Appendices

Appendix A. Ethical approval form (signed and dated)

Appendix B. Organisation, participants and consent

Appendix C. Retained drafts and notes

Appendix D. Early design

Appendix E. First draft

Appendix F. Formal session

Appendix G. Obsidian research maps

Appendix A. Ethical Approval Form

The completed PG2/E1 ethical approval form, signed by the applicant on 13 February 2026 and by the supervisor on 25 February 2026. The pages follow in full.

Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

PG2 / E1 FORM

APPLICATION FOR ETHICAL APPROVAL

RESEARCH STUDENTS
This form is to be completed by the student within **SIX** months for full-time students and **TWELVE** months for part time students, after the commencement of the research degree or following progression to Part Two of your course.

Once complete, submit this form via the ***MyTSD Doctoral College Portal*** at (https://mytsd.uwtsd.ac.uk).

This document is also available in Welsh.

RESEARCH STAFF ONLY
All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk , with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically. A researcher may not be covered by the University's insurance if ethical approval has not been obtained prior to commencement.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

Ethical approval is not required for routine audits, performance reviews, quality assurance studies, testing within normal educational requirements, and literary or artistic criticism.

Please read the notes for guidance before completing ALL sections of the form.

This form must be completed and approved prior to undertaking any research activity. Please see Checklist for details of process for different categories of application.

SECTION A: About You (Principal Researcher)

1	Full Name:		Tristan Paredes			
2	Tick all boxes that apply:		Member of staff:	☐	Honorary research fellow:	☐
	Undergraduate Student	☐	Taught Postgraduate Student	☒	Postgraduate Research Student	☐

3	Institute/Academic Discipline/Centre:	Institute of Management and Health

4	Campus:	Carmarthen
5	E-mail address:	tristp@protonmail.com
6	Contact Telephone Number:	N/A
	For students:	
7	Student Number:	2030431
8	Programme of Study:	MA Professional Practice (Voice Pedagogy)
9	Director of Studies/Supervisor:	Louise Emanuel/Julie Crossman/Debbie Winter

SECTION B: Approval for Research Activity

1	Has the research activity received approval in principle? (please check the Guidance Notes as to the appropriate approval process for different levels of research by different categories of individual)		**YES** ☒	**NO** ☐	
				Date	
2	If Yes, please indicate source of approval (and date where known): ***Approval in principle must be obtained from the relevant source prior to seeking ethical approval***	Research Degrees Committee	☐		
		Institute Research Committee	☐		
		Other (write in) WAPPAR Ethics Board Representative	☒		

SECTION C: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.	
1	**UWTSD Research Ethics & Integrity Code of Practice**	☒
2	**UWTSD Research Data Management Policy**	☒
3	*[List any other relevant documents here]*	☐

SECTION D: External Collaborative Research Activity
If there are external collaborators then you should gain consent from the contact persons to share their personal data with the university. If there are no external collaborators then leave this section blank and continue to section E.

1	Institution	N/A
2	Contact person name	N/A
3	Contact person e-mail address	N/A

4	Is your research externally funded?		**YES**	☐	**NO**	☒
5	Are you in receipt of a KESS scholarship?		**YES**	☐	**NO**	☒
6	Are you specifically employed to undertake this research in either a paid or voluntary capacity?	Voluntary	**YES**	☐	**NO**	☒
7		Employed	**YES**	☐	**NO**	☒
8	Is the research being undertaken within an existing UWTSD Athrofa Professional Learning Partnership (APLP)?	If YES then the permission question below does not need to be answered.	**YES**	☐	**NO**	☒
9	Has permission to undertake the research has been provided by the partner organisation?	(If YES attach copy) If NO the application cannot continue	**YES**	☐	**NO**	☒

Where research activity is carried out in collaboration with an external organisation

10	Does this organisation have its own ethics approval system?	**YES**	☐	**NO**	☒
	If Yes, please attach a copy of any final approval (or interim approval) from the organisation (this may be a copy of an email if appropriate).				

SECTION E: Details of Research Activity

1	Indicative title:	**Exploratory Development of a Low-Cost Nasal Airflow Detection System for Singers**		
2	Proposed start date:	February 10th, 2026	Proposed end date:	October 1st, 2026
	Introduction to the Research (maximum 300 words per section) This research explores whether a student-built, low-cost, non-invasive, safe, electronic device can be developed to detect nasal airflow during singing. In voice research, moderate usage of nasal airflow is discussed as a potential factor in improving vocal efficiency. However, most existing nasal airflow measurement tools are designed for clinical speech pathology and are prohibitabely expensive to the public. As a result, there are no tools which can be used by the general singing population to get feedback on their usage of nasal airflow during vocal taks. The existence of such a device may improve vocal health in singers and serve as a vulable pedagogical tool for voice teachers. The aim of this project is to design, build, and evaluate a simple prototype device capable of detecting relative changes in nasal airflow during phonation. My objectives are to: - Review existing nasal airflow measurement approaches with a strong focus in voice-related research. - Identify a measurement method that balances diagnostical accuracy with affordability and			

	practicality (e.g. Arduino thermistor kit) - Construct a prototype using accessible electronic components. - Create software which can record relevant nasal airflow sensor data. - Conduct preliminary self-testing to evaluate whether the device produces reliable, interpretable data. By investigating a simplified, low-cost alternative to clinical nasalance devices, this project aims to address a gap between laboratory research and studio practice. While my prototype device will not replace clinical or laboratory instrumentation, this exploratory work may contribute to future research by identifying whether accessible technologies can meaningfully detect nasal airflow in singing. Additionally, if the device is servicable it may be useful for voice teachers and singers for detecting and correcting nasal airflow issues while singing. This addresses an important need for practical, affordable tools in vocal pedagogy and singer-focused research.
3	**Purpose of Research Activity** Nasal airflow is a metric in singing research which has been suggested to improve vocal efficiency. However, no consumer-grade device exists on the market for measuring nasal airflow during phonation or singing tasks. The purpose of this research is to explore whether a low-cost, non-invasive, and safe student-built device can detect nasal airflow during singing and/or phonation tasks. Existing tools for measuring nasal airflow were largely developed for speech pathology and are often designed to assess issues such as hypernasality in clinical populations. They are typically expensive, technically complex, and inaccessible outside laboratory environments. This project aims to investigate whether a simple, affordable, safe, non-invasive device can provide meaningful exploratory data on nasal airflow during vocal tasks. The intention is not to produce a medical, clinical, or diagnostic device, but to evaluate feasibility for basic nasal airflow testing for singing students, teachers, and researchers.
4	**Research Question** Can a low-cost nasalance device provide meaningful exploratory measurements of nasal airflow during singing tasks?
5	**Aims of Research Activity** The primary aim of this project is to design, build, and test a low-cost nasal airflow detection system suitable for exploratory use in vocal research or studio settings. A secondary aim, if time permits, is to compare different types of sensors (thermal, air pressure, CO2, etc.) or to compare my prototype device against an existing consumer-grade nasal airflow measurement device such as the SleepSense (used in sleep apnea research but not for phonation tasks) to help determine relative accuracy of both devices.

