Handling Adversarial Attacks on Deep Neural Network through Change Point Detection Application to Smart Home Time Series Data

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*Abstract*— Human activity Recognition (HAR) is a challenging time series classification task based on neural network modeling to classify the activity of new unseen subjects from the collected sensor data. It involves predict the movement/activities of a person based on time series data collected from accelerometer of a smartphone or motion sensors in indoor setup. The classification and prediction uses deep domain expertise and signal processing to engineer features from raw data to fit into prospective machine learning model. The exposed vulnerability of deep learning models to adversarial time series examples may lead to false classification result, which is still not widely addressed in the field of HAR activity recognition. In this project, we propose to classify HAR activities from Ambient Sensor Dataset of UCI repository, with added feature of robust architecture of handling adversarial attack on the time series data. A special noise is added to the input time series to reduce the network’s confidence when classifying instances at test time. We have prepared and engineered the important features from the raw dataset and applied classifier models on the prepared dataset. The adversarial attack mechanism will be applied in the last phase of the project.

Keywords—Human Activity Recognition,, Time Series Data, Activity Classification, Feature Engineering

# Data Source

The dataset of the project is collected from UCI Machine Learning Repository, *Human Activity Recognition from Continuous Ambient Sensor Data* *Dataset*. The dataset is fairly new

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* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
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1. Table Type Styles

| Table Head | Table Column Head | | |
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| Table column subhead | Subhead | Subhead |
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1. Sample of a Table footnote. (*Table footnote*)
2. Example of a figure caption. (*figure caption*)

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity “Magnetization”, or “Magnetization, M”, not just “M”. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write “Magnetization (A/m)” or “Magnetization {A[m(1)]}”, not just “A/m”. Do not label axes with a ratio of quantities and units. For example, write “Temperature (K)”, not “Temperature/K”.

##### Acknowledgment *(Heading 5)*

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##### References

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1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
6. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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