ITU KALEIDOSCOPE
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Machine learning for a 5G future

Undeclared constructions: A government's support deep learning solution for automatic change detection

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Problematic situation and current procedures

- Huge number of undeclared square meters (and growing).
  - **Many problems:**
  - Tax
  - Safety
  - Ecology
  - Ecc.

- How is the problem faced nowadays?

How could the process be improved?

Automation: Detect changes in satellite images automatically.

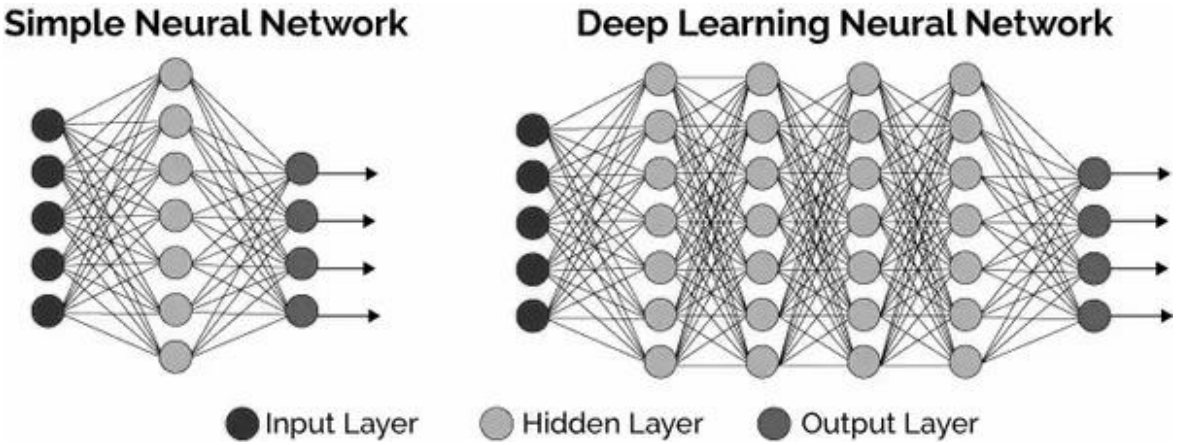
- People focus effort in other tasks.
  - Software's output validation.
  - Visual inspection.

System proposal

Deep learning software to automatically detect changes in buildings.

Why Deep Learning?

- Neural networks are deeper (more layers than Machine Learning).
- Deeper networks can perform *computer vision* with high accuracy.
- Convolutional Neural Networks (CNNs): deep learning technology used in images processing (*computer vision*).



What do we need?

- **Image Dataset**

  – A huge volume of input data: images with high resolution for training and inference

  Solution: SpaceNet, corpus of commercial satellite imagery free to use

- **Neural network**

Neural network architecture

A network is needed → two options:

	Pros	Cons
Generate a new architecture.	Custom development.	Steep learning curve and vast error validation.
Adap an architecture to our needs.	Tuned up architecture amd good error margins.	Adapt implies understand and understand implies time.

Chosen solution: adaptation

SpaceNet Challenge Round 2

- Programming competition to develop building detection networks.
- Winning solutions with Apache 2.0 License
- Outputs of the solutions include the area of polygons.
- Low error levels (considering IOU metric).

Spacenet winning solution

Kohei Ozaki's solution fits to our purposes

- Best performance.
- Well documented.
- Open source

This give us the possibility to automatically detect buildings

But… how can the changes be detected?

