SeeBoard: A Virtual Keyboard for the Motor-Impaired

CS4991 Capstone Report, 2025

Ethan Ermovick
Computer Science
The University of Virginia
School of Engineering and Applied Science
Charlottesville, Virginia USA
keg9ve@virginia.edu

ABSTRACT

People with motor impairments that cause tremors may have difficulty operating standard computer inputs (e.g., mice and keyboards). I propose a different method for these individuals to interact with a computer. SeeBoard is an application that allows users to control a computer with hand gestures. SeeBoard uses a webcam to detect the user's hand movements and translate them into virtual key presses and mouse movements. SeeBoard can not only be used to interact with a computer effectively but may also help with extraneous motion caused by tremors. Future work includes further improvements to the motion damping algorithm to further reduce tremors, as well as elimination of small glitches during application use.

1. INTRODUCTION

There are almost one million people with Parkinson's in the United States today (Parkinson's Foundation, 2024). One of the early symptoms of Parkinson's is tremors (Parkinson's Foundation, 2023). These tremors affect around 80% of people with Parkinsons, causing their hands to shake. Because these tremors are involuntary, the affected cannot control their movements (Nelson, 2022). Naturally, tremors make it difficult for people with Parkinson's to use mice and keyboards, causing duplicate keystrokes or making it harder to control their mouse (Bandl, 2020).

There are some existing solutions to allow people with Parkinson's disease to have a better time interacting with computers, which I will further discuss in the related works section. However, all of these solutions fall short of mine for one reason or another.

2. RELATED WORKS

There are some existing products for people with tremors to more easily use computers. One example is voice recognition software, so people with tremors can verbally control their computers rather than physically (Krull, 2014). However, this can only be used when noise is not a concern. For example, if someone with Parkinson's disease wants to use their computer without disturbing those around them, such as in a library, this is not possible using the voice recognition software.

Another product is the rollermouse, a special type of mouse that is easier for people with Parkinson's to use (Gondola Medical, 2019). This solution does not suffer from the same noise-related problem as voice recognition software; however it requires the purchase of physical hardware and takes longer to get than software.

There are also some existing motion tracking-based keyboards. One example from a Github user is "virtual_keyboard," which presses keys based on the user's hand movements (Mhamdi, 2023). However, this solution does not provide any special support for those with Parkinson's and does not make any efforts to handle the extra tremor motions in a person with Parkinson's hands.

3. PROJECT DESIGN

In this section I discuss how SeeBoard works, breaking up the design into five sections: an overview, and design of the hand-tracking system, keyboard, mouse and the tremor-handling system.

3.1 Overview

I propose the use of SeeBoard, a computer vision based keyboard that addresses all of the problems stated above. SeeBoard is quiet, so it can be used in public spaces, unlike voice recognition. SeeBoard is free and open source software, so it is easy and fast to get started, and has no price, unlike a physical solution. Finally, unlike the "virtual_keyboard" SeeBoard includes methods for reducing errors due to Parkinson's tremors.

3.2 Hand Tracking

The first part of SeeBoard is the hand-tracking system. The user can move their hand around, and the program responds based on hand motions. This was accomplished using Google's MediaPipe library, which provides an interface for recognizing human hands from images (Edge, 2025). The project also used OpenCV to read in frames from the webcam of the computer, to feed into the hand-tracking system (OpenCV, 2019). The frames from OpenCV were fed into MediaPipe, giving the program real-time updates on both the hand position and orientation of the user.

3.3 Keyboard Functionality

The next part of SeeBoard is the virtual keyboard, as shown in Fig. 1.

Fig. 1. Onscreen Keyboard

During keyboard use, the user can move their hand around to select a key. When the program detects the user bringing together their thumb and middle finger (using the hand orientation from section 3.2), a key press is activated. The graphics for the keyboard were done using the User Interface library PyQT (Limited, n.d.). The key presses were done using the python library "keyboard" (BoppreH, 2020).

3.4 Mouse Functionality

SeeBoard also includes a mode for mouse use. When the hand tracking system detects the user tilting their hand to the left, the program switches modes from keyboard to mouse, or vice versa. During mouse mode, the user can move their hand around to control a joystick that moves a mouse around. Like the keyboard, the graphics were made using PyQT (Limited, n.d.). The mouse movements were created using the "mouse" Python library (BoppreH & pavlov99, 2020). The project used a joystick style control, rather than direct mouse control, so that unintentional tremor motion would affect the usability less, slightly changing the acceleration of the mouse rather than the position. Additionally, to reduce tremor impact even further, mouse movement is very slow using the program, so that unintentional movements have less of an effect.

