FINAL SCRIPT: APPROVED FOR FILMING

**Submission ID #: 67742**
**Scriptwriter Name: Debopriya Sadhukhan**
**Project Page Link: https://review.jove.com/account/file-uploader?src=20661358**

# Title: Asthma Detection Research Based on Voice Signal Processing and Machine Learning

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# Author Questionnaire

1. **Microscopy**: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

2. **Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes**

3. **Filming location:** Will the filming need to take place in multiple locations? **No**

**Current Protocol Length**
Number of Steps: 06
Number of Shots: 16

# Introduction

***Videographer: Obtain headshots for all authors available at the filming location.***

**REQUIRED:**

1.1. **Tengteng Li:** My research focuses on acoustic diagnostics. I'll discuss the most recent developments and current experimental challenges in this field next.

1.1.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: LAB MEDIA: Figure 4.*

What are the most recent developments in your field of research?

1.2. **Tengteng Li:** Current technologies use AI-driven voice analysis, machine learning techniques like CNNs and SVMs, signal processing tools such as MFCCs, and wearable acoustic sensors to detect disease-related patterns in sound signals.

1.2.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.6.2.*

What are the current experimental challenges?

1.3. **Tengteng Li:** Current challenges in clinical translation of voice-based diagnostics include scarce data, limited model generalization, privacy-ethics conflicts, and interpretability barriers.

1.3.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

***Videographer: Obtain headshots for all authors available at the filming location.***

**Testimonial Questions:**

***Videographer: Please ensure that all testimonial shots are captured in a wide-angle format, while also maintaining sufficient headspace, given that the final videos will be rendered in a 1:1 aspect ratio.***

How do you think publishing with JoVE will enhance the visibility and impact of your research?

1.4. **Tengteng Li, Ph.D. in Basic Integrated Chinese and Western Medicine, Beijing University of Chinese Medicine**: I believe publishing with JoVE will boost my research's visibility by demonstrating methods visually, enhancing clarity and reproducibility, which encourages broader understanding and citations across the scientific community.

1.4.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

Can you share a specific success story or benefit you've experienced—or expect to experience—after using or publishing with JoVE?

1.5. **Tengteng Li, Ph.D. in Basic Integrated Chinese and Western Medicine, Beijing University of Chinese Medicine**: By studying video protocols on JoVE's platform, our research group significantly shortened new member training time and strengthened cross-team collaboration efficiency.

1.5.1. INTERVIEW: Named Talent says the statement above in an interview-style shot, looking slightly off-camera.

**Ethics Title Card**

This research has been approved by the Ethics Committee of Beijing University of Chinese Medicine and its Third Affiliated Hospital

All participants signed written informed consent before participation

# Protocol

## 2. Construction of SVM and RF Models

**Demonstrator: Tengteng Li**

2.1. To begin, open the command line tool **[1]** and clone the GitHub *(Git-Hub)* repository to the local machine **[1]**.

2.1.1. WIDE: Talent seated at a workstation, opening the command line interface.

2.1.2. SCREEN: 2.1.2.mp4 00:12-end.

2.2. Go to the official Python website to install Python on the machine **[1]**. After installing Python, install the required Python libraries using **requirements.txt** *(Requirements-dot-text)* file **[2]**. Alternatively, if the text file is not available, install the necessary libraries manually using the given command **[3-TXT]**. Then, install PyCharm *(Py-Charm)* from its official website **[4]**.

2.2.1. SCREEN: 2.2.1.mp4 00:16-00:39, 00:56-01:17, 02:06-02:19. *Video Editor: Remove the website loading parts.*

2.2.2. SCREEN: 2.2.2.mp4 00:07-00:14, 00:38-00:42.

2.2.3. SCREEN: 2.2.3.mp4 00:04-end. **TXT: *pip install numpy pandas scikit-learn matplotlib***

2.2.4. SCREEN: 2.2.4.mp4 00:12-00:17, 01:05-01:33, 03:05-end. *Video Editor: If the timestamps are too long for the VO, 01:05-01:33 and 03:05-end part can be removed.*

2.3. Now, locate the main script files in the cloned repository **[1]**. Use PyCharm or a text editor to open the Python files and review their contents and structure **[2]**.

2.3.1. SCREEN: 2.3.1.mp4 00:09-end. *Video Editor: Emphasize RF and SVM files in the directory.*

2.3.2. SCREEN: 2.3.2.mp4 00:00-00:12, 00:28-00:38.

2.4. To configure the dataset, verify that the data files required by the code are available and saved in the Excel format **[1]**. Update the file paths in the scripts to match the actual file locations on the system **[2]**.

2.4.1. SCREEN: 2.4.1.mp4 00:00-00:14.

2.4.2. SCREEN: 2.4.2.mp4 00:00-00:07.

2.5. After identifying the main script, run the code using the appropriate command for that script **[1-TXT]**.

2.5.1. SCREEN: 2.5.1&2.6.mp4 00:00-00:11. **TXT: Navigate to the correct working directory or specify the full path to run the script**

2.6. During execution, the code will load the data, train the machine learning models **[1]**, and display results such as accuracy **[2]**, confusion matrix **[3]**, and the receiver operating characteristic or ROC *(R-O-C)* curve **[4]**. NOTE: The sentence numbers of the VO have been adjusted.

