I.R.C.C.S. ISTITUTO ORTOPEDICO GALEAZZI
Gruppo ospedaliero San Donato

UNIVERSITA' DEGLI STUDI DI MILANO BICOCCA

k-tree

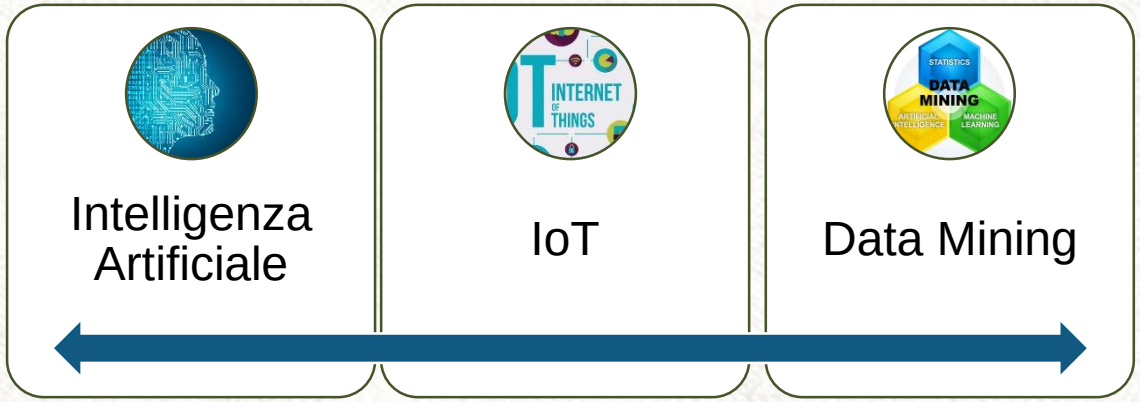
20 June 2019, Colleretto Giacosa (TO)

Presentation of 2 research projects

The company

k-tree

K-Tree Srl is a start-up born in 2015 at ‘’Pépinière d’Entreprise’’ in Aosta Valley. The team is composed by a group of junior and senior researchers and consultants