3.5 Handling Tremor Motion

One way tremor motion was reduced in keyboard mode was by using a linear low pass filter. This filter compares the current hand position to the previous hand position and scales it to be closer to the previous position. This not only helps with large tremor motions, but also with the program's occasional glitches in hand position. The other way tremor motion was reduced was by placing a threshold on the minimum amount of hand motion detected. If the program detects hand motion below a specified threshold, it will ignore it, treating it as noise.

4. RESULTS

SeeBoard has not yet been extensively tested. SeeBoard has been verified for use to control the mouse and keyboard. During tests, as shown in the SeeBoard Demo video on Youtube (Kantorski, 2024), we were able to move the mouse around, click buttons on screen, change to keyboard mode and type using the keyboard. During the testing in the demo video, I also shook my hand to demonstrate what tremors might look like during usage. The program responded fairly well, and I was still able to type with my hand shaking, even though the difficulty of typing increased slightly (Kantorski, 2024).

There were some limitations of the testing of SeeBoard. Due to the time constraints of the project, SeeBoard was not tested for long periods, so there could be edge cases that were not accounted for. During the testing that was done, there were some errors such as false positives or negatives in inputs, although I do not have quantitative data for this. Qualitatively, however, the program was still usable to type and move the mouse, even when my hand was shaking. The second main limitation in the testing was that the project was not tested on people with Parkinson's disease. The closest was the user shaking their hand during usage, which could vary from actual Parkinson's tremors.

5. CONCLUSION

SeeBoard is a new way for people affected by Parkinson's disease to regain some control over their lives, by re-enabling them to use computers. From this project, I have personally learned a lot more about using computer vision, as well as about the entire process of creating a user-oriented application.

6. FUTURE WORK

To be viable as an application, SeeBoard requires more testing. Future work includes testing SeeBoard for longer periods of time, as well as testing on people with Parkinson's disease. These tests should be designed to evaluate and improve the accuracy of SeeBoard. Future work also includes creating a portable installer for SeeBoard, so that it can be easily set up and run on any computer by anyone. Finally, future work includes further styling of the SeeBoard user interfaces to make them more visually appealing.

7. ACKNOWLEDGMENTS

I would like to thank Ethan Coon, Brandon Kantorski, and Aidan Liu for helping to create SeeBoard.

REFERENCES

Gondola Medical. (2019, January 27). *12 Home tools for people with Parkinson's | Gondola*. https://www.gondola-medical.com/news/12-useful-home-tools-for-parkinsons/

Bandl, D. (2020, June 22). *Computer adaptations for people with Parkinson's Disease*. Adaptive Tech Solutions, LLC. https://www.adaptivetechsolutions.com/adaptive-tech-solutions-ideas-information/computer-adaptations-for-people-with-parkinsons-disease/

BoppreH. (2020). keyboard: Hook and simulate keyboard events on Windows and Linux. PyPI. https://pypi.org/project/keyboard/

BoppreH, & pavlov99. (2020). mouse. PyPI. https://pypi.org/project/mouse/

Edge. (2025, January 13). Hand landmarks detection guide. Google for Developers. https://ai.google.dev/edge/mediapipe/solutions/vision/hand_landmarker

Kantorski, B. (2024, September 15). SeeBoard demo. Youtu.be. https://youtu.be/MvYRMQmkn1k

Krull, J. (2014, June 12). *Computer access and Parkinson's: 3 great products and a freebie!—North Dakota Assistive*. North Dakota Assistive. https://ndassistive.org/blog/computer-access-and-parkinsons-3-great-products-and-a-freebie/

Limited, R. C. (n.d.). PyQt5: Python bindings for the Qt cross platform application toolkit. PyPI. https://pypi.org/project/PyQt5/

Mhamdi, M. (2023). *GitHub - The virtual hand gesture keyboard.* GitHub. https://github.com/MohamedAlaouiMhamdi/virtual_keyboard

Nelson, A. (2022). *Parkinson's tremors: What you need to know*. WebMD. https://www.webmd.com/parkinsons-disease/parkinsons-tremors

OpenCV. (2019). OpenCV library. Opencv.org. https://opencv.org/

Parkinson's Foundation. (2023). *Tremor | Parkinson's Foundation*. www.parkinson.org. https://www.parkinson.org/understanding-parkinsons/movement-symptoms/tremor

Parkinson's Foundation. (2024). *Statistics*. Parkinson's Foundation. https://www.parkinson.org/Understanding-Parkinsons/Statistics