Diseño de escenarios interactivos de aprendizaje con realidad aumentada para experiencias de computación creativa

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Facultad de Informática
Universidad Complutense de Madrid

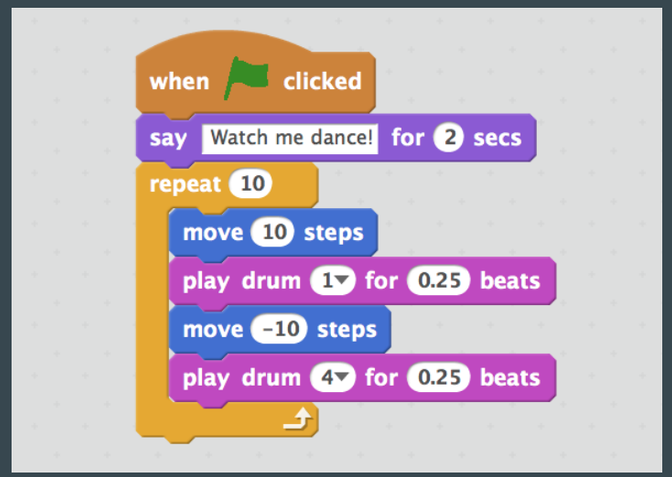
Juan Manuel Dodero Beardo
Software Process Improvement Research Group
Departamento de Ingeniería Informática
Universidad de Cádiz
juanma.dodero@uca.es

UNIVERSIDAD COMPLUTENSE MADRID

UCA Universidad de Cádiz

What is Creative Computing?

(Brennan, Balch & Chung – Harvard Grad School of Education)



CC is about Creativity

CS and computing-related fields have long been introduced to [young] people disconnected from their interests– emphasizing technical detail over creative potential

CC is about Empowerment

Many [young] people with access to computers participate as consumers, rather than designers or creators

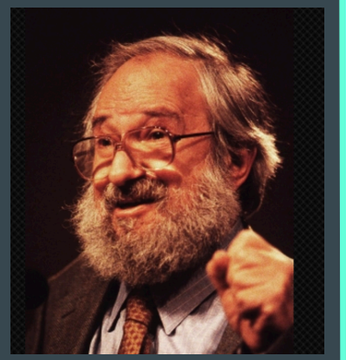
CC is about… Computing

Creating computational artifacts supports [young] people's development as computational thinkers in all aspects of their lives, across disciplines and contexts

Antecedents

Computational Thinking

> Seymour Papert (1981)
"programming the computer to [...] establish an intimate contact with some of the deepest ideas from science, from maths, and from the art of intellectual model building."



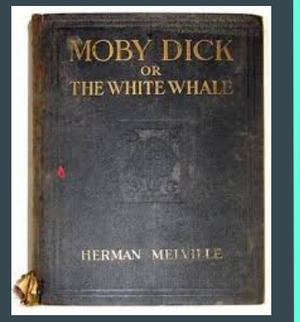
> Jeannette M. Wing (2006)

> STEM

Computing and Humanities (STEAM)

> S. Krishnamurthi (Brown U.)
"we are just overly intoxicated with computer science"

> English student (Stanford):
"I don't see myself as having skills missing [...] When you are analyzing Melville, you have to unpack that language and synthesize it back"



Computing in Education

> Mark Guzdial (Georgia Tech)

"There is no reliable research showing that computing makes one more creative or more able to problem-solve."

"For the same reasons people should understand biology, chemistry or physics, it makes a lot of sense to understand computing in our lives"

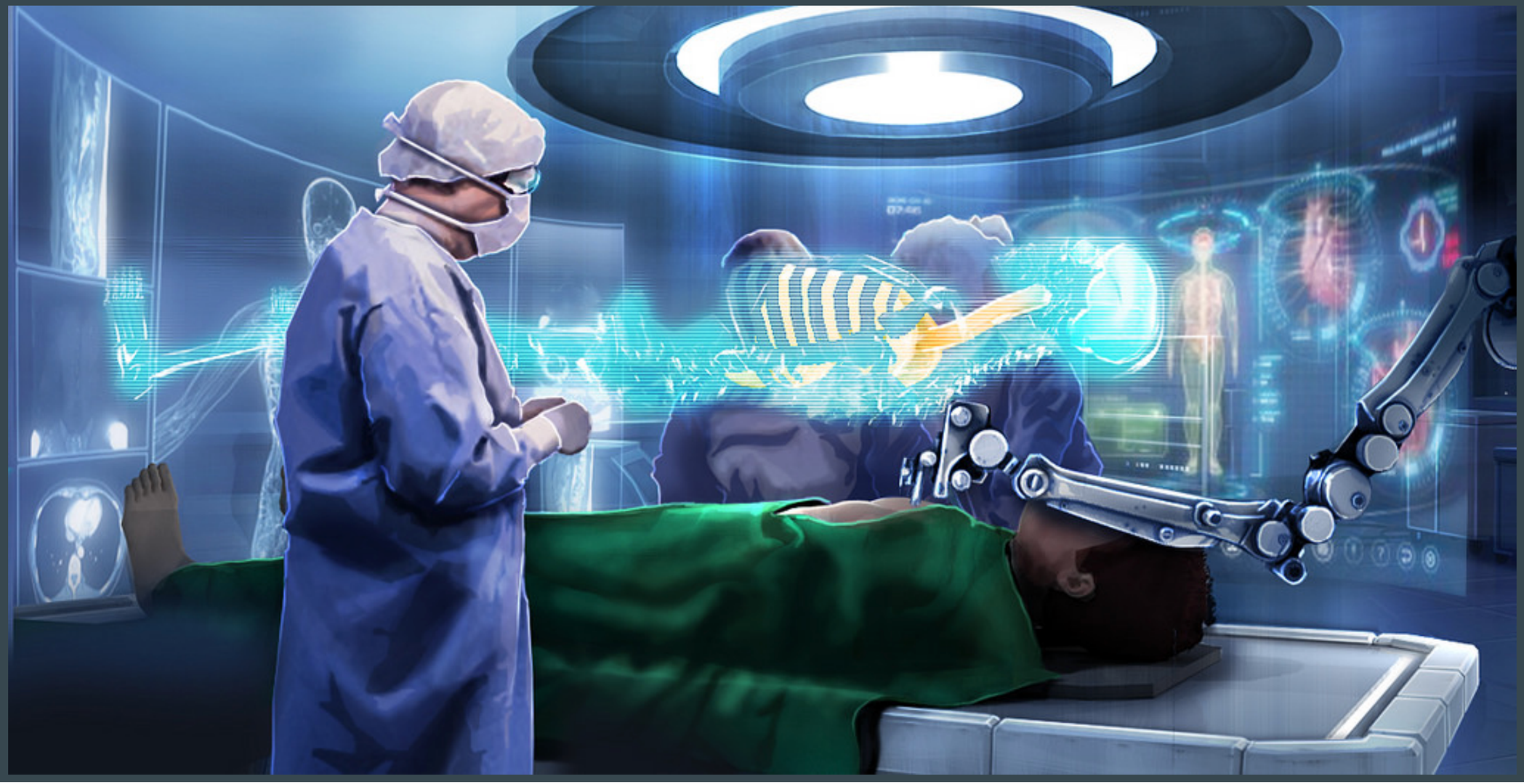
> STEM+C

Program or be programmed

The debate over whether the Net is good or bad for us fills the airwaves and the blogosphere. But for all the heat of claim and counter-claim, the argument is essentially beside the point: it's here; it's everywhere. The real question is, do we direct technology, or do we let ourselves be directed by it and those who have mastered it? “Choose the former," writes Rushkoff, “and you gain access to the control panel of civilization. Choose the latter, and it could be the last real choice you get to make."

But... in a mobile world context

with a mixed reality...



gestural interactions...

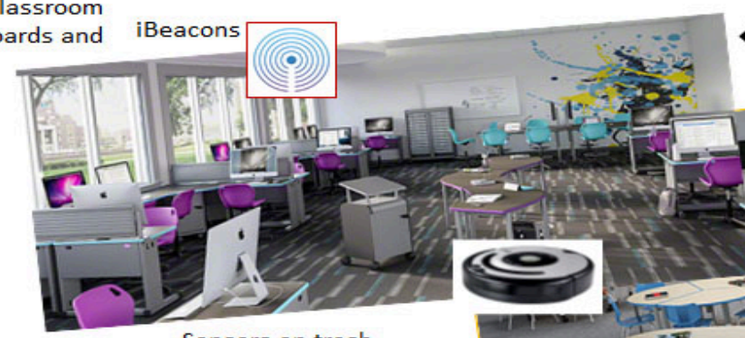
empowered by gadgets and wearables...

...in a cyber-physical *brave new world*

Personalized learning with adaptive eTextbooks

Digital classroom white boards and display

iBeacons



Complete coverage with high performance Wi-Fi

Wearables for athletics and attendance tracking

Video recorders for lecture capture

Supplies and inventory tracking by sensor with auto-reorder

International Collaboration and social exchange

Online testing

Sensors on trash receptacles

Robot cleaning

Augmented and virtual reality

Makerspaces with 3D printers and laser trimmers

Student devices & eTextbooks

- Notebooks
- Tablets
- Smartphones

Robotics for STEM and remote presence

Internet of Things-based HVAC

Monitor and display of air quality throughout school

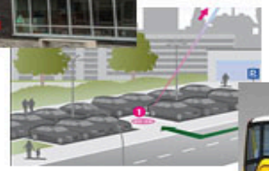
File and program storage, local or cloud-based

- Demographics, academics, behavior, interests
- LMS, CMS, SIS
- Educational programs and applications
- Video files: lectures and recorded lab experiments

Surveillance security cameras

Wi-Fi sensors and locks

- Entrances and exits
- Classroom doors

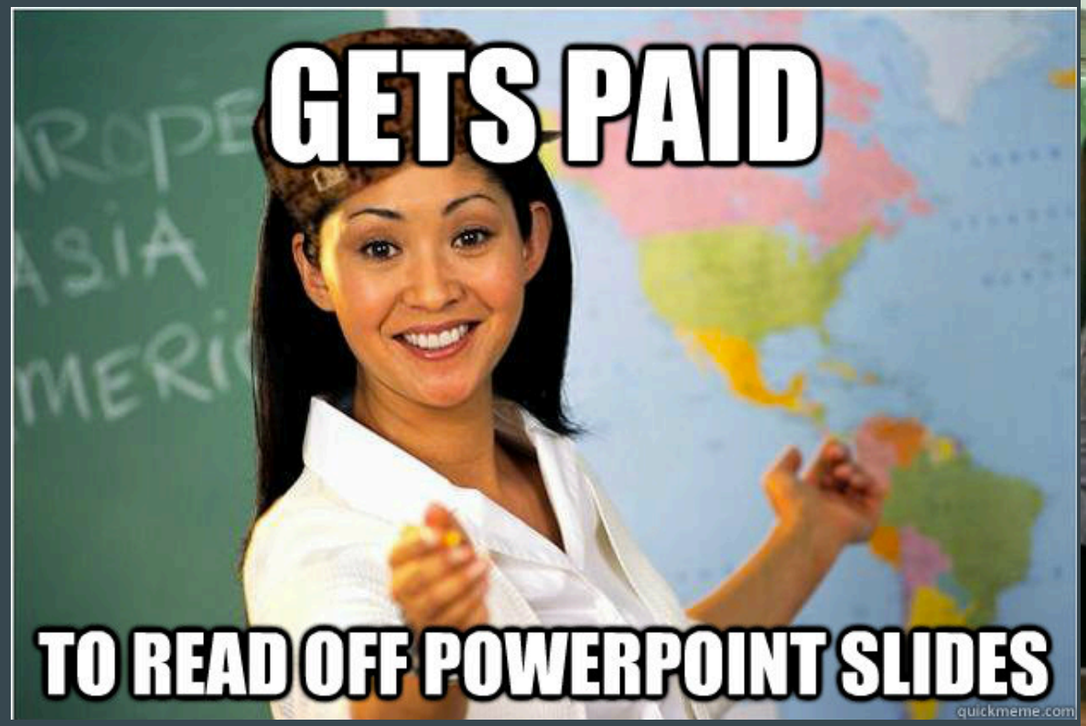


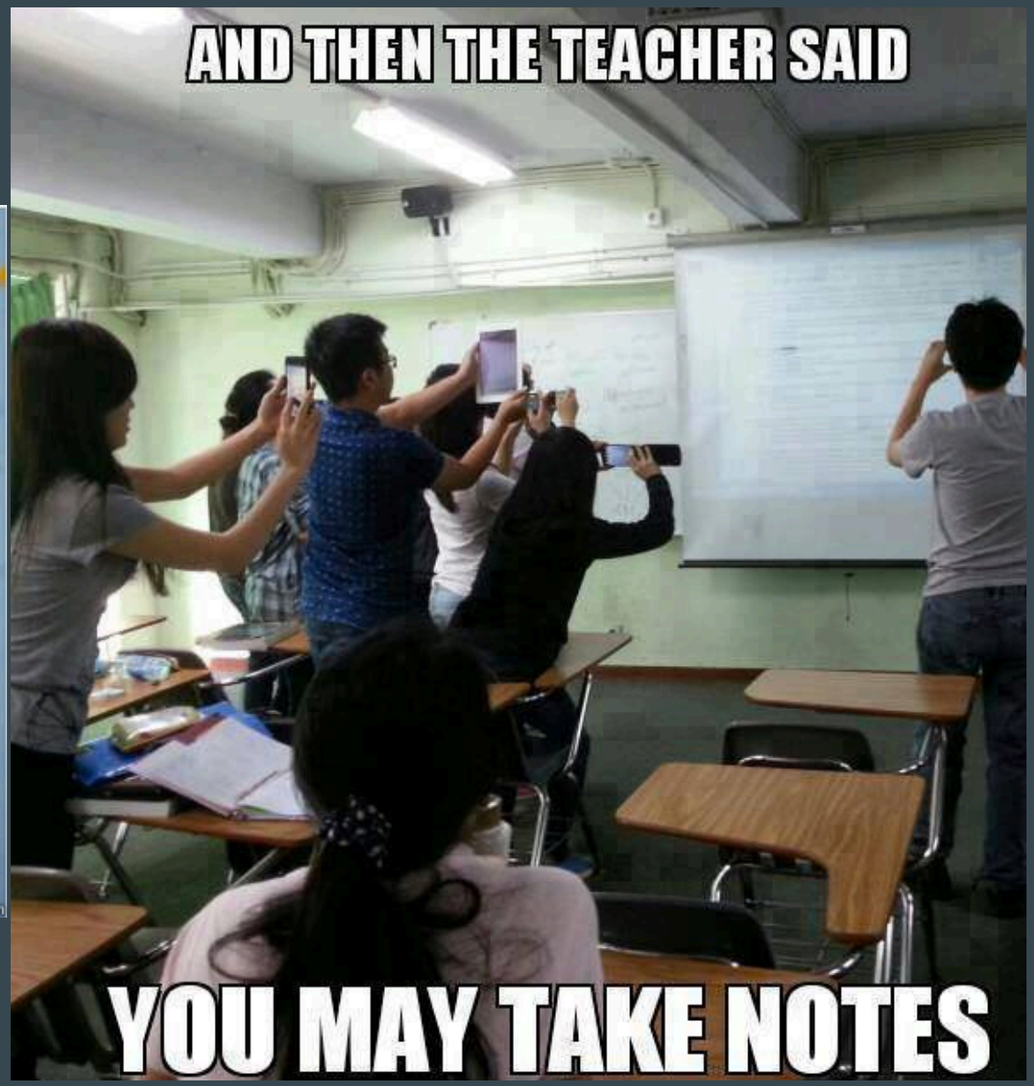
Sensors track buses and verify student passengers