Research areas

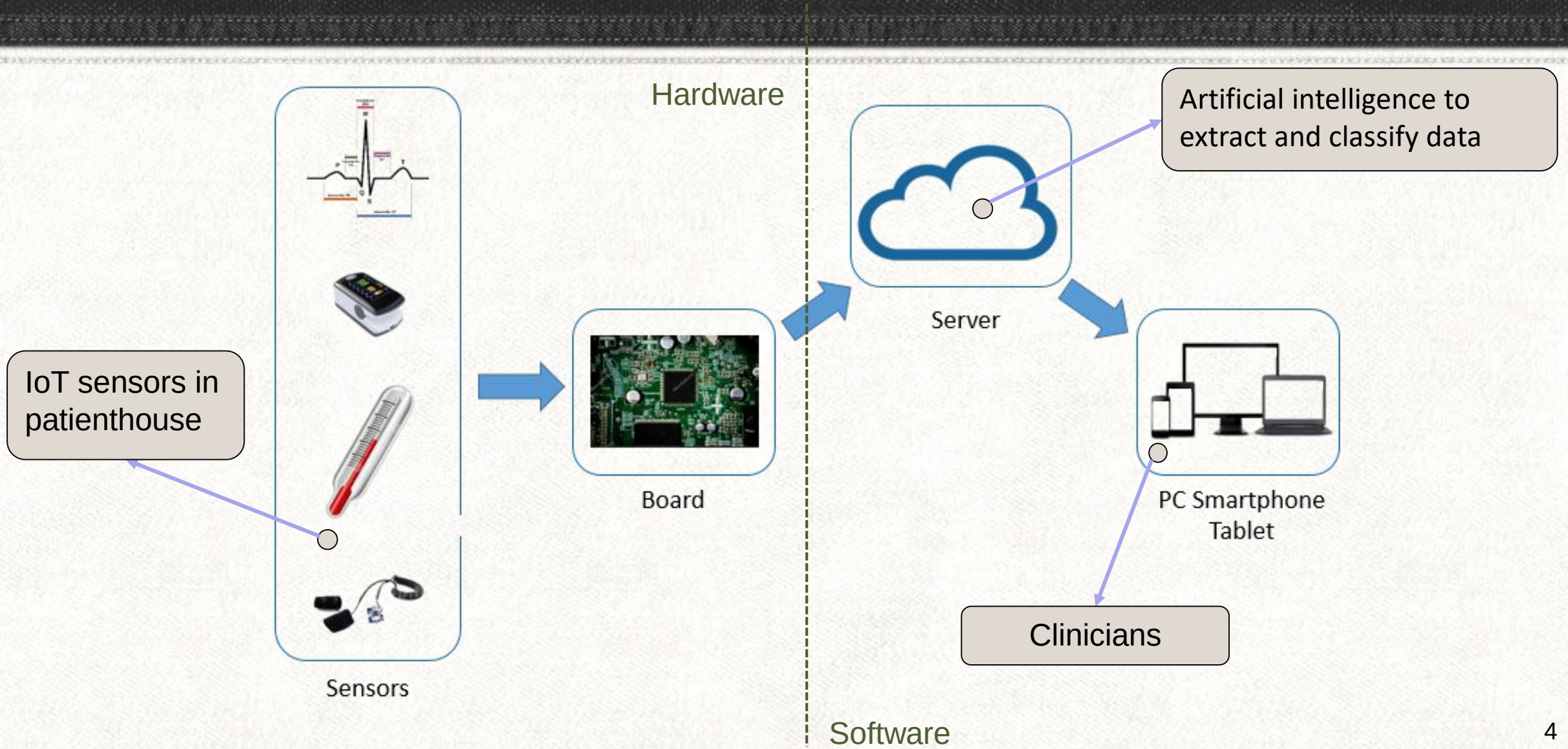
Monitoring system

- Objective parameters: detection of vital parameters and motion with IoT sensors
- Subjective parameters: administration of standardized questionnaires to collect PROMs

Medical images analysis

- Automatic analysis of medical images through deep learning
- Calculation of relevant parameters of the spine (angles and distances)

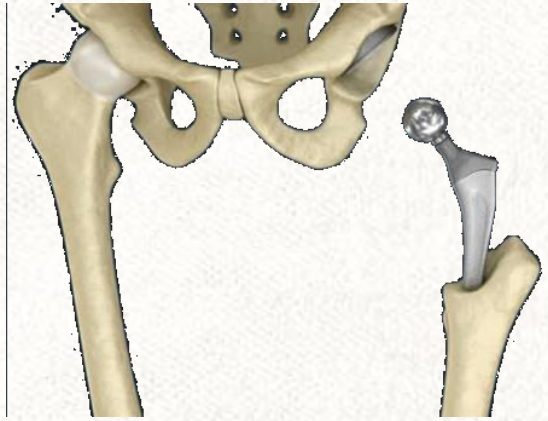
Configurable monitoring system



Target patients

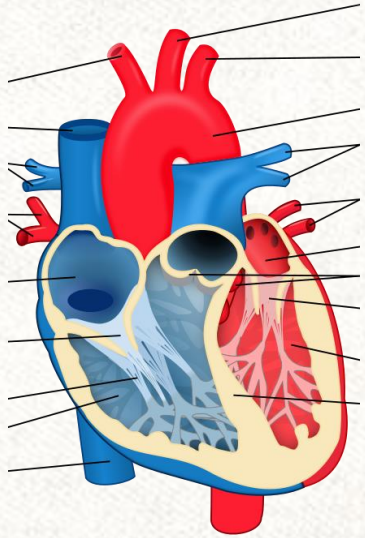
POST OPERATIVE MONITORING:

- Orthopedic surgery patients
- Monitoring: motion, heart rate and generation of messages for the patient to remind the therapy

