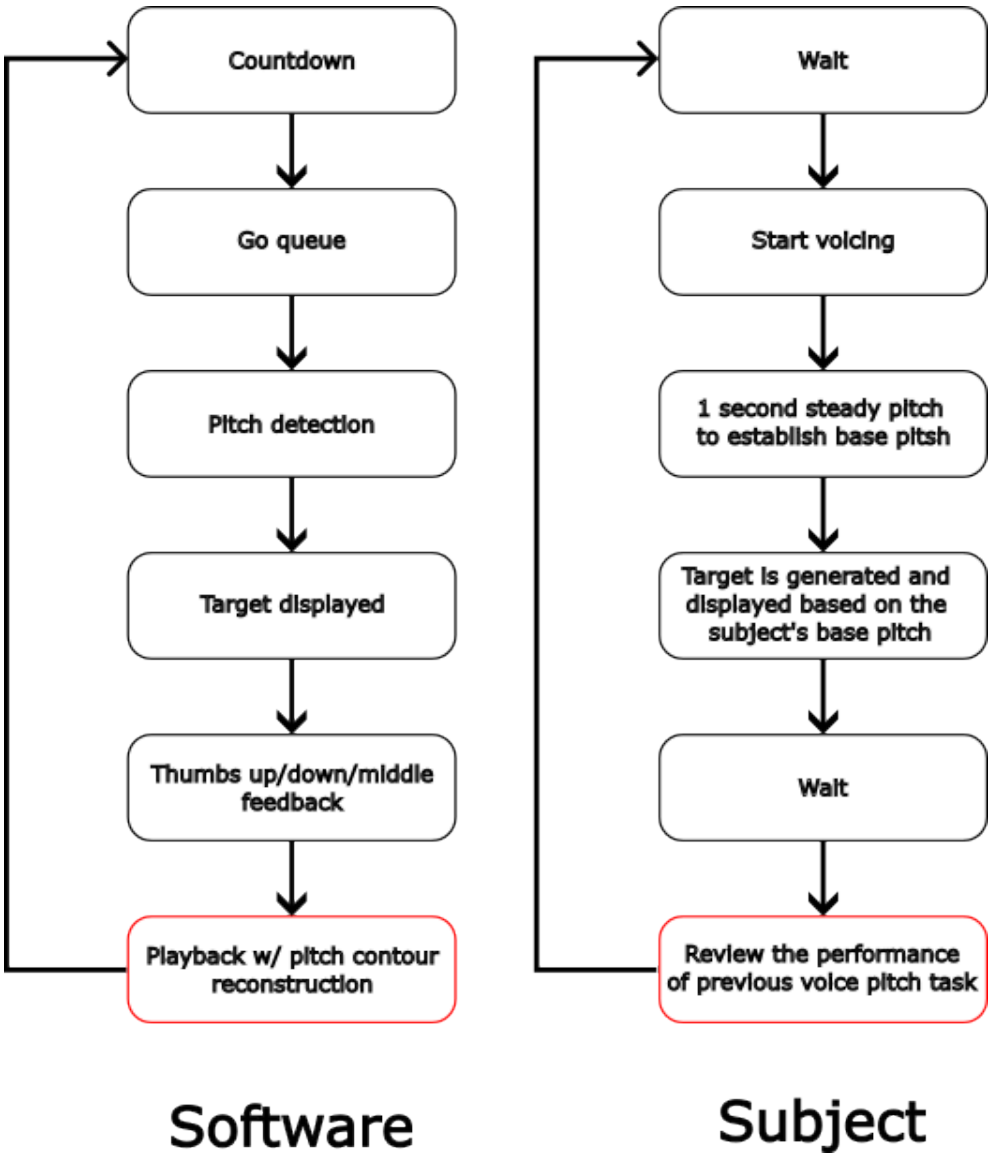
Even with the simplest settings, you can conduct use cases: 3.2, 3.3 and 3.4