Network application analytics to monitor devices and network behavior

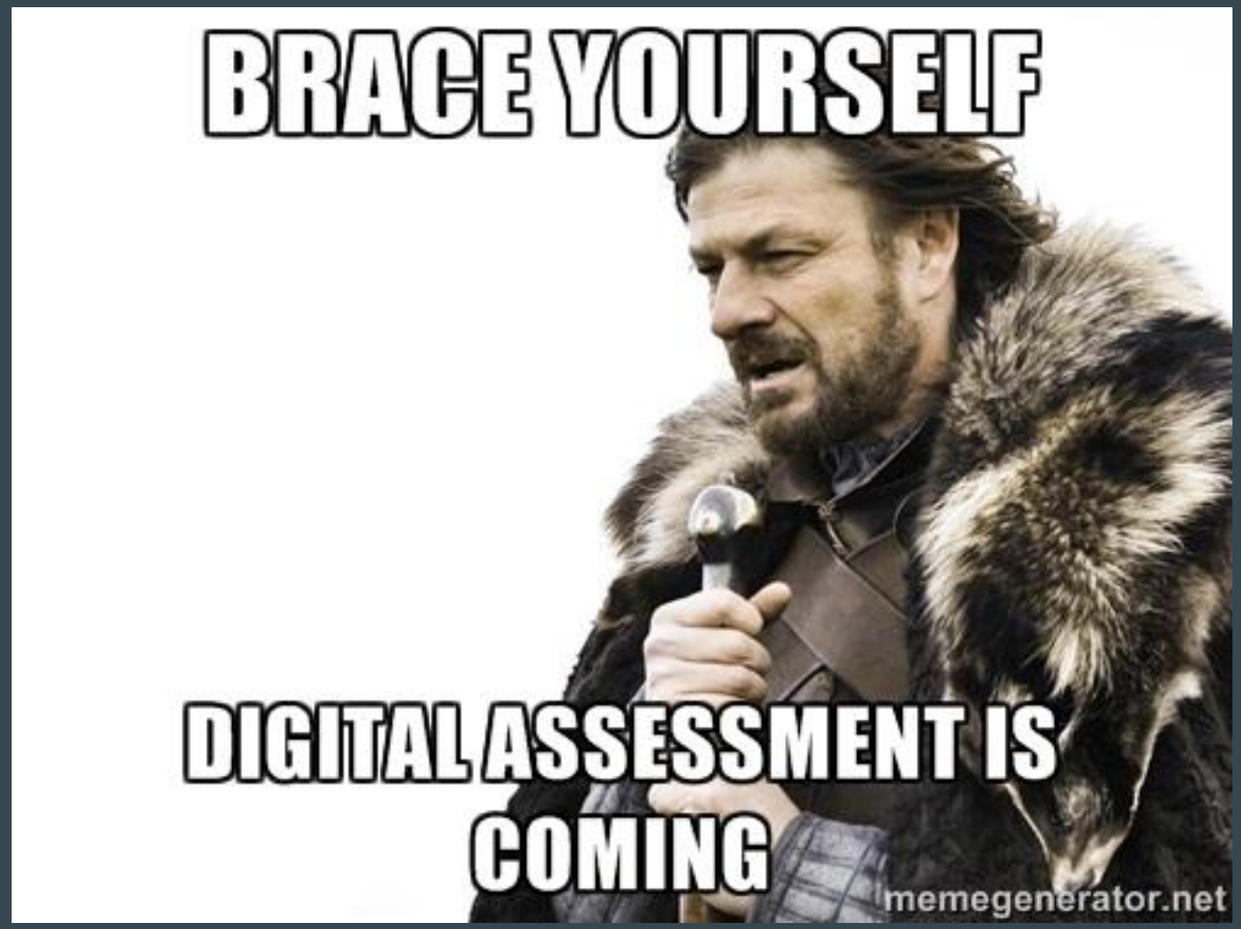
Sensors in parking lot and driveways

Where is the teacher?

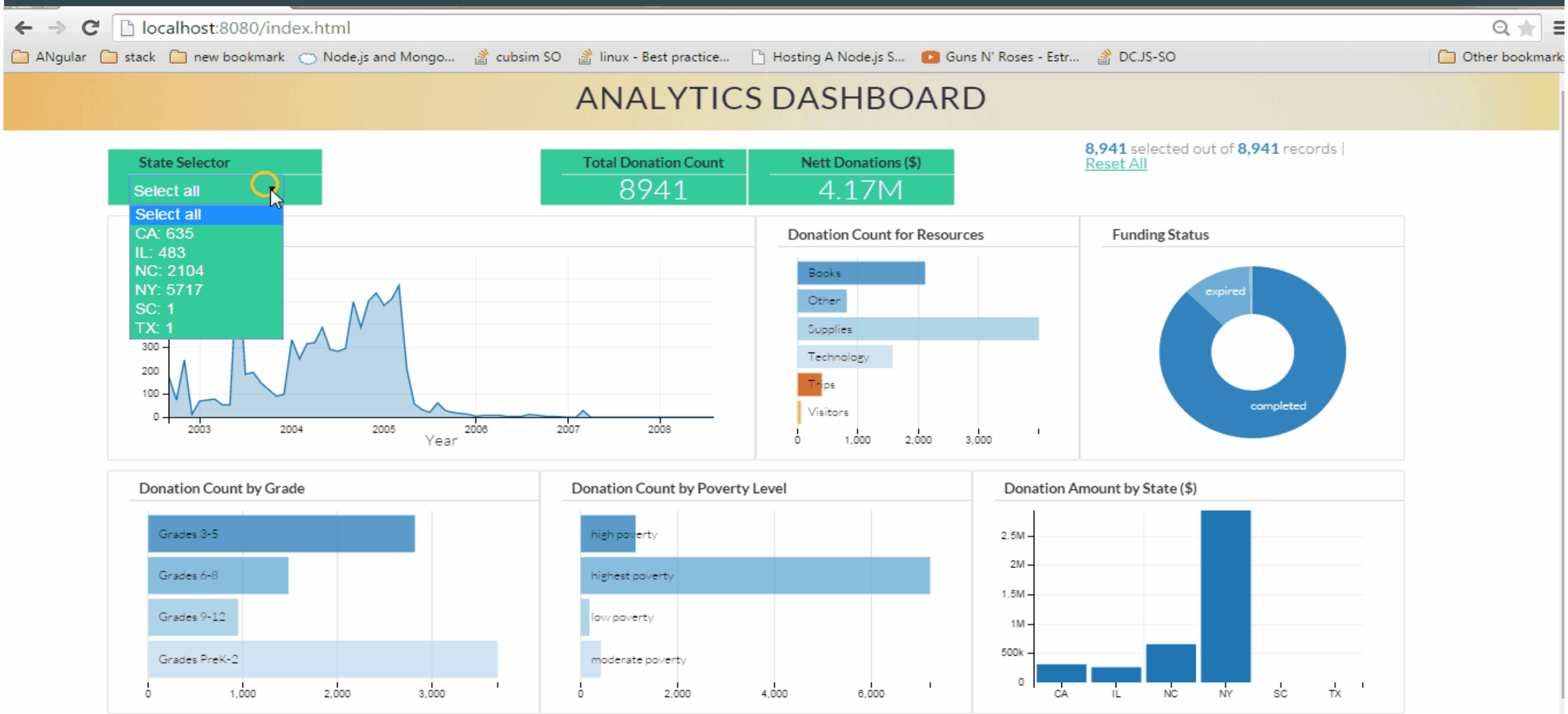




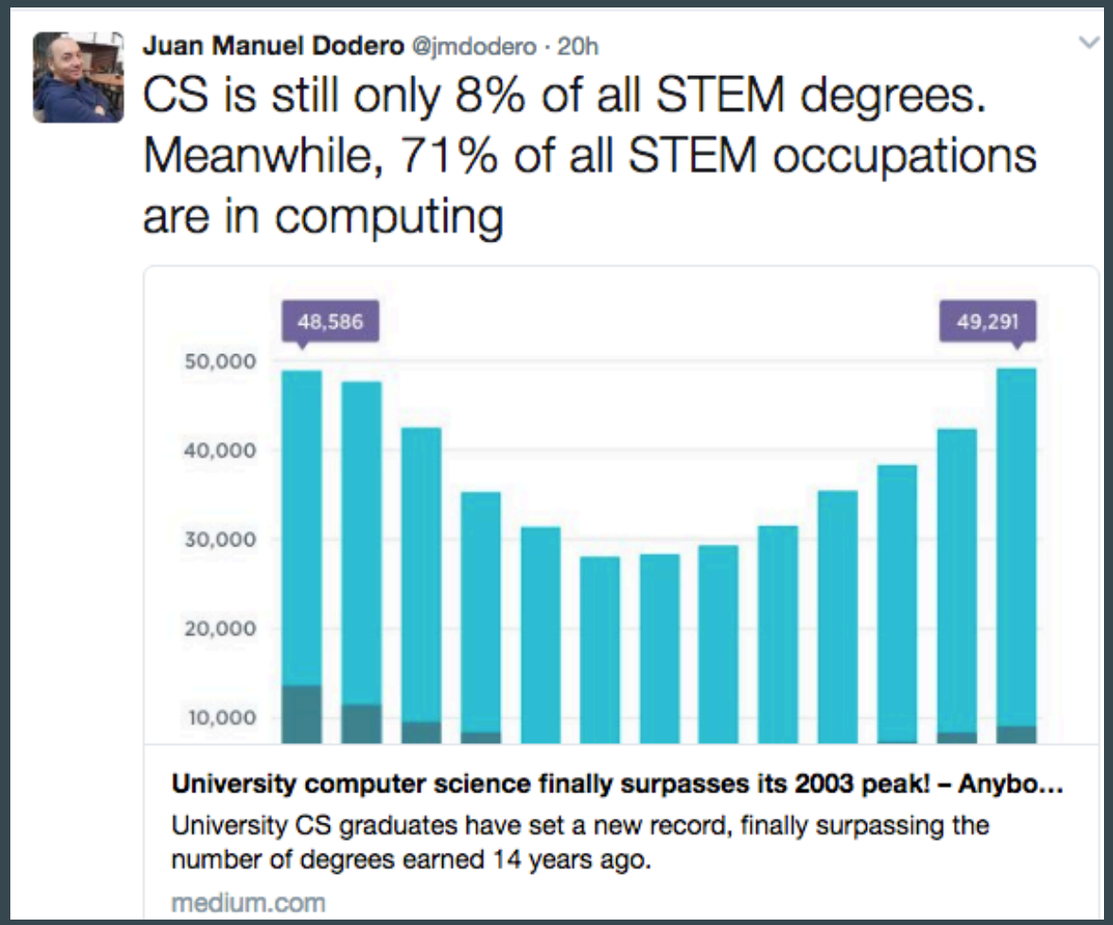
What about assessment?



Learning Analytics: Who is going to build this?

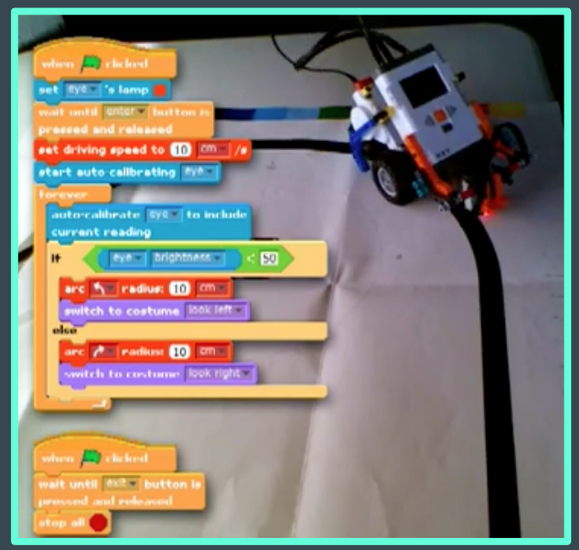


Computer Scientists only?

