TOUCH TYPE DISCRIMININATION USING ARTIFICIAL WHISKERS

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BACKGROUND

Artificial whiskers collect information from the surroundings as pressure and temperature. These pressure differences can be classified according to touch types, textures, object location, etc.

PURPOSE

- Develop the abilities of biomimetic whiskers useful for navigation and object recognition.
- Provide more interaction from the surrounding (real world) to the whiskers.

METHODOLOGY

Raw data collection from whiskers, manual (Figure 1) and automated (Figure 2) experiments. Z-scores and standard deviation are the main mechanisms to process the raw data before applying the neural network, with 12 inputs, 5 outputs, one hidden layer. Automated data was collected in 34 sets (divided in half, 17 for training and 17 for testing)
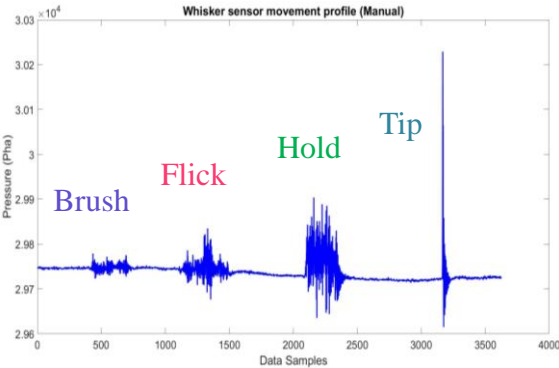

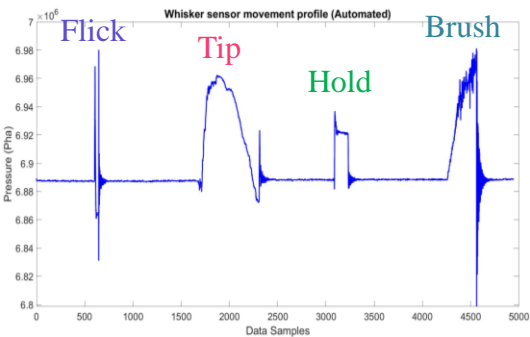Figure 1. Touch type response from sensor profile of manual experiment.

Figure 2. Touch type response from sensor profile of automated experiment.
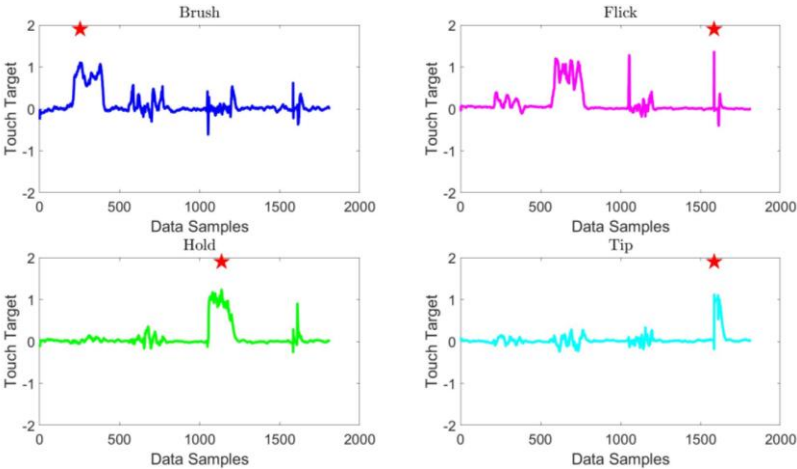
RESULTS

Figure 3. Output response for neural network according maximum value outcomes from manual experiment

Table 1. Testing and Training on half sets of data, adjacent odd and even samples points

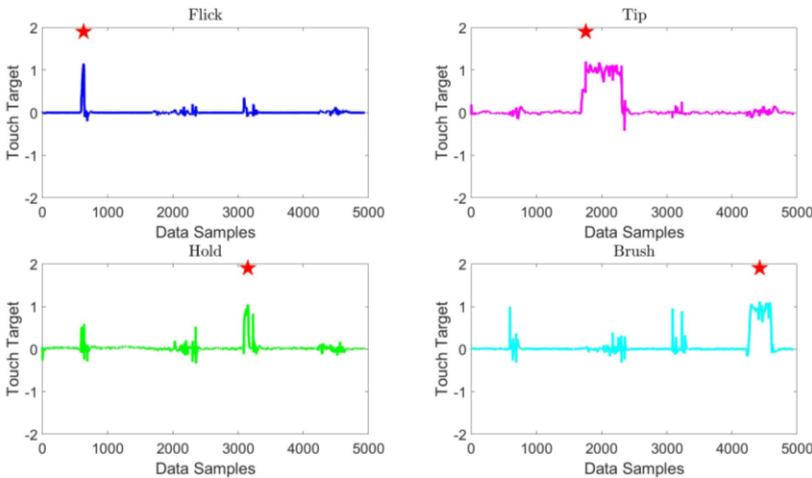| Item	Training accuracy	Test accuracy
1	99.2%	73.6%
2	98%	55.5%
3	95.5%	95.8%
4	95.7%	95.5%

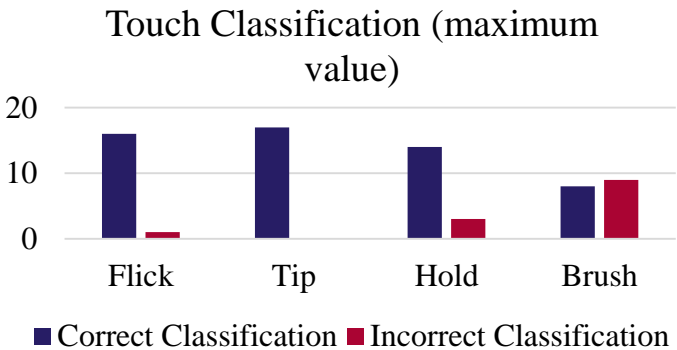Figure 4. Automated outcomes after testing neural network trained with 17 sets of data.

Figure 5. Correct/incorrect classification according **maximum value** from each testing set (17 in total)

Table 2. Confusion matrix for the response accuracy on each sample point from all touch types.

	Flick %	Tip %	Hold %	Brush %	No touch %
Flick	39.32	0	48. 70	4.56	7.42
Tip	0	85.58	0.18	0.62	13.62
Hold	7.12	1.69	30.43	6.25	54.51
Brush	1.40	0	7.22	84.59	6.79

CONCLUSIONS

The findings suggest that the neural network has a high performance at generalization in different aspects:

- Test data from the proximity of the training data.
- New sets of automated data (!7 sets) from the sensors' raw data collection.

Furthermore:

- Touch types differ because of duration and pressure applied to the sensors.
- Pre-processing already defines good discrimination between touch types.

Therefore:

- Possible to classify different textures, since they give different pressure amplitudes.
- Pre-process raw data according to energy and duration of touch types.
- Apply touch types in a different order.

REFERENCES

- T. Prescott, M. Pearson, B. Mitchinson, J. Sullivan, and A. G. Pipe, "Whisking with robots from rat vibrissae to biomimetic technology for active touch," *IEEE Robotics and Automation Magazine*, vol. 16 (3). pp. 42-50, 2009.
- Zhuang, C., Kubilius, J., Hartmann, M.J., & Yamins, D.L. "Toward Goal-Driven Neural Network Models for the Rodent Whisker-Trigeminal System," *NIPS*, 2017.

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