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Educative games: the case study of an App to teach handwriting

Yves Rybarczyk, PhD.

Outline

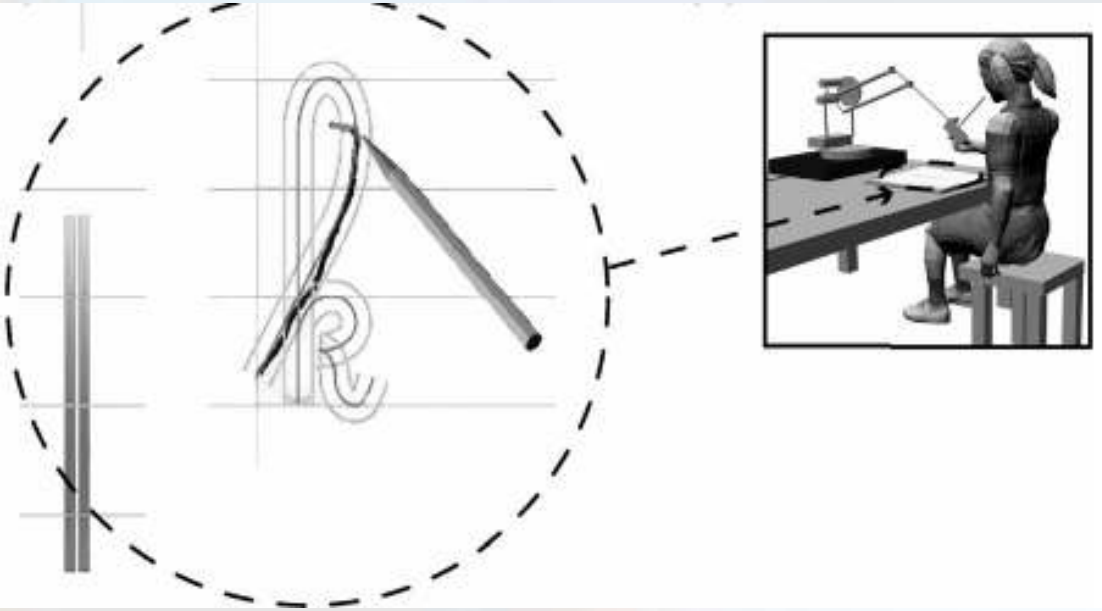
- Overview of gaming in education
- Examples of digital handwriting supports
- Proposal
- Game-based App implementation
- User testing
- Conclusions & perspectives

Gaming in education - challenges & trends

- *"Training the workforce of tomorrow with the high schools of today is like trying to teach kids about today's computers on a 50-year-old mainframe. It's the wrong tool for the times."* *(Bill Gates, 2005)*
- Consciousness to prepare students for *what* and *how* they will learn in the 21st century: much more technology driven
- Increasing interest of the educational establishments to use digital games as serious learning & assessment tools
- Digital games are seen to promote:
  - Skill reinforcement
  - Engagement & motivation
  - Effective & less intrusive assessment
  - Personalized learning
  - …