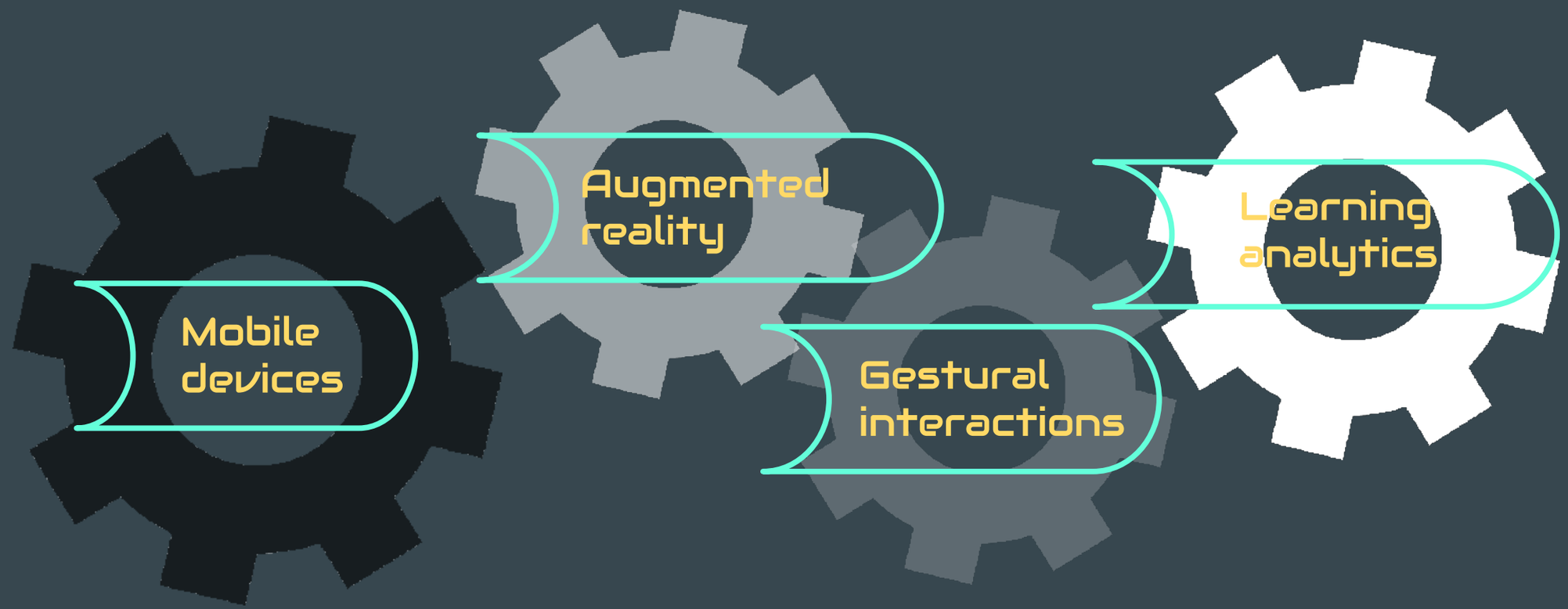


Motivation

Involve teachers in the creation of their own extended {mobile, AR, gestural,...} learning scenarios using creative computing



Focus


Mobile devices
Augmented reality
Gestural interactions
Learning analytics

State of the art: e.g. augmented reality tools

For programmers

Qualcomm vuforia

ARTOOLKIT

metaio

wikitude

For non programmers

AUGMENT

AURASMA

Aumentaty
El valor de la Realidad Aumentada

colAR Mix

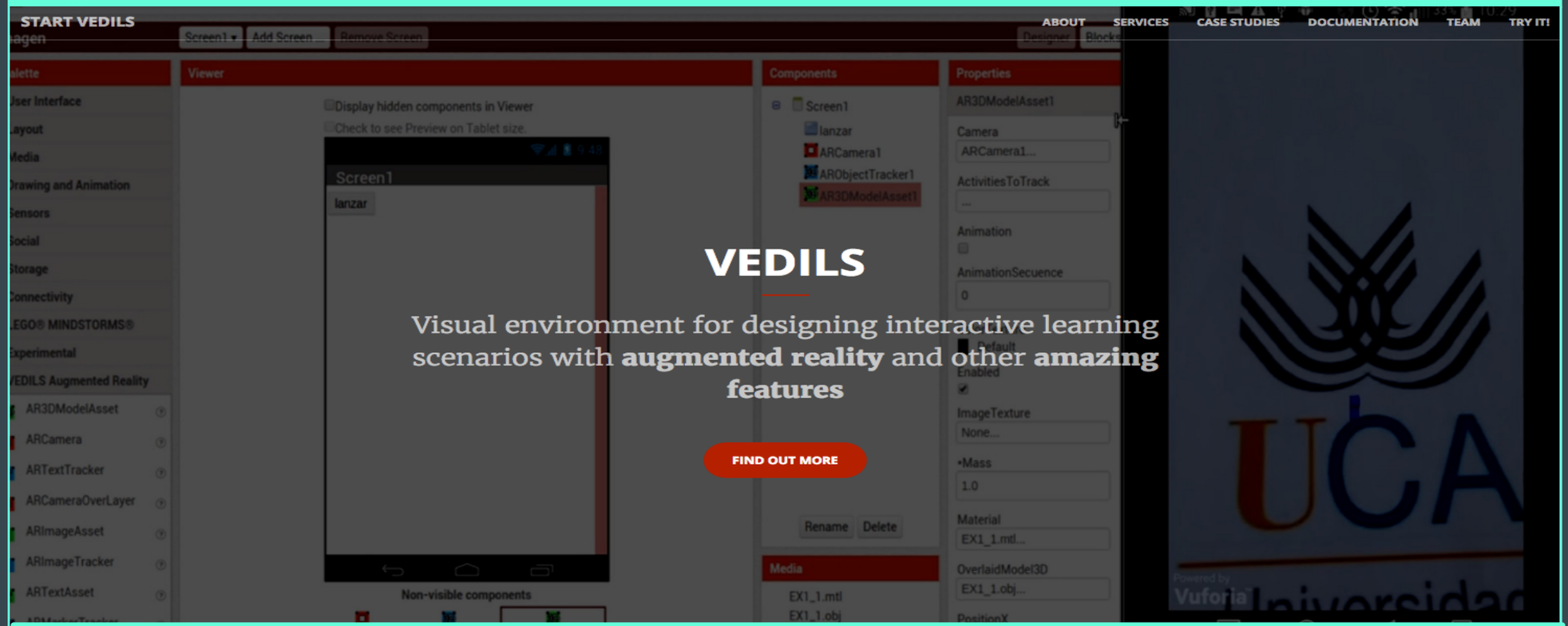
General hypothesis

Visual programming languages can help to develop creative computing abilities to build such **extended** learning scenarios

...

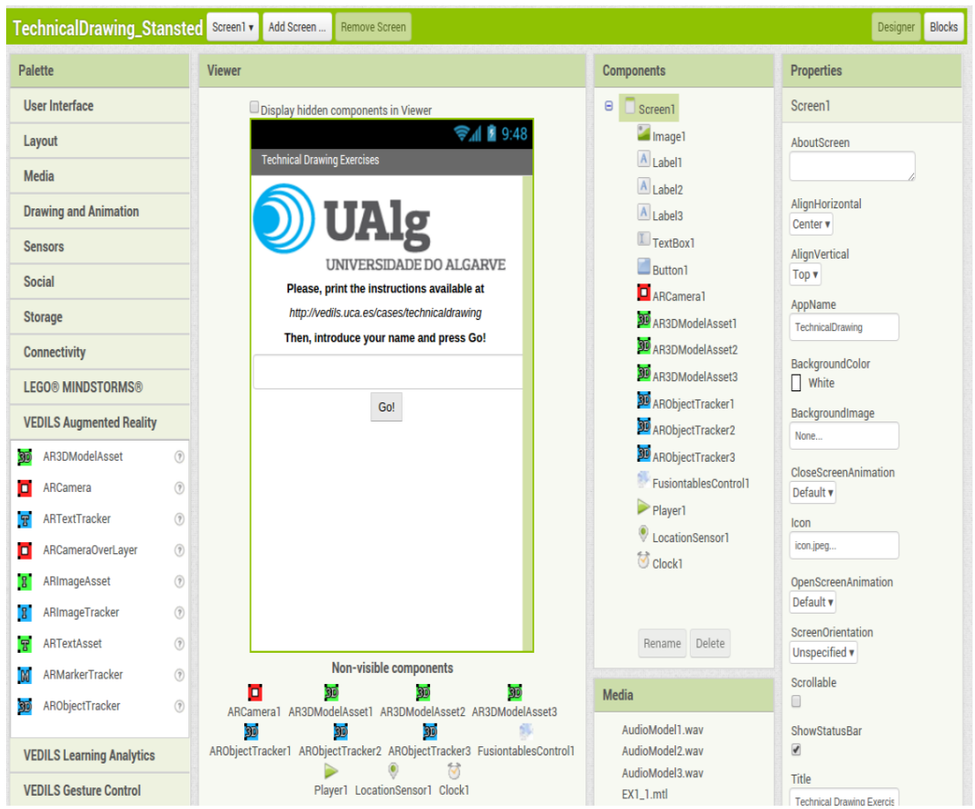
State of the art: Visual Languages

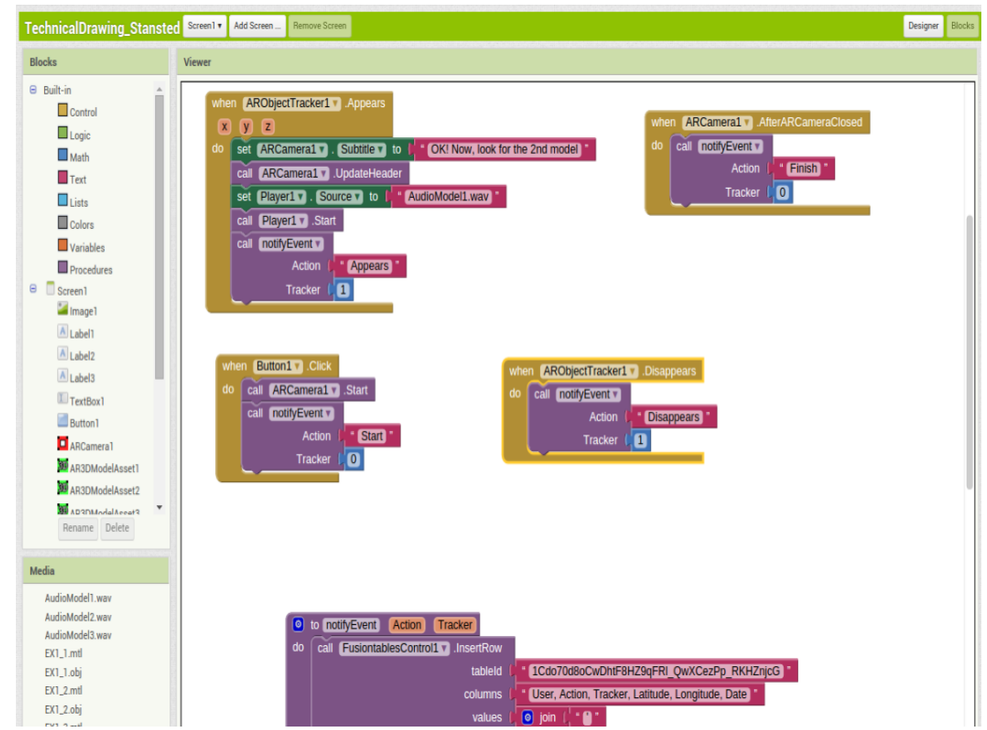
Authoring framework



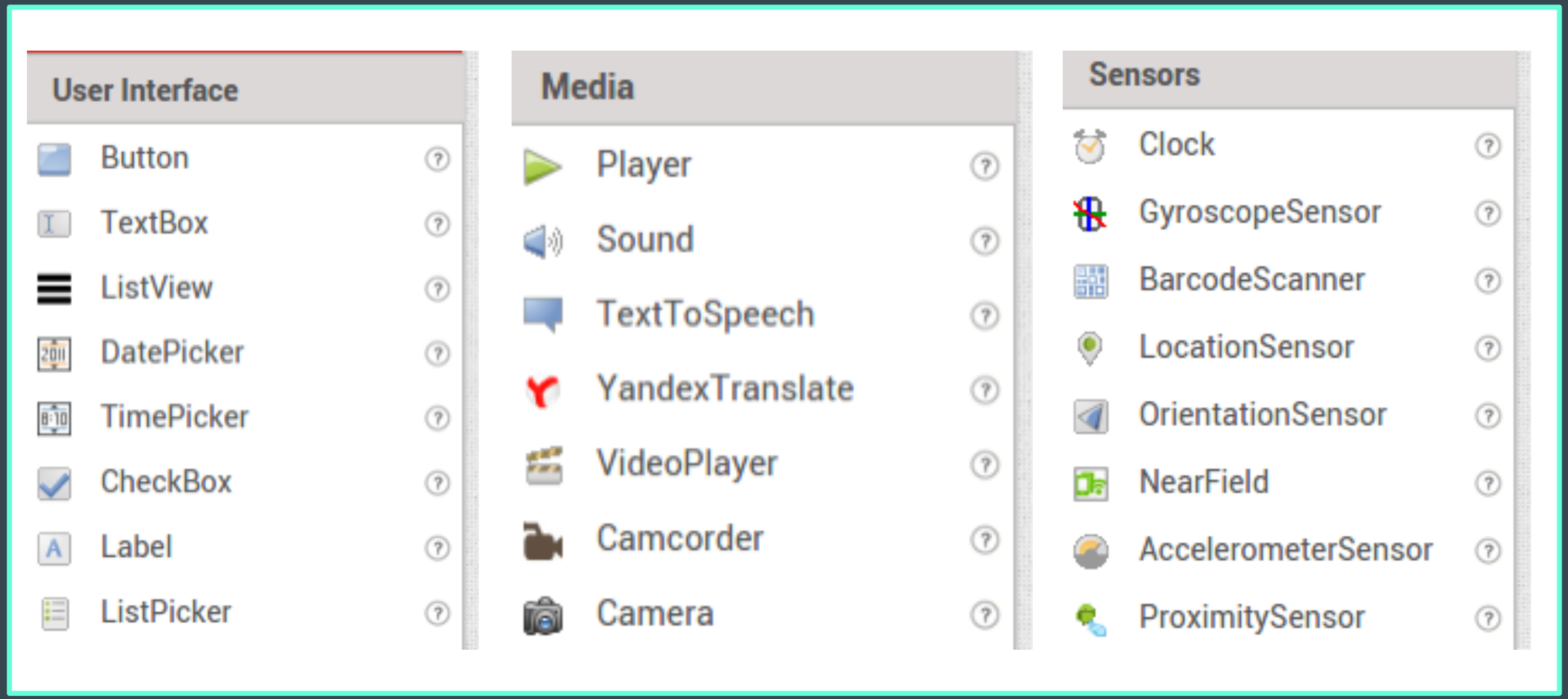
http://vedils.uca.es

Based on AppInventor





Existing components



Specific objectives

Augmented reality

> Marker, text and image recognizing

3D Engine

> 3D interactive objects (.OBJ, .3DS, .MD2, etc.)

