Defect Detection in Porcelain Industry based on Deep Learning Techniques

Adriana Birluțiu, “1 Decembrie 1918” University of Alba Iulia
Adrian Burlacu, “Gheorghe Asachi” Technical University of Iași
Manuella Kadar, “1 Decembrie 1918” University of Alba Iulia
Daniela Onița, “1 Decembrie 1918” University of Alba Iulia

Outline

- Motivation and approach
- Deep Learning
- Experimental evaluation
- Conclusions and directions for future work

Manufacturing process of porcelain

- Preparing the ceramic mass
- Powder atomization
- Shaping the object
- Burning I
- Glazing
- Burning II
- Final sorting

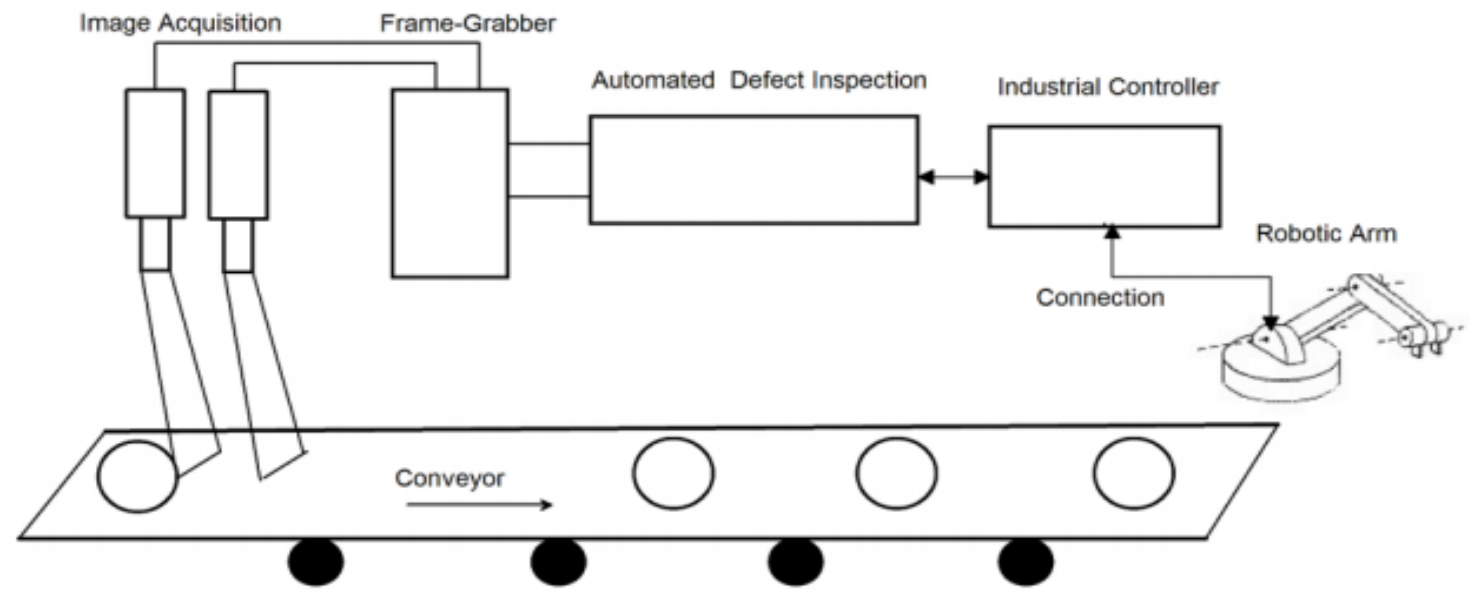
Quality control in the porcelain industry

- Performed manually
- Expensive process, which requires trained personnel
- Prone to human error

The need for automated inspection!