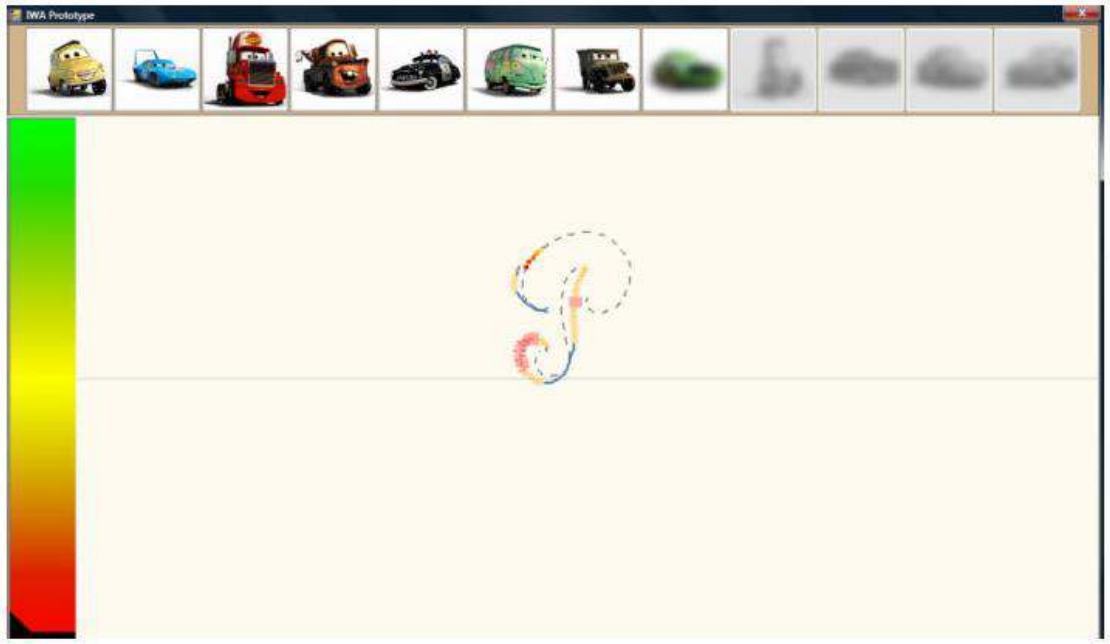
Handwriting teaching systems

- **Telemaque** *(Palluel-Germain et al., 2007)*



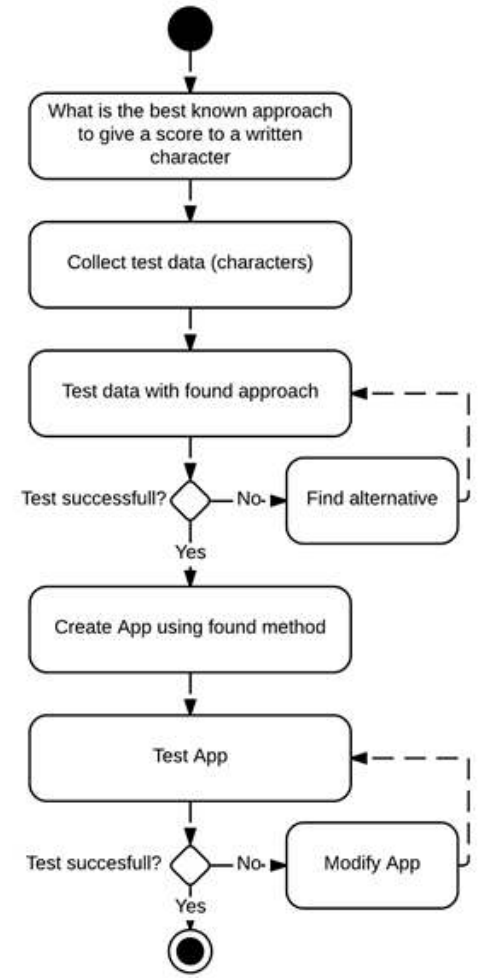
Handwriting teaching systems

- **IWA** *(Pereira et al., 2009)*



Proposal

- Improve the handwriting skills of children by use of a tablet



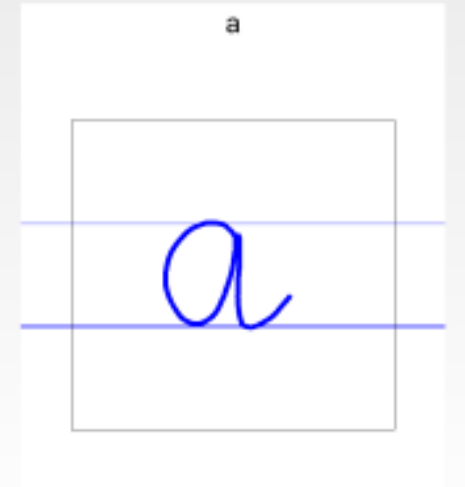
Method 1 - pure machine learning

- Using Weka software & testing with a 10-fold cross-validation
  - Results with the MNIST handwritten number dataset:

Classifier	Successful classification
J48 Decision Tree	82.5%
Naïve Bayes	84.3%
K-Nearest Neighbor (Lazy IBK)	96.9%

Method 1 - pure machine learning

– Results with handwriting alphabetic characters:



Classifier	Successful classification
J48 Decision Tree	38.6%
Naïve Bayes	73.9%
K-Nearest Neighbor (Lazy IBK)	61.8%

