

# IMPROVING TYPING EXPERIENCES THROUGH THE USE OF A KEYBOARD INTERFACE WITH INTEGRATED GESTURE RECOGNITION (KIWIGR)

Samantha Norrie, Department of Computer Science  
March 7, 2023

This research was supported by the Jamie Cassels Undergraduate Research Award, University of Victoria

Supervised by Dr. Miguel Nacenta

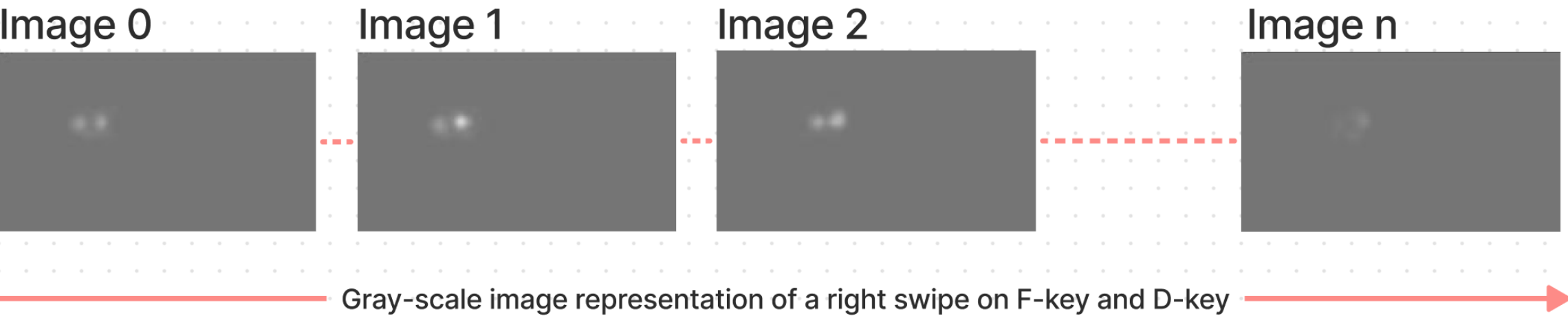
## INTRODUCTION

The current keyboard typing experience is inefficient due to the need to rely on external technologies such as mice or trackpads. The Keyboard Interface With Integrated Gesture Recognition (KIWIGR) aims to remedy this by allowing users to navigate around and modify their documents directly from their keyboard.