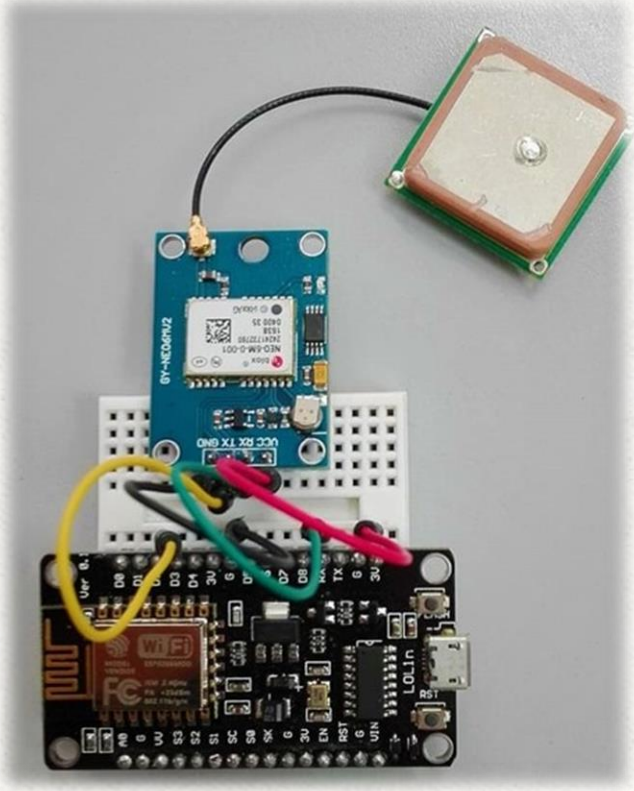


CHRONIC PATIENTS MONITORING

- Chronic cardiovascular disease
- Monitoring: heart rate and blood oxygenation, ECG, breath frequency, body temperature