6	**Objectives of Research Activity** • Review existing measurement devices used in nasalance and nasal airflow research. • Design and assemble a safe, non-invasive nasal airflow sensing system (likely thermal airflow or airflow pressure based) likely using an Arduino-compatible platform (affordable and modular with plentiful online resources and learning communities). • Develop basic software to record and visualize airflow-related signals, again, likely using Arduino. • Perform controlled phonation tasks myself to evaluate whether the system detects nasal airflow changes. • Evaluate the practical feasibility, reliability, and limitations of the prototype
	Proposed methods (maximum 600 words) **Overall Design: Mixed Methods (Quantitative and Qualitative)** This project uses a mixed-methods design combining quantitative physiological signal recording with qualitative observational and reflective documentation. All testing will be conducted by the researcher on themselves. No additional participants will be recruited. **Method 1: Quantitative Physiological Data Collection** A prototype student-built Nasal Transductive Airflow Device (NTAD) will be used to detect exhaled nasal airflow during structured phonation tasks. The NTAD sensor (likely a thermal sensor or an air pressure sensor) will be positioned beneath one or both nostrils using a lightweight, non-invasive support structure (e.g., modified soft mask, headband, or shallow nasal cannula positioned at the nostril entrance). The device signal will be recorded via USB connection to a computer and logged digitally using custom data-logging software. Audio/video recordings of vocal tasks (e.g., sustained vowels, pitch glides, sustained consonants, selected sung phrases) will be collected for time-alignment, audio spectral analysis (if audio quality is high enough), and potentially also for readers to reference in the final paper in the form of playable recordings, images, etc. Adequate audio/video devices will be used to ensure reasonable quality. If time permits, additional sensor configurations may be evaluated for comparison (e.g., thermal, airflow pressure, CO2, etc.) Minor modifications to the NTAD support structure may also be explored, such as introducing a simple separation plate to reduce potential mixing of oral and nasal airflow. The collected data will include time-series sensor signal data, synchronized audio recordings, video recordings, and photographic documentation of the device's configuration. All data will be stored locally on a password-protected device. **Method 2: Structured Self-Observation and Field Notes** During testing sessions, structured qualitative field notes will be recorded immediately after each task session. Notes may include perceived nasal airflow usage, registration (mix, belt, etc.), comfort and usability of the device, observed signal behavior (such as stability, delay, or noise), and other relevant factors. These notes will support the interpretation of the quantitative signal patterns and assist in evaluating the accuracy, practicality, and usability of the prototype device (NTAD). **Method 3: Reflective Research Journal** A reflective journal will be maintained throughout the project to document the device construction process, technical adjustments, troubleshooting, calibration observations,

	practical limitations, and iterative design changes. This journal will serve as a record of methodological development and decision-making during prototype refinement. **Observations** No focus groups or external participant observations will be conducted. All observations relate solely to the researcher's own vocal tasks and device performance during testing sessions.
7	**Data Collection** Data collection will involve structured vocal tasks. These tasks may include tasks such as sustained phonation or short singing phrases. For example, nasalized consonants (such as /m/) can be used and compared to non-nasalized consonants to determine if the device is functional. More complex tasks can be included (singing a short phrase, including higher notes, multi-note singing exercises on a single vowel, vowel changes, etc.) to further evaluate the accuracy and limitations of the device. The primary purpose of these tasks is to determine how well the device detects relative changes in airflow presence and magnitude across different tasks. These tasks will be recorded with audio and video. Photos will be taken of the device and of myself using the device. Nasal airflow measurements will also be recorded. Audio recordings of vocal tasks may be collected for synchronization and comparison with sensor output. All data will be stored securely on the student's own password-protected device. No personal data from external participants will be collected. The researcher will be the sole participant.
	Location of research activity Identify all locations where research activity will take place.
8	My home vocal studio in the United States.
	Research activity outside of the UK If research activity will take place overseas, you are responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. Specify any local guidelines (e.g. from local professional associations/learned societies/universities) that exist and whether these involve any ethical stipulations beyond those usual in the UK (provide details of any licenses or permissions required). Also specify whether there are any specific ethical issues raised by the local context in which the research activity is taking place, for example, particular cultural and/or legal sensitivities or vulnerabilities of participants. If you live in the country where you will do the research then please state this.
9	Yes, I will be conducting research in the United States. ***a***

10	Use of documentation not in the public domain: Are any documents **NOT** publicly available?	**NO**	☒
		YES	☐
11	If Yes, please provide details here of how you will gain access to specific documentation that is not in the public domain and that this is in accordance with the current data		

	protection law of the country in question and that of England and Wales.

	Does your research relate to one or more of the seven aims of the Well-being of Future Generations (Wales) Act 2015?	**YES**	**NO**
12	A prosperous Wales	☐	☒
13	A resilient Wales	☐	☒
14	A healthier Wales	☐	☒
15	A more equal Wales	☐	☒
16	A Wales of cohesive communities	☐	☒
17	A Wales of vibrant culture and thriving Welsh language	☐	☒
18	A globally responsible Wales	☐	☒
19	If YES to any of the above, please give details:		

SECTION F: Scope of Research Activity

	Will the research activity include:	**YES**	**NO**
1	Use of a questionnaire or similar research instrument?	☐	☒
2	Use of interviews?	☐	☒
3	Use of focus groups?	☐	☒
4	Use of participant diaries?	☒	☐
5	Use of video or audio recording?	☒	☐
6	Use of computer-generated log files?	☒	☐
7	Participant observation with their knowledge?	☒	☐
8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒
10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒

16	Procedures that may have a negative impact on the environment?	☐	☒
17	Other primary data collection methods. Please indicate the type of data collection method(s) below.		
	Details of any other primary data collection method:	☐	☒

If NO to every question, then the research activity is (ethically) low risk and **may** be exempt from **some** of the following sections (please refer to Guidance Notes).

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION G: Intended Participants

If there are no participants then do not complete this section, but go directly to section H.

	Who are the intended participants:	**YES**	**NO**
1	Students or staff at the University?	☒	☐
2	Adults (over the age of 18 and competent to give consent)?	☒	☐
3	Vulnerable adults?	☐	☒
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☒
5	Prisoners?	☐	☒
6	Young offenders?	☐	☒
7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☒
8	People engaged in illegal activities?	☐	☒
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.		
	Details of any other participant groups: Complete this only if your participants cannot give consent. This includes animals.	☐	☒

	Participant numbers and source Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?	
10	How many participants are expected?	One
11	Who will the participants be?	Myself

12	How will you identify the participants?	I will indicate the research was conducted on myself.

	Information for participants:	**YES**	**NO**	**N/A**
13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☒	☐	☐
14	Will you tell participants that their participation is voluntary?	☒	☐	☐
15	Will you obtain written consent for participation?	☒	☐	☐
16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☒	☐	☐
17	If the research is observational, will you ask participants for their consent to being observed?	☒	☐	☐
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☒	☐	☐
22	If NO to any of above questions, please give an explanation			

	Information for participants:	**YES**	**NO**	**N/A**
24	Will participants be paid?	☐	☒	☐
25	Is specialist electrical or other equipment to be used with participants?	☒	☐	☐
26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☒	☐
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☐	☒	☐
28	If YES to any question, please provide full details			
	I will be recording myself (video and audio) using and performing phonatory tasks utilizing the prototype nasal airflow device (NTAD.) I may also take photos of myself wearing the device. Data will be recorded and analysed from the device of my phonatory tasks which will measure nasal airflow.			