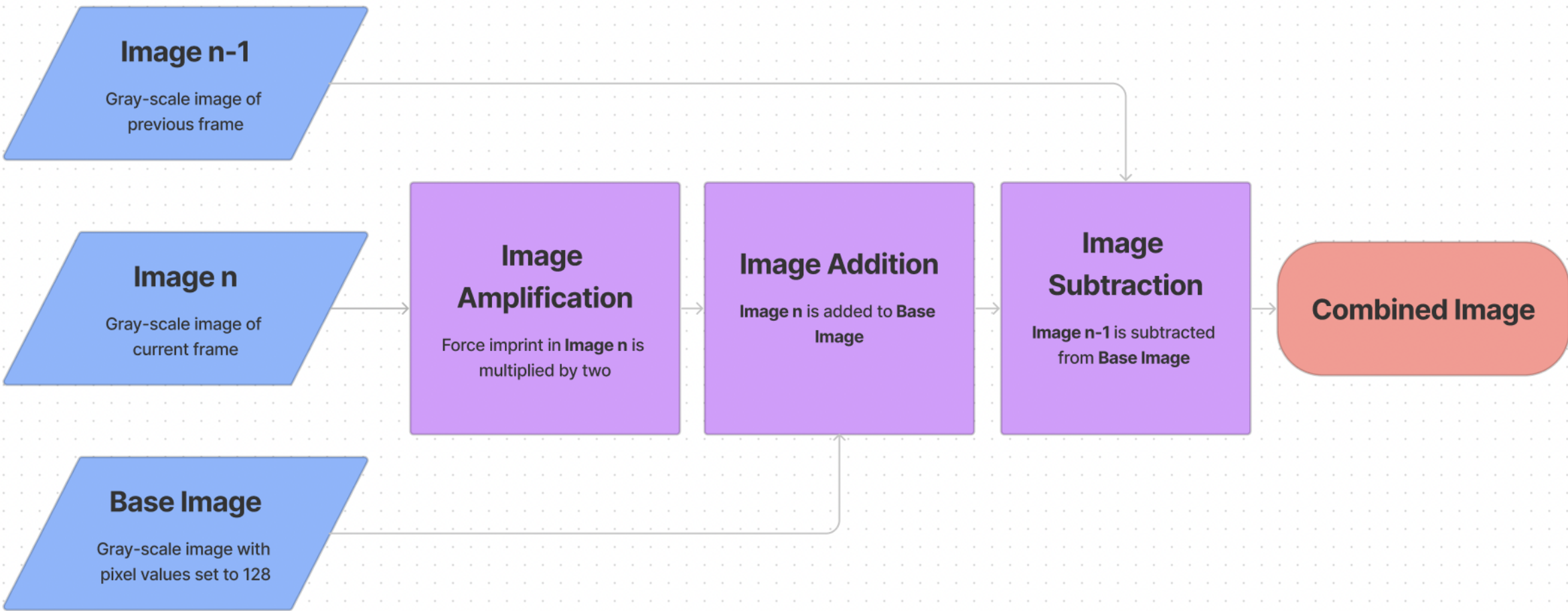
## MATERIALS AND METHODS

The KIWIGR was built using a Sensel Morph sensor tablet, a Sensel Morph Keyboard overlay, as well as multiple application programming interfaces (APIs) and software libraries. The following steps occur whenever a gesture event (i.e. force on the sensor tablet) is detected:

1. The raw force values of the gesture event detected by the sensor tablet are converted into gray-scale images. Each image represents a frame of the gesture event.

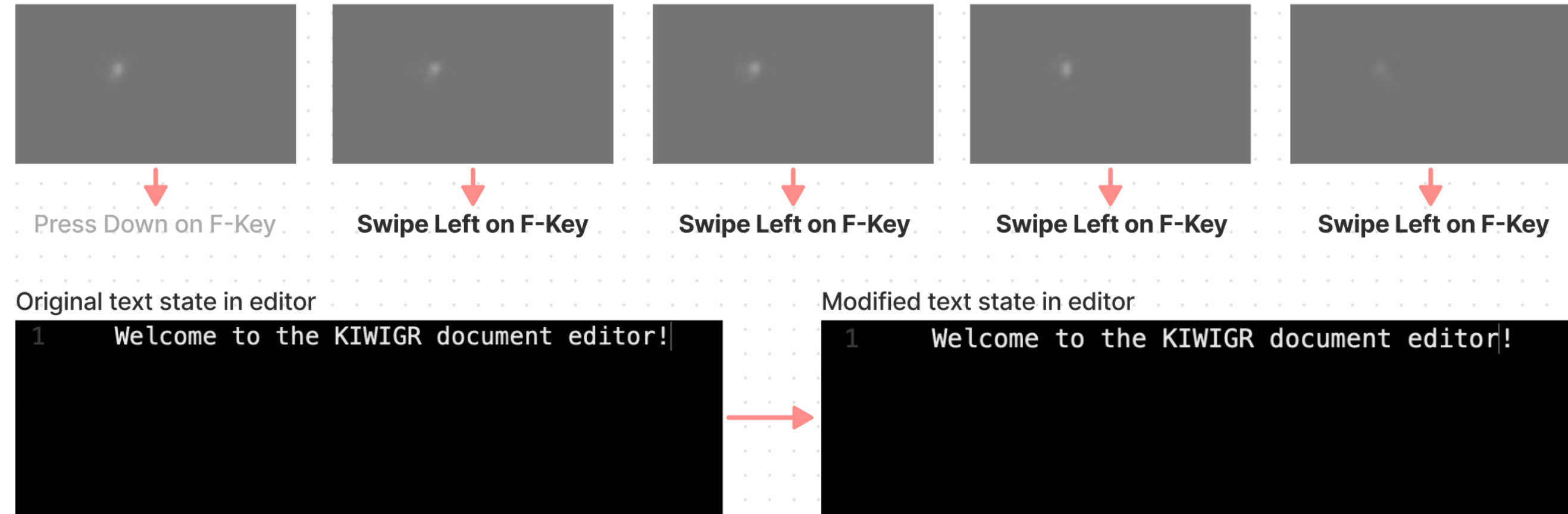


2. The gray-scale images are used to create new combined images. The diagram below demonstrates the algorithm used to combine images.



3. The combined images are passed to a convolutional neural network (CNN) machine learning model.

4. The predicted gesture for each gray-scale image are recorded. Once all images have been passed through the model, the most predicted gesture is projected in a CodeMirror program.