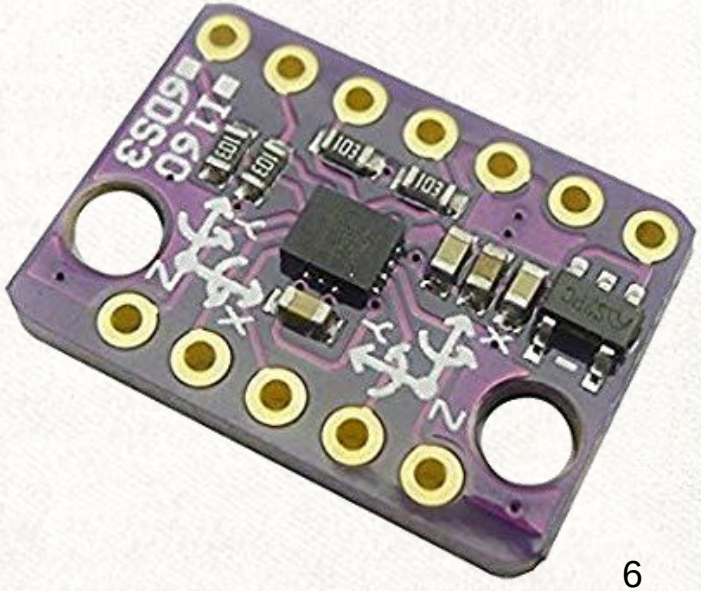


IoT sensors for the movement detection

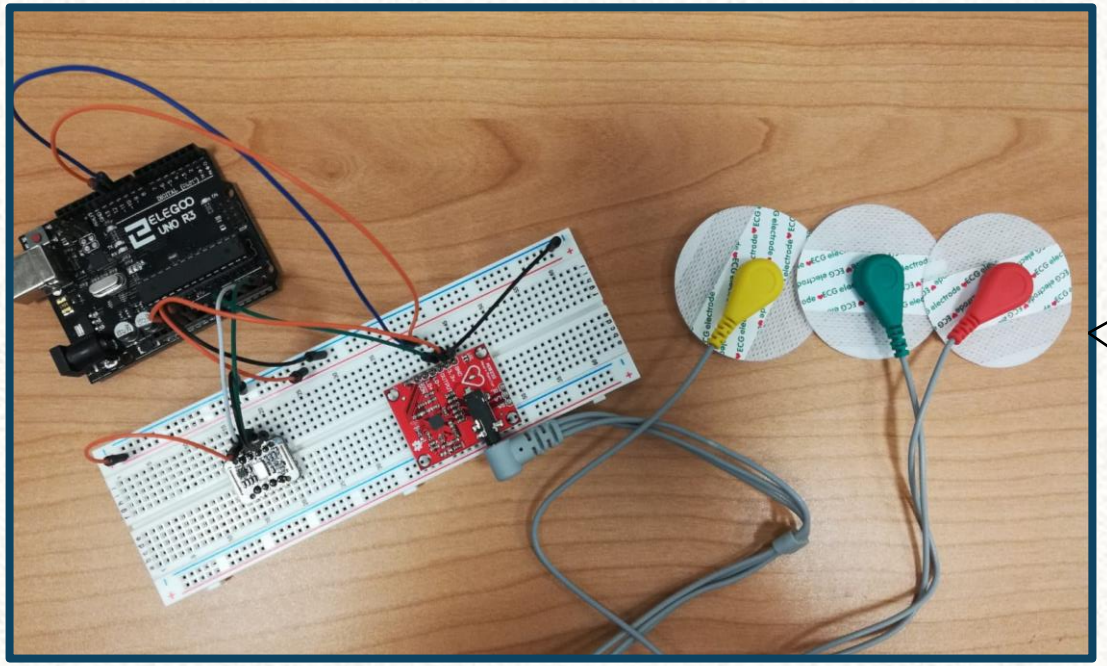


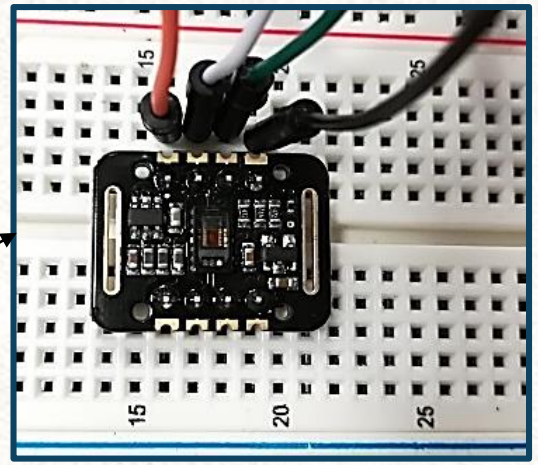
GPS: sensor to monitor the patient position all the time (the data have a different meaning depending on the position of the patient)

ACCELEROMETER: 6-axis accelerometer with integrated pedometer to monitor the movement (possible falls and steps)

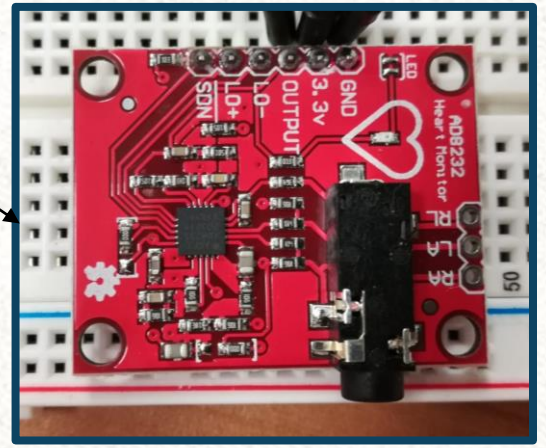


IoT sensors for the vital parameters collection

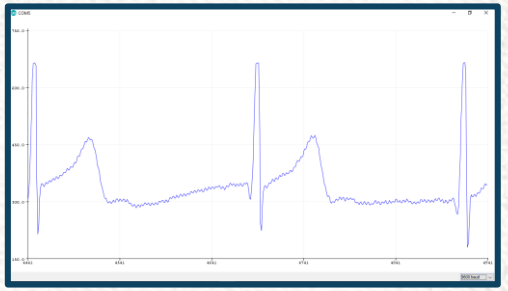




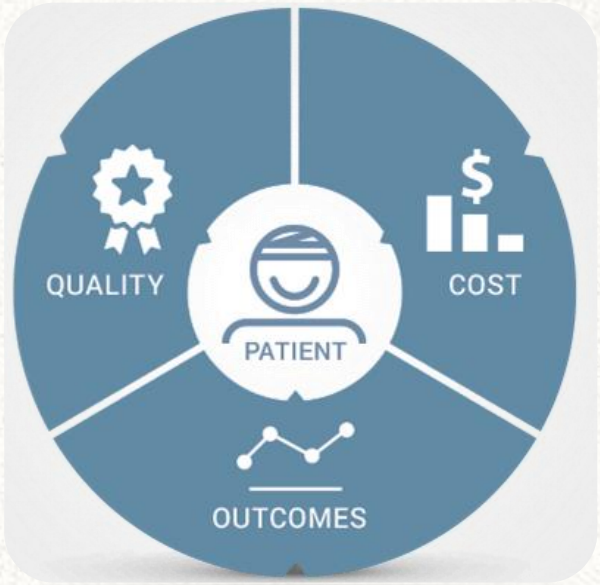
Blood oxygenation and heart rate



2-lead ECG



Subjective parameters collection: PROMs



Main problem: inappropriateness of medical procedures

→total reimbursement of medical treatement

Solution: Value-Based Healthcare
→different approach to medical treatement reimbursement

