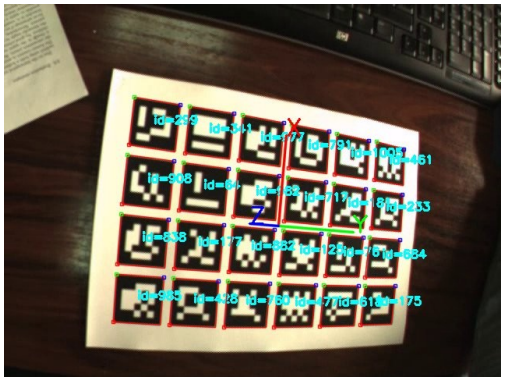
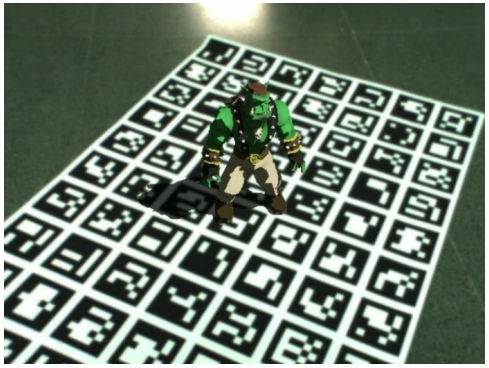
Seminario

Introducción a la Realidad Aumentada

OpenCV + ArUco





Sistemas Multimedia Interactivos e Inmersivos

Grado de Ingeniero en Informática. Escola Tècnica Superior de Enginyeria Informàtica. Curso 2018/2019

Manuel Agustí

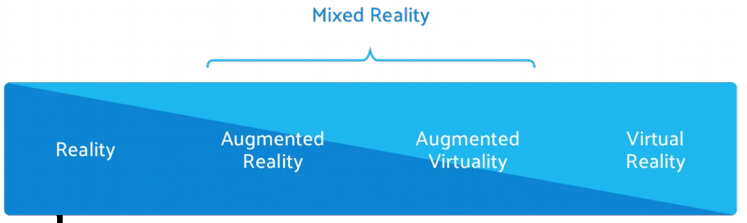
Objetivos

- Conocer el contexto de uso de aplicaciones basadas en sistemas interactivos e inmersivos basados en RA.
- Exponer las herramientas para desarrollo de aplicaciones de RA.
- Conocer y experimentar las operaciones más elementales con OpenCV
- Conocer y experimentar con librerías especializadas en este campo: OpenCV – ArUco

Índice

Introducción: Intro. a la RA

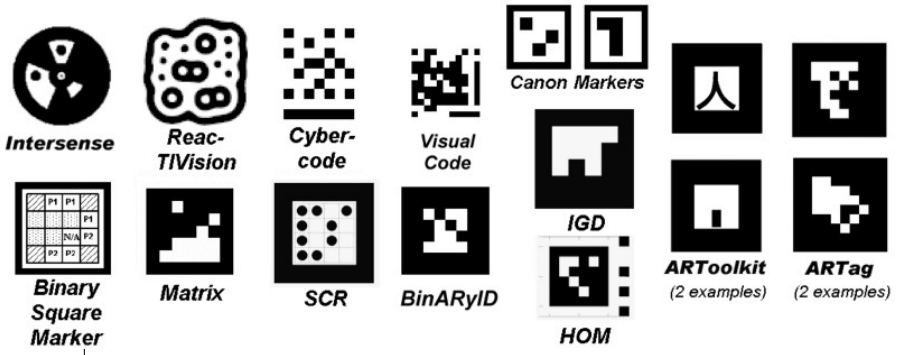
- Definición
  - Contexto
    - Interacción con el computador
      - Metáfora del escritorio
        - Mundo virtual + dispositivos E/S (teclado, ratón, pantallas, joystic, guantes, superfícies táctiles, …)
    - Inmersión: mezclas dentro del rango RV .. RA
  - RA: componentes
    - Añadir información, utilizando diferentes media (visuales, sonoro, *háptico*, olfativo, gustativo), con el mundo real.
    - Interacción y en tiempo real.
    - La información está asociada a posiciones (2D o 3D) en el mundo real

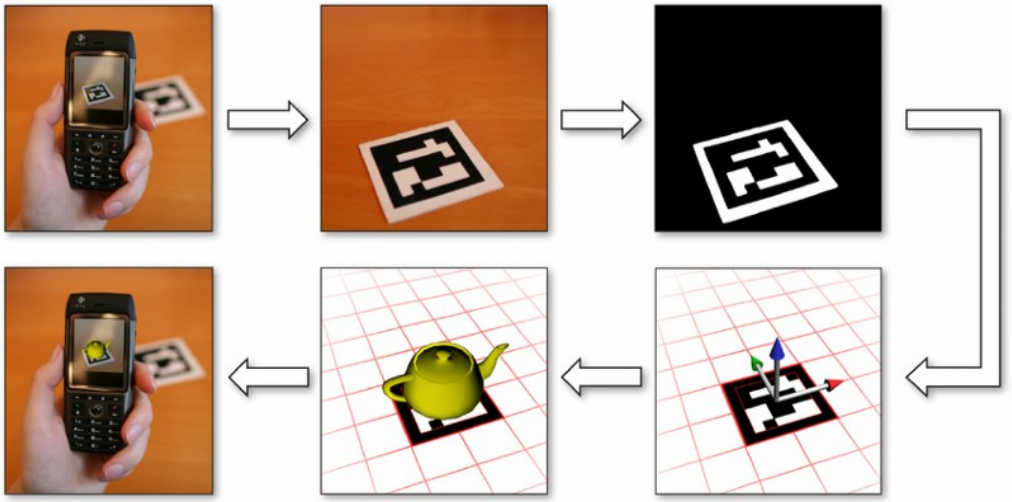


Fuente:António Lima. (2018). "Augmented Reality—A Simple Technical Introduction" <https://medium.com/deemaze-software/augmented-reality-a-simple-technical-introduction-83d5e77206b9.>.

Introducción: Intro. a la RA (II)

- ARToolKit (1999) + dispositivos móbiles (cámaras)
  - SDK abierto y multiplataforma para RA
    - Funcionalidades de seguimiento (*tracking*) 3D
    - Usa "marcas": "*fiducial markers*"
      - Fáciles de obtener, proporcionan una identificación única, representaciones accesibles para un computador
      - Obtener la "pose": posición, orientación y escala que relación la posición del usuario y de la marca.