Gesture interaction

> Hand gestures
> Arm movements

Learning analytics

> Cloud store of interaction data
> Queries + datatables + charts

Qualcomm vuforia

GPCT

[fusiontables]

Extensions

Augmented reality
> Marker, text and image recognizing

3D Engine
> 3D interactive objects (.OBJ, .3DS, .MD2, etc.)

Gesture interaction
> Hand/arm gestures

Learning analytics
> Cloud store of interaction data
> Queries + datatables + charts

VEDILS Augmented Reality

- AR3DModelAsset
- ARCamera
- ARCameraOverLayer
- ARImageAsset
- ARImageTracker
- ARMarkerTracker
- ARObjectTracker
- ARTextAsset
- ARTextTracker

VEDILS Interactions

- ArmbandGestureSensor
- BrainwaveSensor
- HandGestureSenso

VEDILS Communications

- DeviceInfo
- GoogleCloudMessaging
- ThingSpeakLocationSensor

VEDILS Learning Analytics

- ActivityAggregationQuery
- ActivitySimpleQuery
- ActivityTracker
- Chart
- DataTable

Qualcomm vuforia

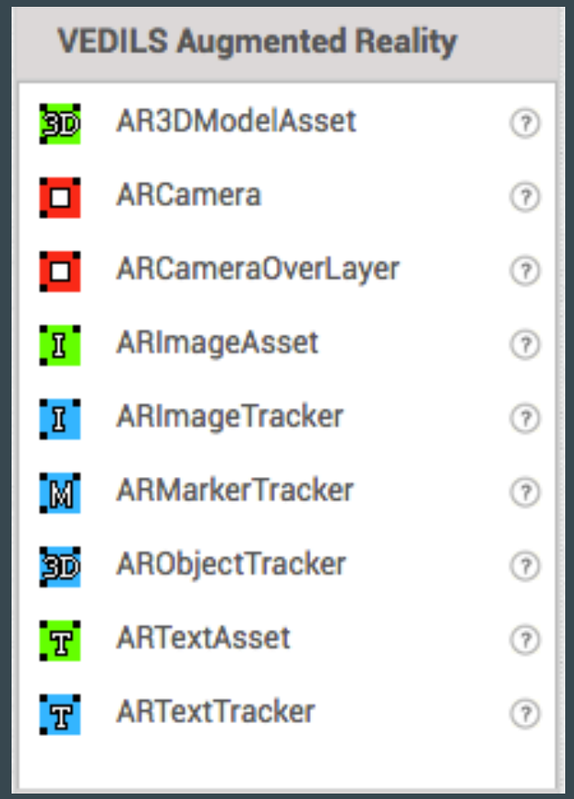
LEAP

[fusiontables]

Specific objective 1

Extension of the visual language to build augmented-reality mobile apps

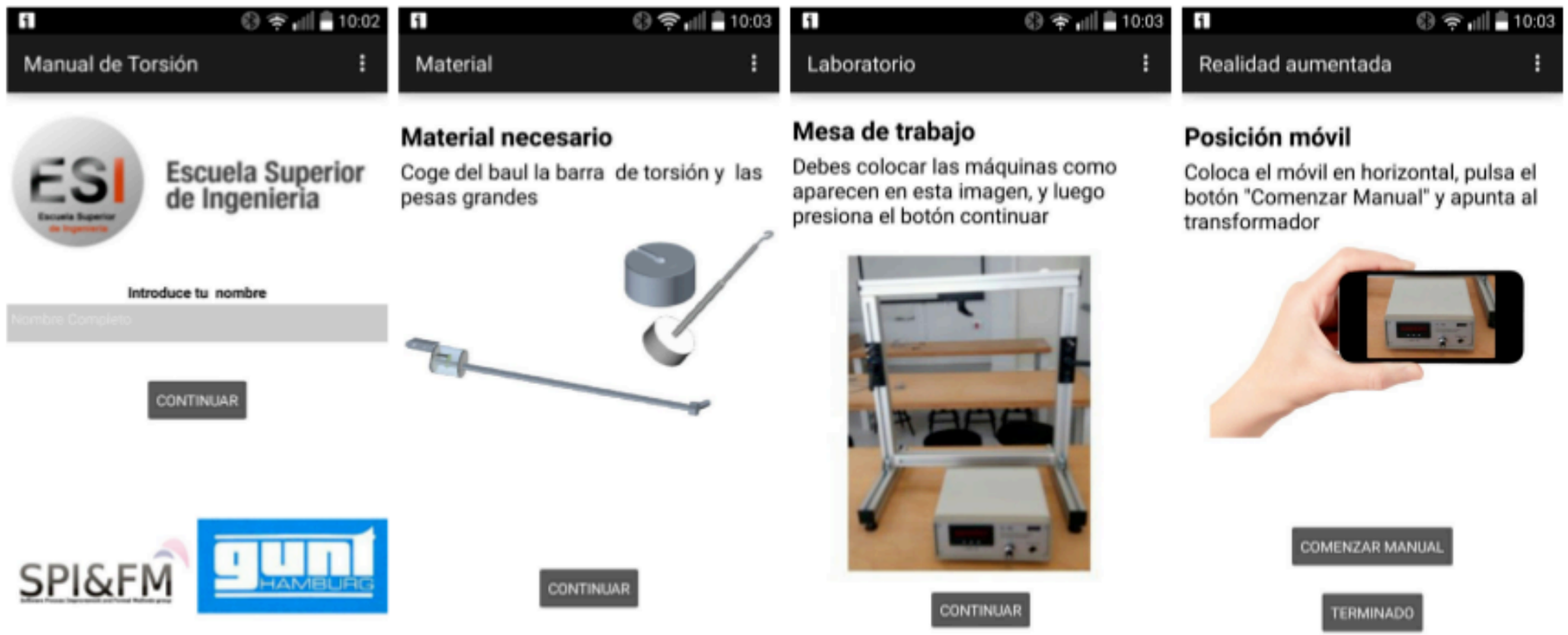
VEDILS AR components



Case study: material resistance lab

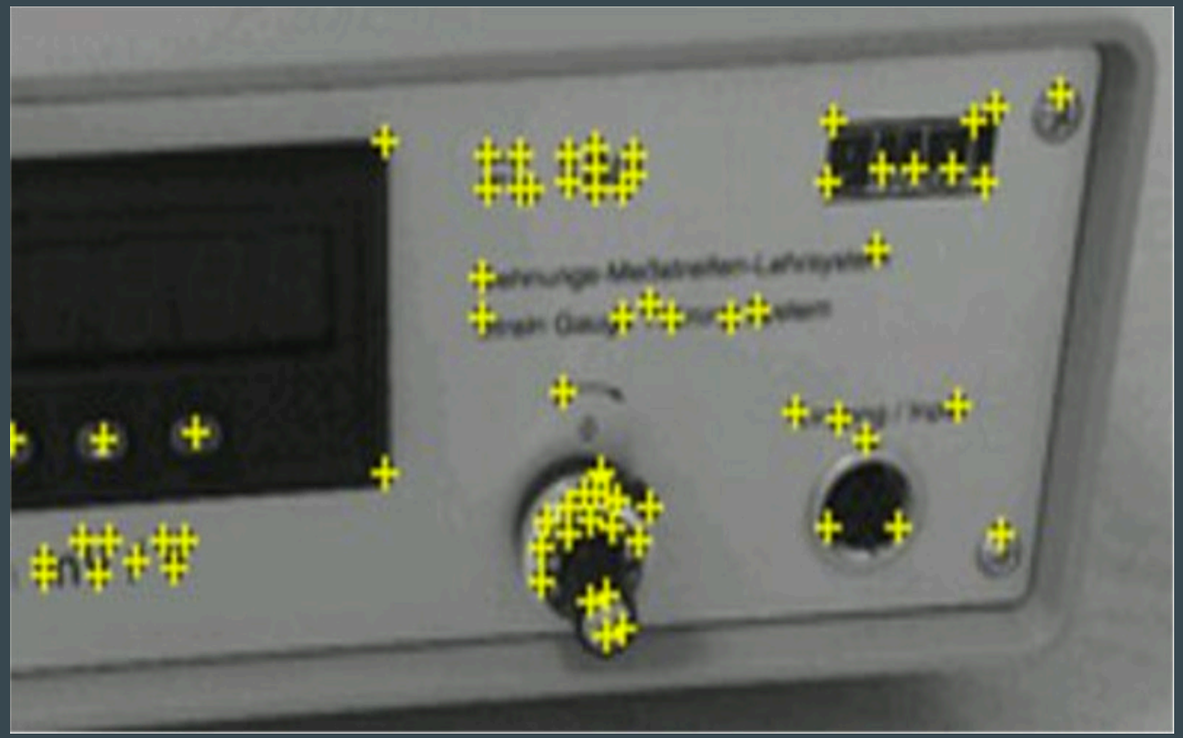
Use machines and tools for a **torque test** lab task assignment, preventing damage to the equipment and uncompromising the student's safety

Mobile App development

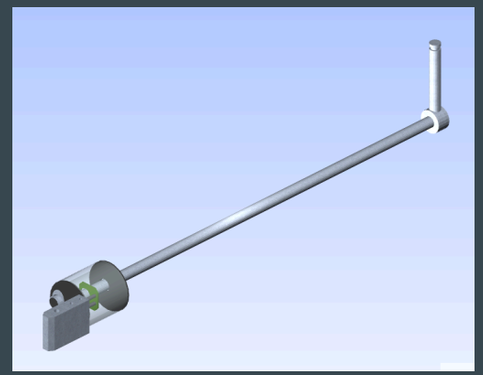


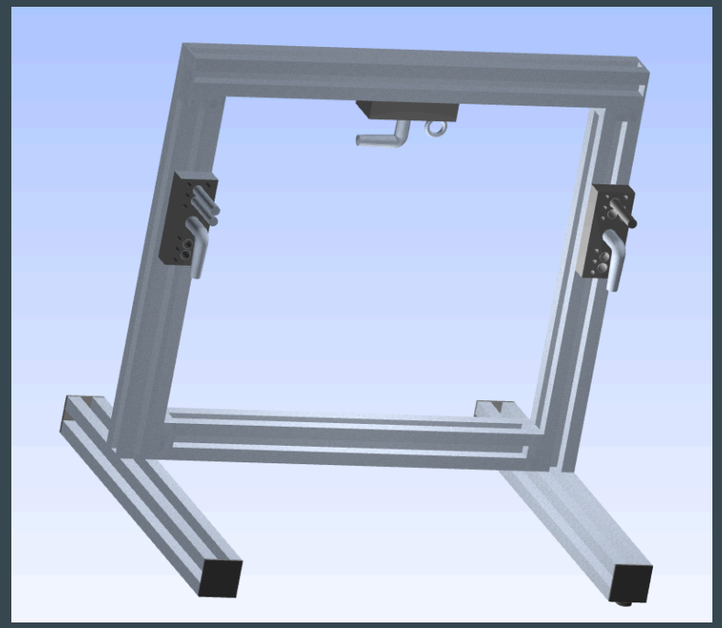
(a) Inicio (b) Material necesario (c) Mesa de trabajo (d) Posición móvil