2.6.1. SCREEN: 2.5.1&2.6.mp4 00:15-00:26. NOTE: The timestamps for 2.6.1 and 2.6.2 are merged.

~~2.6.2. SCREEN: To be provided by authors: Terminal output displaying the progress or confirmation of model training.~~

2.6.3. SCREEN: 2.5.1&2.6.mp4 00:27-00:30.

2.6.4. SCREEN: 2.5.1&2.6.mp4 00:34-00:36.

2.6.5. SCREEN: 2.5.1&2.6.mp4 00:31-00:33, 00:37-00:42.

# Results

## 3. Results

3.1. This figure presents the confusion matrices for the Support Vector Machine or SVM model and the Random Forest or RF model, showing their classification results for asthma and healthy control subjects **[1]**.

3.1.1. LAB MEDIA: Figure 4.

3.2. The SVM *(S-V-M)* model accurately classified 14 asthma subjects **[1]** and 12 healthy controls **[2]** out of 30 samples in the confusion matrix **[3]**.

3.2.1. LAB MEDIA: Figure 4. *Video Editor: Only show the left image (SVM). Highlight the cell with 14.*

3.2.2. LAB MEDIA: Figure 4. *Video Editor: Only show the left image. Highlight the cell with 12.*

3.2.3. LAB MEDIA: Figure 4. *Video Editor: Only show the left image.*

3.3. The RF *(R-F)* model also correctly predicted 14 asthma cases **[1]** and 12 healthy controls **[2]**, showing comparable classification results **[3]**.

3.3.1. LAB MEDIA: Figure 4. *Video Editor: Only show the right image (RF). Highlight the cell with 14.*

3.3.2. LAB MEDIA: Figure 4. *Video Editor: Only show the right image (RF). Highlight the cell with 12.*

3.3.3. LAB MEDIA: Figure 4. *Video Editor: Only show the right image (RF).*

3.4. The SVM model achieved a higher area under the curve value of 0.95 in the ROC analysis, reflecting superior classification performance **[1]**.

3.4.1. LAB MEDIA: Figure 5. *Video Editor: Highlight the stairs-like orange curve in the left graph (SVM).*

3.5. Both SVM and RF models achieved an identical overall classification accuracy of 87% on the test dataset **[1]**.

3.5.1. LAB MEDIA: Table 5. *Video Editor: Highlight the entire Accuracy column.*

3.6. In class-wise performance, the SVM model showed higher recall in the asthma group at 0.93 **[1]**, but lower recall in the healthy control group at 0.80 **[2]**, suggesting that while SVM is effective at identifying asthma, it may misclassify some healthy individuals **[3]**.

3.6.1. LAB MEDIA: Table 5. *Video editor: Highlight the Recall value "0.93" in the "Asthma group" row for the SVM model (the 0.93 in the top row).*

3.6.2. LAB MEDIA: Table 5. *Video editor: Highlight the Recall value "0.80" in the "Healthy control group" row for the SVM model (the 0.80 in the 2nd row from the top).*

3.6.3. LAB MEDIA: Table 5.

3.7. The RF model achieved the same recall values of 0.93 for asthma **[1]** and 0.80 for healthy controls **[2]**, indicating that both models have similar sensitivity and are equally capable of identifying positive cases **[3]**.

3.7.1. LAB MEDIA: Table 5. *Video editor: Highlight the Recall value "0.93" in the "Asthma group" row for the RF model (the 0.93 in the 3rd row from the bottom).*

3.7.2. LAB MEDIA: Table 5. *Video editor: Highlight the Recall value "0.80" in the "Healthy control group" row for the RF model (the 0.80 in the 2nd row from the bottom).*

## Pronunciation Guides:

**1. GitHub**

**Pronunciation link:**
https://www.merriam-webster.com/dictionary/GitHub
**IPA:** /ˈgɪtˌhʌb/
**Phonetic Spelling:** git-hub

**2. Python**

**Pronunciation link:**
https://www.merriam-webster.com/dictionary/Python
**IPA:** /ˈpaɪˌθɑn/
**Phonetic Spelling:** pie-thaan

**3. PyCharm**

**Pronunciation link:**
https://www.howtopronounce.com/pycharm
**IPA:** /ˈpaɪˌtʃɑrm/
**Phonetic Spelling:** pie-charm

**4. pip**

**Pronunciation link:**
https://www.howtopronounce.com/pip
**IPA:** /pɪp/
**Phonetic Spelling:** pip

**5. numpy**

**Pronunciation link:**

https://www.howtopronounce.com/numpy
**IPA:** /ˈnʌmˌpaɪ/
**Phonetic Spelling:** num-pie

**6. pandas**

**Pronunciation link:**
https://www.howtopronounce.com/pandas-python
**IPA:** /ˈpændəz/
**Phonetic Spelling:** pan-duhz

**7. scikit-learn**

**Pronunciation link:**
https://www.howtopronounce.com/scikit-learn
**IPA:** /ˈsaɪ.kɪt lɜrn/
**Phonetic Spelling:** sigh-kit lern

**8. matplotlib**

**Pronunciation link:**
https://www.howtopronounce.com/matplotlib
**IPA:** /ˈmæt.plɒt.lɪb/
**Phonetic Spelling:** mat-plot-lib

**9. SVM (Support Vector Machine)**

**Pronunciation link:**
https://www.howtopronounce.com/svm
**IPA:** /ˌɛs.viːˈɛm/
**Phonetic Spelling:** ess-vee-em

**10. RF (Random Forest)**

**Pronunciation link:**
https://www.howtopronounce.com/rf
**IPA:** /ˌɑrˈɛf/
**Phonetic Spelling:** ar-eff

**11. ROC (Receiver Operating Characteristic)**

**Pronunciation link:**
https://www.howtopronounce.com/roc
**IPA:** /ɑr.oʊ.si/
**Phonetic Spelling:** ar-oh-see