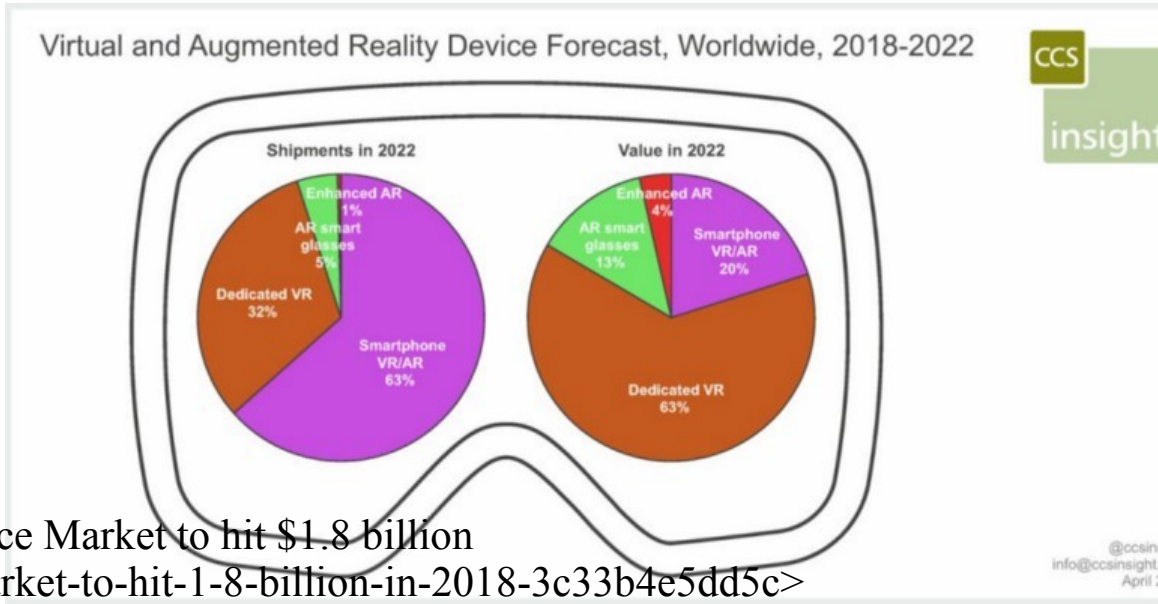




Fuente:António Lima. (2018). "Augmented Reality—A Simple Technical Introduction" <https://medium.com/deemaze-software/augmented-reality-a-simple-technical-introduction-83d5e77206b9 >.

Introducción: Intro. a la RA (III)

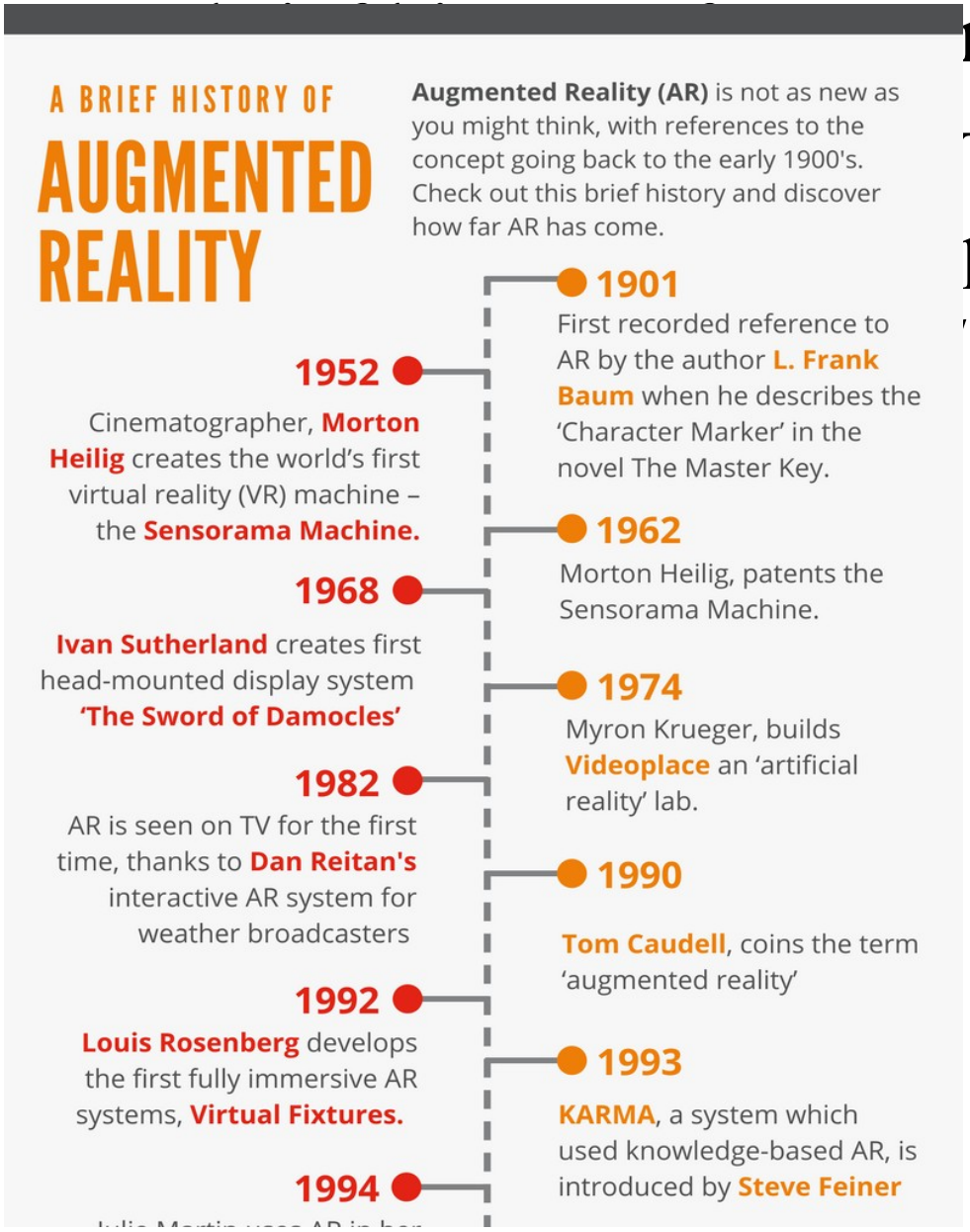
- Panorama de mercado
  - Forecast by analyst firm CCS Insight paints an optimistic picture of Immersive Tech adoption.
  - The report … by CCS Insight shows the worldwide market for virtual reality (VR) and augmented reality (AR) head-worn devices growing by an average of 50 percent annually over the next five years. In 2022, a total of 121 million units will be sold, with a value of $9.9 billion.