Image recognition

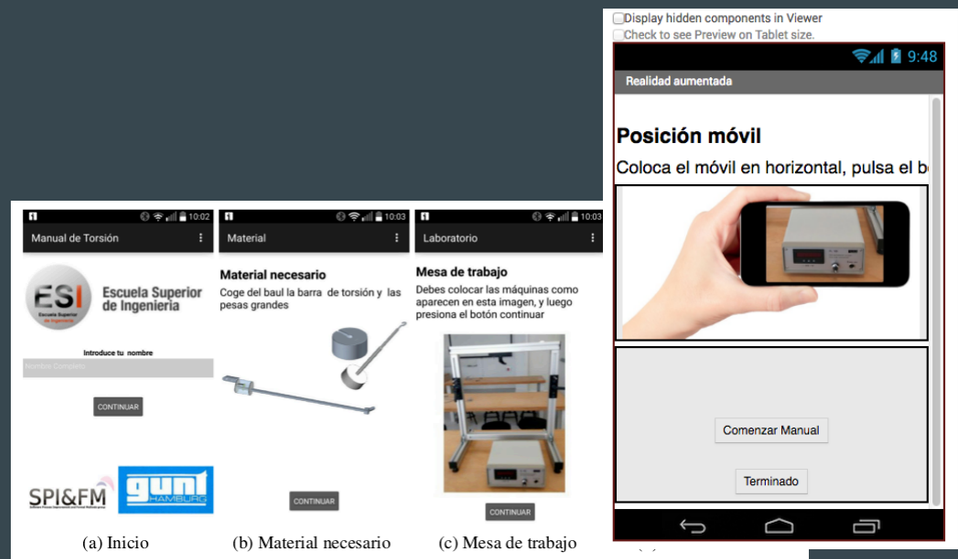


Creating 3D models

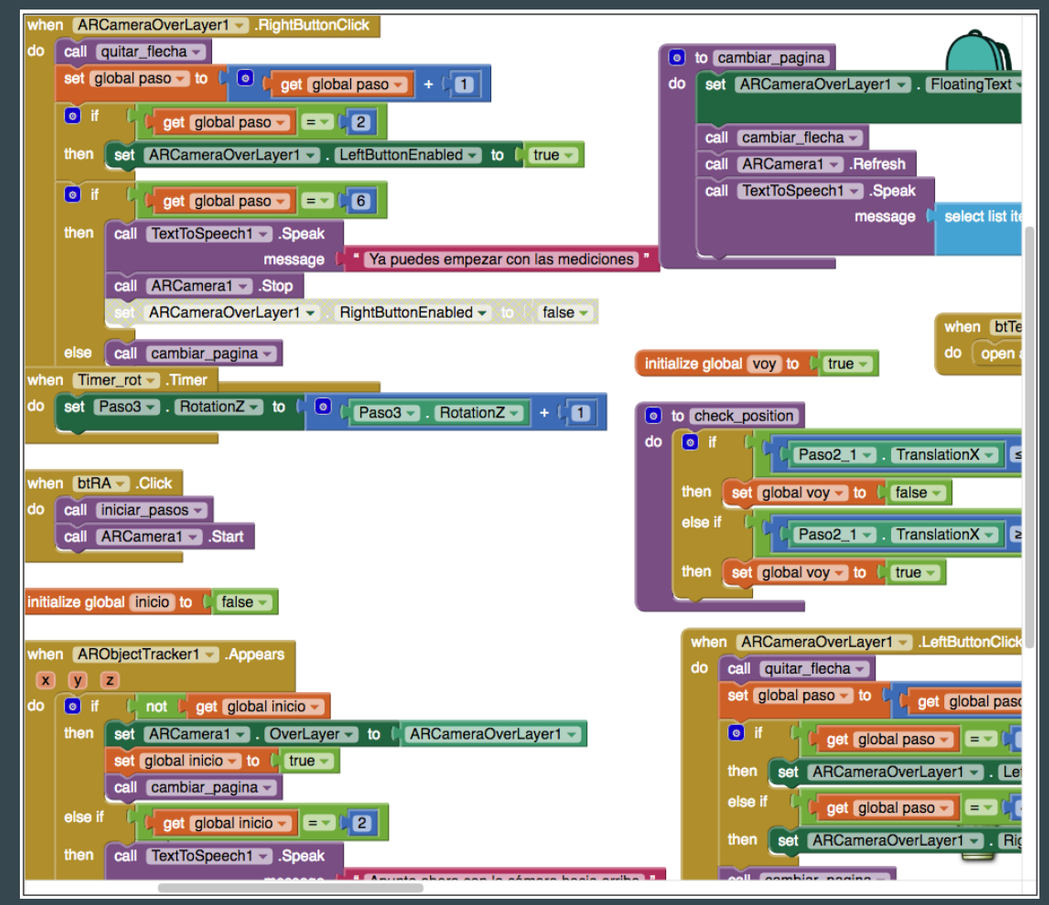




App behavior programming



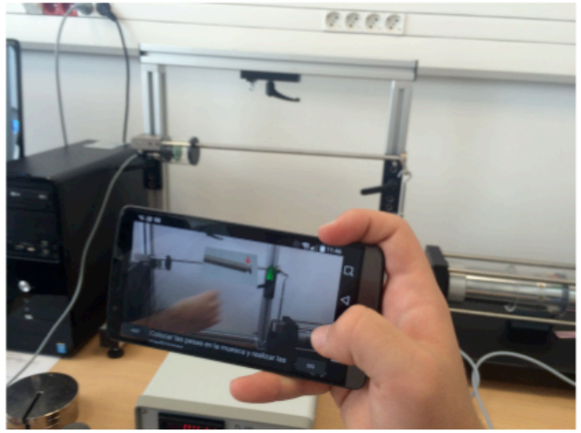
(a) Inicio (b) Material necesario (c) Mesa de trabajo



Lab development

(a) Inicio práctica

(b) Colocación barra



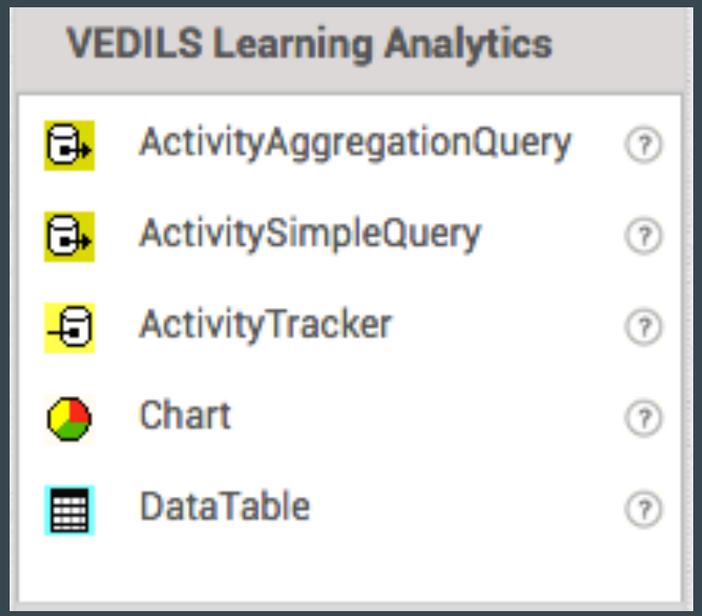
(c) Lugar de pesas

(d) Conectando transformador

Specific objective 2

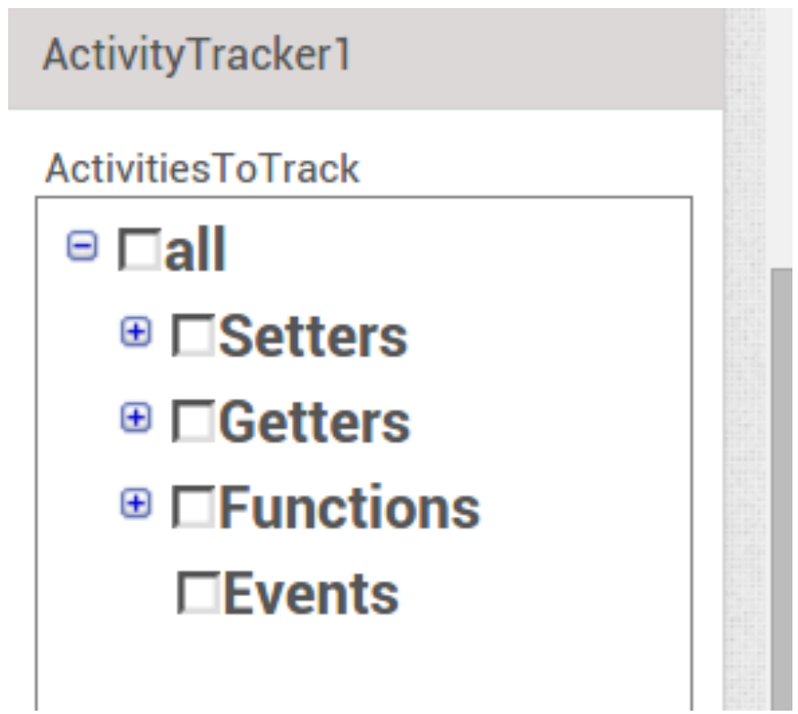
Extension of the visual language to build learning analytics mobile apps

VEDILS LA components

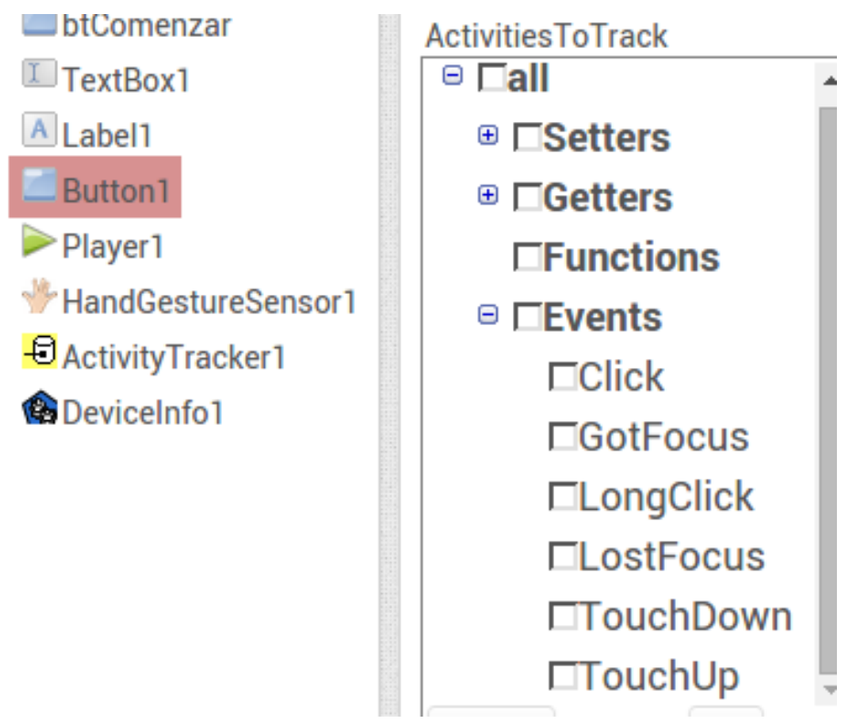


ActivityTracker selectable automatic tracking

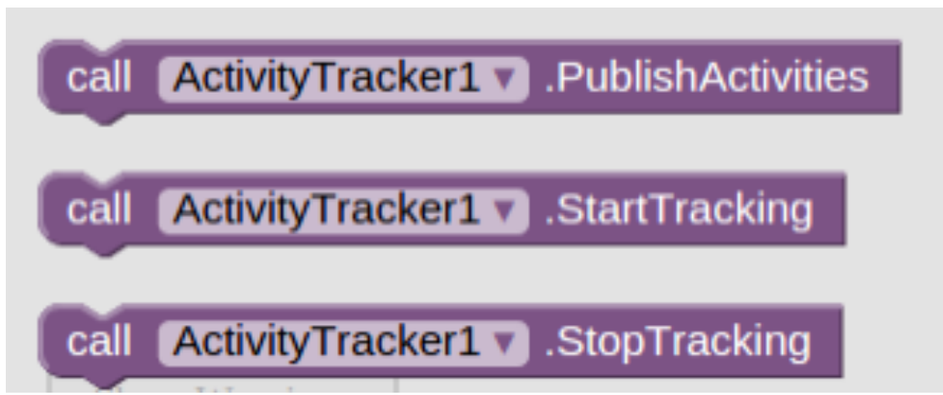
Global Actions

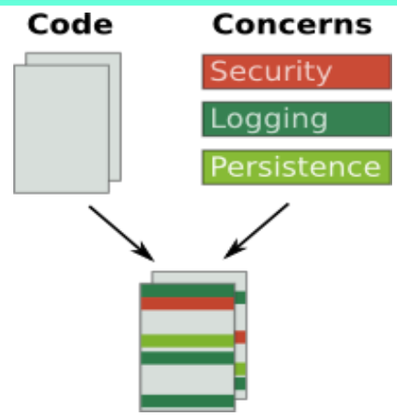


Focused action (e.g. button)



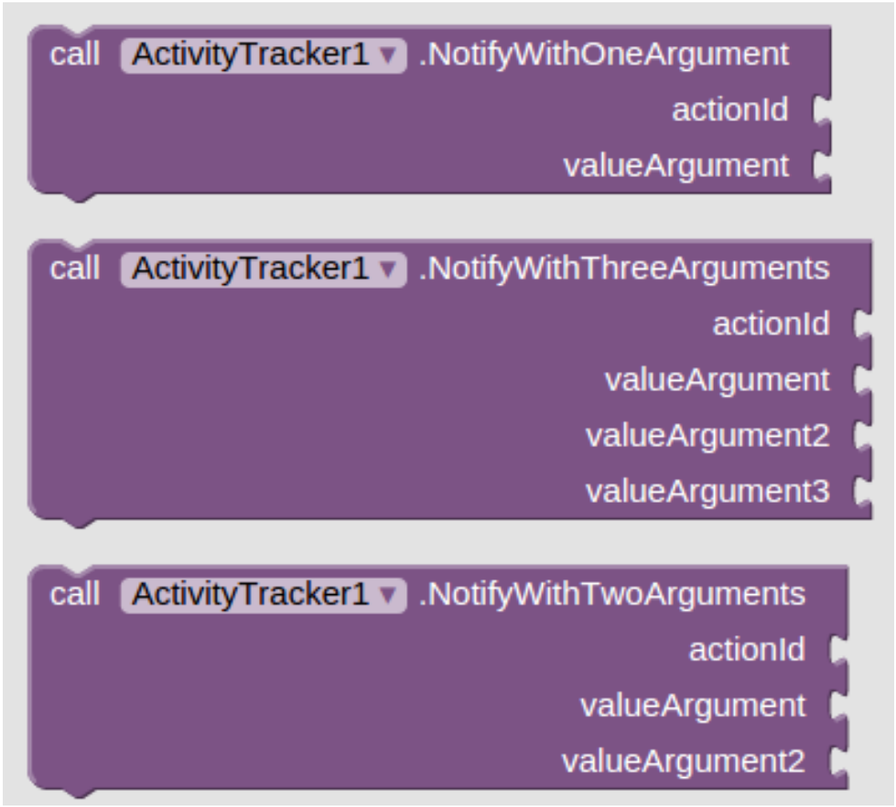
ActivityTracker blocks





aspectj

http://www.eclipse.org/aspectj/



ActivityTracker tracked data

UserID	IP	MAC	IMEI	Latitude	Longitude	Date
Test	192.168.1.3	40:40:a7:58:81:f2	354188073617271	36.53859	-6.202123333333333	2016-06-30 01:04:52
Test	192.168.1.3	40:40:a7:58:81:f2	354188073617271	36.53859	-6.202123333333333	2016-06-30 01:04:54
Test	192.168.1.3	40:40:a7:58:81:f2	354188073617271	36.53859	-6.202123333333333	2016-06-30 01:04:58
Test	192.168.1.3	40:40:a7:58:81:f2	354188073617271	36.53859	-6.202123333333333	2016-06-30 01:05:02