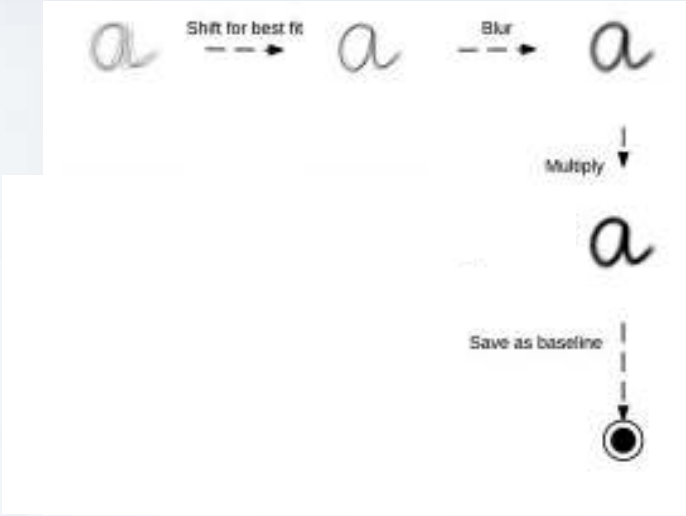
Alternative method required

Method 2 - machine learning + image processing

- Image processing

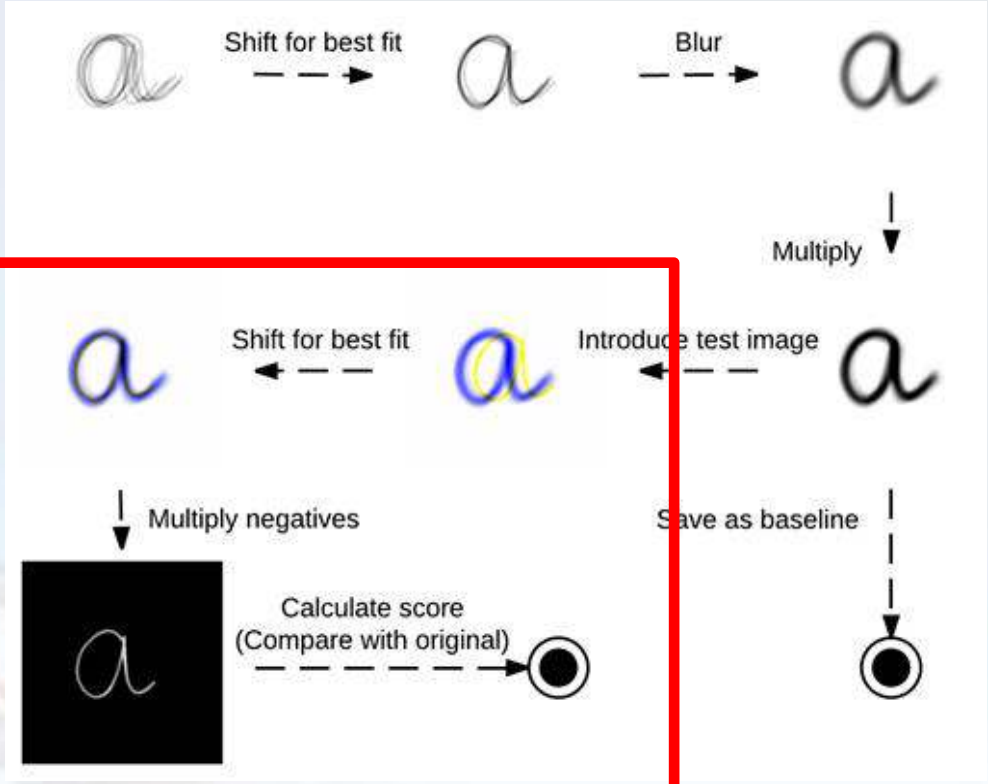
  For each character, an image type (or baseline) is built from a combination of images of the same character, such as images are:

  - centred
  - blurred
  - multiplied
  - saved



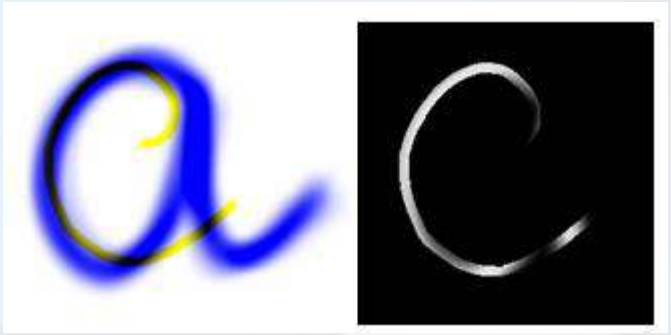
Method 2 - machine learning + image processing

- Character classification
  - The image trial is:
    - introduced
    - centred
  - Trial & baseline pixels are:
    - inverted (=> ideal line is white)
    - multiplied