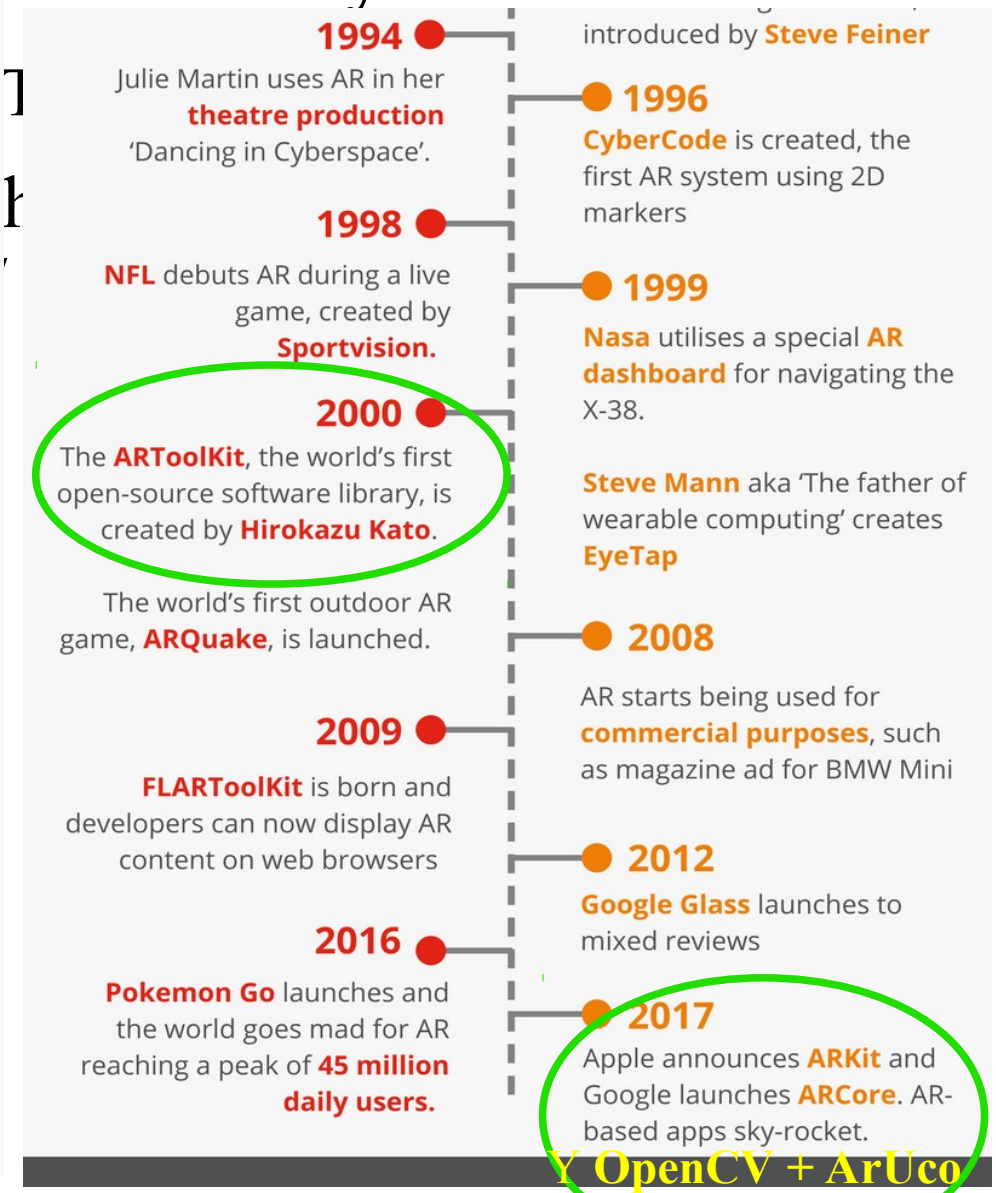


FuenteA. Bonasio. (2018). Report: VR and AR Device Market to hit $1.8 billion <https://arvrjourney.com/report-vr-and-ar-device-market-to-hit-1-8-billion-in-2018-3c33b4e5dd5c>

Introducción (IV)