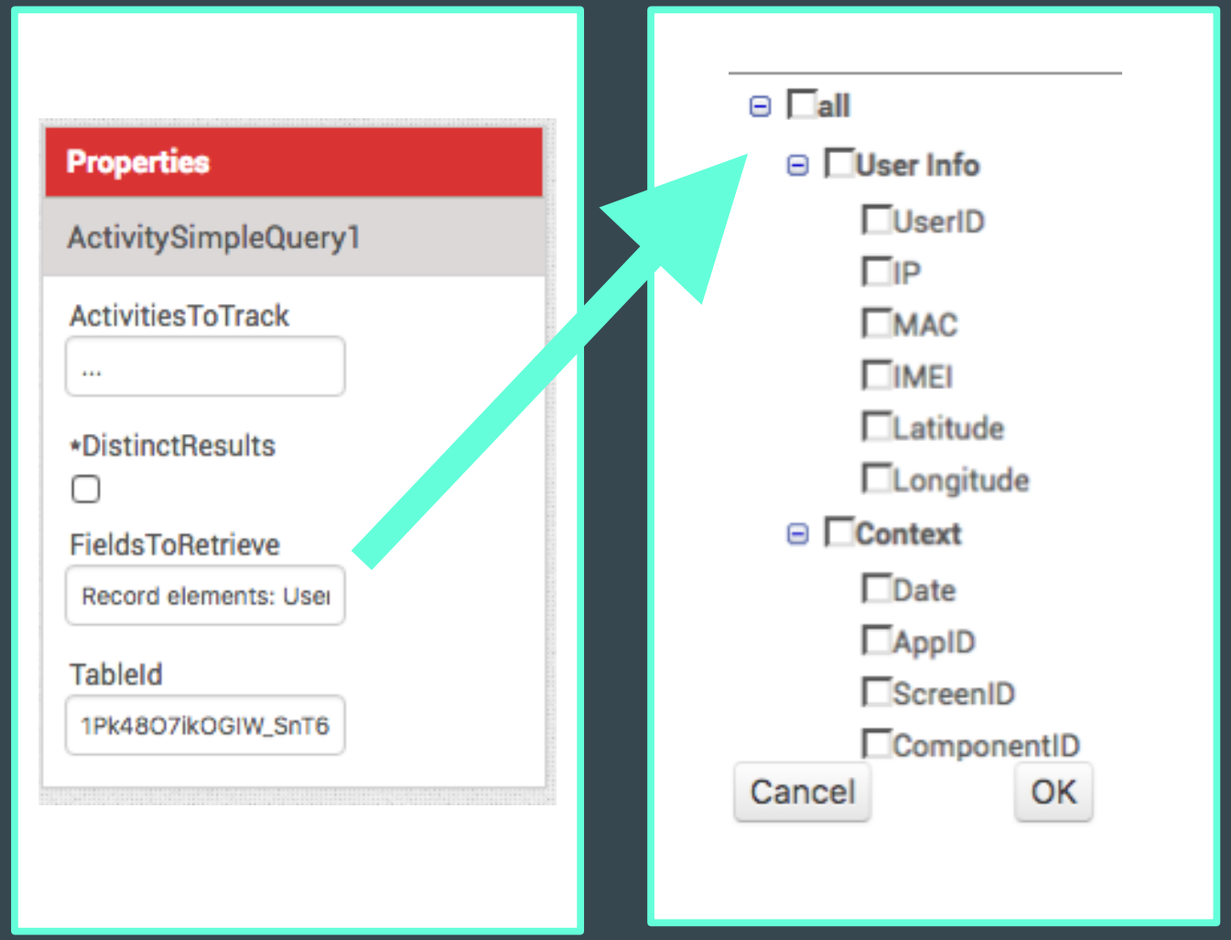
AppID	ScreenID	ComponentID	ComponentType	ActionID	ActionType	InputPar
appinventor.ai_tatyperson22.TestActivityTracker	Screen1	Button4	Button	Click	Event	
appinventor.ai_tatyperson22.TestActivityTracker	Screen1	Button1	Button	Click	Event	
appinventor.ai_tatyperson22.TestActivityTracker	Screen1	Button2	Button	Click	Event	
appinventor.ai_tatyperson22.TestActivityTracker	Screen1			CaseOne	SPECIFIC	1

ActivitySimpleQuery design

DistinctResults:
To avoid duplicated results.

FieldsToRetrieve:
Data to recover from the data storage

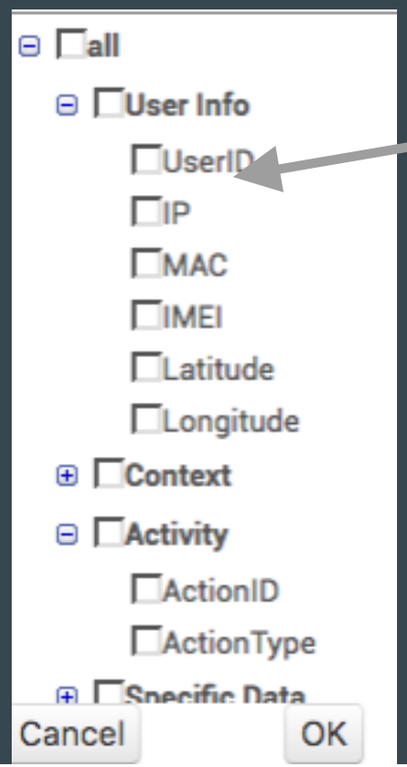
TableId:
Google Fusion Tables id

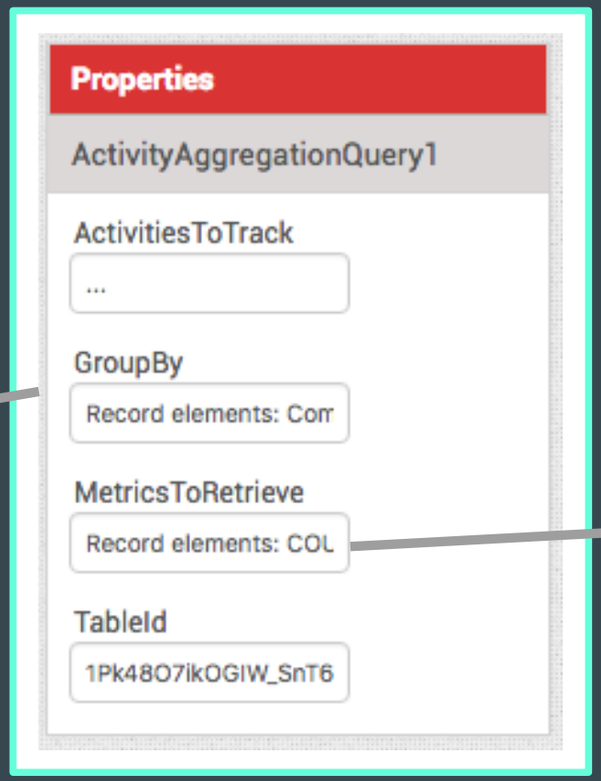


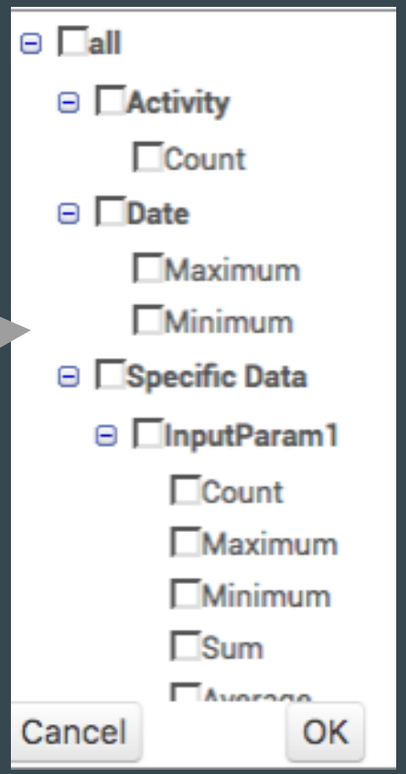
ActivityAggregationQuery design

Group By: Fields to group the results

MetricsToRetrieve: aggregations







DataTable & Chart design

Query: Query from which obtain data

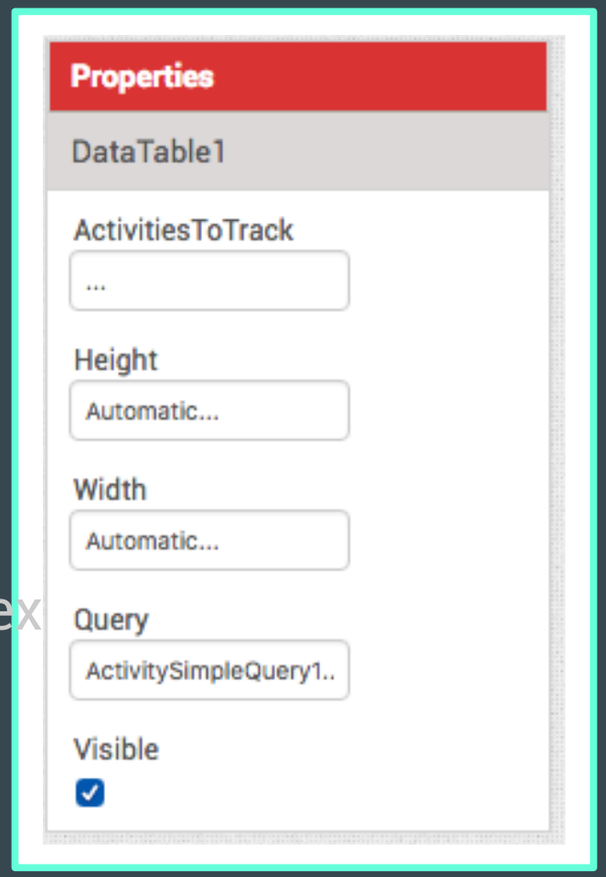
Height/width: dimensions in screen

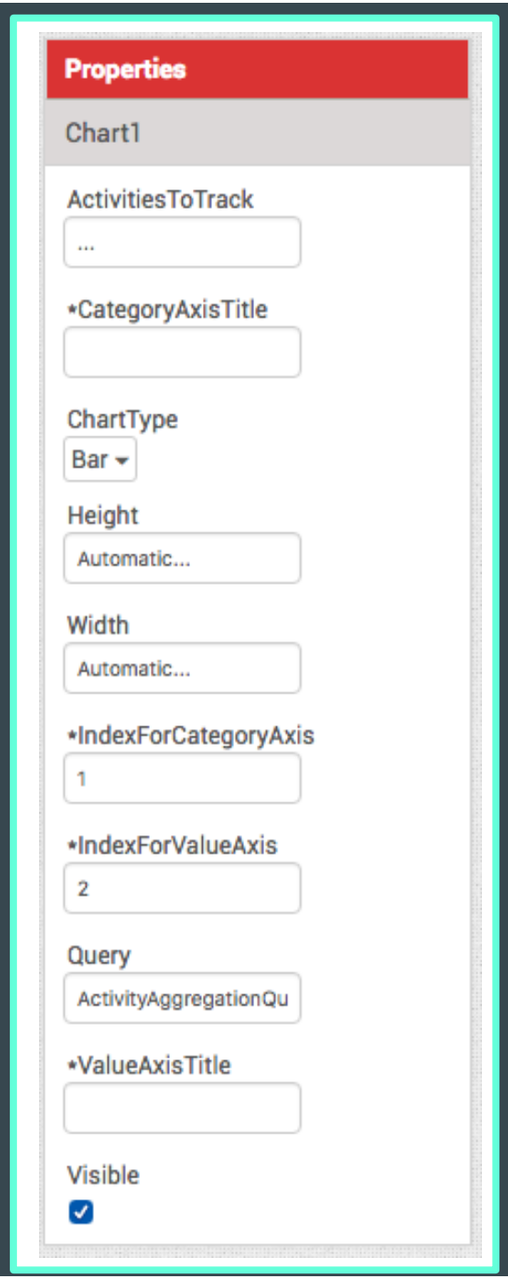
Visible: To show/hide the table/chart

ChartType: (currently) line/bar chart

IndexFor[Category/Value]Axis: data index

[Category/Value]AxisTitle: label





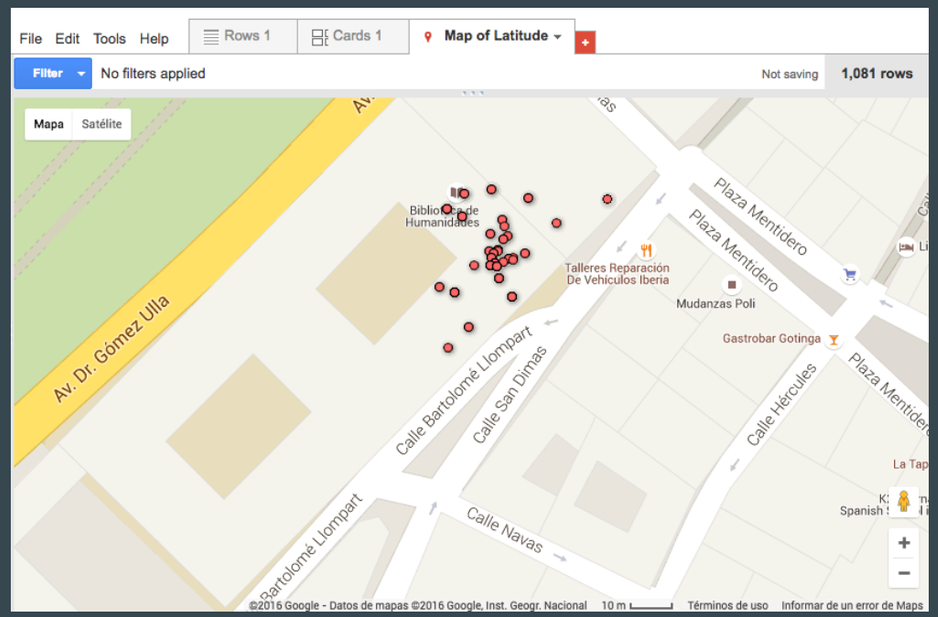
Case study: Foreign language learning

Teacher implementation of Who am I? game in a German language course including augmented reality