3.2 The Simplest Use Case



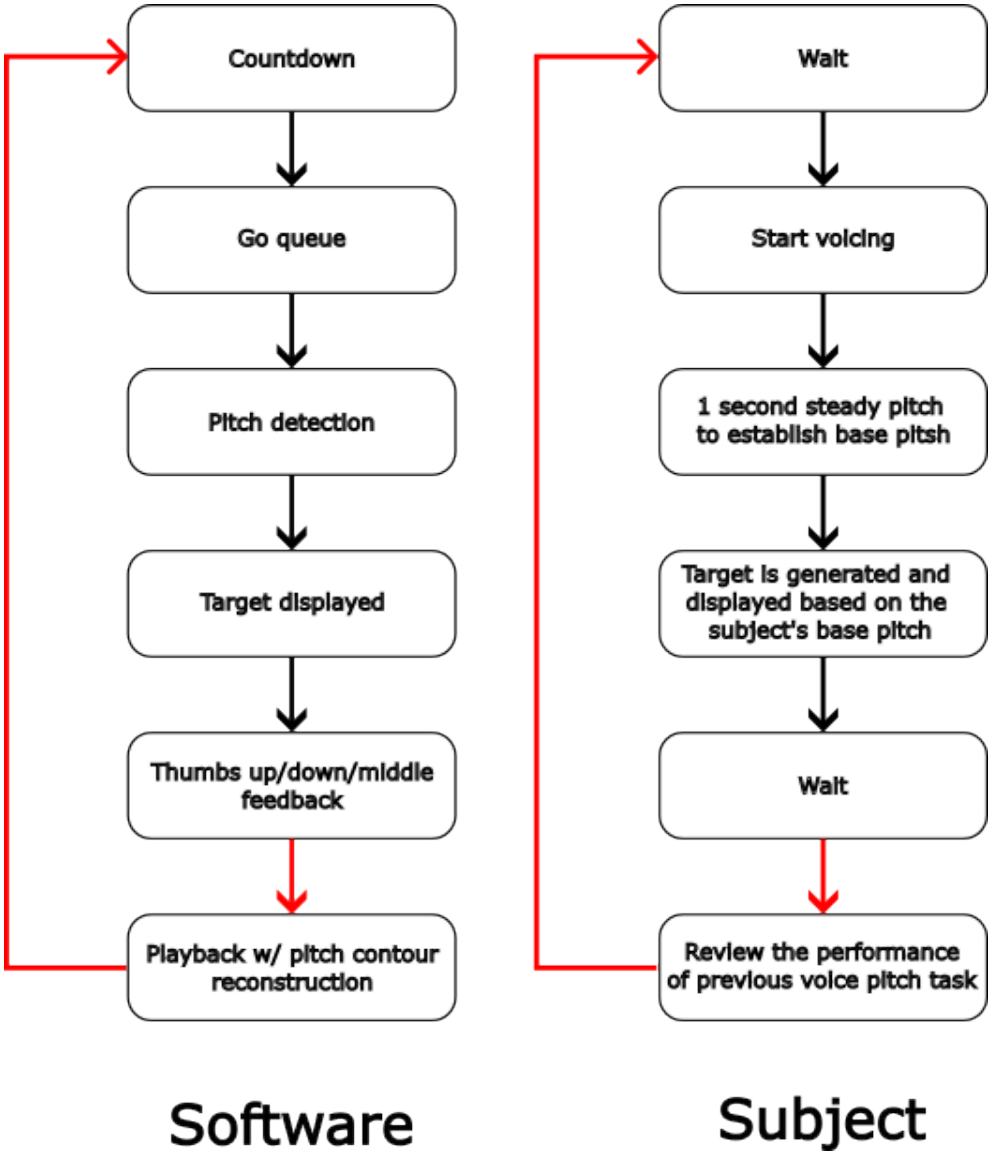
This figure represents the simplest use case of the GVPT, which prompts voice pitch tasks in a loop.