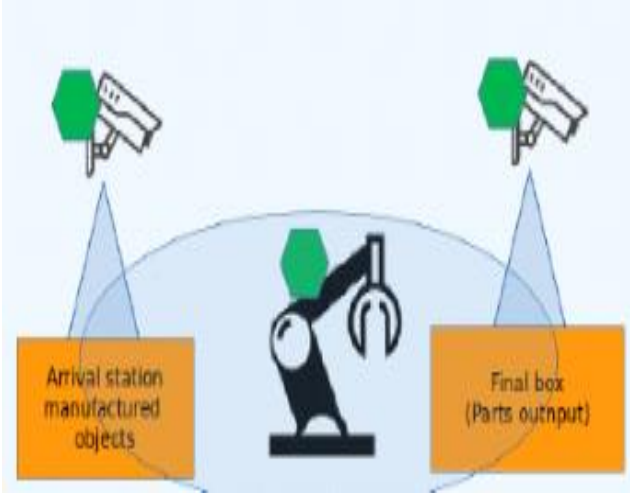
Project motivation

Automated processes in porcelain industry



The optimized system will be integrated in the porcelain production flow

1. Product reaches the inspection system
2. Sensor detects the product and sends a signal to the artificial vision system
3. The product is illuminated
4. Artificial vision system receives the image from the sensor
5. Software algorithms running on the artificial vision system process and analyze the received image

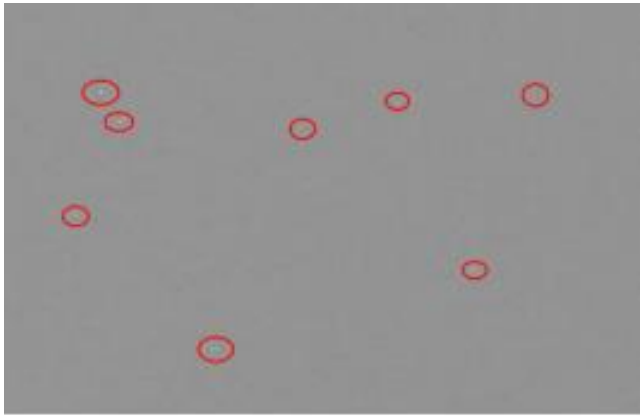


Types of defects

- 2D defects
- 3D defects
- structure defects

(a) Deterioration after pressing.

(d) Margin deformation.

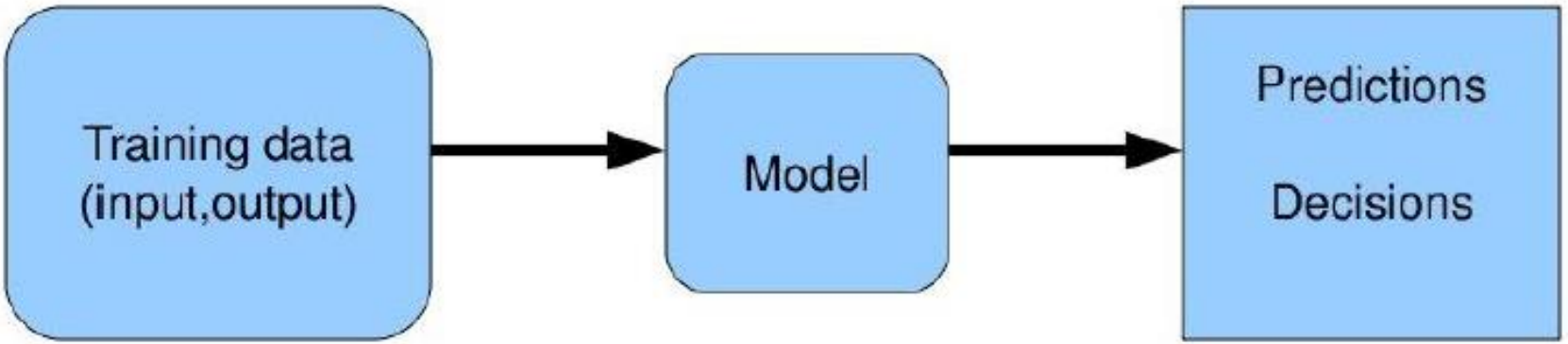


(b) Bumps.

(c) Texture defects.