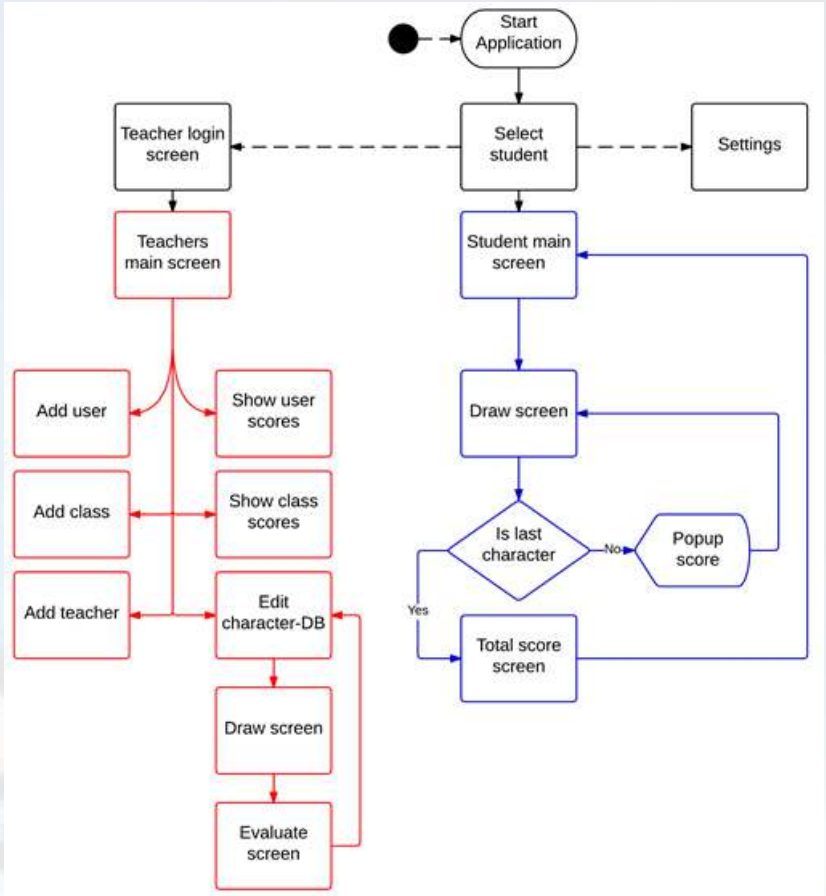
Method 2 - machine learning + image processing

- Result
  - Example:
    - trial ‘c’ / baseline ‘a’