SECTION H: Anticipated Risks

<table>
<tr><td></td><td colspan="3">Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them.

If you have completed a full risk assessment (for example as required by a laboratory, or external research collaborator) you may append that to this form.</td></tr>
<tr><td>1</td><td colspan="2">Full risk assessment completed and appended?</td><td>Yes ☐
No ☒</td></tr>
<tr><td>2</td><td colspan="3">Risks to participants
For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information</td></tr>
<tr><td></td><td>Risk to participants:

• Mild skin irritation if adhesive is used.
• Discomfort from wearing a small mask or sensor mount.
• Slight alteration of natural breathing sensation.
• Low-voltage, USB-powered Arduino-based prototype (minimal electrical risk)
• Vocal fatigue risk
• Data privacy</td><td colspan="2">How you will mitigate the risk to participants:

• Use lightweight materials.
• Ensure sensor does not meaningfully obstruct airflow.

• Allow participant to stop at any time.
• Insulated wiring.
• Electrical safety precautions
• No exposed conductive surfaces near skin.
• Device tested before use.
• Data stored locally.</td></tr>
<tr><td>3</td><td colspan="3">If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities</td></tr>
<tr><td></td><td colspan="3">N/A</td></tr>
<tr><td>4</td><td colspan="3">Risks to the investigator
For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest</td></tr>
<tr><td></td><td>Risk to the investigator:

• Confirmation bias
• Self-experimentation bias
• Overinterpretation of data
• Learning curve stress
• Mild health and safety concerns related to low voltage electronic equipment</td><td colspan="2">How you will mitigate the risk to the investigator:

• Frame findings explicitly as exploratory
• Avoid clinical claims
• Document limitations clearly
• Modular design
• Stepwise testing
• Clear scope boundaries.</td></tr>
</table>

5	**University/institutional risks** For example: adverse publicity, financial loss, data protection	
	Risk to the University: • Device could be misinterpreted by readers as a clinical diagnostic tool • Findings could be overstated or misrepresented publicly • Data protection issues if data is mishandled • Ethical concerns regarding self-experimentation	*How you will mitigate the risk to the University:* • Clearly state in all documentation that the device is exploratory and non-clinical • Explicitly frame results as preliminary prototype data with clear limitations • Store any recordings locally on securely password-protected devices; researcher is sole participant • Use only low-voltage components • Ensure procedures are non-invasive, minimal-risk, and that participation can stop at any time
6	**Environmental risks** For example: accidental spillage of pollutants, damage to local ecosystems	
	Risk to the environment: • Electronic waste generated from discarded components • Improper disposal of sensors or circuit elements • Potential use of single-use plastic components (e.g., cannulas) • Increased energy consumption from repeated device testing	*How you will mitigate the risk to environment:* • Reuse and repurpose components wherever possible • Dispose of electronic components through approved e-waste recycling facilities • Minimize single-use materials and sanitize reusable components safely • Use low-power devices and limit testing sessions to necessary duration

	Disclosure and Barring Service			
	If the research activity involves children or vulnerable adults, a Disclosure and Barring Service (DBS) certificate must be obtained before any contact with such participants.	**YES**	**NO**	**N/A**
7	Does your research require you to hold a current DBS Certificate?	☐	☒	☐
8	If YES, please give the certificate number. If the certificate number is not available please write “Pending”; in this case any ethical approval will be subject to providing the appropriate certificate number.			

SECTION I: Feedback, Consent and Confidentiality

1	**Feedback** What de-briefing and feedback will be provided to participants, how will this be done and when?
	I am the sole participant.
2	**Informed consent** Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation.
	I am the sole participant.
3	**Confidentiality / Anonymity** Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case.
	I am the sole participant.

SECTION J: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 "GDPR" and the Data Protection Act 2018 "DPA")?	**YES**	**NO**
1	***"Personal data"*** *means any information relating to an identified or identifiable natural person ('data subject'). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.*	☑	☐
	If YES, provide a description of the data and explain why this data needs to be collected:		
2	Audio/visual data as well as nasal airflow metrics. This data is needed in order to conduct the study.		
	Does it involve special category data (as defined by the GDPR)?	**YES**	**NO**
3	***"Special category data"*** *means sensitive personal data consisting of information as to the data subjects' –* *(a) racial or ethnic origin,* *(b) political opinions,* *(c) religious beliefs or other beliefs of a similar nature,* *(d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992),* *(e) physical or mental health or condition,* *(f) sexual life,* *(g) genetics,* *(h) biometric data (as used for ID purposes),*	☐	☑

	If YES, provide a description of the special category data and explain why this data needs to be collected:
4	N/A

	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?	**YES**	**NO**
5	Manual files (i.e. in paper form)?	☐	☒
6	University computers?	☐	☒
7	Private company computers?	☐	☒
8	Home or other personal computers?	☒	☐
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	“Cloud” storage or websites?	☐	☒
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation:		
	All data will be kept in password protected storage on local devices which will not be shared. *Any USB sticks used to store or transfer data will be password protected. Since I am the sole participant, I consent to using my own data however I see fit once the study has concluded.*		

	Data Protection		
	Will the research activity involve any of the following activities:	**YES**	**NO**
13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☐	☒
16	Export of data outside the UK or importing of data from outside the UK?	☒	☐
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☐	☒
18	Publication of data that might allow identification of individuals?	☒	☐
19	Use of data management system?	☐	☒
20	Data archiving?	☐	☒
21	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and any international equivalents, where appropriate):		

	All data will be kept in password protected storage on local devices which will not be shared. Any USB sticks used to store or transfer data will be password protected. Since I am the sole participant, I consent to using my own data however I see fit once the study has concluded.		
22	List all who will have access to the data generated by the research activity:		
	The principal researcher (myself).		
23	List who will have control of, and act as custodian(s) for, data generated by the research activity:		
	The principal researcher (myself)		
24	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form. Will data be archived – if so how and if not why not.		
	All data will be kept in password protected storage on local devices which will not be shared. Any USB sticks used to store or transfer data will be password protected. Since I am the sole participant, I consent to using my own data however I see fit once the study has concluded.		
25	Please indicate if your data will be stored in the UWTSD Research Data Repository (see https://researchdata.uwtsd.ac.uk/). If so please explain. (*Most relevant to academic staff)*		
	No.		
26	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtsd.ac.uk/library/research-data-management/)	**YES**	☒
27	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	**YES**	☒

SECTION K: Declaration

	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants**.** In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtsd.ac.uk/research/research-ethics/		
1	**Signature of applicant:**	Tristan Paredes	**Date: Feb 13, 2026**

For STUDENT Submissions:

2	Director of Studies/Supervisor:	Laura James	**Date: 25-02-2026**
3	Signature:	Laura James	

For STAFF Submissions:

4	Academic Director/ Assistant Dean:		**Date:**
5	Signature:		

Checklist: Please complete the checklist below to ensure that you have completed the form according to the guidelines and attached any required documentation:

☒	I have read the guidance notes supplied before completing the form.
☒	I have completed **ALL RELEVANT** sections of the form in full.
☒	I confirm that the research activity has received approval in principle
☒	I have attached a copy of final/interim approval from external organisation (**where appropriate**)
☒	I have attached a full risk assessment (where appropriate) *ONLY TICK IF YOU HAVE **ATTACHED A FULL RISK ASSESSMENT***
☒	I understand that it is my responsibility to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice.
☒	I understand that before commencing data collection all documents aimed at respondents (including information sheets, consent forms, questionnaires, interview schedules etc.) must be confirmed by the DoS/Supervisor, module tutor or Academic Director.