nted reality

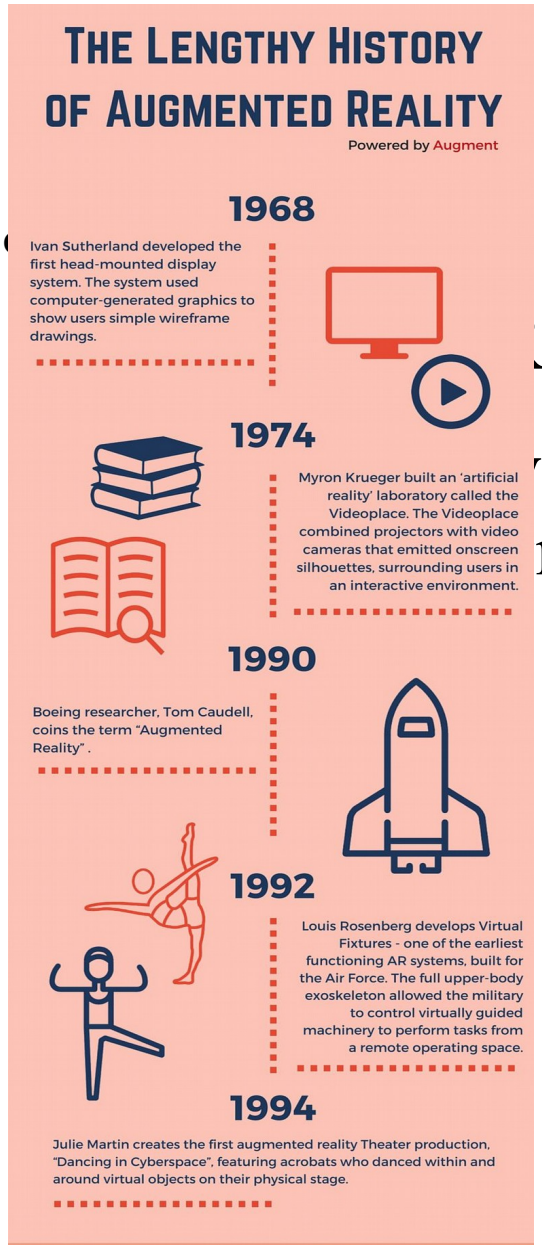


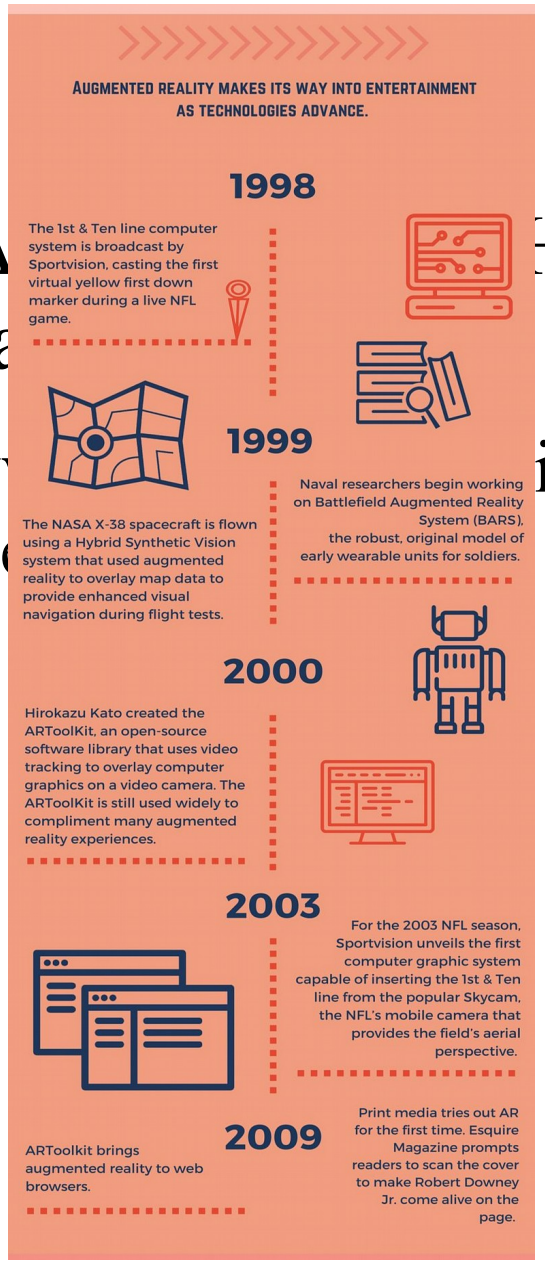


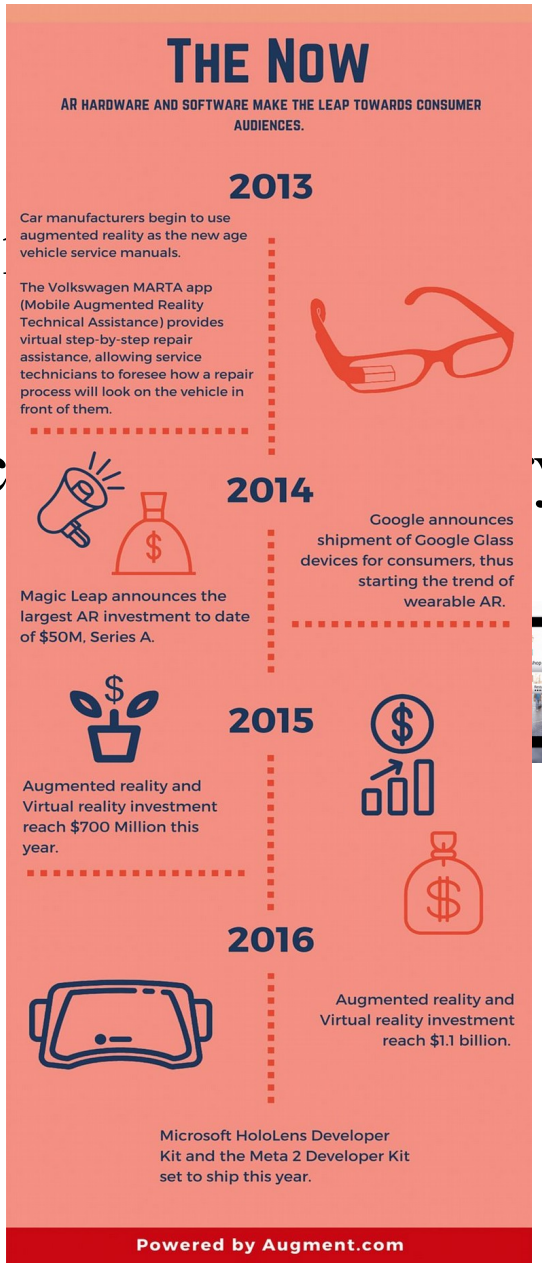
Y OpenCV + ArUco

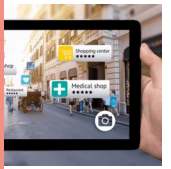
Fuente: R. Corps (2017). "A brief history of augmented reality." <http://adsreality.com/history-of-augmented-reality-infographi

Introducción (V)









Fuente: "Infographic: The History of Augmented Reality" <https://www.colocationamerica.com/blog/history-of-augmented-reality> y "Infographic: The History of Augmented Reality" <https://www.augment.com/blog/infographic-lengthy-history-augmented-reality/>.

Introducción: Ejemplos de aplicaciones

- Asistencia para el aparcamiento

- *En programas de TV , para:*
  - *marcar la posición de jugadores o elementos en el campo*
  - *ambientar escenarios o animar las presentaciones*

- *Últimamente en móviles*
  - *Google Translate, Google Maps, ... , Pokemon, Holo, Google Lens, Aruler, Snapchat, YouCam Makeup, IKEA Place*
  - *Algunas "listas" de aplicaciones*
    - *https://es.digitaltrends.com/entretenimiento/mejores-aplicaciones-realidad-aumentada/*
    - *https://www.tomsguide.com/us/pictures-story/657-best-augmented-reality-apps.html#s5*

Fuente:António Lima. (2018). "Augmented Reality—A Simple Technical Introduction" <https://medium.com/deemaze-software/augmented-reality-a-simple-technical-introduction-83d5e77206b9.>.

- Brainstorm - real-time 3D graphics and virtual set solutions

  - In 1994, Brainstorm's first anniversary also marked the first time in the history of television that a real-time 3D virtual set was used in live production, an interview with Mike Oldfield for the promotion of his album "Songs from the Distant Earth", for Antena 3 TV in Spain. At this live show, the musician was at the virtual studio in Antena 3 TV in Madrid, while he was interviewed by journalists located in the Madrid Planetarium some distance away. Two days later, Brainstorm started a daily live weather show for Antena 3 TV, the first and revolutionary daily show of its kind, and possibly the basis of the multitude of live virtual shows of many formats broadcasted today. This show was a tremendous success at the time and received a European Award for the best weather presentation.

  - According to Ricardo Montesa, "this technology went one step, albeit a big one, beyond traditional Chroma keying, with the introduction of 3D real-time graphics and complex camera movements, that significantly

Fuente "http://www.brainstorm3d.com/>, Infinity Set <http://www.brainstorm3d.com/products/i

Introducción: Ejemplos de aplicaciones

- *Star Wars – Jedi Challenges*

Equipamiento y especificaciones

STAR WARS
JEDI CHALLENGES

Galería de fotos


Mando de espada láser


Dispositivo de realidad aumentada Lenovo Mirage


Baliza de seguimiento

VER GALERÍA

Contenido de la caja

Gafas de realidad aumentada Lenovo Mirage
Mando espada láser
Baliza de seguimiento
Bandeja para el teléfono
Cable de lightning a micro-USB
Cable de USB-C a micro-USB
Cable de micro-USB a micro-USB
2 pilas AA
Cargador de pared 5V/1A y cable de alimentación
Guía de inicio rápido

Es necesario un smartphone compatible

La aplicación *Star Wars*: Jedi Challenges te ofrece una experiencia para smartphone compatible con dispositivos Android e iOS.

Compatible con: iPhone® Xs, iPhone® Xs Max, iPhone® X, iPhone 8 Plus, iPhone 8, iPhone 7 Plus, iPhone 7, iPhone 6s Plus, iPhone 6s, iPhone 6 Plus, iPhone 6, Samsung Galaxy S9, S8, Samsung Galaxy S7 edge, Samsung Galaxy S7, Google Pixel XL, Google Pixel, Moto Z2 Force, Moto Z, LG G6. Mate 10, Mate 10 Pro, Nova 2S, Xiaomi MIX2, Sony Xperia XZ1

Próximamente se añadirán más dispositivos. Vuelve pronto para consultar las novedades.

Mando de espada láser

Dimensiones:	315,5 mm x 47,2 mm
Peso:	275 g
Botones:	Encendido, matriz de activación, botón de control

Dispositivo de realidad aumentada Lenovo Mirage

Dimensiones:	209,2 mm x 83,4 mm x 154,8 mm
Peso:	477 g
Botones:	Seleccionar, Cancelar, Menú
Cámara	Cámaras de seguimiento de movimiento dual

Baliza de seguimiento

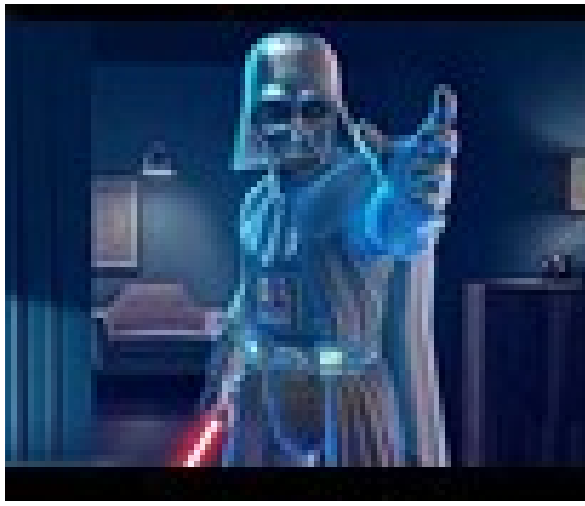
Dimensiones:	94,1 mm x 76,7 mm
Peso:	117 g
Botones:	Encendido / Cambio de color

Información adicional

Conexión:	conexión bluetooth al teléfono
Idiomas:	inglés, alemán, japonés, francés y español

Descargar aplicación gratuita

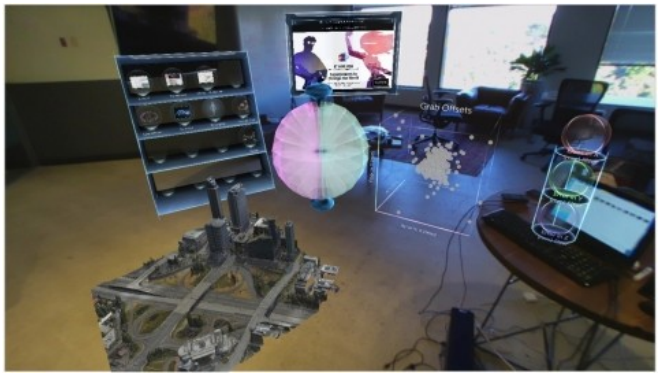
GET IT ON Google Play Download on the App Store



Fuente: <https://www.lenovo.com/es/es/jedichallenges/>.