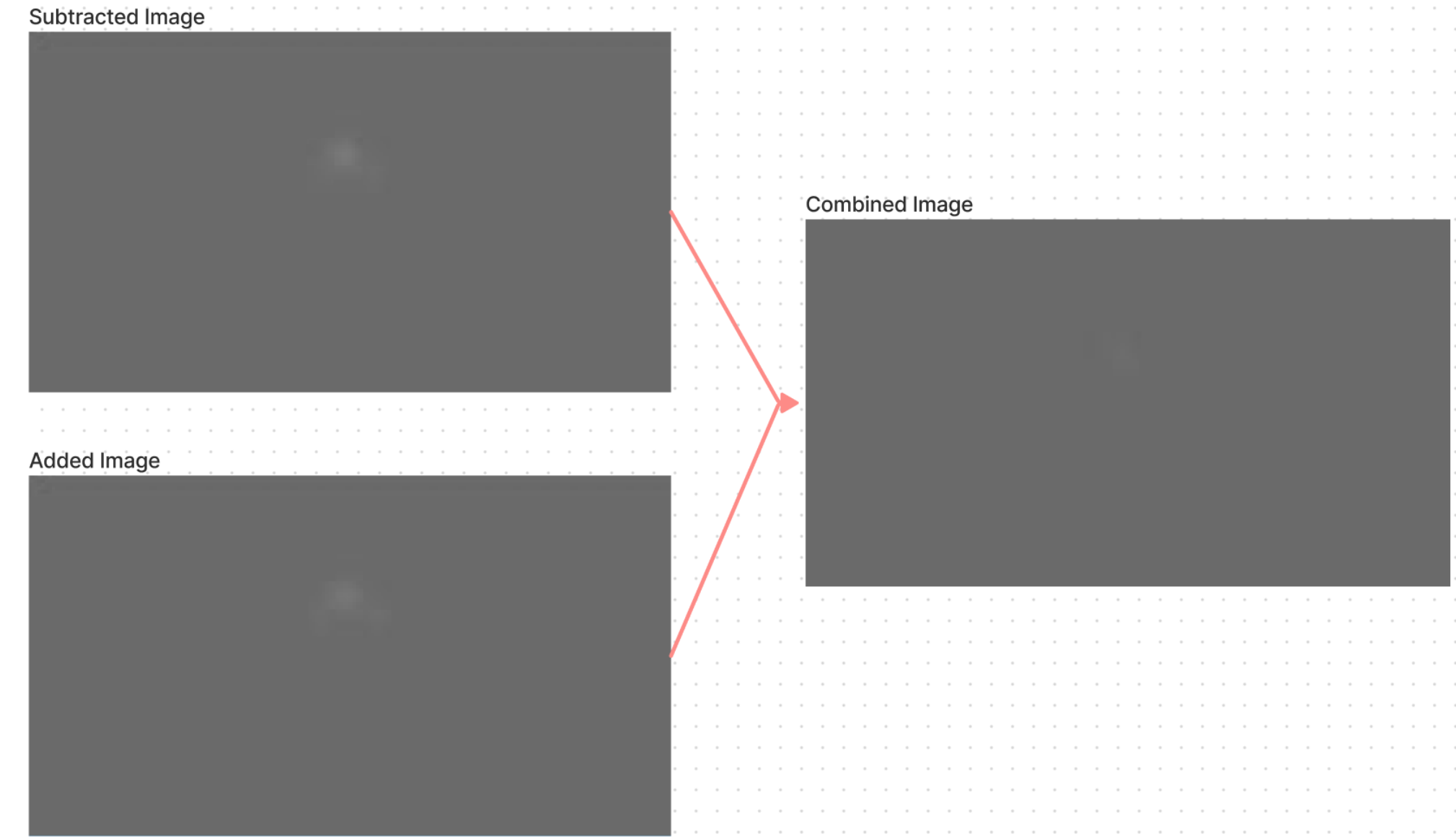


## RESULTS



- The keys highlighted in purple can be used to move the cursor around the text in a document. Users can swipe left, right, up, and down on the A-key, S-key, D-key, and the F-key. By swiping on multiple keys, users can amplify the distance they move the cursor by.
- The keys highlighted in blue can be used to move the cursor around the text in a document. Users can swipe left, right, up, and down on the A-key, S-key, D-key, and the F-key. By swiping on multiple keys, users can amplify the amount of text that is highlighted. Users must also hold the J-key, K-key, and L-key to enable the text highlighting gestures.
- While individual images of multi-touch gestures implemented into the KIWIGR have high prediction accuracies (i.e. prediction accuracies greater than 95%), single-touch gestures have lower prediction accuracies (i.e. prediction accuracies less than 80%). This is due to the latter resembling typical key-presses.
- Predicting the gesture performed only after all images of the gesture event have been evaluated aided in increasing the accuracy of the prototype.

- Not using image amplification in the image combination algorithm led to a dramatic decrease in classification accuracy. This was due to most sequential pairs of frame images being quite similar, which led to the difference displayed in the combined image being quite minimal.



## DISCUSSION

- Combining frame images before passing them to the CNN machine learning model helps introduce a spatio-temporal component to the model without needing to add spatio-temporal layers (such as Recurrent Neural Networks or Hidden Markov Models) to it.
- Future research related to the KIWIGR should explore adding additional key gestures to the prototype in addition to conducting user studies and improving the current machine learning model.

## ACKNOWLEDGEMENTS

- I would like to thank Dr. Miguel Nacenta for supervising this research project and for teaching me about conducting research. No matter what I end up doing in the future, I know that the this experience will help me be a better computer scientist and software developer.
- I would also like to thank Dr. George Tzanetakis for his advice on how to incorporate machine learning into this research project.
- Additionally, I would like to thank the entire VIXI lab for welcoming me into their lab space.
- Lastly, I would like to thank the Learning and Teaching Support Innovation office for providing me with the JCURA and for hosting many educational research workshops.