RESEARCH STUDENTS ONLY Once complete, submit this form via the **MyTSD Doctoral College Portal** at (https://mytsd.uwtsd.ac.uk).
RESEARCH STAFF ONLY All communications relating to this application during its processing must be in writing and

emailed to pgresearch@uwtsd.ac.uk , with the title 'Ethical Approval' followed by your name.
STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

Appendix B. Organisation, Participants and Consent

I carried out this project as a self-employed vocal coach in my home teaching studio. There is no employer or partner organisation, so there is no letter of organisational approval (ethics form, Section D).

I was the only participant, so there are no participant consent forms, information sheets or interview transcripts.

Appendix C. Retained Drafts and Notes

All drafts, notes, and working files from this project have been kept and are available on request.

Appendix D. Early Design

Initial designs were thermal based.

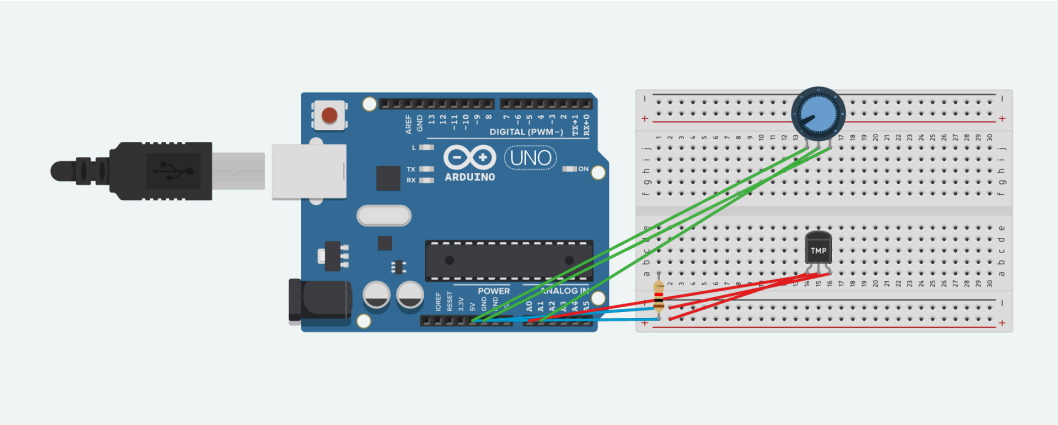


Figure D1. May 18, 2026, first blueprint, a thermal design via Tinkercad.

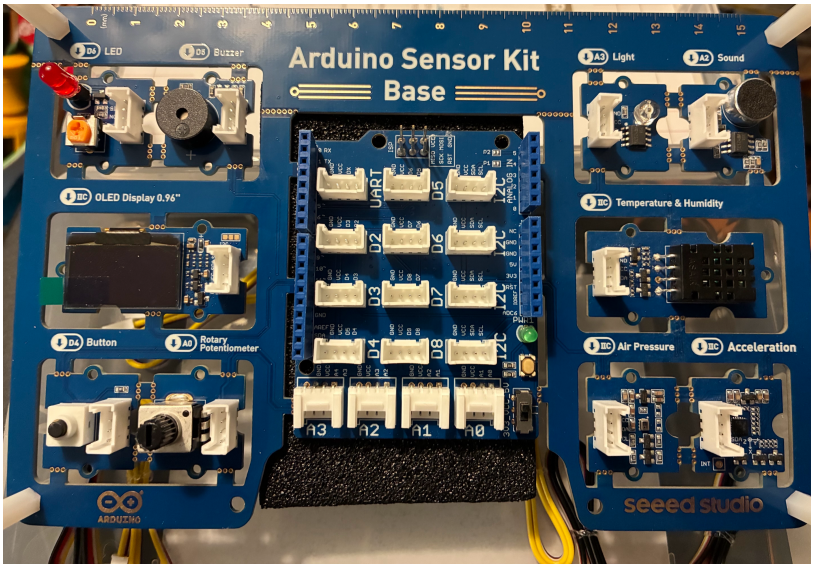


Figure D2. I purchased the Sensirion and thought that since I had an Arduino Sensor Kit, an Arduino Controller, random cables, and a breadboard I could put something together. Apparently not!

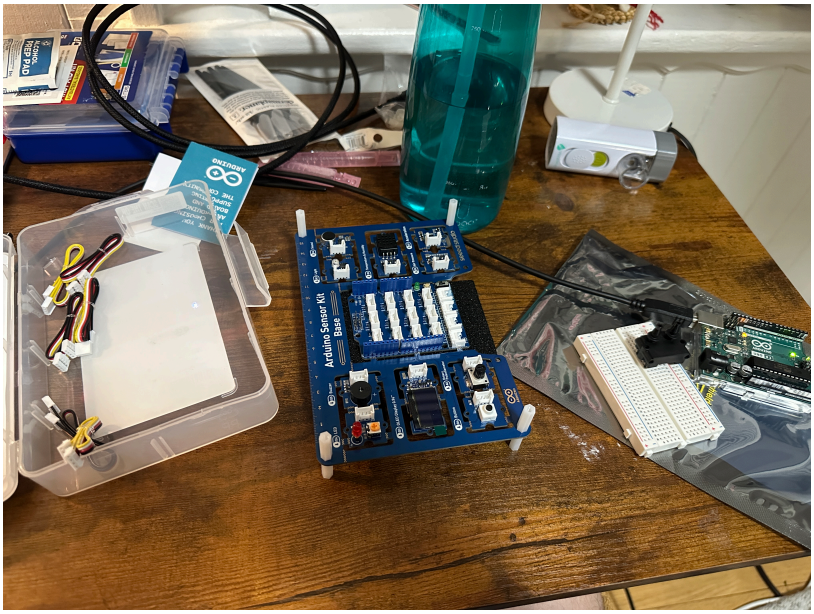


Figure D3. Just a bunch of unrelated board things I bought thinking I would just be able to plug it all in and make it work.