3.3 Playback



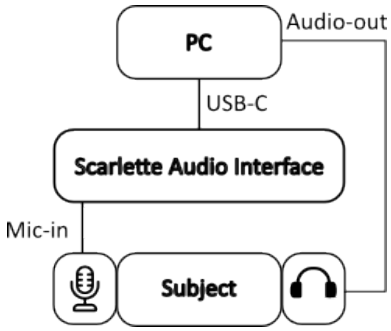
You can add playback after each task trial for the subject to assess their previous performance.

3.4 Randomizing Playback Delays



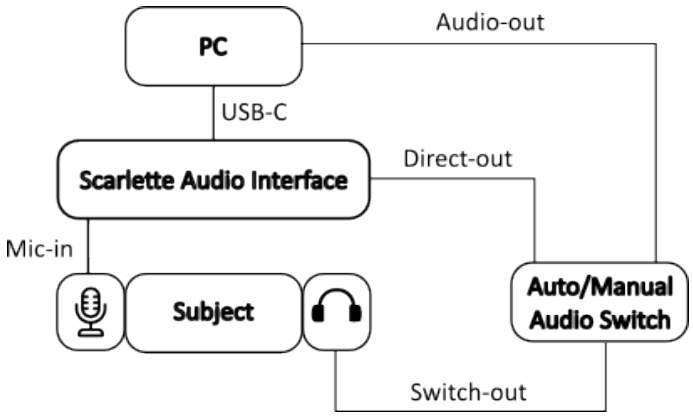
You can randomize the delay time(in red arrow) of the playback to spread the timing. This function is mostly used to offset each trials randomly to spread frequencies for EEG and fMRI analysis.

3.5 Audio Interfaces



You can add audio switches to further enhance the audio signals. Refer to peripheral section at 5.2.

3.6 Real-time Playback



You can add audio switches to offer real-time playback as the subject is mid-trial.

You can also split the Mic-in directly to the audio switch by using an audio splitter cable. This is where you can be very creative on how you setup the project hardware.

Refer to peripheral section:

- 5.3 Automatic Audio Switch
- 5.4 Manual Audio Switch

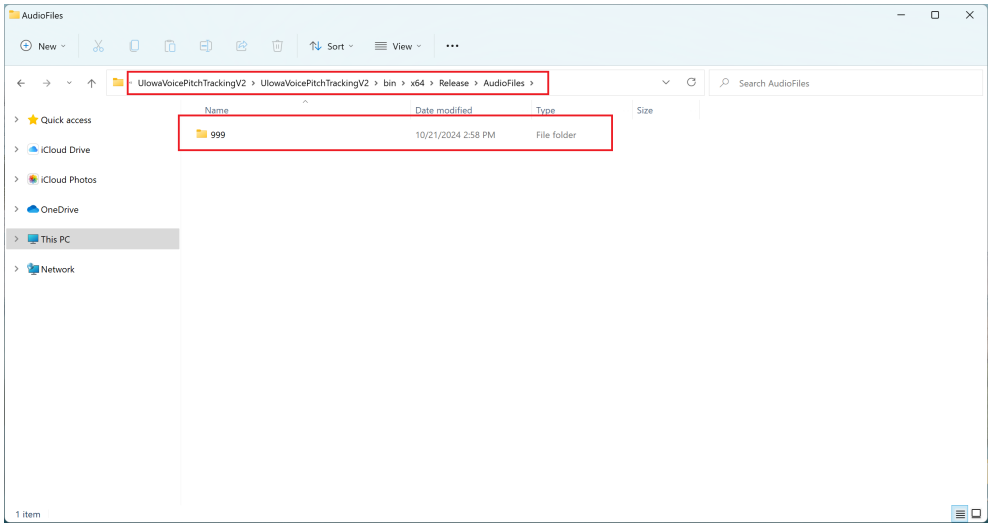
4 Output Files

Upon conclusion of the experiment, the software generates 5 output files.

- 4.3 Audio file for the entire experiment (in .wav)
- 4.4 Event logs w/ timestamps (in .csv)
- 4.5 Detected pitch (in .csv)
- 4.6 Pitch target contour (in .csv)
- 4.7 Target pitch (in .csv)

You can consume the csv logs with your preferred method - Excel, Pandas, Matlab, text editors, etc.

