

Group D Presentation

Sign Language Recognition on **Low Power, Low Reliability, Low Latency** Devices

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The Ohio State U, USA / PhD

(Presentation title)

Theoretical Approaches for Handling Soft Errors
in KrylovSubspace Methods

(Research field / theme)

High Performance Computing- Computational
Science

Siddharth D Jaiswal

Indian Institute of Science, India / MA

(Presentation title)

(Research field / theme)

STEM: STrreaming Edge-based Motif
Preserving Graph Partitioning Large Scale
Graph processing

D

Yasuhiro Nakahara

Kumamoto U, JPN / MA

(Presentation title)

CNN accelerator for edge computing

(Research field / theme)

Embedded system, deep learning

Yuta Shimane

Tokyo U of Science, JPN / MA

(Presentation title)

Development of a neuro-musculoskeletal model
of rat

(Research field / theme)

Bio-mechanics

Outline

- Introduction
- Problem Definition
- Sequence Diagram
- Proposed Solution
- Methodology
- Conclusion

Sign language

Translate sign language to text for deaf/mute people



There are more than **466 million** deaf people in the world (WHO, 2019)

It is difficult to translate message using sign language

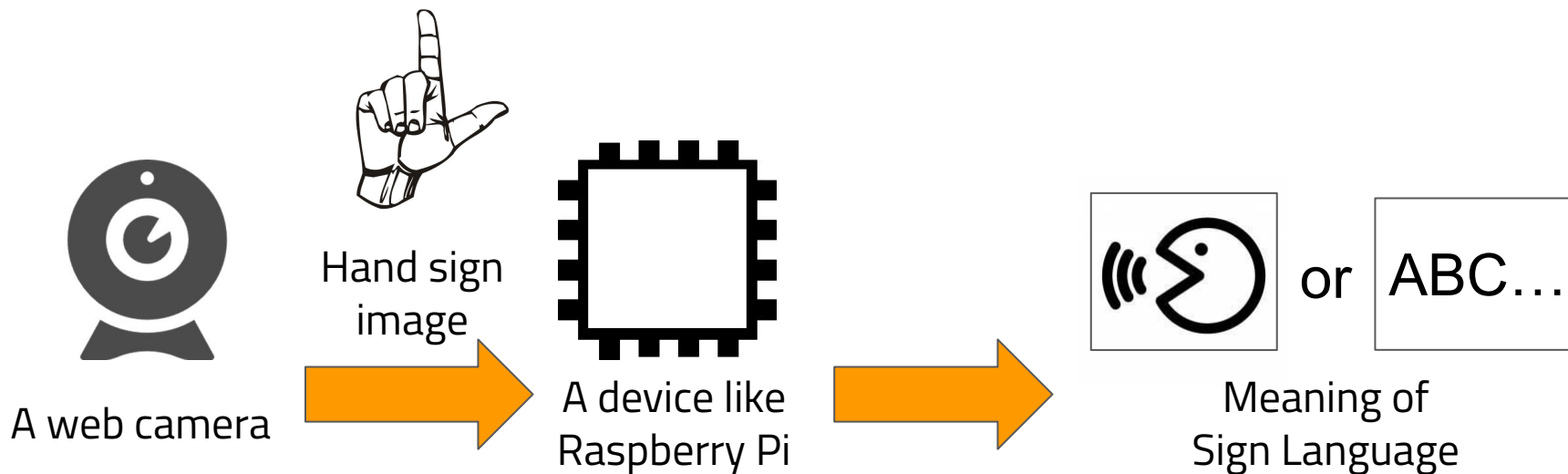
e.g call emergency



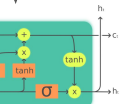
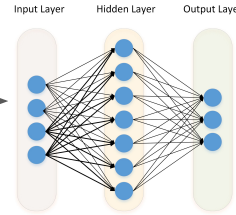
Need to develop device which **deaf people can use to communicate with other people easily**

System Configuration

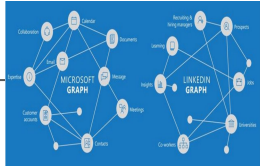
1. Shooting hand with webcam
2. Infer meaning of sign language with a device
3. Output sign language meaning by voice or text



Sequence Diagram



Legend: Layer (orange square), Pointwise op (yellow circle), Copy (arrow icon)



