





# CASE STUDIES OF SIGNAL PROCESSING APPLICATIONS

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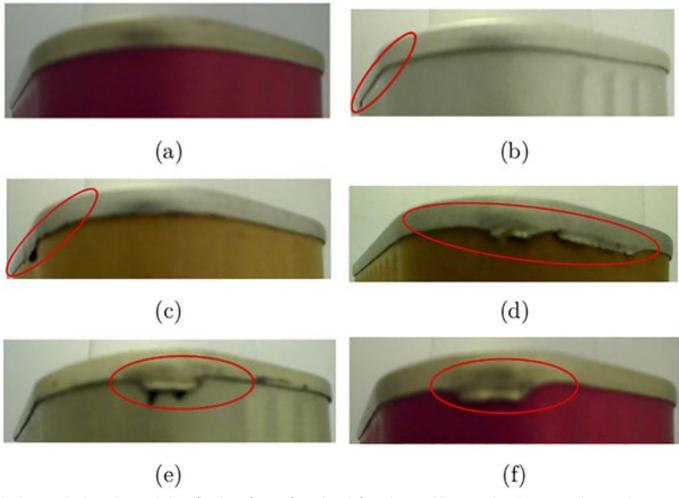


## **Example: Classification of manufacturing defects**





Images: (a) without defect, (b)-(c) with small defects, and (d)-(f) with big defects.



Source: O. Essid, H. Laga, C. Samir, Automatic detection and classification of manufacturing defects in metal boxes using deep neural networks, *PLOS ONE*, Nov. 2018, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0203192



### **Example: Anomaly detection of time** series sound data





Sound data is acquired from SMD assembly machine with 192 kHz of sampling rate. The data collection process is shown in (a). Sequential machine operational sound data are collected from an operating SMD assembly machine placing a microphone as indicated by the red bounding box in (b).



(a) the Surface Mounted Device (SMD) assembly machine



(b) the microphone for collecting data

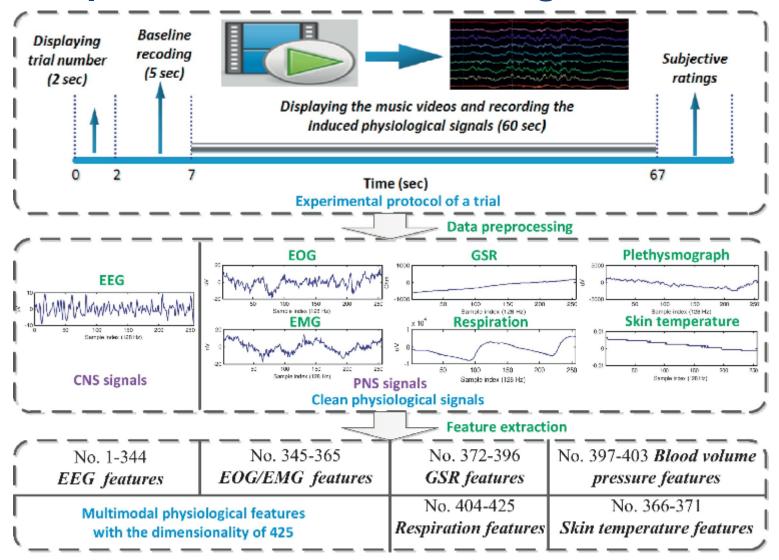
Source: Y. Park and I. Yun, Fast Adaptive RNN Encoder–Decoder for Anomaly Detection in SMD Assembly Machine, *Sensors*, Oct. 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6211082/



#### **Example: Human emotion recognition**







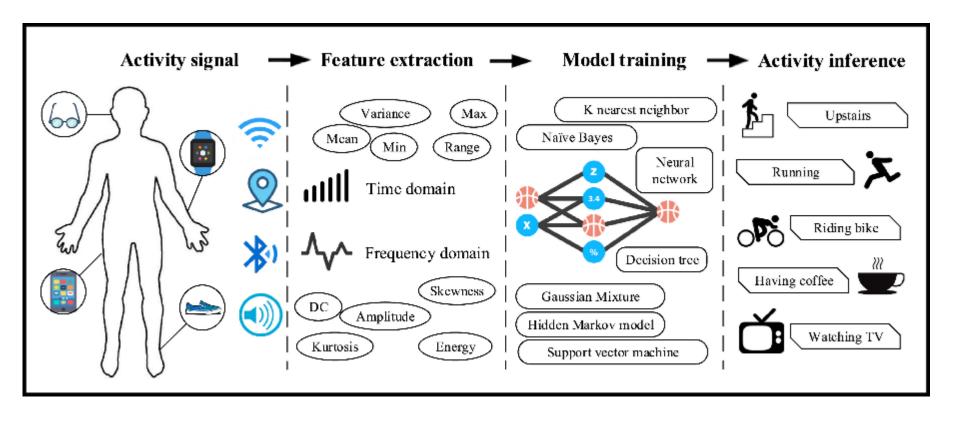
Source: Z. Yin, M. Zhao, Y. Wang, J. Yang, J. Zhang, "Recognition of emotions using multimodal physiological signals and an ensemble deep learning model," *Computer Methods and Programs in Biomedicine*, Vol. 140, Mar. 2017, pp. 93-110.