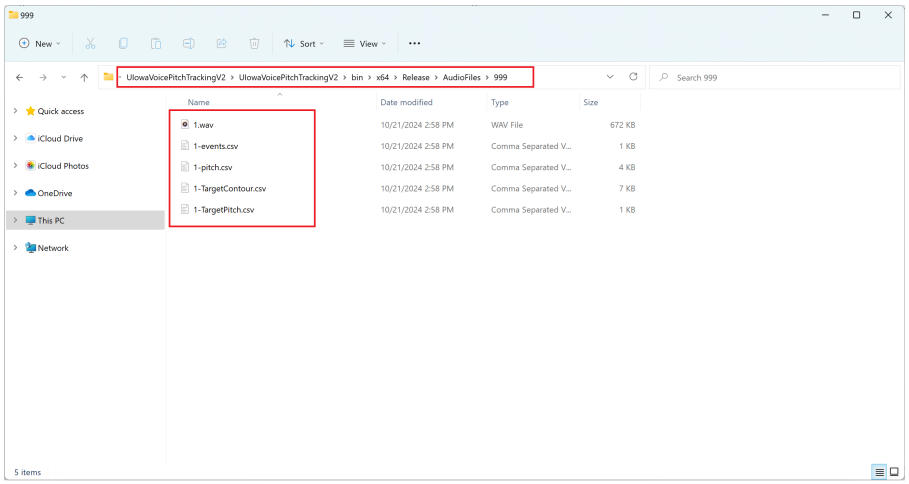
4.1 Output File Location



The output files will organize each subject ID into separate folders. You can access these files based on how you are launching GVPT:

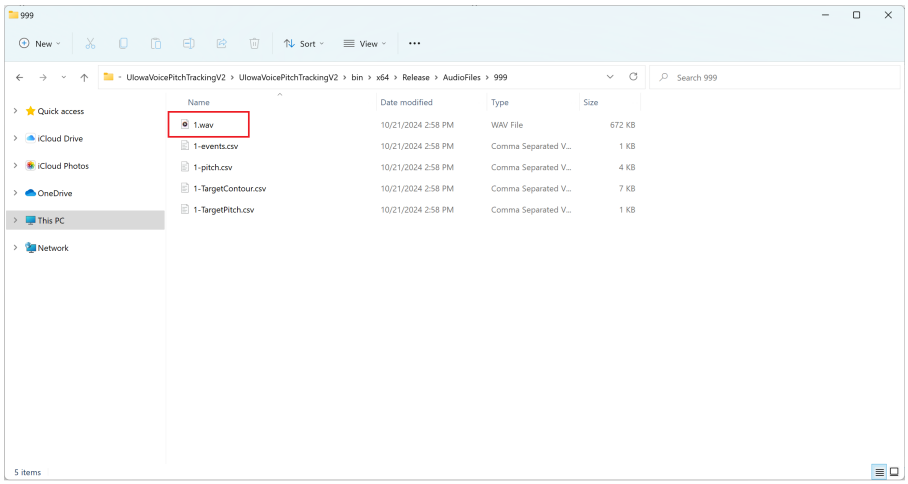
- C# Codebase: (SolutionDirectory)/UIowaVoicePitchTrackingV2/UIowaVoicePitchTrackingV2/bin/(Debug or Release - based on your build configuration)/AudioFiles/(SubjectID)
- Windows Executable(.exe): (ExecutableFileDirectory)/AudioFiles/(SubjectID)