Introducción: Ejemplos de aplicaciones

- *The desktop of the future is here now: augmented reality in the workplace*



  - *AR Workspace For Meta Introduced at AWE 2017*
    - *https://www.vrfocus.com/2017/06/ar-workspace-for-meta-introduced-at-awe-2017/*
  - *https://www.computerworld.com/article/3249424/the-desktop-of-the-future-is-here-now-augmented-reality-in-the-workplace.html*

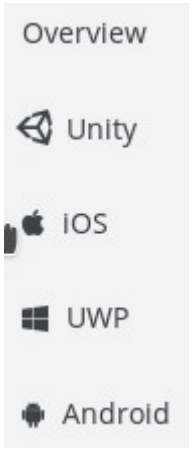
- Asistencias a la conducción
- What Virtual Reality trends and Augmented Reality trends will be revealed in 2019?
  - https://www.marxentlabs.com/trends-augmented-reality-virtual-2019/

Introducción: Herramientas para RA

- *Herramientas*
  - *Ejemplo básico con "tablero"*
    - ***SimplAR*** ← ***OpenCV***
  - *SDKs*
    - *ARToolkit, ... ,* ***OpenCV*** **+** ***ArUco****,*
    - ***Vuforia****, ARKit (Apple), ARCore (Google)*
  - *"De autor"*
    - *LayAR/BlipAR, ...*

Plataformas

- Vuforia + Unity →



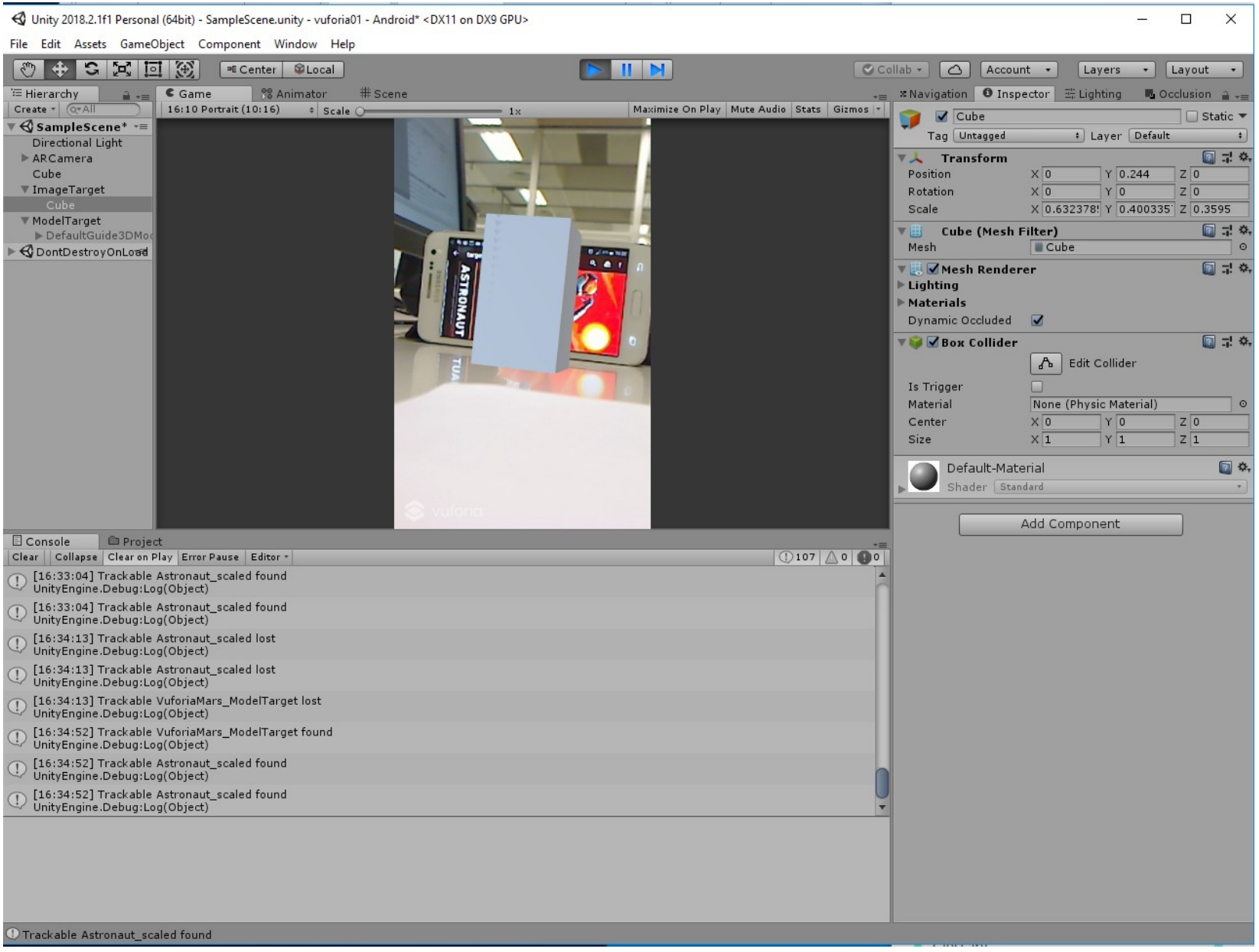
  - Plataformas

Device OS		Development OS		Unity Version	
Android (1)	4.1.x+	Windows (2)	7+	Windows (2)	2017.2+
iOS (2)	9+	OS X	10.11+	OS X	2017.2+
Windows (2)	10 UWP				

1. 32-bit only
2. 32 & 64-bit

Fuente: “Getting Started with Vuforia Engine in Unity” <https://library.vuforia.com/articles/Training/getting-started-with-vuforia-in-unity.html>
“Top Tutorials To Learn Vuforia To Develop AR Applications” <https://medium.com/quick-code/top-tutorials-to-learn-vuforia-to-develop-ar-applications-274eedc2b18f>