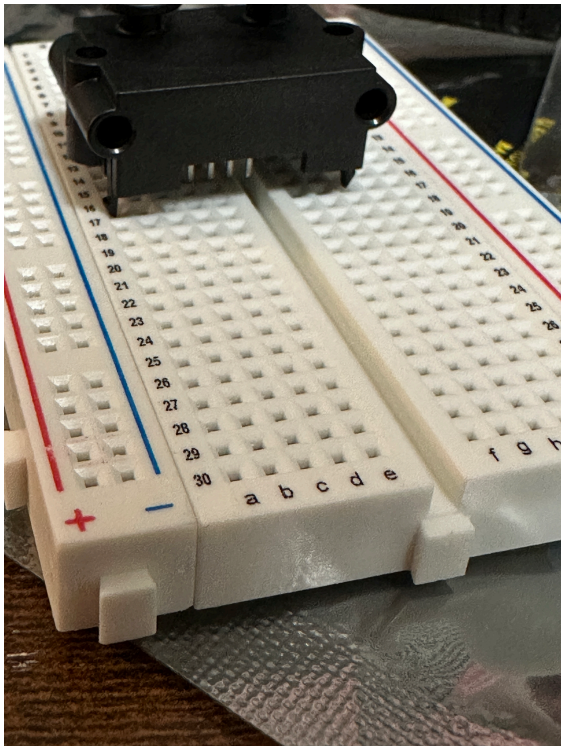


Figure D4. I thought I could just plug the Sensirion into the breadboard. It doesn't work that way.

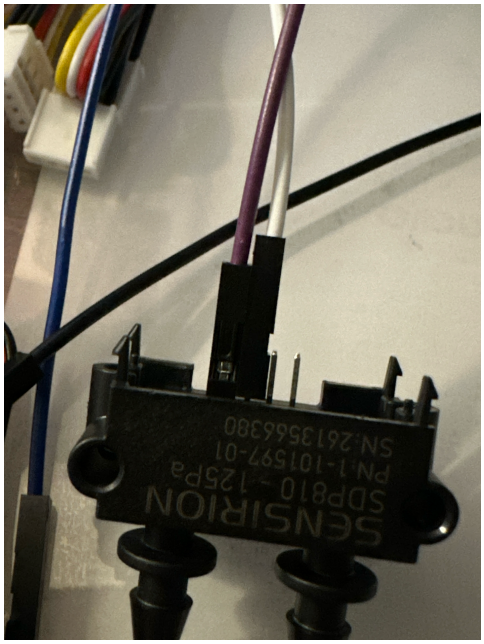


Figure D5. Attempted to plug Dupont wires into the Sensirion. They didn't fit. Nothing I tried seemed to work and no one online seemed to have a blueprint for the design.



Figure D6. I almost broke it (don't worry, it was unplugged, there was no voltage).

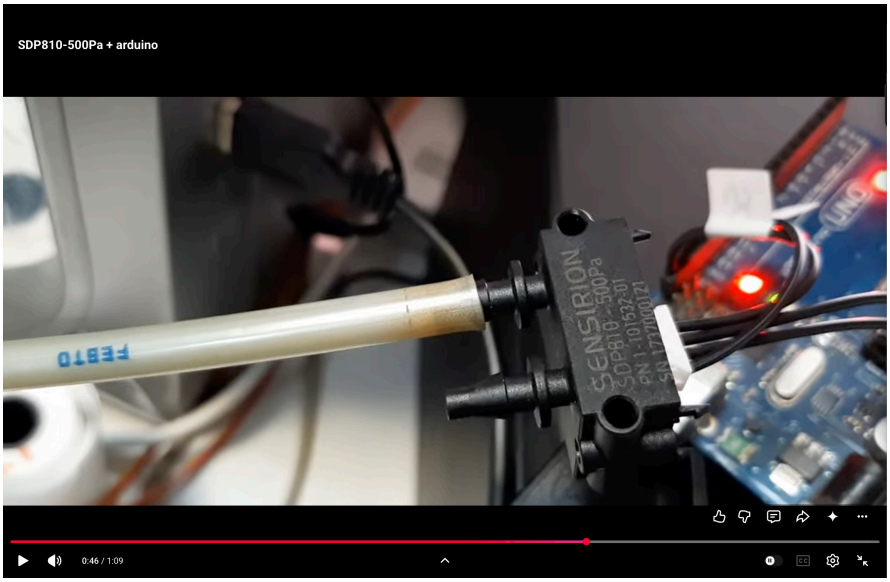


Figure D7. If I couldn't connect it, I would have to start over. I had spent a lot of time and was heavily invested in the Sensirion. I finally managed to find a YouTube video of someone who rigged it to an Arduino. I bought a similar connector. I saw that the user simply connected tubing to one of the ports for readings, and it inspired Iteration 0.



Figure D8. July 7th, 2026, Iteration 0 was constructed. It worked! Kind of..

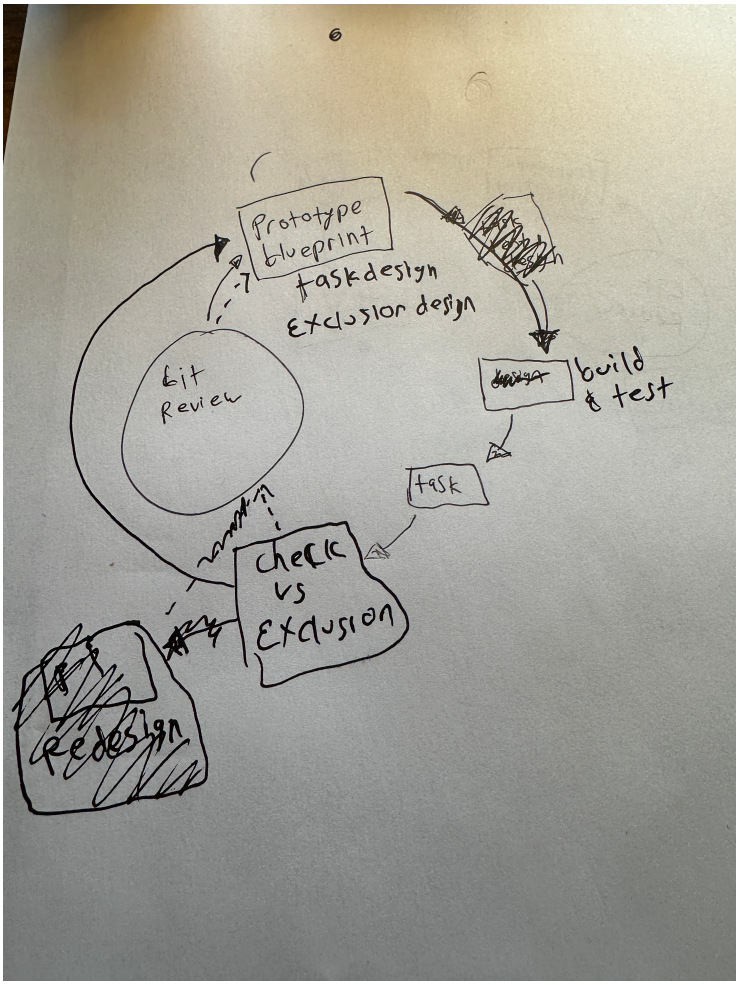


Figure D9. Early design iteration model, which is now the NTAD Loop.

