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IEEE UKCAS 2019

Smart Multi-Sensor Wristband for Gesture Classification

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OVERVIEW

We present a smart wristband device with high sensitivity, which could accurately recognize hand gestures. Piezoelectric sensors were used to measure the wrist muscle and tendon movements. Machine learning algorithms were also used for analysing and classifying the captured data from the wristband. The bracelet device will be powered using energy that will be harvested and scavenged from flexible piezoelectric materials and PV cells. This self-sustainable smart wristband could be used for health monitoring applications, especially for patients with Parkinson's disease who suffer from tremors and movement disorders.

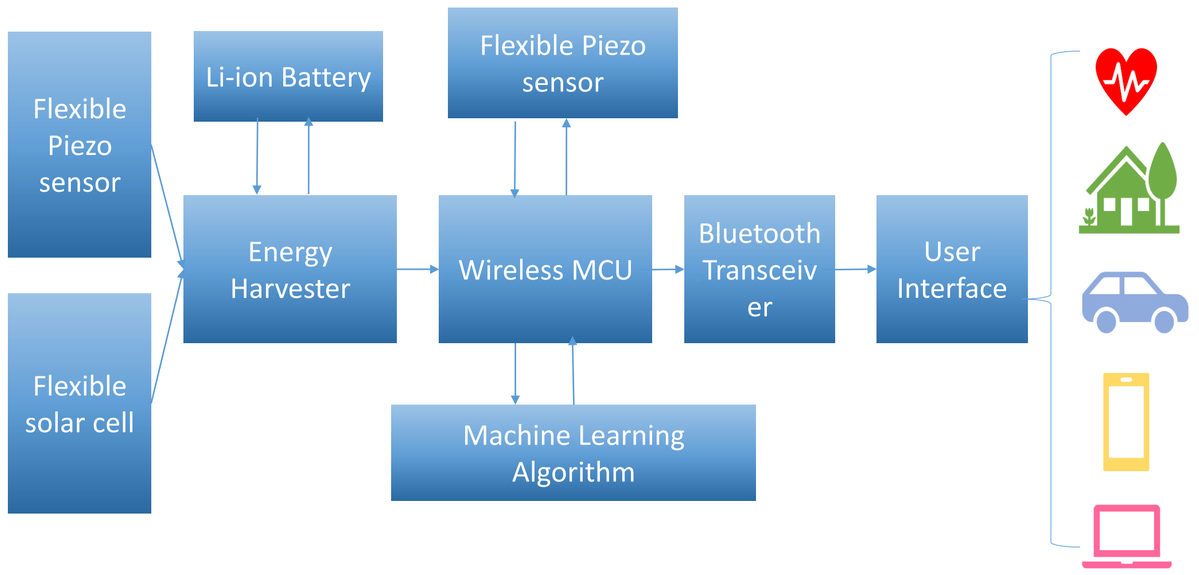

Fig1. The block diagram of smart bracelet.

IMPLEMENTATION

Four flexible piezoelectric sensors were fabricated. The flexible piezoelectric sensors generate voltage differences when applying force on it. The voltage difference between sensor surface is the valuable information for gesture classification. Meanwhile, like the flexible solar cell, the piezoelectric sensors also provide electric energy to power the whole system.

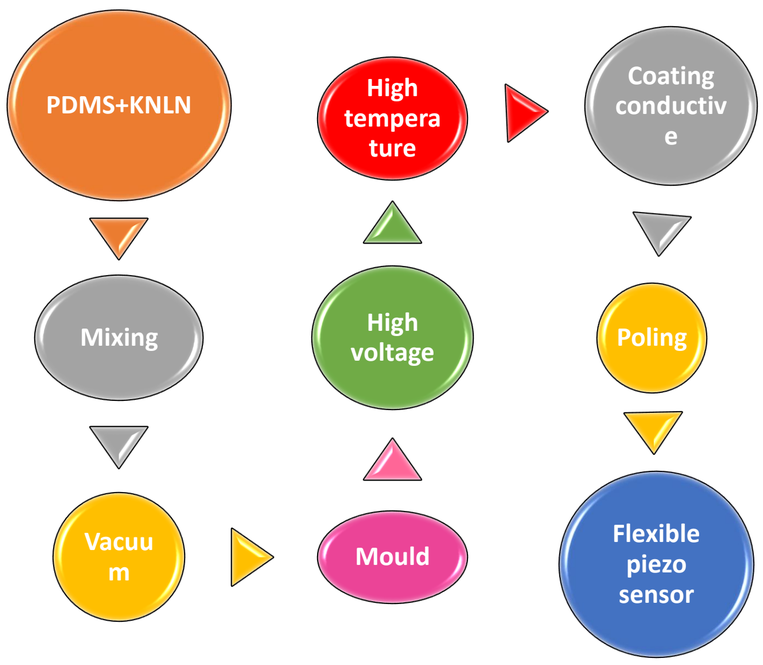

Fig2:The fabrication process of homemade piezoelectric sensors

RESULTS

Three algorithms SVM, KNN and BDT are made a comparison in this project to find a high accuracy and fast operation algorithm which is suitable for hand gesture recognition. Meantime, we involved feature extraction to distinguish five fingers tapping gestures and compared with the original signal to find a better type of data for higher classification accuracy. 15 different time domain features are considered including the signal mean, maximum, minimal, peak-to-peak, median absolute deviation and autoregression coefficients.

Algorithm	KNN	BDT	SVM
Accuracy with row data	96.49%	92.86%	98.25%
Accuracy with features extraction	73.68%	70.18%	85.95%
Time(s)	24.53	4.25	485

Fig3: Results of hand gesture recognition with different algorithms

CONCLUSION AND FUTURE WORK

A self-sustainable hand gesture recognition system has been implemented by collecting pressure signals with flexible piezoelectric sensors. Power harvesting techniques are used to convert mechanical energy of human motions and solar energy into electrical energy for powering the wearable electronics. In the future, various sensors will be involved in the smart wristband to develop more functions.

REFERENCES

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ACKNOWLEDGMENT
I would like to thank all meLab members, for their participation, contributions and suggestions at various stages of this project.

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