Objetivo


Unity 2018.2.1f1 Personal (64bit) - SampleScene.unity - vuforia01 - Android* <DX11 on DX9 GPU>
File Edit Assets GameObject Component Window Help
Hierarchy
SampleScene*
Directional Light
ARCamera
Cube
ImageTarget
Cube
ModelTarget
DontDestroyOnLoad
Game
Animator
Scene
Maximize On Play
Mute Audio
Stats
Gizmos
Inspector
Lighting
Occlusion
Transform
Position
Rotation
Scale
Cube (Mesh Filter)
Mesh Renderer
Lighting
Materials
Dynamic Occluded
Box Collider
Edit Collider
Is Trigger
Material
None (Physic Material)
Center
Size
Default-Material
Shader
Standard
Add Component
Console
Project
Clear
Collapse
Clear on Play
Error Pause
Editor
[16:33:04] Trackable Astronaut_scaled found
UnityEngine.Debug:Log(Object)
[16:33:04] Trackable Astronaut_scaled found
UnityEngine.Debug:Log(Object)
[16:34:13] Trackable Astronaut_scaled lost
UnityEngine.Debug:Log(Object)
[16:34:13] Trackable Astronaut_scaled lost
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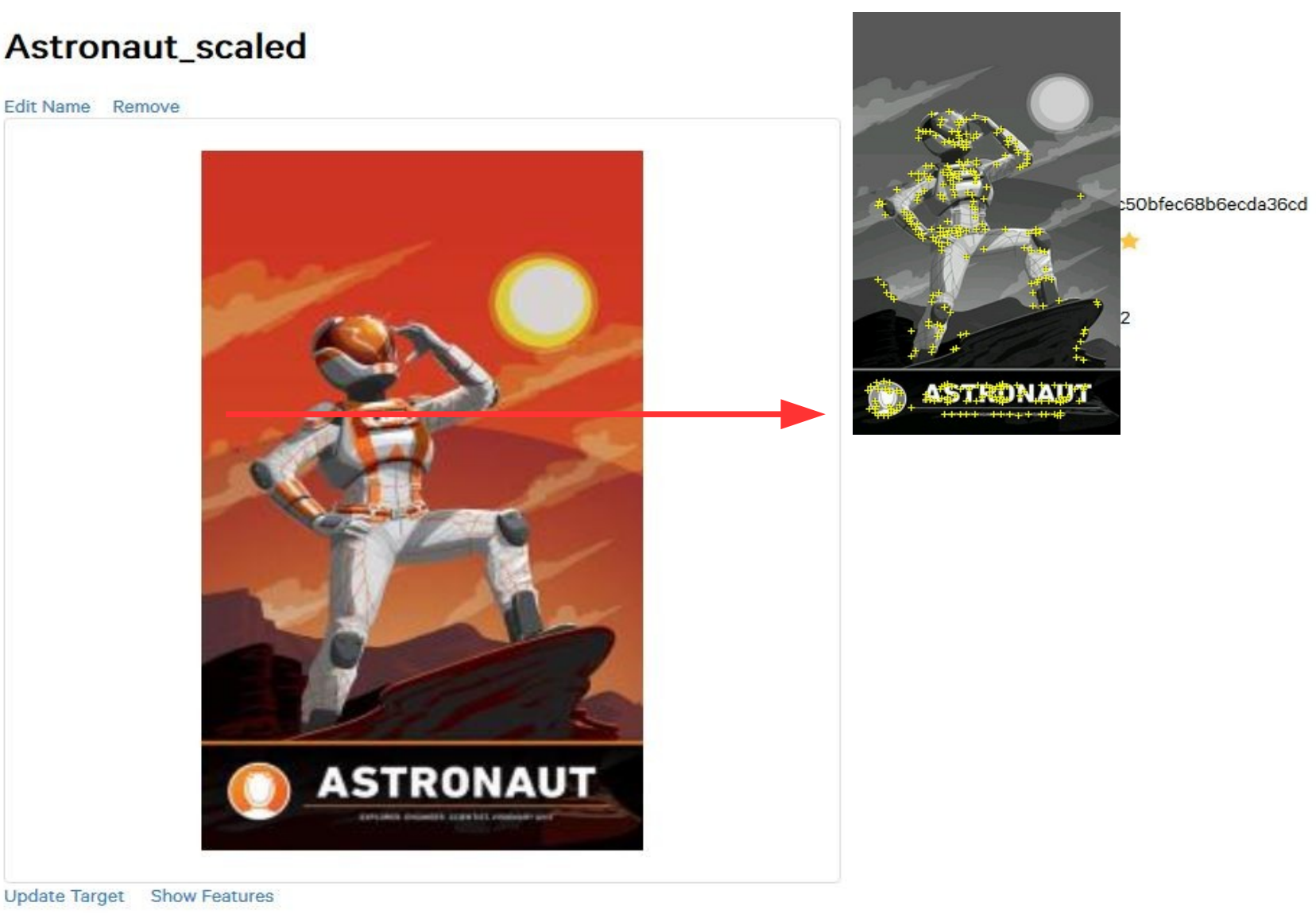
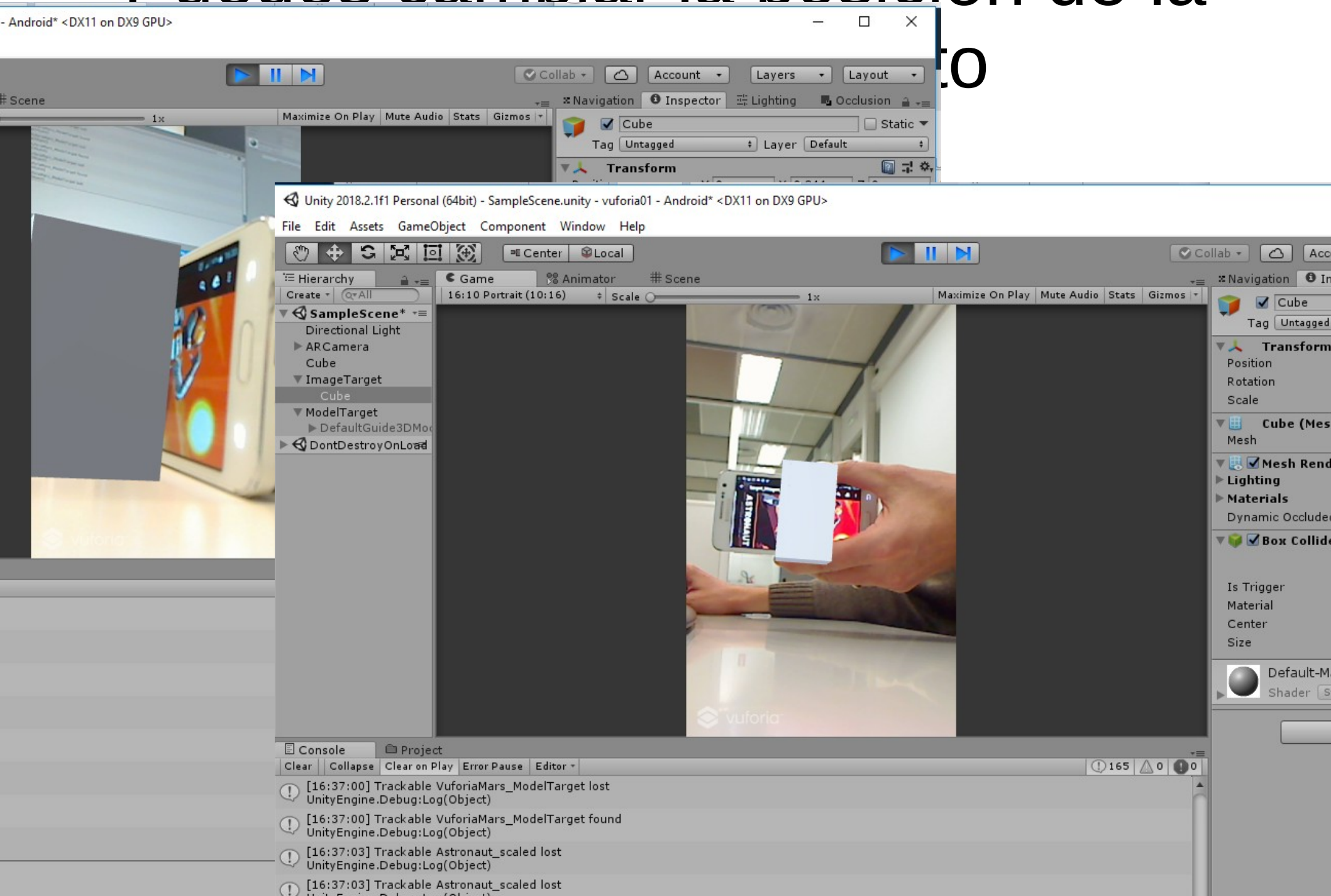
[16:34:52] Trackable Astronaut_scaled found
UnityEngine.Debug:Log(Object)
[16:34:52] Trackable Astronaut_scaled found
UnityEngine.Debug:Log(Object)
Trackable Astronaut_scaled found