Approach: Supervised Machine Learning

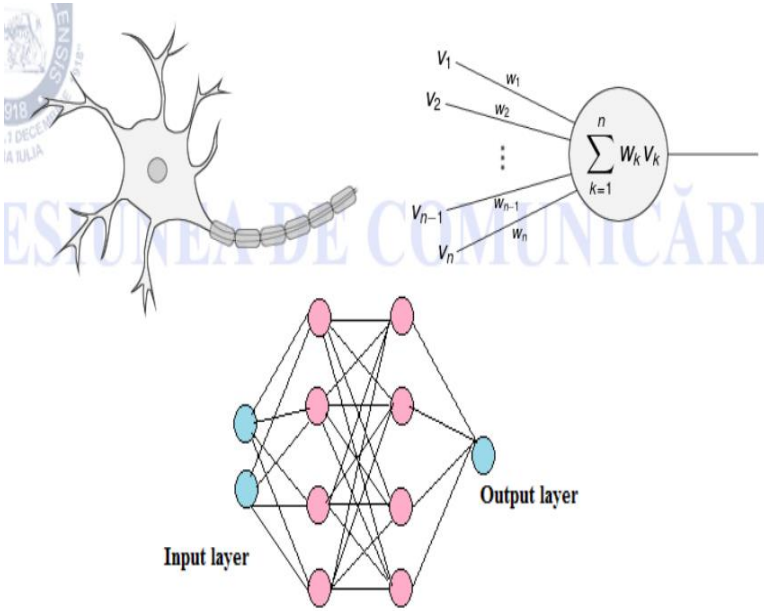
Deep Learning - Convolutional Neural Networks



Deep Learning: what is it?

Briefly, deep learning is:

1. A framework of machine learning techniques
2. Enables the automatic learning of feature hierarchies
3. Usually based on artificial neural networks



Deep Learning: how is it different?

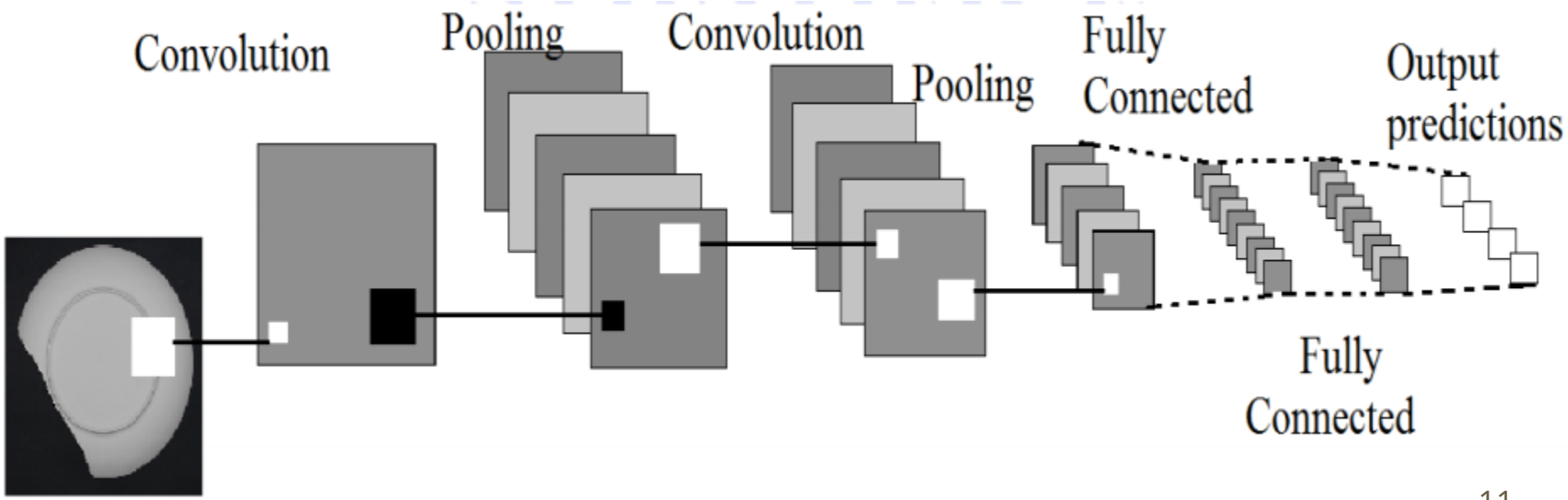
- 2013 Kaggle-hosted quest to save the whales
- The challenge was: given a set of 2-second sound clips from buoys in the ocean, classify each sound clip as containing a call from a North Atlantic Right whale or not.
- Winning team emphasized the importance of feature engineering