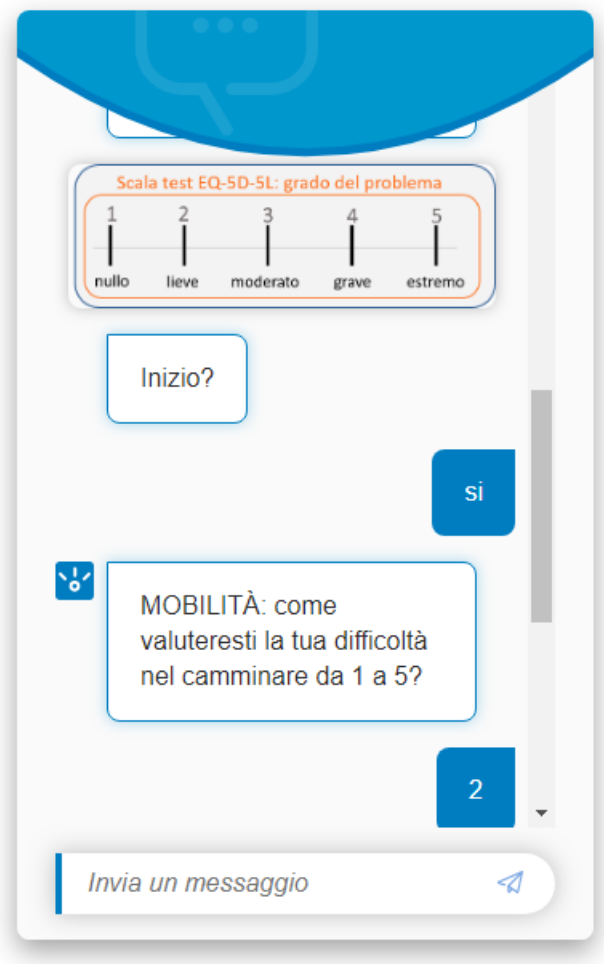
Secondary problems: PROMs collection
→the tool behind the VBHC

Solution: Automate PROMs collection

→brief and more frequent questionnaires

Mobile Application (ortopedic patients)

- Development of a mobile application to administer the EQ-5D-5L questionnaire for orthopedic patiens to evaluate the mobility and the autonomy in the post surgery
- 5 dimensions evaluation:
  1. MOBILITY
  2. SELF-CARE
  3. USUAL ACTIVITIES (work, study…)
  4. PAIN
  5. ANXIETY AND DEPRESSION



Aree di Ricerca [2]

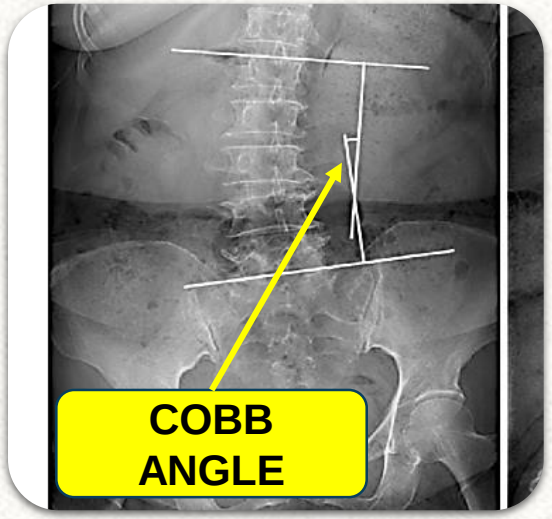
Monitoring system

- Objective parameters: detection of vital parameters and motion with IoT sensors
- Subjective parameters: administration of standardized questionnaires to collect PROMs

Medical images analysis

- Automatic analysis of medical images through deep learning to support clinicians during the spine deformity surgery
- Calculation of relevant parameters of the spine (angles and distances)

The problem to be solved



Pre-operative images

Optimal angles and distances to be achieved during the surgery

Surgery

Qualitative estimation of achievement with fluoroscopic images

Post operative images

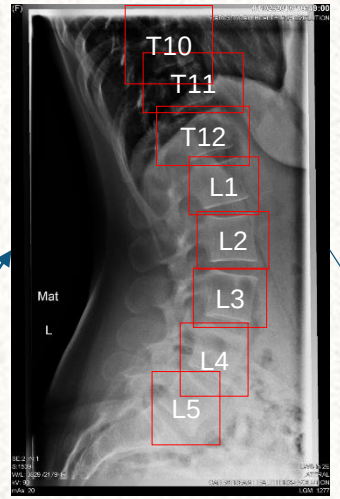
Achievement of target corrections assessed only after the surgery