Las marcas

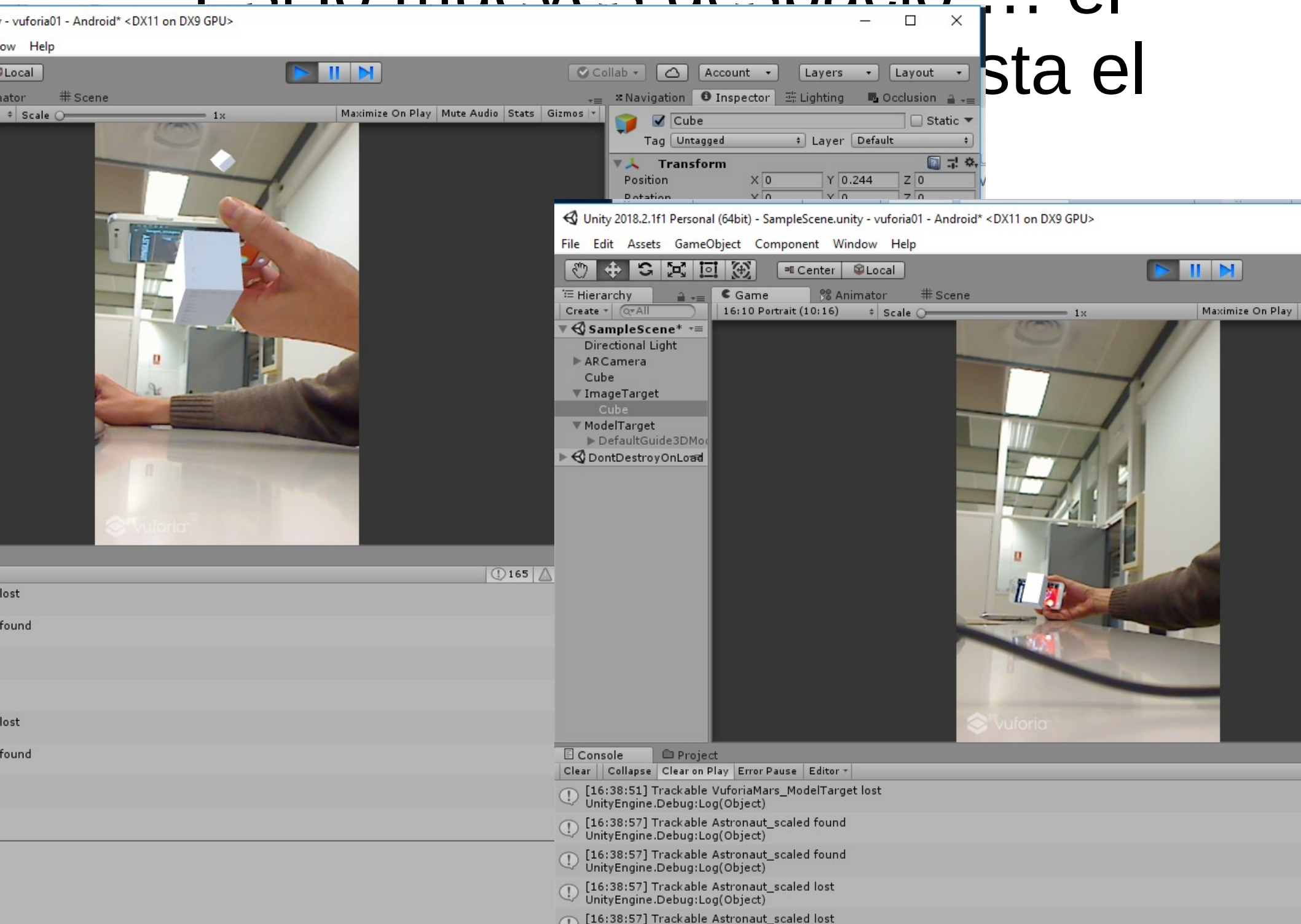
Setting up Image Targets



Puedes cambiar la posición de la
to



Y si lo mueves despacio … el sta el

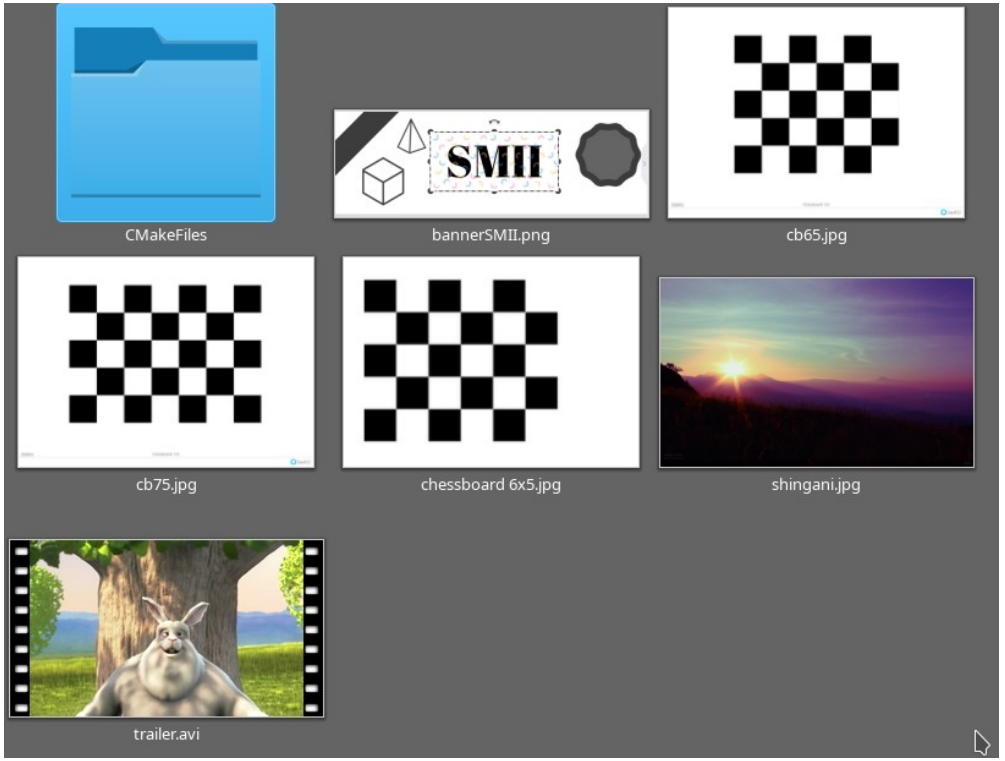


Índice

SimplAR

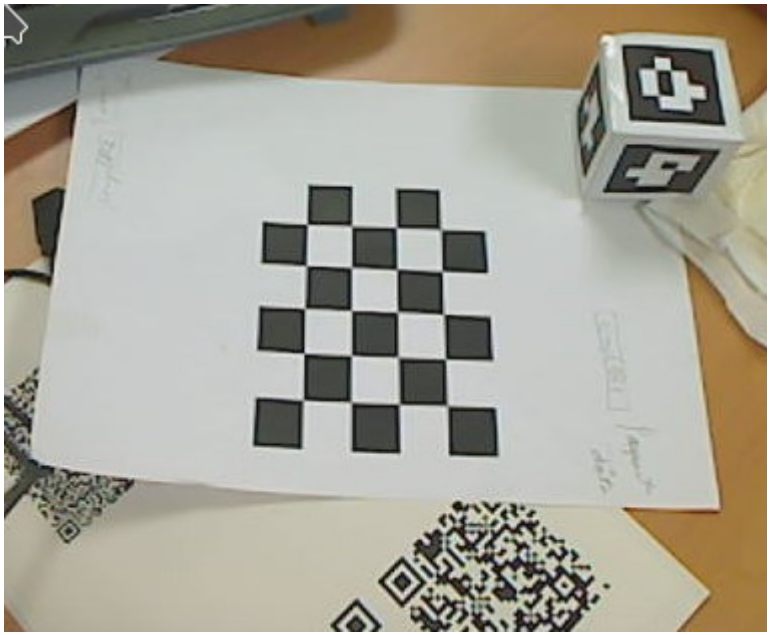
- Ejemplo de RA sin posicionamiento

  - simplAR: Augmented reality for OpenCV beginners



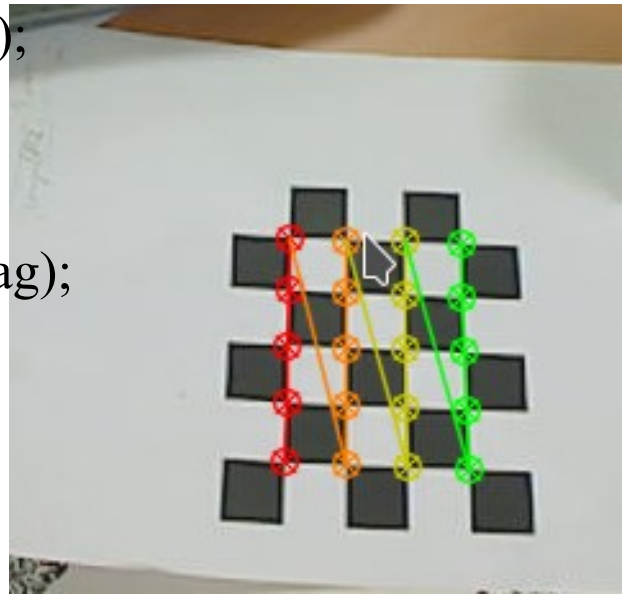
Fuente: “ simplAR: Augmented reality for OpenCV beginners ” <http://dsynflo.blogspot.com/2010/06/simplar-augmented-reality-for-opencv.html>.

SimplAR



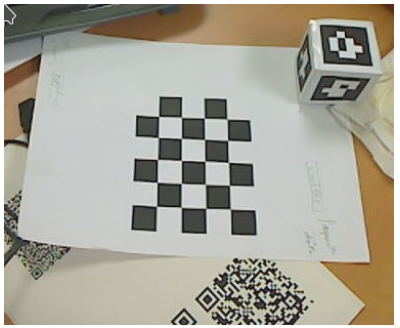
- Detectar la marca

```
capture >> img;
…
 cvtColor(img, gray, CV_BGR2GRAY);

 flag = findChessboardCorners(img, board_size, corners);

 if(flag == 1)
 {
    drawChessboardCorners(img, board_size, corners, flag);
 }
...
```

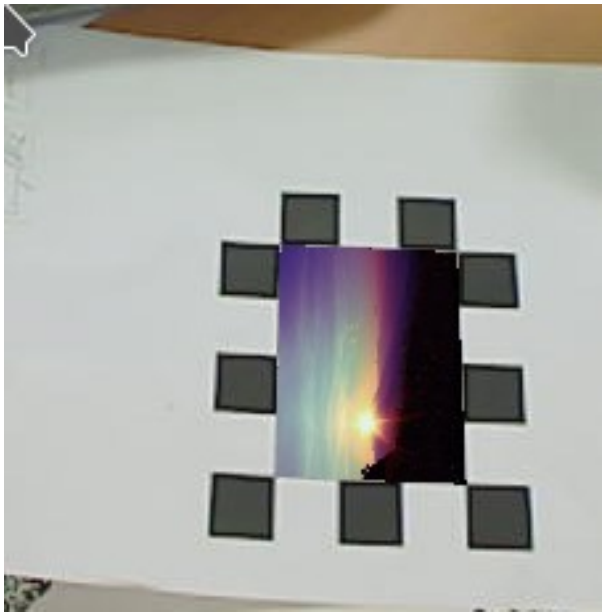


SimplAR

- Posicionar un objeto sintético estático

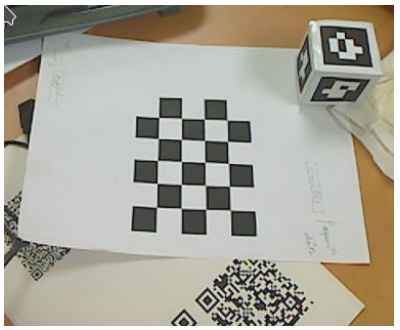


```
void mostrarImatgeEstatica_sobreMarca( Mat img, Mat display ) {
 …
  cvtColor(img, gray, CV_BGR2GRAY);
  flag = findChessboardCorners(img, board_size, corners);
  if(flag == 1)
  {
     cornerSubPix(gray, corners, Size(11,11), Size(-1,-1), TermCriteria(CV_TERMCRIT_EPS+CV_TERMCRIT_ITER, 30, 0.1));

     src.push_back(Point2f(0,0));
     ...
     dst.push_back(corners[0]);
     ...
     // Compute the transformation matrix,
     // i.e., transformation required to overlay the display image from 'src' points to
     // 'dst' points on the image