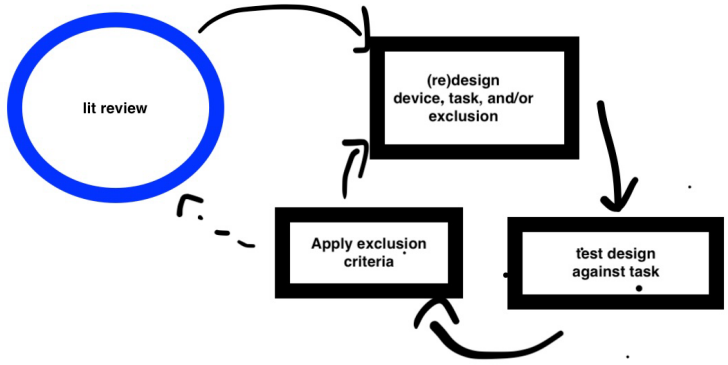


Figure D10. September 1st, 2026, my first digital version of the NTAD dev cycle (previously NTAD loop)

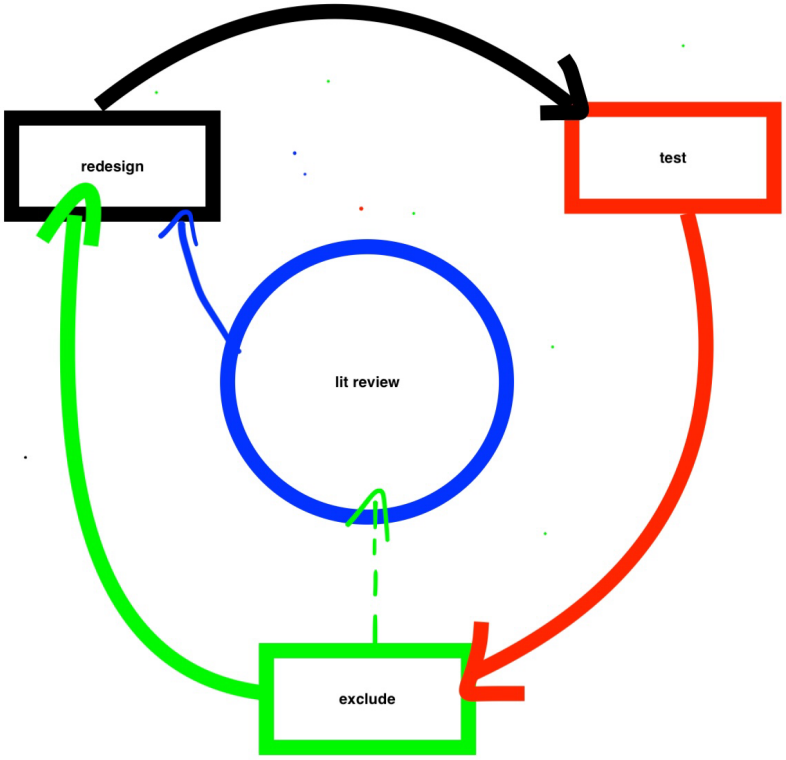


Figure D11.

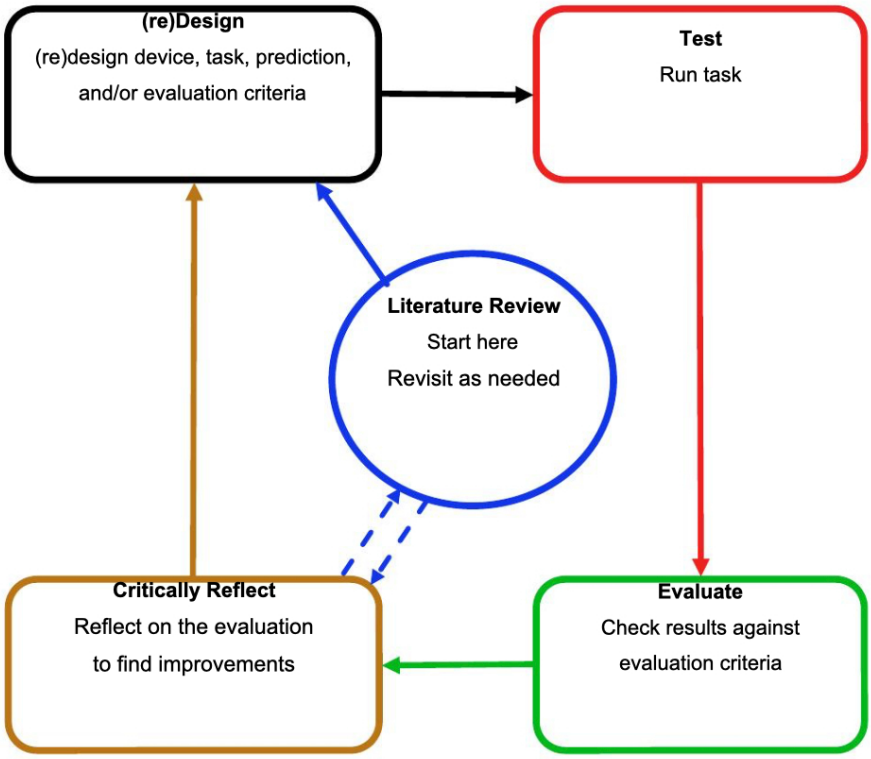

(re)Design
(re)design device, task, prediction,
and/or evaluation criteria
Test
Run task
Literature Review
Start here
Revisit as needed
Critically Reflect
Reflect on the evaluation
to find improvements
Evaluate
Check results against
evaluation criteria

Figure D12.

Appendix E. First Draft

January 20, 2026, my first draft? I initially viewed the problem as being only about understanding nasal emissions such as thermal or flow. My final submission, instead, focused on the velopharyngeal port opening, which causes the emission. I initially thought a thermal emission sensor could be effective, and it was my first blueprint (Fig D1)

Thankfully, the wonderful staff at the Voice Study Center helped me get in touch with a prominent researcher in the field who talked me out of the thermistor (for good reason- they're just not that great). Thank you!

Intro

Despite increased interest in nasal coupling and resonance in singing, research on nasalance in trained voices remains limited compared to the speech literature. One key reason appears to be the lack of accurate and accessible tools for studying nasal behavior in singers. Most existing nasalance instruments were developed for speech pathology, where the goal is typically to assess hypernasality in disordered speech. As a result, commercially available devices such as acoustic nasometry systems are optimized for clinical speech tasks rather than for the needs of singers.

This mismatch raises concerns about validity when these devices are applied to singing research. Acoustic nasometry systems quantify nasalance by comparing nasal and oral acoustic energy using dual microphones. While this approach can correlate reasonably well with perceived hypernasality in clinical populations, it may not accurately reflect underlying physiological behavior in trained singers. In singing, nasal coupling can occur without producing a perceptually "nasal" tone, and conversely, timbres described as "nasal" can arise from resonance strategies unrelated to nasal airflow. This suggests that conclusions drawn from tools designed for speech may oversimplify the complex interaction between airflow, resonance, and timbre in singing.

There are also practical barriers. Systems that may be more physiologically informative, such as dual-channel oral–nasal airflow measurement devices, are often prohibitively expensive for individual researchers, students, and voice teachers. Together, these conceptual and practical limitations suggest a need to critically review the tools used in existing nasalance research on singing and to explore whether lower-cost approaches could be developed. The aim of this project would be to investigate the feasibility of a low-cost nasalance or nasal airflow measurement device for singers and teachers. This work would be exploratory in nature and not intended to replace lab-grade instrumentation or have clinical applications.