Learning analytics capabilities

Google Fusion Tables data

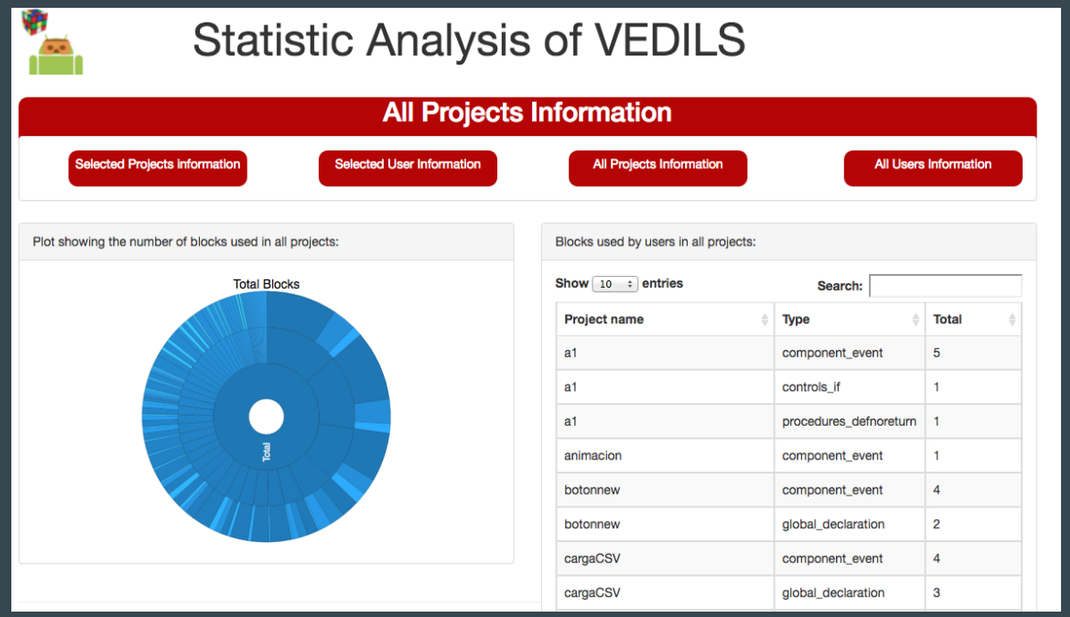
> Ejemplo: Wir Ben Ich



Pentaho dashboard

> Projects

> Users



Learning analytics results

Interactions

> Compilation of students' interactions relevant for assessment : e.g. number of attempts to guess a character, characters that are more difficult to guess, etc.

File Edit Tools Help | Rows 1 | Cards 1 | Map of Latitude

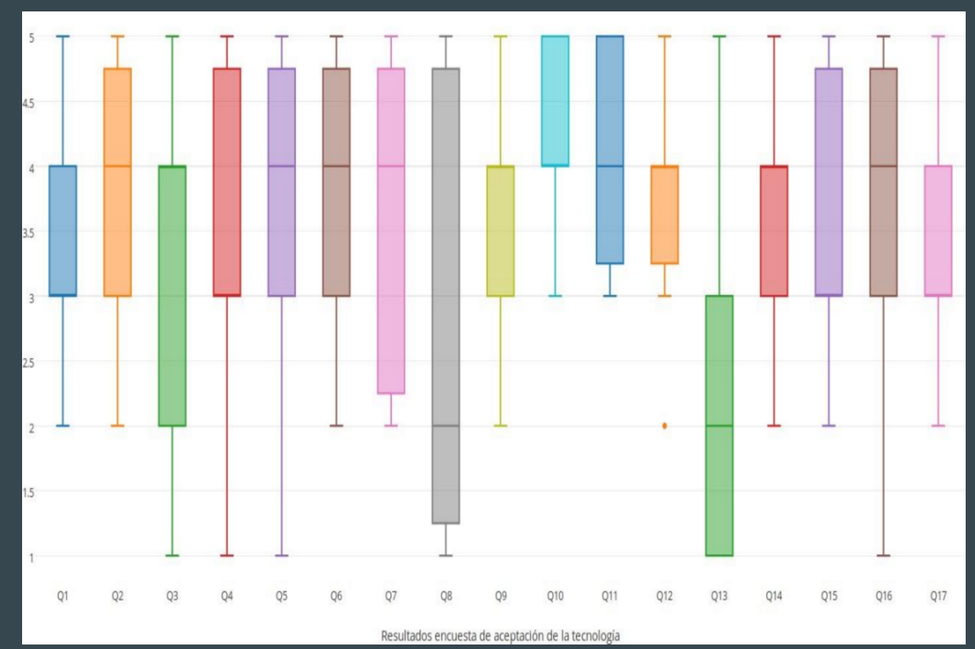
Filter | No filters applied

201-300 of 1081

UserID	IP	Latitude	MAC	Longitude	Date	AppID	ScreenID	Com...	Com...	ActionID
David	0.0.0.0	36.536...	E8:B4:C8:50:F9:4C	-6.3014331348...	23/02/16 16:24	appi...	Jugando			Select Solution Incorre
Nicolás	10.181.1...	0.0	ac:cf:85:a2:91:d3	0.0	23/02/16 16:24	appi...	Jugando			Closed
manuel	0.0.0.0	0.0	78:40:E4:C9:92:E6	0.0	23/02/16 16:24	appi...	Encuesta Final			Encuestta Final
inma	10.181.1...	36.536...	24:00:ba:f9:23:f7	-6.3022861	23/02/16 16:25	appi...	Jugando			Select Solution Incorre
luis	10.181.1...	36.536...	24:09:95:a8:49:11	-6.3023068	23/02/16 16:25	appi...	Elige tu personaje			FoundCharacter
luis	10.181.1...	36.536...	24:09:95:a8:49:11	-6.3023068	23/02/16 16:25	appi...	Elige tu personaje			FoundCharacter
Pablo Domínguez Correa	0.0.0.0	0.0	00:07:88:c6:e1:ba	0.0	23/02/16 16:29	appi...	Encuesta Final			Encuestta Final
luis	10.181.1...	36.536...	24:09:95:a8:49:11	-6.3022948	23/02/16 16:26	appi...	Jugando			Select Solution Incorre

Survey

> Inside the app to know learners' opinion



Case study: Technical Drawing

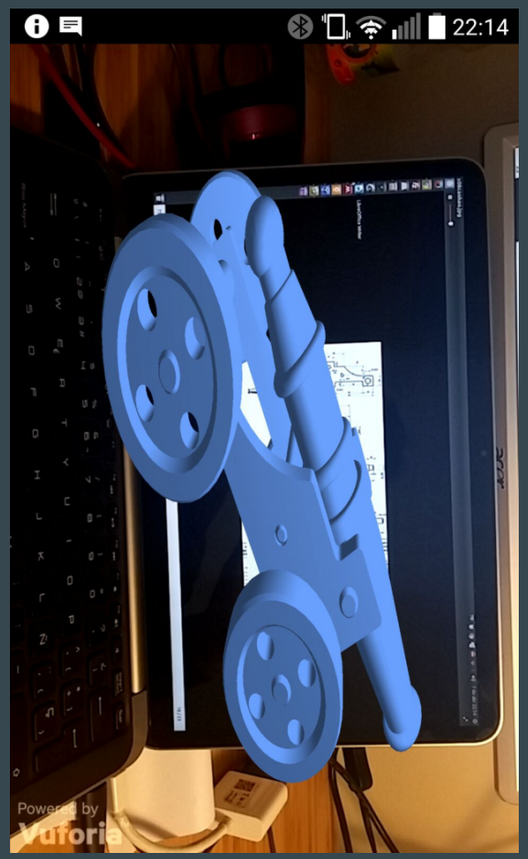
University of Algarve, Mechanical Engineering, “Design I” class

Learn foundations of **technical drawing** including **perspectives**

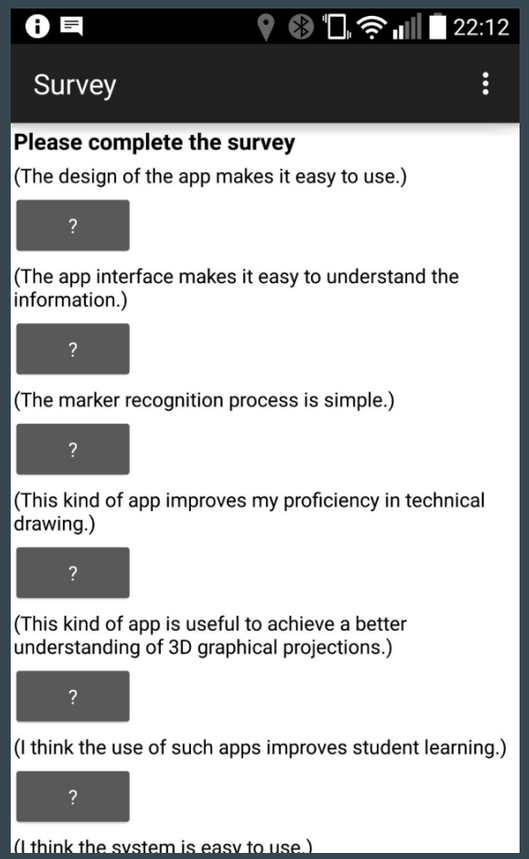
APP BASED ON AUGMENTED REALITY

Welcome screen

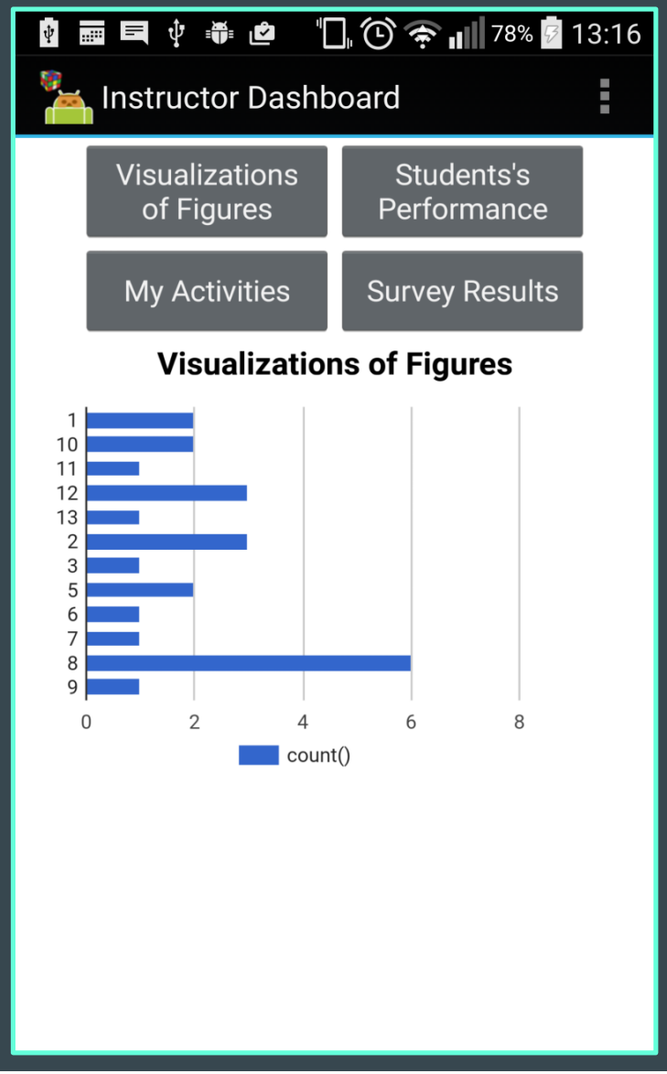
Rendering 3D models

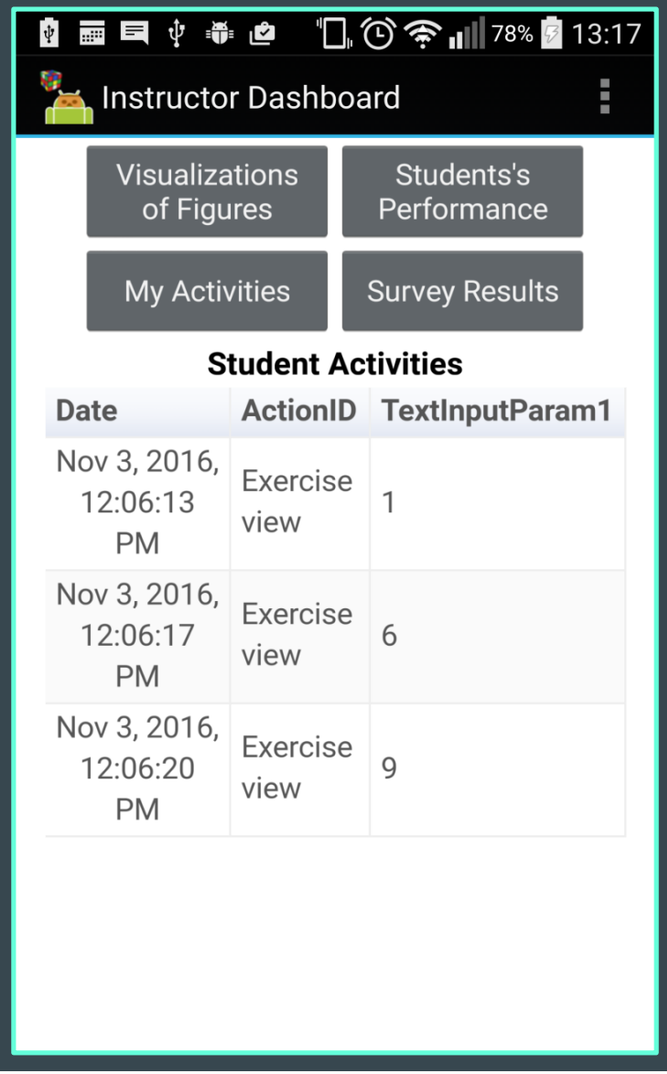


Survey on useful of the application.