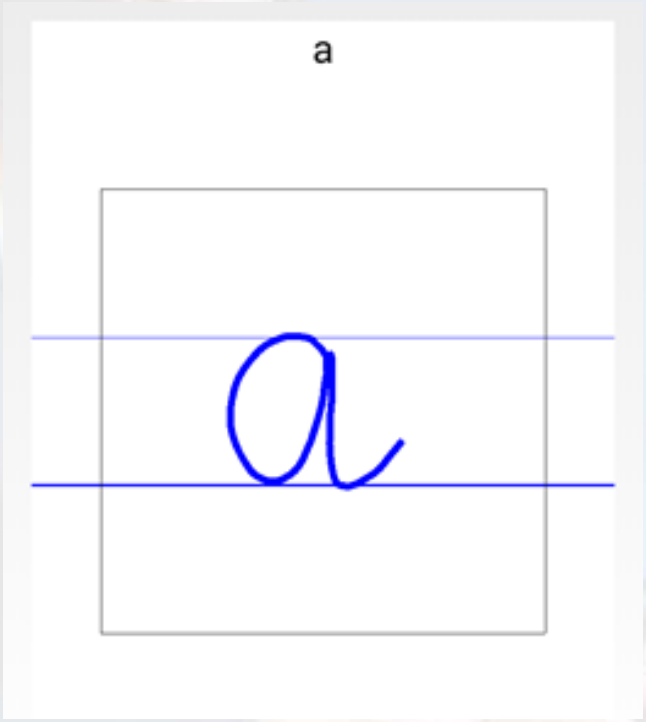


  - Overall:
    - more than **90% of correct classification**

App development - architecture

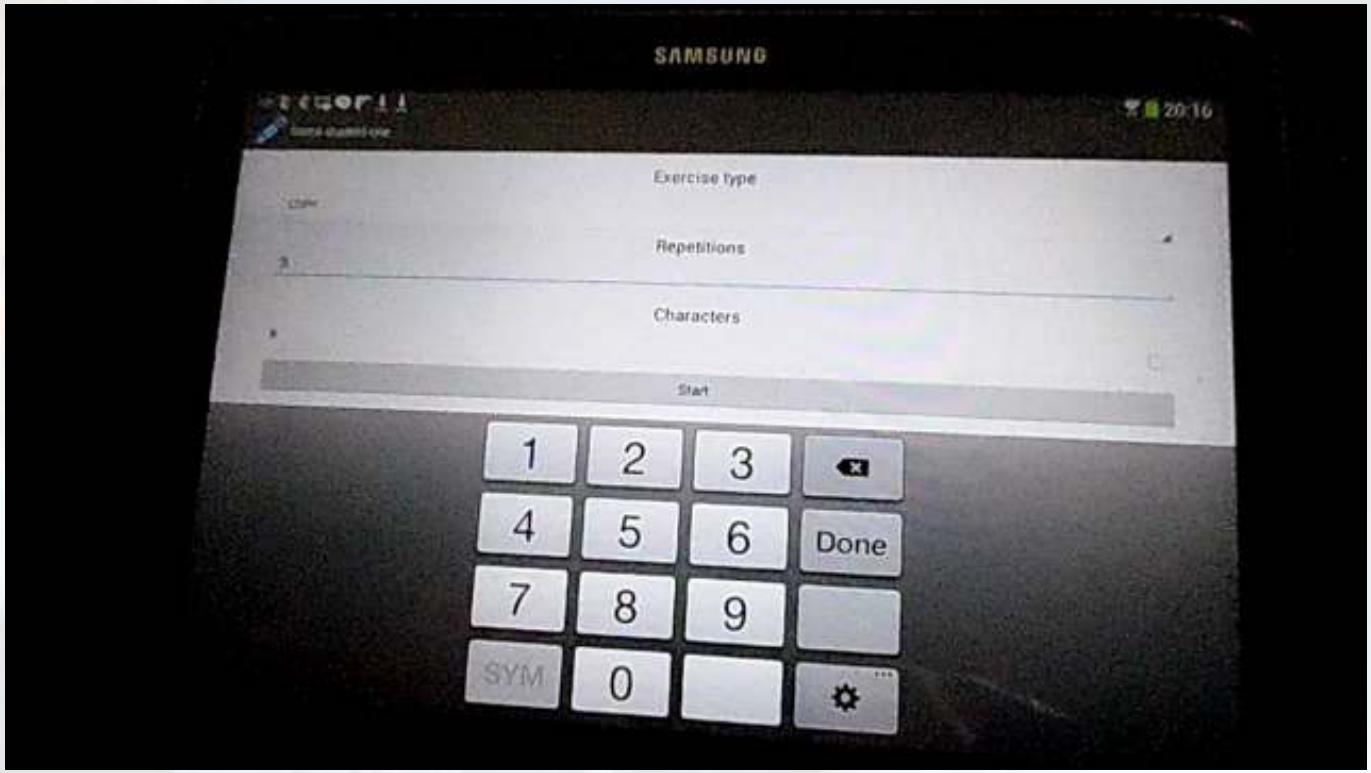


App development - user's interface



Demo - copy

Demo - draw


SAMSUNG
20:16
Exercise type
Repetitions
Characters
Start
1
2
3
4
5
6
Done
7
8
9
SYM
0

User testing

- Participants

  13 students (6-11 years old)