Nasalance Measurement Devices

A recurring issue in nasalance studies involving singing is that many tools were developed for speech pathology rather than vocal performance. Clinical nasometry devices, for example, quantify perceived hypernasality in disordered speech by comparing acoustic energy from the oral and nasal cavities using dual microphones. While this has clear clinical value for populations such as individuals with velopharyngeal insufficiency or cleft palate, its relevance to singing is less clear. In trained singers, nasal coupling can occur without a perceptually nasal tone, and "nasal" timbres may result from resonance strategies unrelated to nasal airflow. This suggests that acoustic nasalance measures may not reliably reflect underlying physiological behavior in artistic voice use. Nevertheless, some singing studies rely primarily on acoustic nasometry, which may limit the conclusions that can be drawn. These issues highlight the need to reconsider measurement approaches and to explore alternative methods such as direct nasal airflow measurement, nasal thermal flow sensing, or CO_2-based detection systems.

Direct Naslaance Measuring Systems

There are X types of nasalance detection systems. Thermal, airflow, and CO2 (maybe more).

Review of thermal flow research

Peer-reviewed research has employed thermistor-based nasal airflow sensors, often referred to as nasal anemometers, to measure airflow during speech and phonation. For example, Besar and Khairy (1998) used an anemometer incorporating a specific thermistor (RA53-171) in a bridge circuit, sampled at 300 Hz, to record nasal airflow during phonetic tasks. Airflow data was analyzed alongside audio recordings. Other instrumentation-focused studies similarly describe non-invasive thermistor-based systems with documented sensor placement and circuit design. These precedents suggest that constructed thermistor-based nasal airflow measurement can yield meaningful signals under controlled conditions.

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THE SYSTEM DESCRIPTION

The system consists of a nasal mask holding the sensor thermistor, signal recovery and signal processing unit (signal conditioning unit), a personal IBM compatible computer) configured with data acquisition card type Das16F) and a special software package written in Turbo Pascal. Fig.4 shows the system setup.

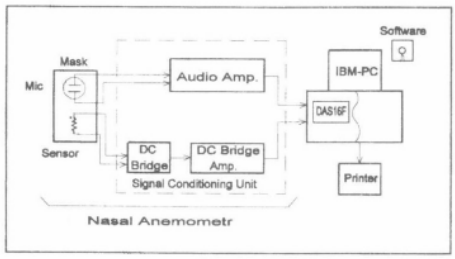


Fig.4. The system setup

The mask has been designed to ensure that the sensor thermistor will always be in the longitudinal path of the nasal airflow, and also will fit both adult and child patients. Next to the sensor a microphone (type EM6) is affixed. The system has two channels the first is the nasal airflow channel which is the dc bridge and the dc bridge amplifier. In parallel to that channel, an audio amplifier channel has been used to record the speech signal. Both the nasal airflow and the speech signals are fed to the data acquisition card DAS16F type placed in one of the free slots of the PC [8].

Besar and Khairy (1998)

Existing Thermal Devices and Costs

While several clinical devices exist for measuring airflow, SleepSense offers a relatively affordable thermal oral/nasal airflow system originally designed for detecting sleep apnea. The device uses thermistor-based sensors integrated into a nasal cannula to detect temperature changes associated with both nasal and oral airflow and is intended to provide measures of respiratory flow during sleep. Although the system is supported by clinical use in sleep research, there appears to be little to no published evidence evaluating its validity for short, task-based phonation, speech, or singing contexts. It therefore remains unclear whether the data collected by the SleepSense system are appropriate for detecting fine-grained

changes in nasal airflow during vocal tasks. This gap suggests a potential opportunity for exploratory evaluation, such as comparing the output of a SleepSense device against a custom-built thermistor-based sensor informed by existing speech research, to assess whether it could function as a low-cost tool for vocal research or the voice studio.

Sleepsense: https://sleepsense.com/product-category/sleepsense-thermocan/

Limitations of thermal devices

(planned discussion: effects of room temperature, sensitivity, calibration issues)

Thermal Device Conclusion

Thermal seems like the most promising area since I can maybe test my device against the sleepsense device. However, the sleepsense device might just not be sensitive enough wheras if I build my own device it can be.

Review of Airflow devices/research

(review here)

Review of co2 devices/research

(review here)

Choosing a sensor and building a prototype device

An Arduino-compatible sensor kit was selected as part of the prototyping process due to its low cost, accessibility, customizability, and flexibility. The kit provides a range of basic electronic components and sensors that allow for hands-on experimentation with data acquisition, signal reading, and communication between sensors and a computer. This makes it a practical starting point for learning. The platform is also supported by extensive online documentation and community resources, which makes troubleshooting and development more feasible in a student-led project. Overall, the kit supports an exploratory, modular, “plug and play” approach to building and refining a low-cost nasalance measurement device.

Arduino Sensor Kit: https://store.arduino.cc/products/sensor-kit-bundle

(planned section)

(planned section)

Choosing a sensor and building a prototype device

(planned section)

Writing the code (what is possible? Limitations?)

Experiment

Test my built device with recorded audio samples. Maybe have expert listeners evaluate the samples to determine if the device is accurate? Compare the device to an existing device like the sleepsense?

Appendix F. Formal Session

Photos from the formal session.



Figure F1. September 28, 2026, 8:52 pm, take 6: "I think it's my fault, I don't think I'm doing it correctly."

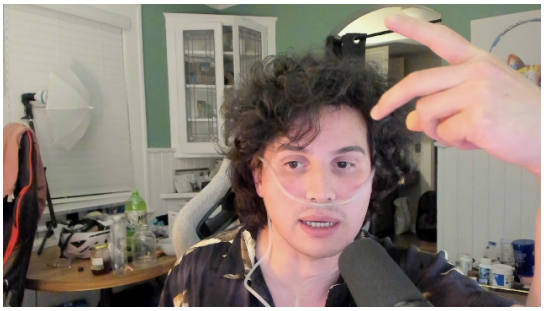


Figure F2. September 28, 2026, 10:24 pm, take 16, Singer's Formant Task: Attempting to control my nose with my hand



Figure F3. September 28, 2026, 10:36 pm, take 18: "Oh, that was good. The first one had no flow, second one had some flow."



Figure F4. September 28, 2026, 10:37 pm, take 18: "That last one is a good pinch test."