The solution

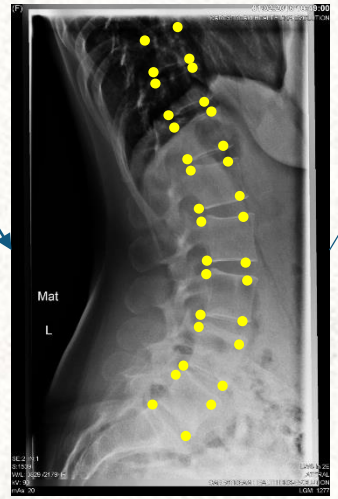
Pre/intra operative images

Deep Learning

Detection and localization of vertebrae

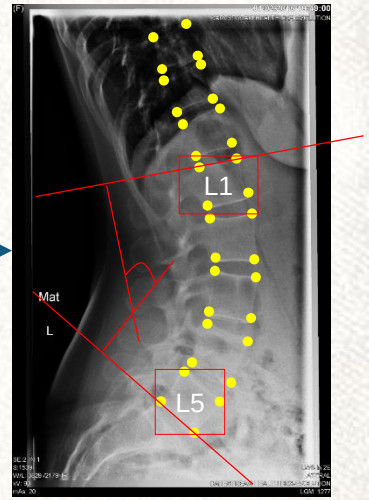


Vertebral corners