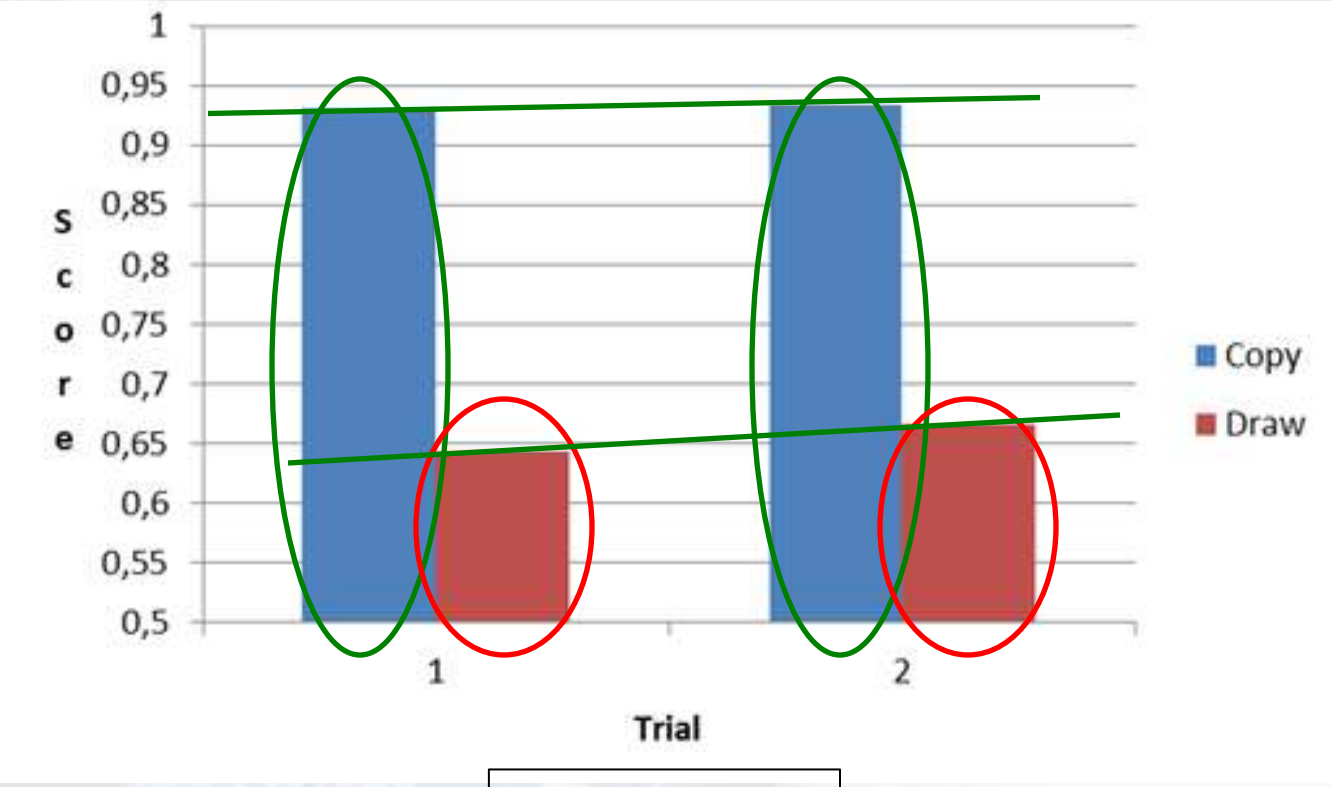
- Task

  Handwrite 10 different characters twice

- Experimental design

	1st trial	2nd trial
7 participants	copy	draw
6 participants	draw	copy

Results



$Z = 3.18$; $p < .01$

Conclusions

- **Strengths**
  - High percentage of handwriting recognition (> 90%)
  - Promising approach to promote an autonomous way of learning
- **Weaknesses**
  - Tablets tend to increase jerk in children
  - Naturalness of the hand's position (e.g., wrist cannot get inside the drawing area)

Perspectives

- **Development**
  - Take into account starting point and movement direction
  - Transform the application into a complete serious game (i.e., find a narrative)
  - Use game monitoring to adapt the level of difficulty according to child's performances
- **Evaluation**
  - Longitudinal study on a larger period of time
  - Transversal study by comparison to a control group

People involved

UNIVERSIDAD INDOAMERICA

MIST Mecatrónica y Sistemas Interactivos

Authors

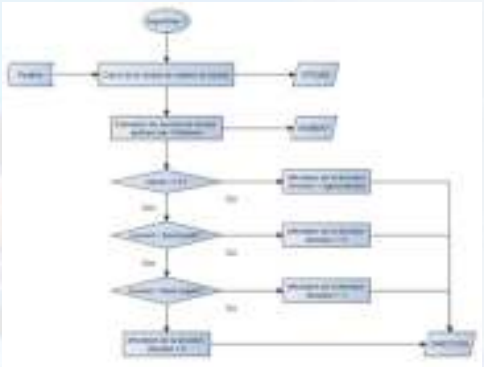
- **Steven Sybenga**
  University of Twente (The Netherlands)
- **Yves Rybarczyk**
  MIST - Universidad Tecnológica Indoamérica (Ecuador)

Collaborations

- Escola Branca (Caparica Monte, Portugal)
- Colégio Campo de Flores (Charneca da Caparica, Portugal)
- Colégio A Formiguinha (Sintra, Portugal)

Dominios de investigación del MIST

- Sistemas mecánicos poliarticulados
- Electrónica embarcada y móvil
- Programación y sistemas comunicantes
- Procesos industriales
- Interacción persona-máquina



Ejes aplicativos del MIST

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Mecatrónica & Sistemas Interactivos

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