4.2 Overview



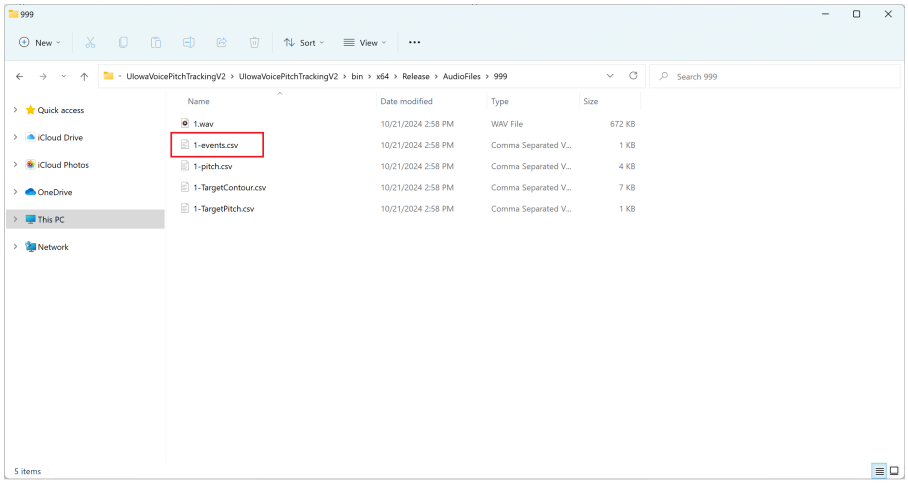
The output files will have incremental file numbers starting at 1.

4.3 Audio file



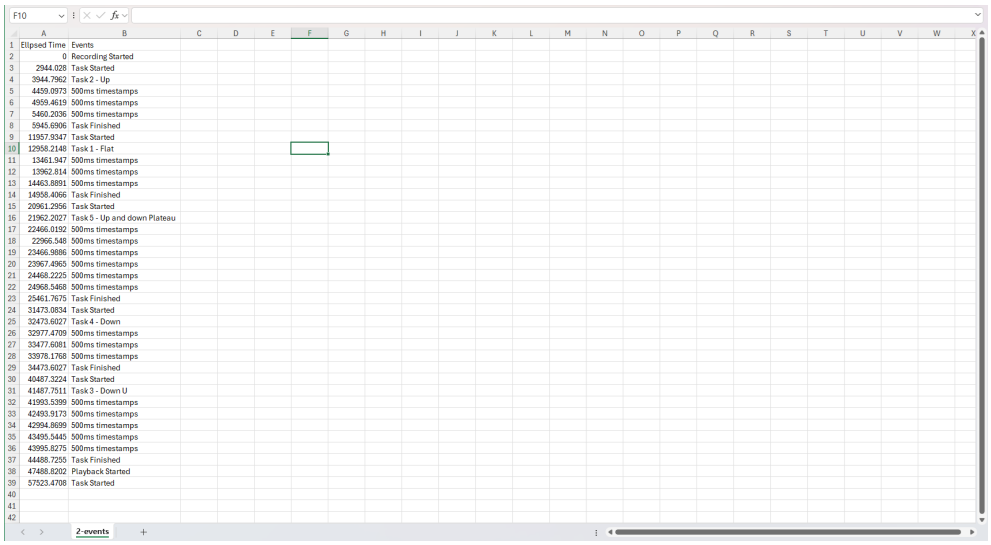
The audio file output contains every sound that the microphone picked-up during the experiment at proctor selected sampling rate.

4.4 Event Logs



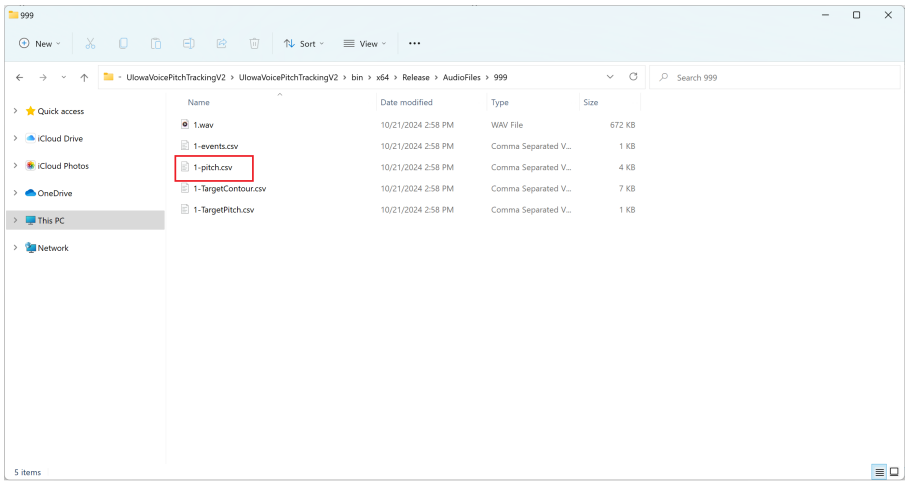
The event logs are formatted with elapsed time(with respect to the time the record button was pressed), and the following events:

- Task Started - when the 'Go queue' was displayed
- Task X - when the base pitch was established and target pitch contour was displayed
- 500ms timestamps - for every tasks, there are timestamps in every 500ms to assist alignment with other logs
- Task Finished - is when each task was terminated.



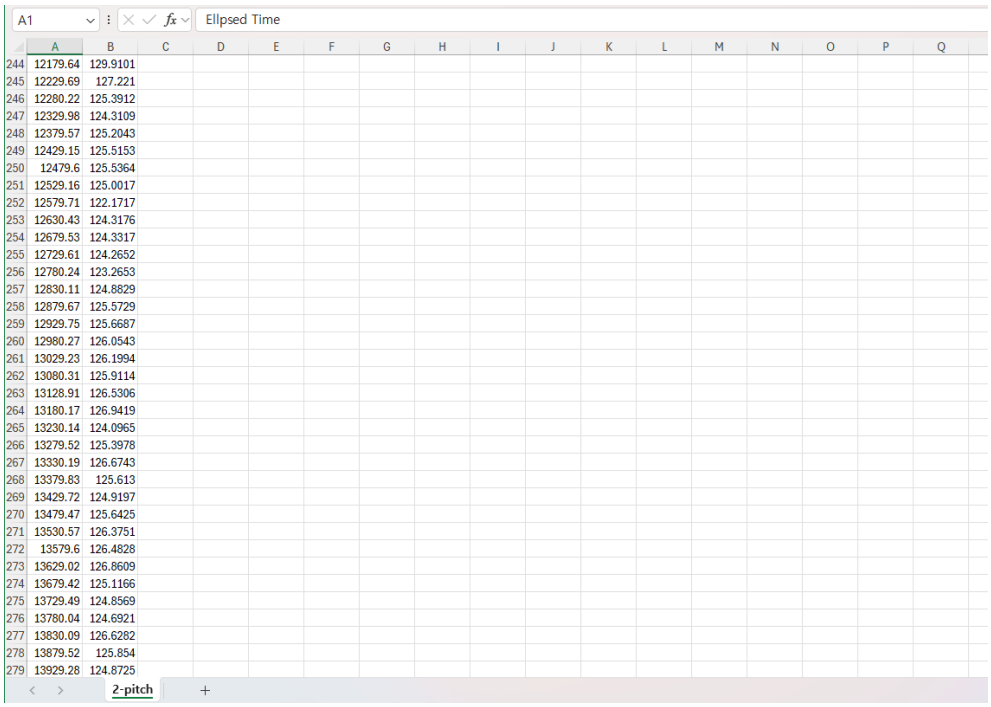
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Ellpsed Time	Events																						
2	0	Recording Started																						
3	2944.028	Task Started																						
4	3944.7962	Task 2 - Up																						
5	4459.0973	500ms timestamps																						
6	4959.4619	500ms timestamps																						
7	5460.2036	500ms timestamps																						
8	5945.6906	Task Finished																						
9	11957.9347	Task Started																						
10	12958.2148	Task 1 - Flat																						
11	13461.947	500ms timestamps																						
12	13962.814	500ms timestamps																						
13	14463.8891	500ms timestamps																						
14	14958.4066	Task Finished																						
15	20961.2956	Task Started																						
16	21962.2027	Task 5 - Up and down Plateau																						
17	22466.0192	500ms timestamps																						
18	22966.548	500ms timestamps																						
19	23466.9886	500ms timestamps																						
20	23967.4965	500ms timestamps																						
21	24468.2225	500ms timestamps																						
22	24968.5468	500ms timestamps																						
23	25461.7675	Task Finished																						
24	31473.0834	Task Started																						
25	32473.6027	Task 4 - Down																						
26	32977.4709	500ms timestamps																						
27	33477.6081	500ms timestamps																						
28	33978.1768	500ms timestamps																						
29	34473.6027	Task Finished																						
30	40487.3224	Task Started																						
31	41487.7511	Task 3 - Down U																						
32	41993.5399	500ms timestamps																						
33	42493.9173	500ms timestamps																						
34	42994.8699	500ms timestamps																						
35	43495.5445	500ms timestamps																						
36	43995.8275	500ms timestamps																						
37	44488.7255	Task Finished																						
38	47488.8202	Playback Started																						
39	57523.4708	Task Started																						
40																								
41																								
42																								