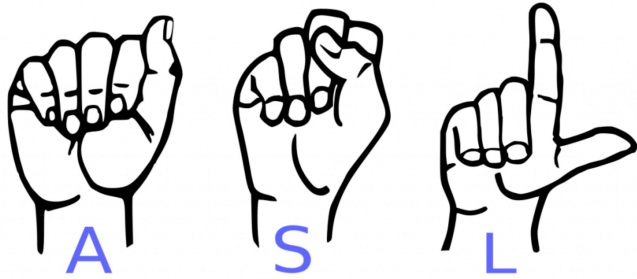
3. jactitate: particular / annoyed / emotion.
 4. surrender: to remove / to give in / to avoid
 5. neglect: be careless of / be careful with / destroy
 6. confirm: prove wrong / make certain of / disagree
 7. flexible: strong / smooth / easily bent
 8. tender: sore / painful / delicate
 9. aquatic: living on land / living on trees / living in water
 10. tragedy: a serious event / an insult / grief
 11. punctual: careful / on time / set down
 12. participate: keep off / take part in / bring for
 13. aware: avoid / aware / long for
 14. minuscule: sixty seconds / very small / a garment
 15. deduct: subtract / make up / anger
 16. embark: make up / enjoy / set out
 17. haulier: an in / unhappily / gather together
 18. compel: force / give ground / work hard
 19. illiterate: down and out / undisciplined / unwilling
 20. possession: a parade / ownership / rental
- Now write 9 sentences using the 9 LEAST FAMILIAR words from above

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https://miro.medium.com/max/1340/0*mVoNuITCR4aApd1

https://upload.wikimedia.org/wikipedia/commons/thumb/3/3b/The_LSTM_cell.png/170px-The_LSTM_cell.png
<https://images.clipartlogo.com/files/istock/previews/1060/106077627-hand-drawn-set-of-speech-bubbles-with-dialog-words.jpg>
<https://content.linkedin.com/content/dam/engineering/site-assets/images/blog/posts/2016/10/knowledgegraph1.jpg>
https://busyteacher.org/uploads/posts/2012-11/thumbs/1353839366_best-meaning.png

Capturing sign language

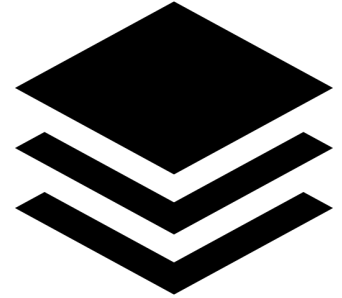
Sign language



Video Camera



Image data

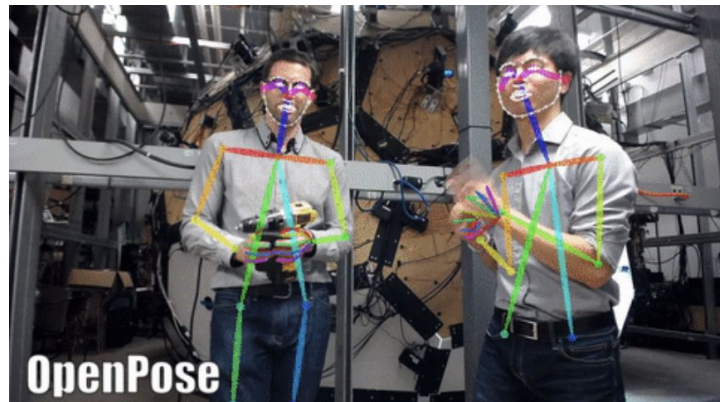


American sign language

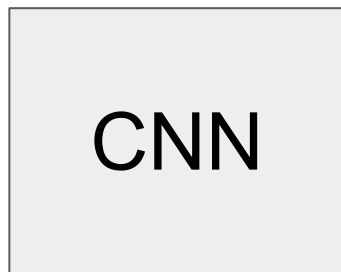
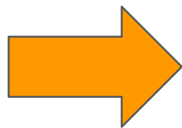
Getting Image information of sign language in a series of motion using video camera as also as Ashio K sahu, 2014.

Hand bone recognition

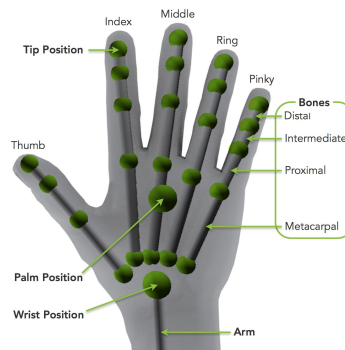
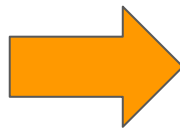
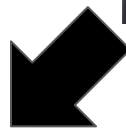
- Estimate hand bones using Openpose's method
 - Processing is fast because only hand recognition
 - Convert images to coordinates to reduce data size



A Hand image



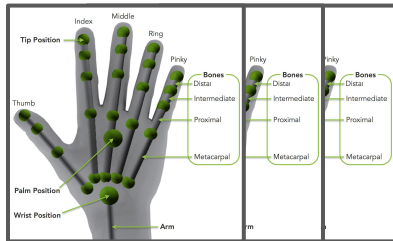
OpenPose for detection
of Hands bones



Hand bones

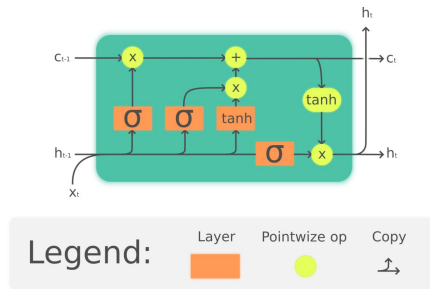
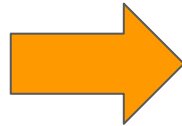
Hand bone to word conversion

- Infer words from time-series data of hand bones
 - it can be implemented with small models, since input is coordinates

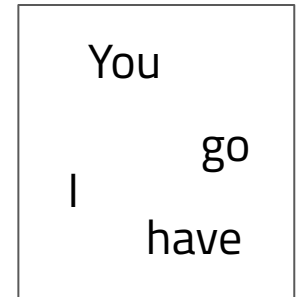
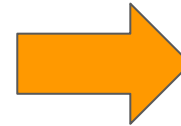


time-series data
of hand bones

...