## Example: Sensor-based human activity recognition







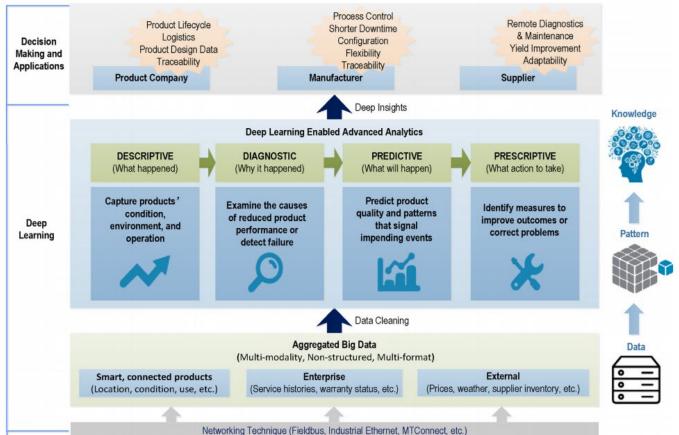
Source: J. Wang, Y. Chen, S. Hao, X. Peng, and L. Hu, "Deep learning for sensor-based activity recognition: A survey," *Pattern Recognition Letters*, Vol. 119, Mar. 2019, pp. 3-11.



### Example: Smart manufacture







Location

Activities

Process
Performance
Results
Source: J. Wang, Y. Ma, L. Zhang, R. Gao, and
D. Wu, "Deep learning for smart manufacturing:
Methods and applications," Journal of
Manufacturing Systems, Vol. 48, Part C, Jul.
2018, pp. 144-156

Electricity

Temperature

Operations

Abnormalities

Equipment

Sensor

Quality

Object

Products

Parts

Smart

Connected Process Product

Number

Progress



### Example: Smart living





- Activity Recognition in Home Using Ubiquitous Sensors, http://courses.media.mit.edu/2004fall/mas622j/04.projects/home
- Sensor: Switch sensor
- Description: Around 80 sensor data collection boards equipped with reed switch sensors were installed in two single-person apartments for two weeks. The sensors were installed in everyday objects such as drawers, refrigerators, containers, etc. to record opening-closing events (activation deactivation events) as the subject carried out everyday activities.









Source: http://courses.media.mit.edu/2004fall/mas622j/04.projects/home



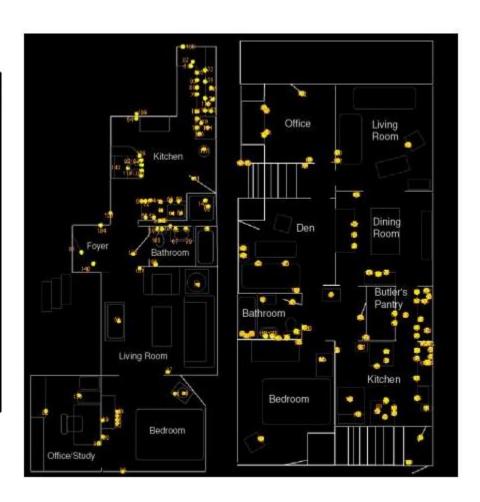
### Example: Smart living





#### Example data

Activity	Subject 1	Subject 2
Preparing dinner	8	14
Preparing lunch	17	20
Listening to music	( <del>-</del> )	18
Taking medication	343	14
Toileting	85	40
Preparing breakfast	14	18
Washing dishes	7	21
Preparing a snack	14	16
Watching TV	-	15
Bathing	18	32 <u>4</u> 3
Going out to work	12	2 <del>7</del> 2
Dressing	24	-
Grooming	37	32
Preparing a beverage	15	8 <del>7</del> 0
Doing laundry	19	-
cleaning	8	_



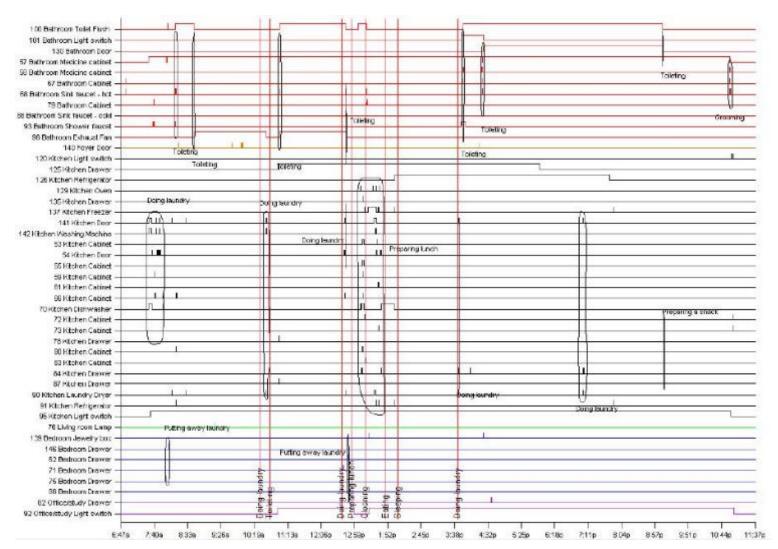


### Example: Smart living





#### Example data







### Thank you!

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