4.5 Detected Pitch



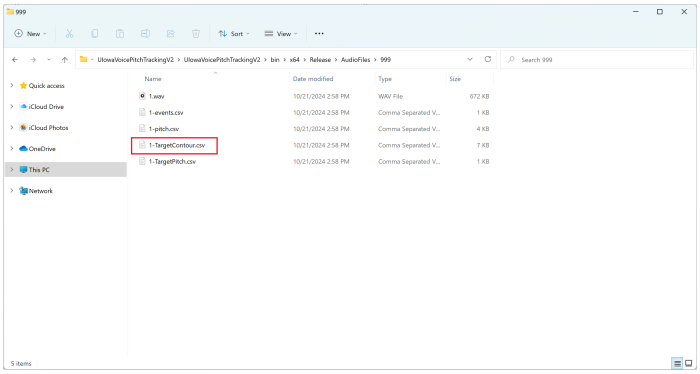
The detected pitch log contain every pitch detection and its timestamps.

- Voice pitch detection is vulnerable to noise. -1 is returned as a default if pitch detection failed at that timestamp.

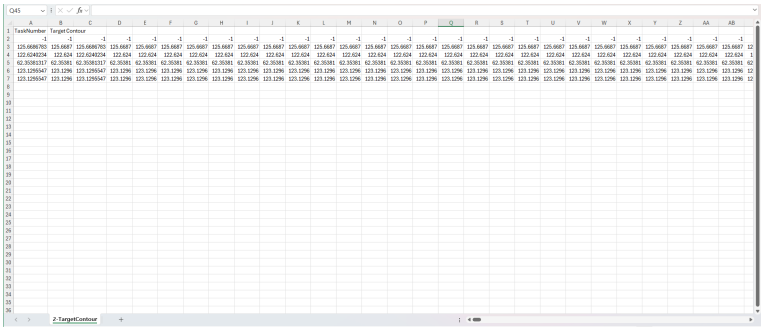


	A	B
244	12179.64	129.9101
245	12229.69	127.221
246	12280.22	125.3912
247	12329.98	124.3109
248	12379.57	125.2043
249	12429.15	125.5153
250	12479.6	125.5364
251	12529.16	125.0017
252	12579.71	122.1717
253	12630.43	124.3176
254	12679.53	124.3317
255	12729.61	124.2652
256	12780.24	123.2653
257	12830.11	124.8829
258	12879.67	125.5729
259	12929.75	125.6687
260	12980.27	126.0543
261	13029.23	126.1994
262	13080.31	125.9114
263	13128.91	126.5306
264	13180.17	126.9419
265	13230.14	124.0965
266	13279.52	125.3978
267	13330.19	126.6743
268	13379.83	125.613
269	13429.72	124.9197
270	13479.47	125.6425
271	13530.57	126.3751
272	13579.6	126.4828
273	13629.02	126.8609
274	13679.42	125.1166
275	13729.49	124.8569
276	13780.04	124.6921
277	13830.09	126.6282
278	13879.52	125.854
279	13929.28	124.8725