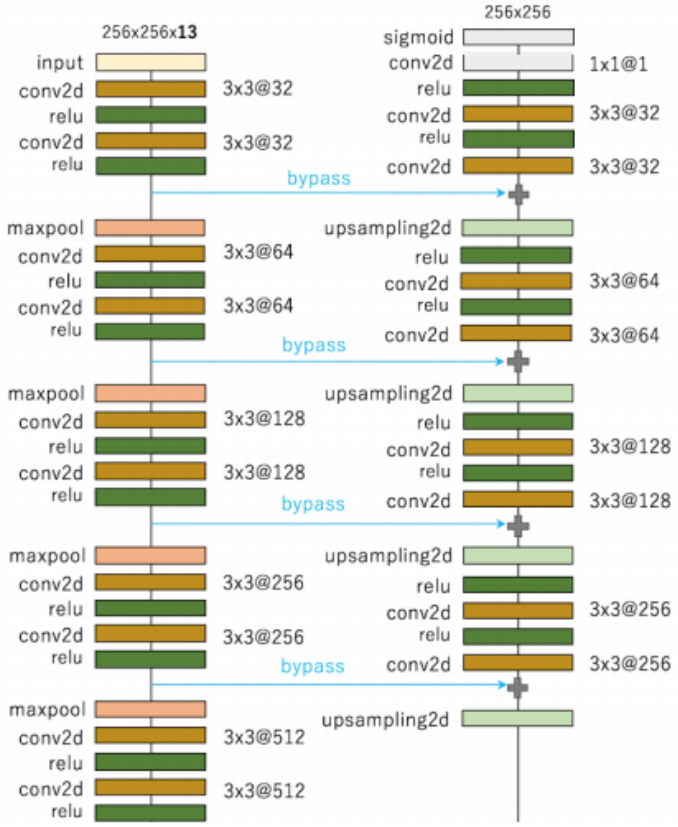


Image comparison

- Images comparison algorithm
  - Input images with a building detection algorithm.
  - Output is used in a new algorithm that compares different outputs at different times.

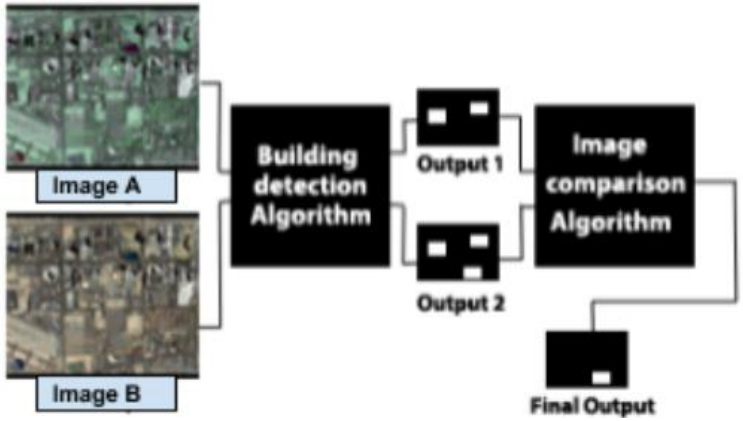
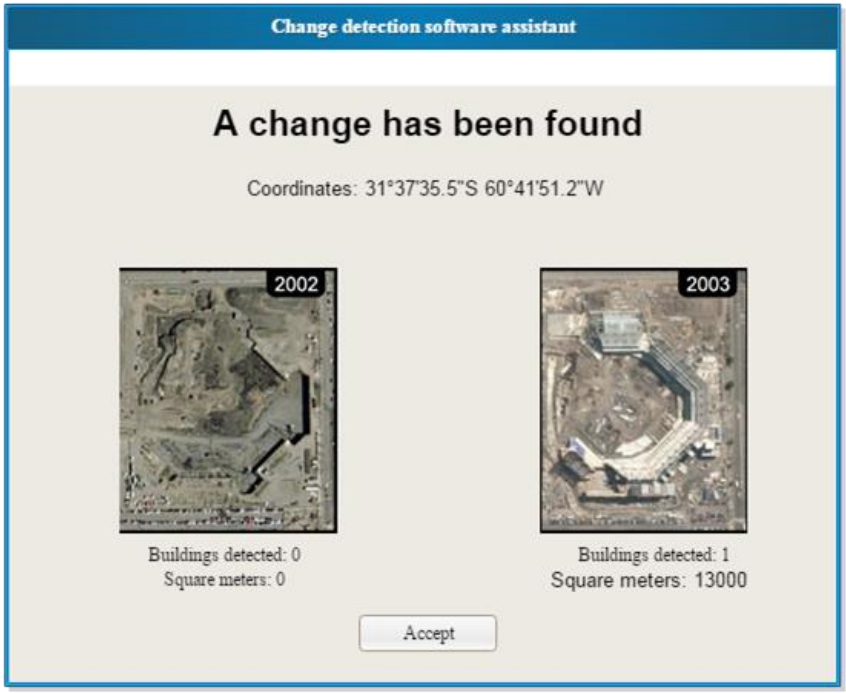


Image comparison

Main functions

- **Recognize** what is or is not a building
- **Compare** two inputs spaced in time.
- **Show** in the software GUI the specific coordinates and how many square meters of construction were found.



Conclusions. What comes next?

- **Drone images**
- **3d Detection:** many undeclared square meters are built in new floors.
- **PaaS:** The image comparison software could be proposed as platform as a service.

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Thank you

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