     warp_matrix = getPerspectiveTransform(src, dst);
    …
     // Transform overlay Image to the position       - [ITEM1]
     warpPerspective(display, neg_img, warp_matrix, Size(neg_img.cols, neg_img.rows));
     // Transform a blank overlay image to position
     warpPerspective(blank, cpy_img, warp_matrix, Size(cpy_img.cols, neg_img.rows));

     bitwise_not(cpy_img, cpy_img);                  // Invert the copy paper image from white to black
     bitwise_and(cpy_img, img, cpy_img);             // Create a "hole" in the Image to create a "clipping" mask - [ITEM2]
     bitwise_or(cpy_img, neg_img, img);              // Finally merge both items [ITEM1 & ITEM2]
  }
…
}
```



SimplAR

- Posicionar un objeto sintético dinámico



```
void mostrarImatgeEstatica_sobreMarca( Mat img, Mat display2 ) {
…
}


        capture >> img;
 …
        videoEnDisc >> display2;
        mostrarImatgeEstatica_sobreMarca( img, display2 );
…
}
```

Índice

Índice

Bibliografía

- Open Computer Vision Library (OpenCV)
  - Sitio web <http://opencv.org>
  - Documentación <https://docs.opencv.org/ >
  - Repositorio <http://sourceforge.net/projects/opencvlibrary> / Github <https://github.com/opencv/opencv>
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- [7] Detection of ArUco Markers. URL <https://docs.opencv.org/3.2.0/d5/dae/tutorial_aruco_detection.html >.
- [8] Detection of ChArUco Corners. URL < https://docs.opencv.org/3.2.0/df/d4a/tutorial_charuco_detection.html >.
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