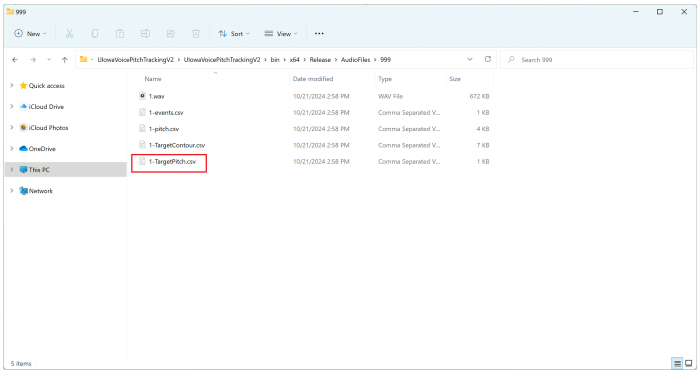
4.6 Pitch Target Contour



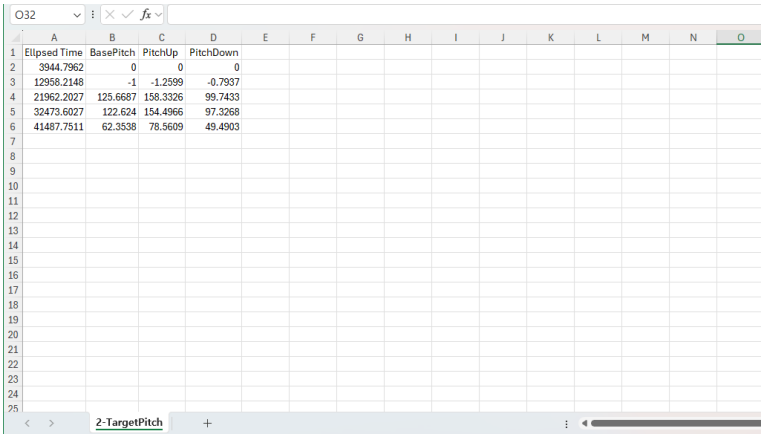
The target contour log contain the pitch target contour that was displayed to the user.



4.7 Target Pitch



The target pitch log contains the base pitch of each task, and pitch moved up & down as the proctor configured experiment setup from the base pitch.



	A	B	C	D
1	Ellpsed Time	BasePitch	PitchUp	PitchDown
2	3944.7962	0	0	0
3	12958.2148	-1	-1.2599	-0.7937
4	21962.2027	125.6687	158.3326	99.7433
5	32473.6027	122.624	154.4966	97.3268
6	41487.7511	62.3538	78.5609	49.4903

5 Peripherals

5.1 USB2TTL module

The adapter typically occupies the COM3 port, but if COM3 is unavailable, it may occupy another port (such as COM4, COM7, or COM8). If you cannot connect via COM3, check the Windows Device Manager under "Ports" to identify which port the adapter is using.

5.2 Audio Pre-Amp

We currently use Scarlett Solo 3rd gen to connect all the devices together.

5.3 Automatic Audio Switch

If you want an automatic audio switch for real-time playback (during task). We recommend using Bobwire's RCA1.

This device will switch audio source automatically based on how you configure its primary & secondary source and switching threshold. If you need more information about the automatic switch, please contact Bob at **bobwireaudio@gmail.com**

5.4 Manual Audio Switch

If you prefer to switch audio sources manually, we recommend using a stereo audio switch. This is one model that we used for other projects - Amazon link, but you may use any analog audio switch that fits your purpose and cabling needs.

6 Update History

Version 1.0.0 - Initial release

7 Acknowledgement

The GVPT software is relying on many projects. Special thanks to:

- MahApps.Metro
- MoreLINQ
- NAudio
- NLog
- OxyPlot
- Prism Library
- ReactiveProperty