Deep Learning Approaches

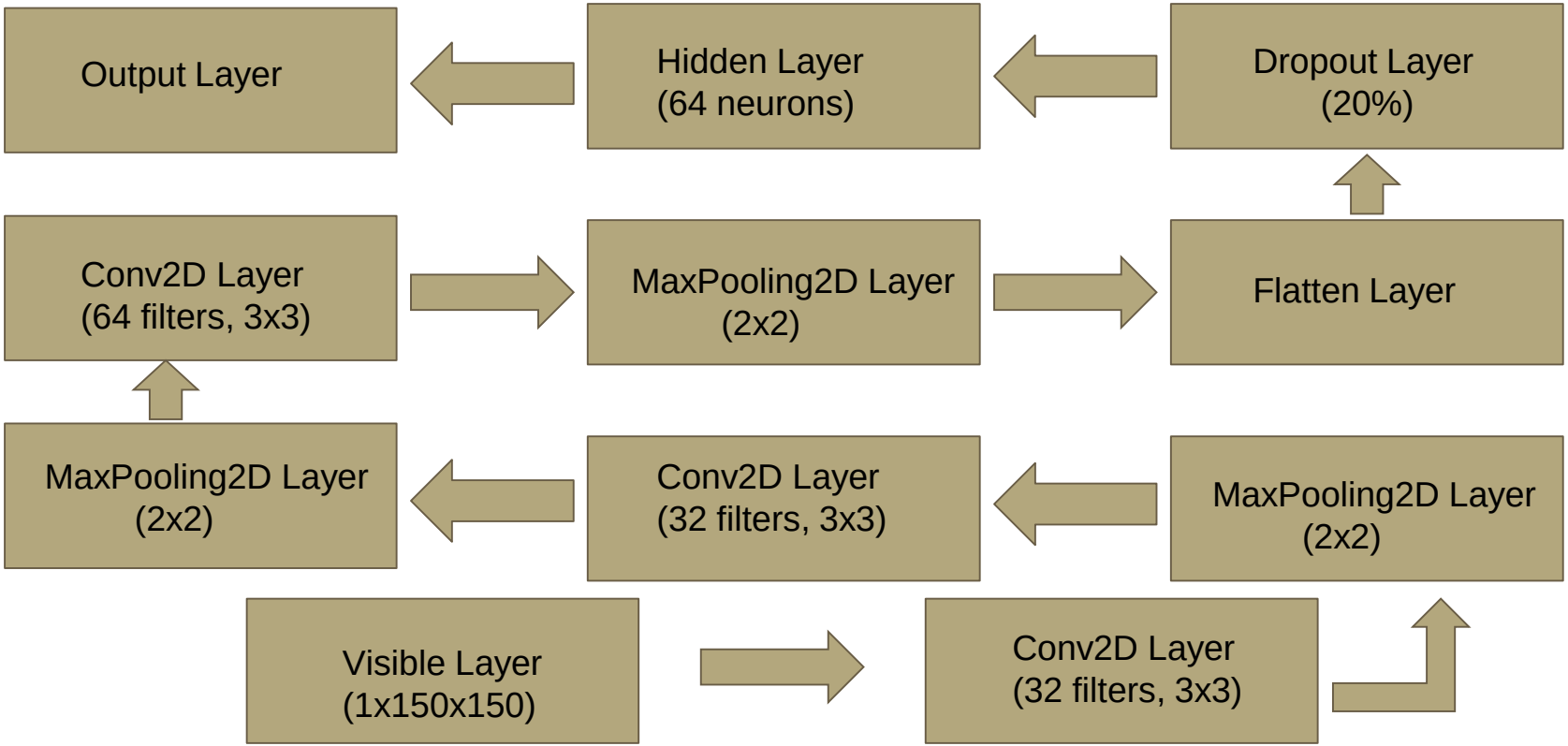
#	Δrank	Team Name * in the money	Score	Entries
1	–	SluiceBox *	0.98384	70
2	–	alfnie *	0.98379	27
3	↑1	RBM	0.98226	32
4	↓1	Free Willzyx	0.98210	38
5	–	Jure Zbontar	0.98080	24
6	–	Daniel Nouri	0.98070	16
7	↑1	Tree growers	0.97982	80