Calculation of relevant parameters

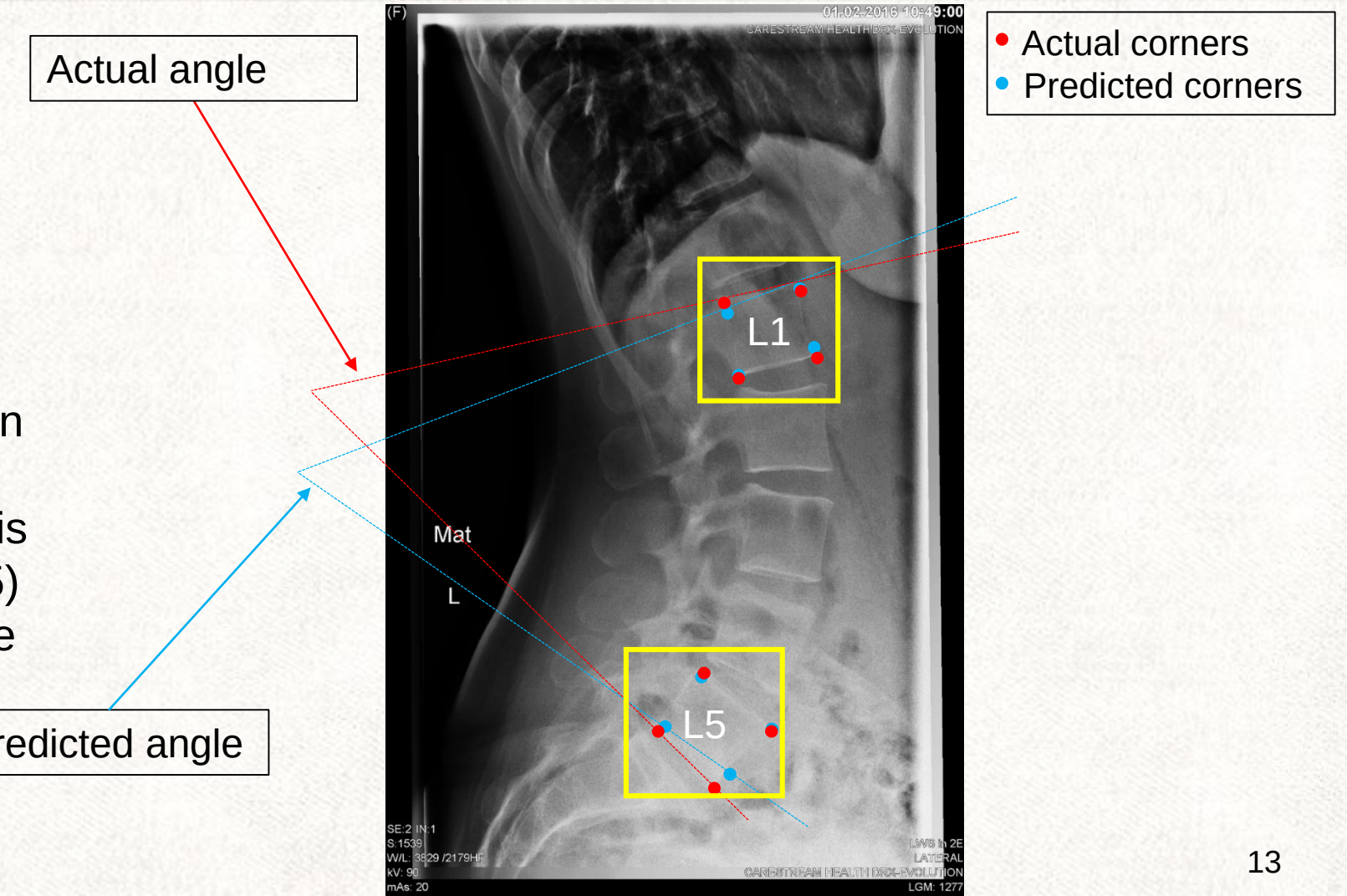
For example L1-L5 angle



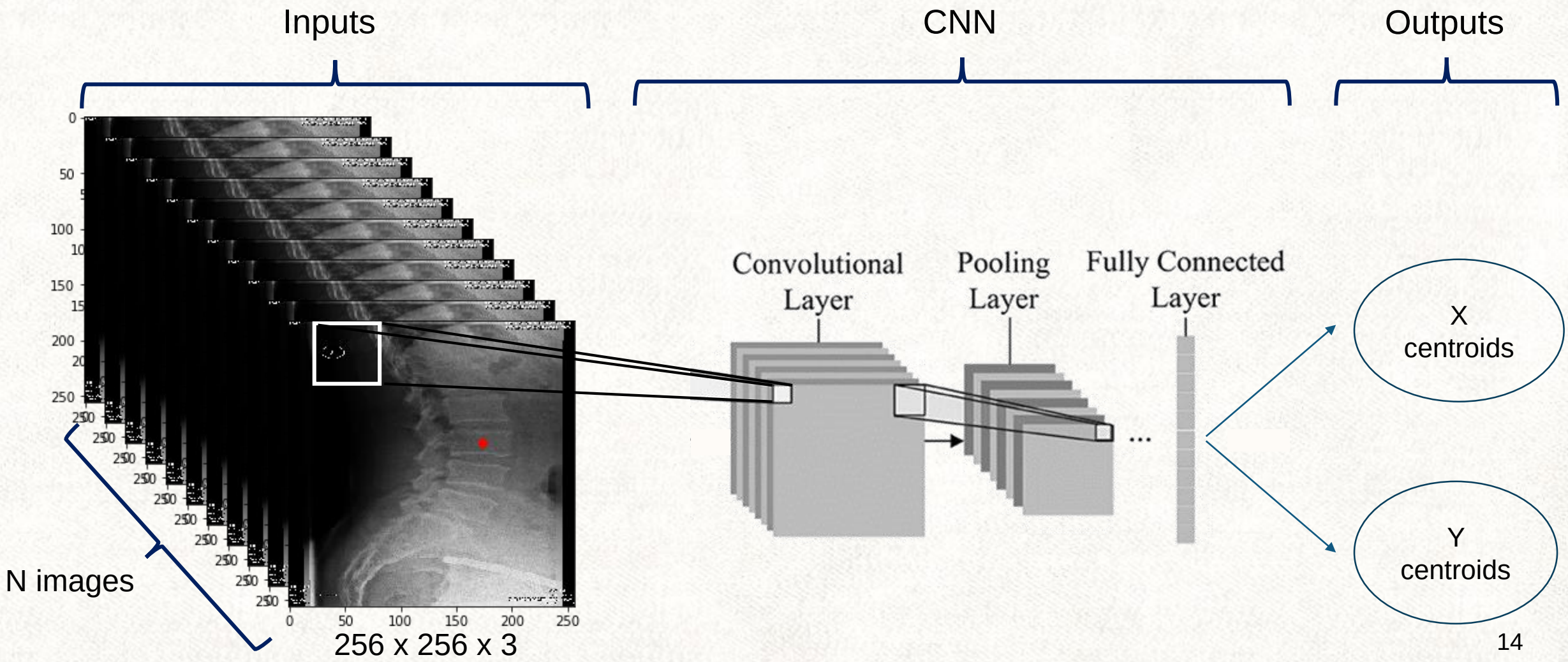
Example of L1-L5 lordosis angle calculation