LSTM

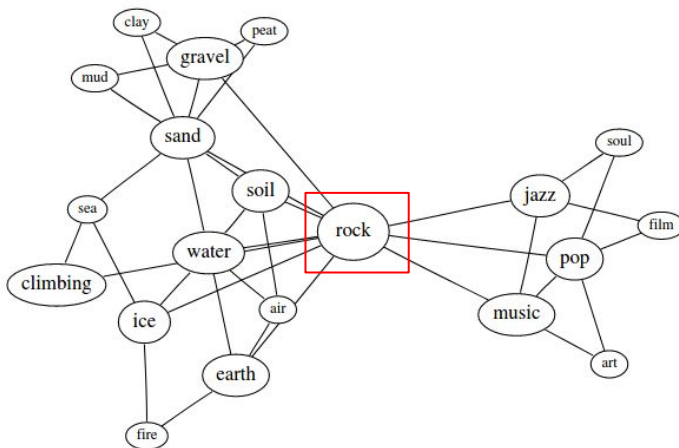


Word

Using Graphs to extract Meaning

“I am convinced that the crux of the problem of learning is recognizing relationships and being able to use them”
-Christopher Strachey in a letter to Alan Turing, 1954

We create a graph from the words generated in the previous step and use contextual closeness to infer meaning from the words and take necessary action.



Resilience Analysis and Improving Fault Tolerance

- Hardware level fault
- Silent Data Corruption

The Consequence of Error

- Hardware faults that impact the parameters of a DNN (e.g., weights) can have drastic impacts on its classification accuracy

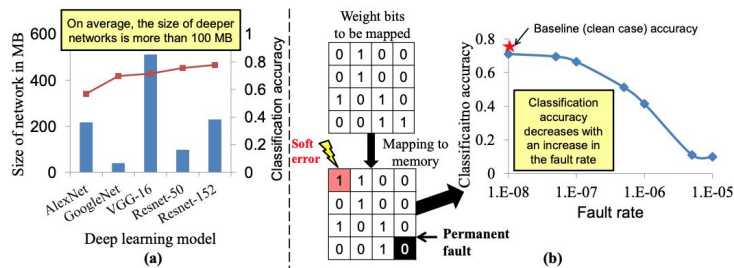
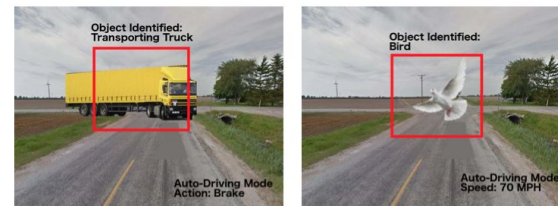


Figure 1: (a) Memory consumption of state-of-the-art DNN models. (b) The impact of hardware faults (bit flips in the weight memory) on the classification accuracy of AlexNet.



(a) Fault-free execution: A truck is correctly identified by the DNN and brakes are applied
 (b) SDC: Truck is incorrectly identified as bird and brakes may be not applied

Figure 2: Example of SDC that could lead to collision in self-driving cars due to soft errors

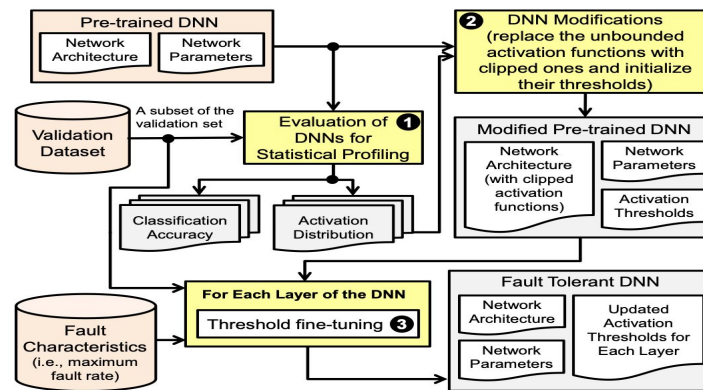


Figure 4: Our methodology to improve the resilience of a pre-trained DNN model

Conclusion

We propose the following-

Interpretation and Understanding of sign language symbols(eg. ASL) from handicapped people to help in emergency situations, in the absence of other human presence.

For this, we plan to use a combination of Visual Analytics and NLP to associate meaning to the statements generated from the sign language symbols.

Thank You!