Convolutional Neural Networks

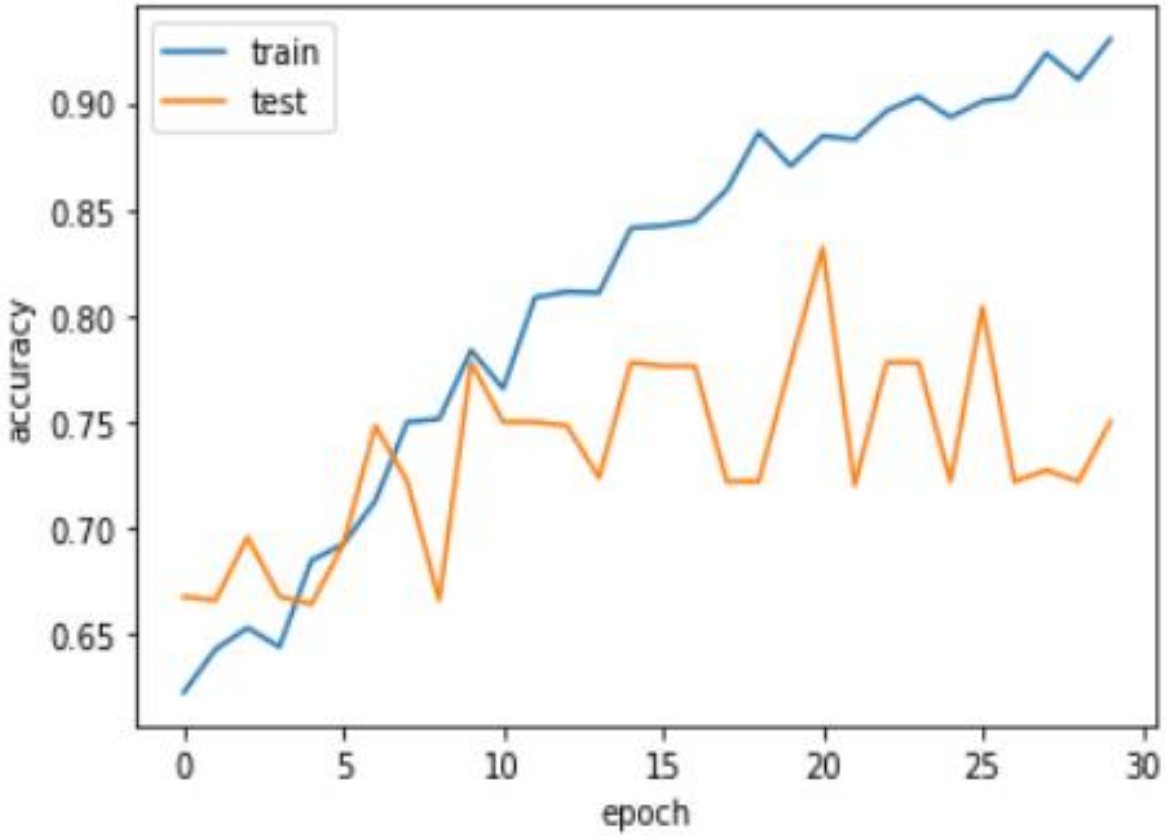
- Types of layers: convolutional, pooling, fully connected



CNN structure



Experimental results



Conclusion and future work

- Integrates robots, artificial vision and machine learning
- Defect detection at different phases of the production process
- Positive economic impact, shorten production time

- Fine-tune the parameters
- Examine the combination of different CNNs
- Change CNN’s structure

Thank you for your attention!

- Questions?
- Contact: adriana.birlutiu@uab.ro
- References

  - Ceramic Tiles - Part 2: Determination of dimensions and surface quality. National Standart Corporation, SNI ISO 10545-2, (2010)
  - Ahmadyfard, A.: A Novel Approach for Detecting Defects of Random Textured Tiles Using Gabor Wavelet. World AppliedcSciences Journal. 7(9): 1114- 1119, (2009)
  - Baeta, R.: Automated Quality Control in Ceramic Industry.Dissertation. Mechanical Engineering Department, Instituto Superior Tcnico, Lisboa, Portugal (2013)
  - Bastien, F., Lamblin, P., Pascanu, R., Bergstra, J., Goodfellow, I., Bergeron, A., Bouchard N., Warde-Farley, D., Bengio, Y.: Theano: new features and speed improvements. NIPS 2012