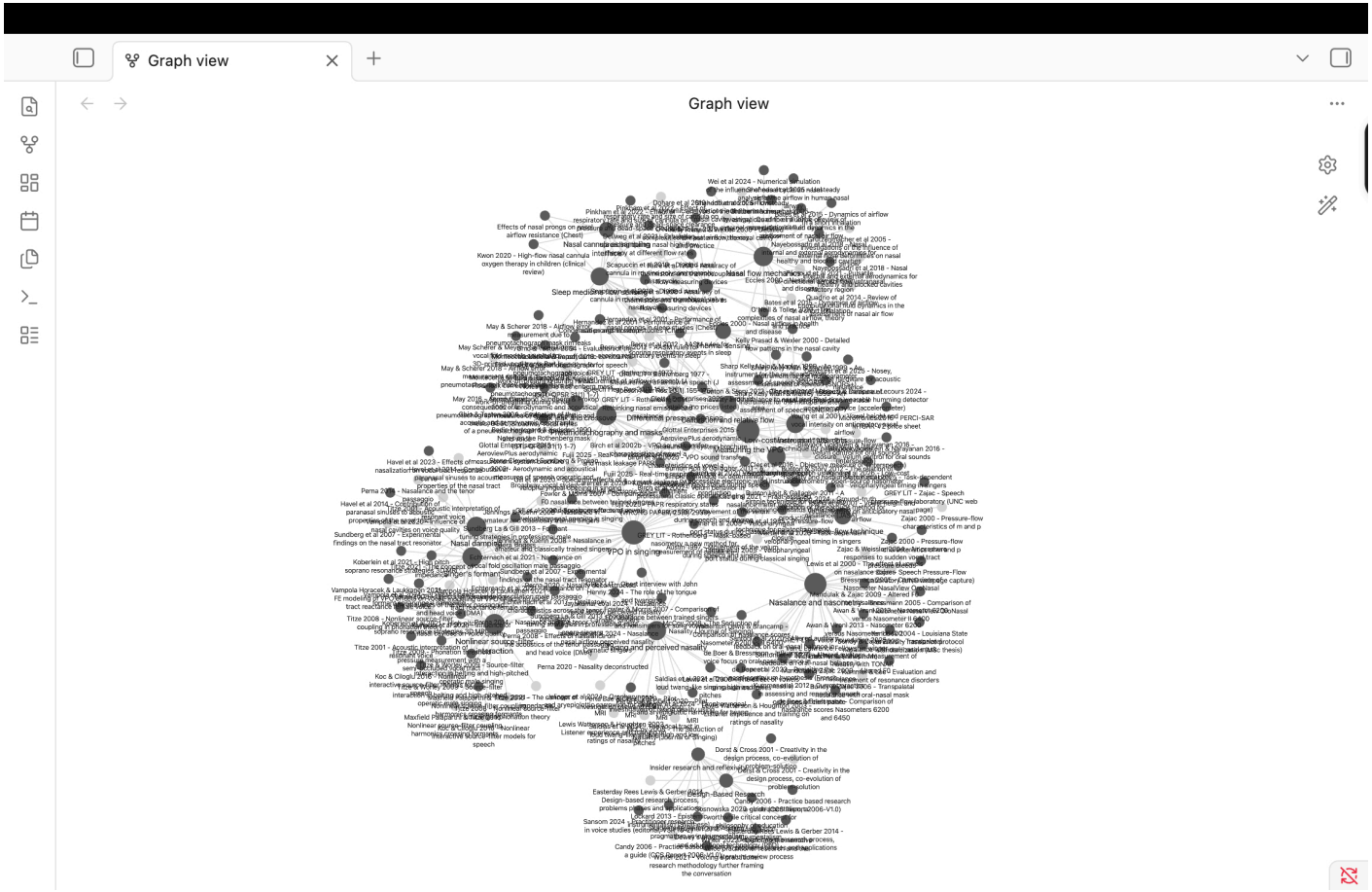


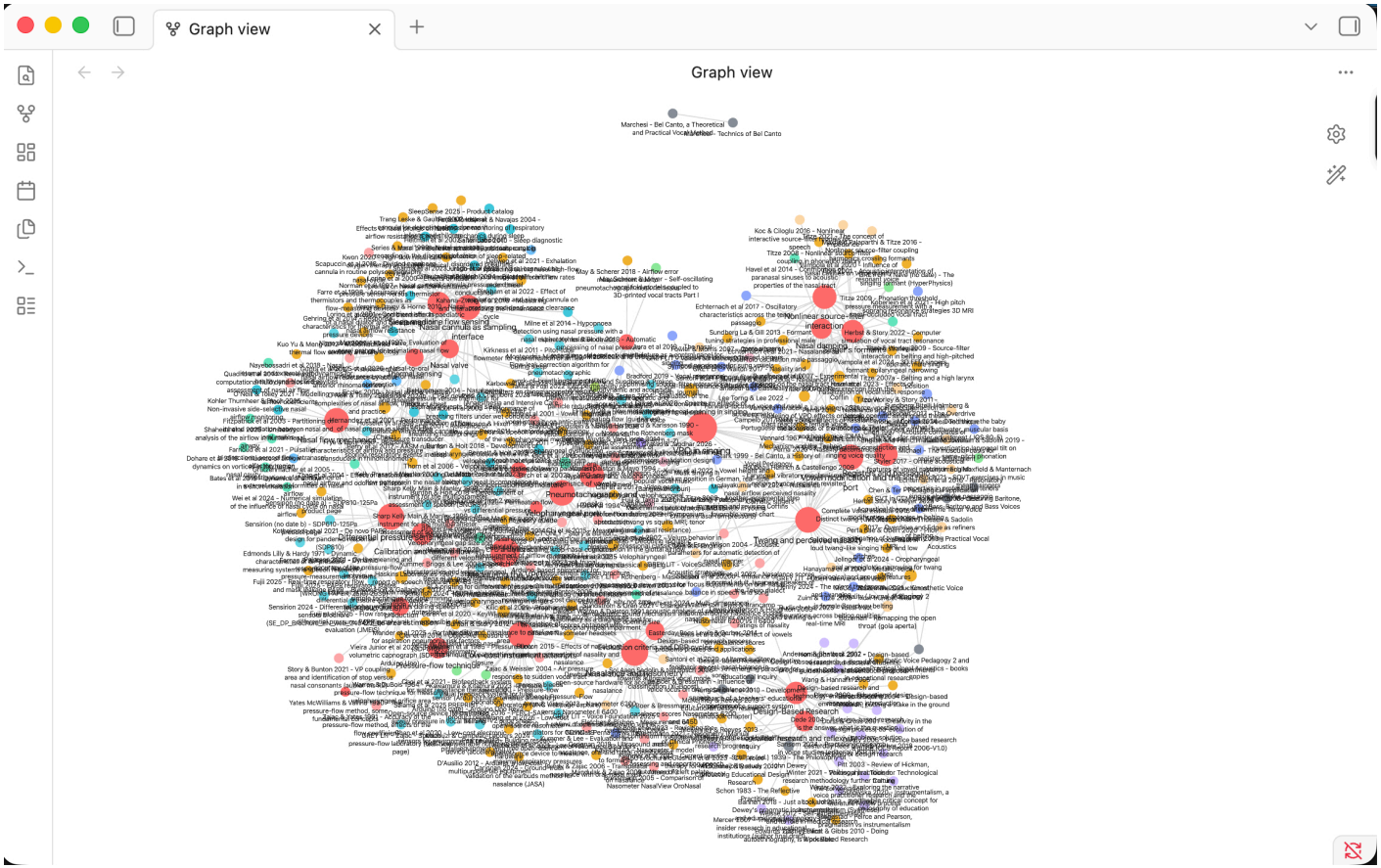
Figure F5. September 28, 2026, 10:45 pm, take 19: Action shot



Figure F7. September 28, 2026, 11:11 pm, take 21: Must... not... sing with nasal flow!

Appendix G. Obsidian Research Maps




Graph view
Graph view