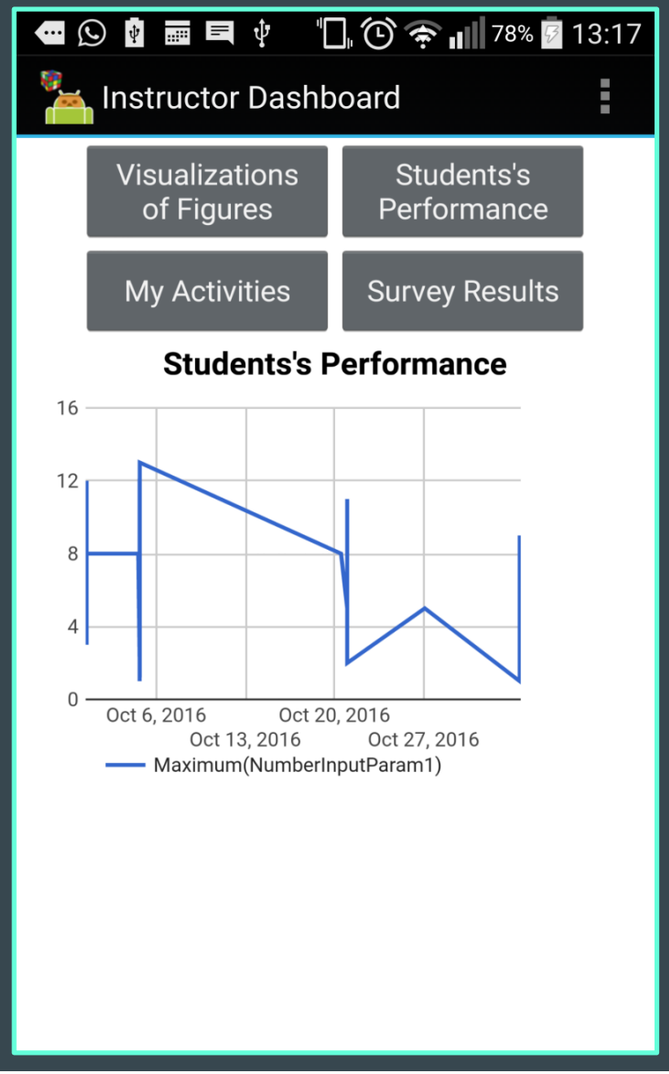


Different display types

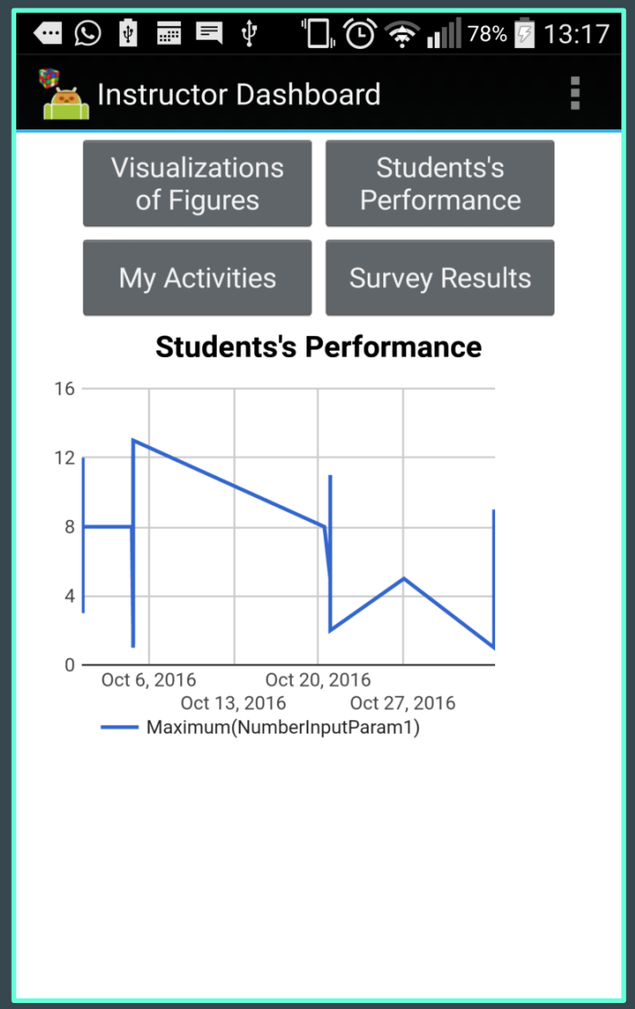




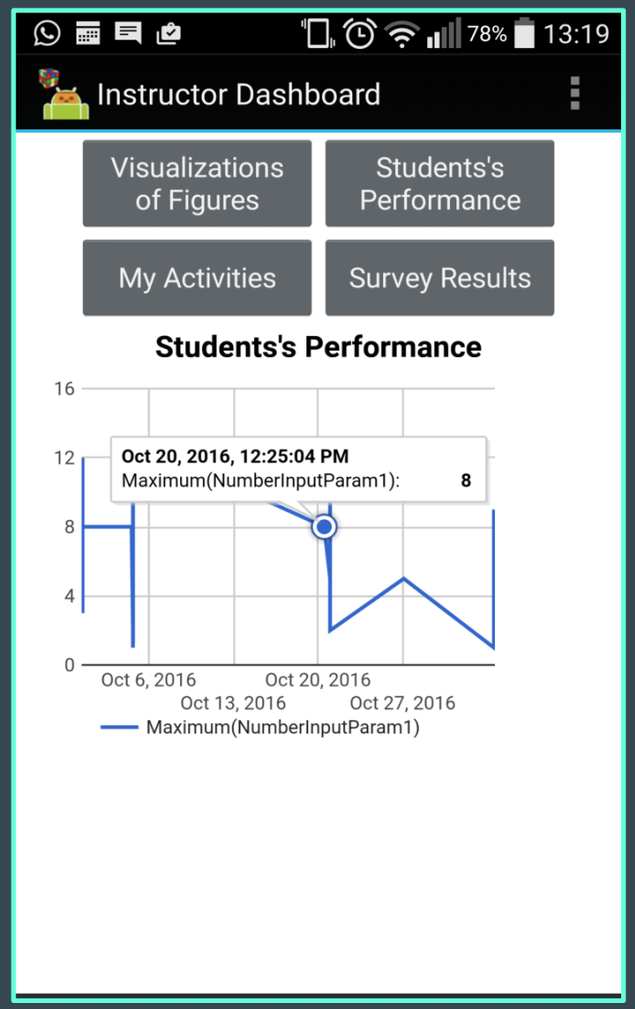
Date	ActionID	TextInputParam1
Nov 3, 2016, 12:06:13 PM	Exercise view	1
Nov 3, 2016, 12:06:17 PM	Exercise view	6
Nov 3, 2016, 12:06:20 PM	Exercise view	9



Extended information



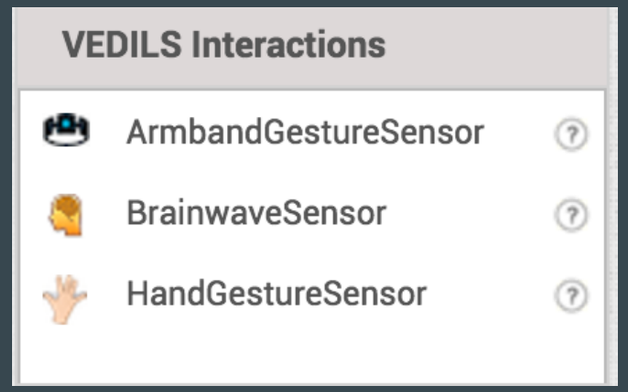
Touching the graph you obtain more detailed information

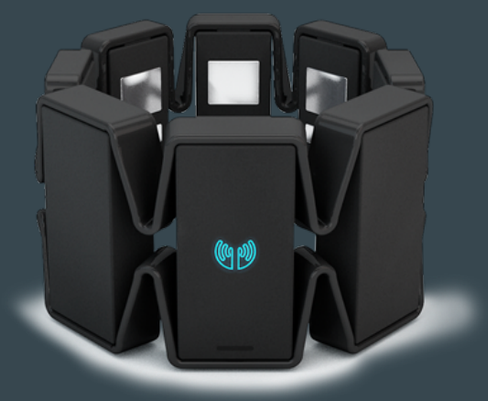


Specific objective 3

Extension of the visual language to build gadget-enriched mobile apps

VEDILS HMI components





Case study: e-Health project

http://emphasys.uca.es/

Conclusions

Ease the creation of enriched mobile apps by non-programmers

Create and visualize assessment information from the app

Future work

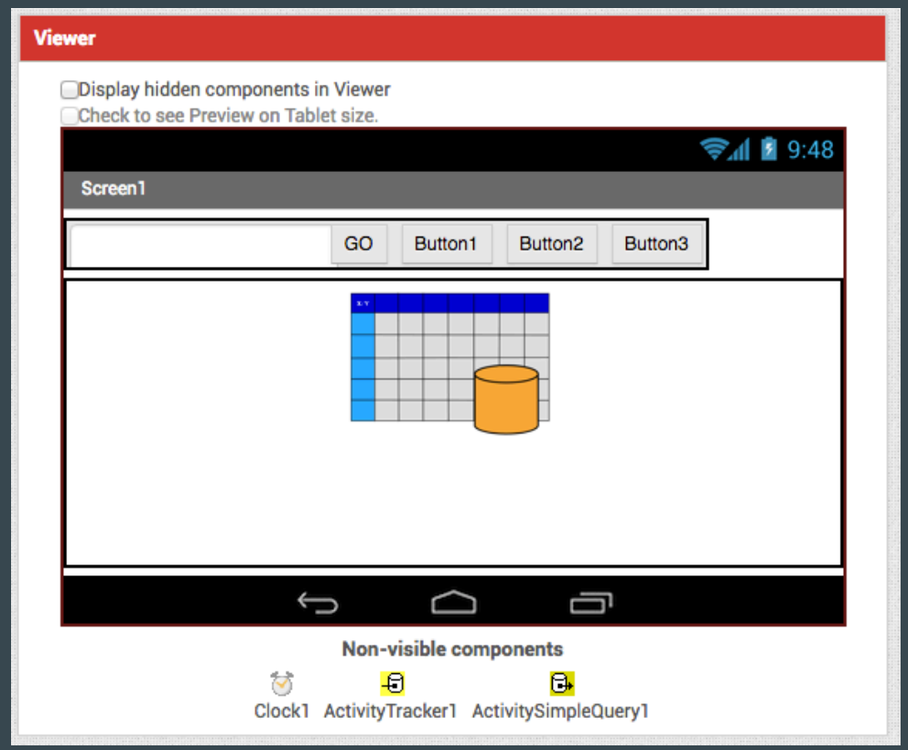
Integration with data mining libraries to ease assessment interpretation

Version of the authoring framework to develop eHealth gadget-enriched mobile apps

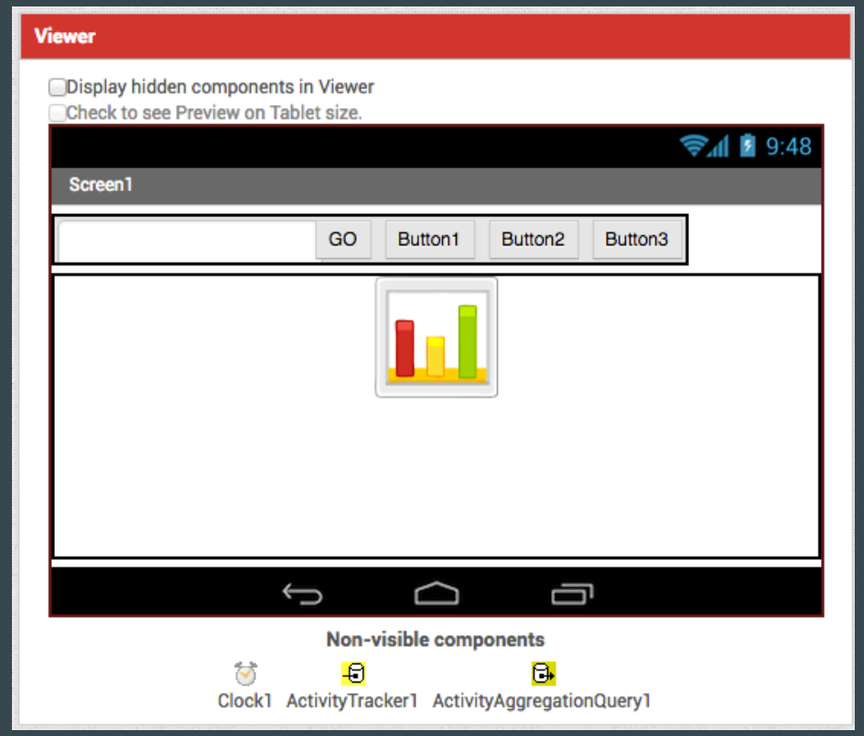
http://emphasys.uca.es/

Not only low cost devices: HTC Vive, Hololens, etc.

VEDILS LA Demo: simple query + data table



VEDILS LA Demo: aggregation query + chart



Thanks

http://vedils.uca.es

Escuela Superior de Ingenieria

SPI&FM
Software Process Improvement and Formal Methods group

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Images from:

http://elearningindustry.com/augmented-future-elearning-augmented-reality-elearning
http://www.educatorstechnology.com/2013/06/20-ways-to-use-augmented-reality-in.html