Example of L1-L5 lordosis angle calculation:

1. Detect and identify vertebrae
2. Predict the vertebral corners
3. Calculate a straight line between the 2 points of interest both for real and predicted corners(in this case top of L1 and bottom of L5)
4. Calculate the angle between the lines
5. Evaluate the prediction

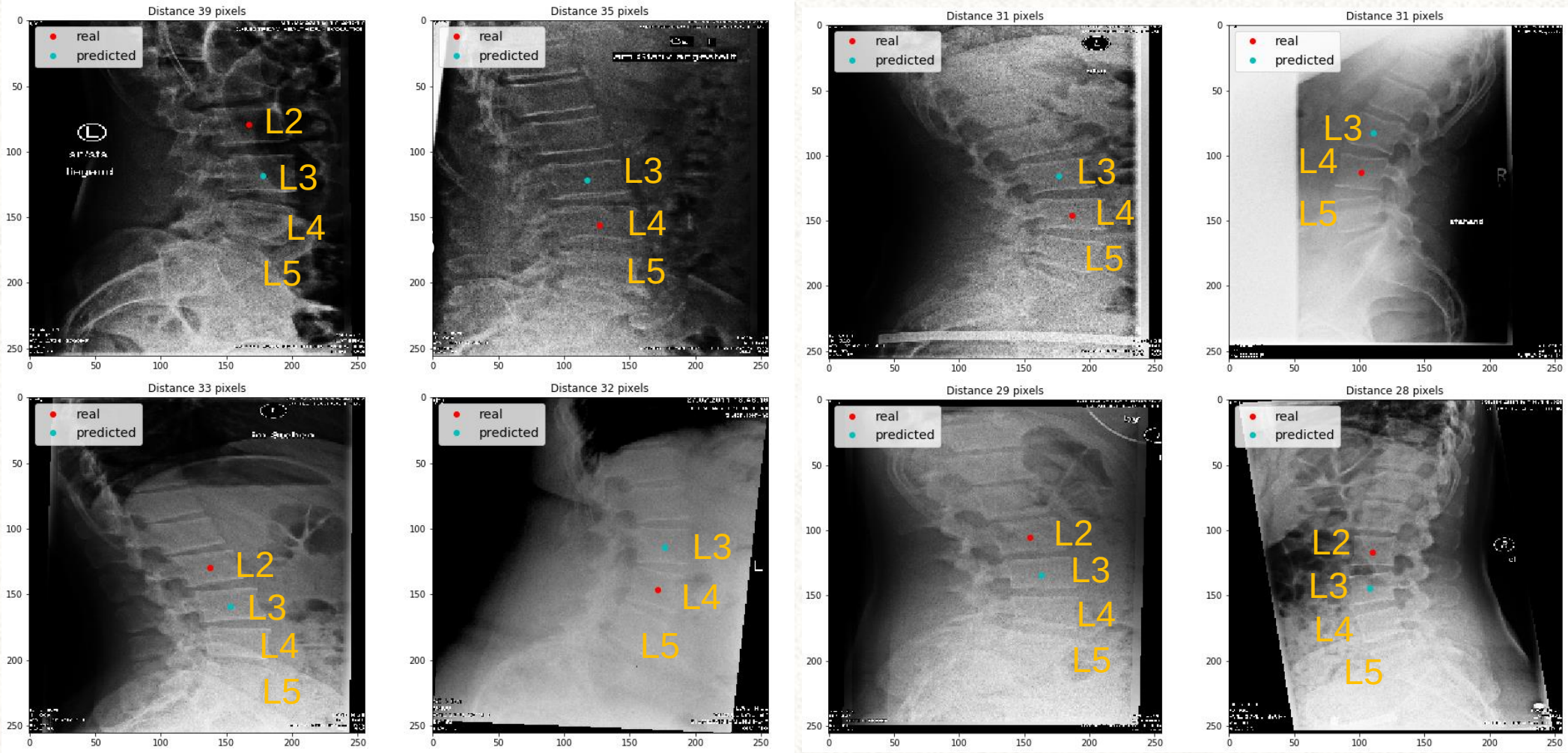


Early test to predict L3 centroid coordinates



8 worst predictions
according to distance between the predicted centroid and the actual centroid

	x	y
MAE (pixel)	1,27	1,91
MAPE (%)	0,9	1,6



Thank you!

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