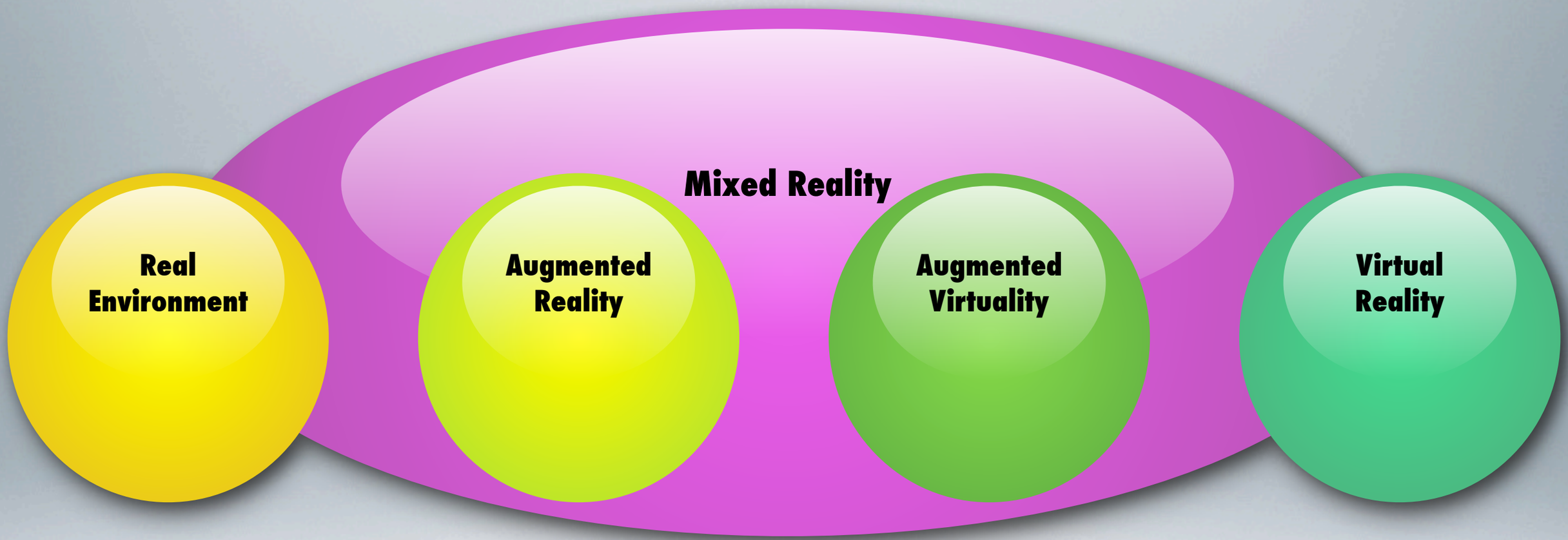
MOBILE AUGMENTED REALITY
LOOKING BEYOND THE HYPE

Dr Paul Coulton

Banksy



MIXED REALITY CONTINUUM

Paul Milgram

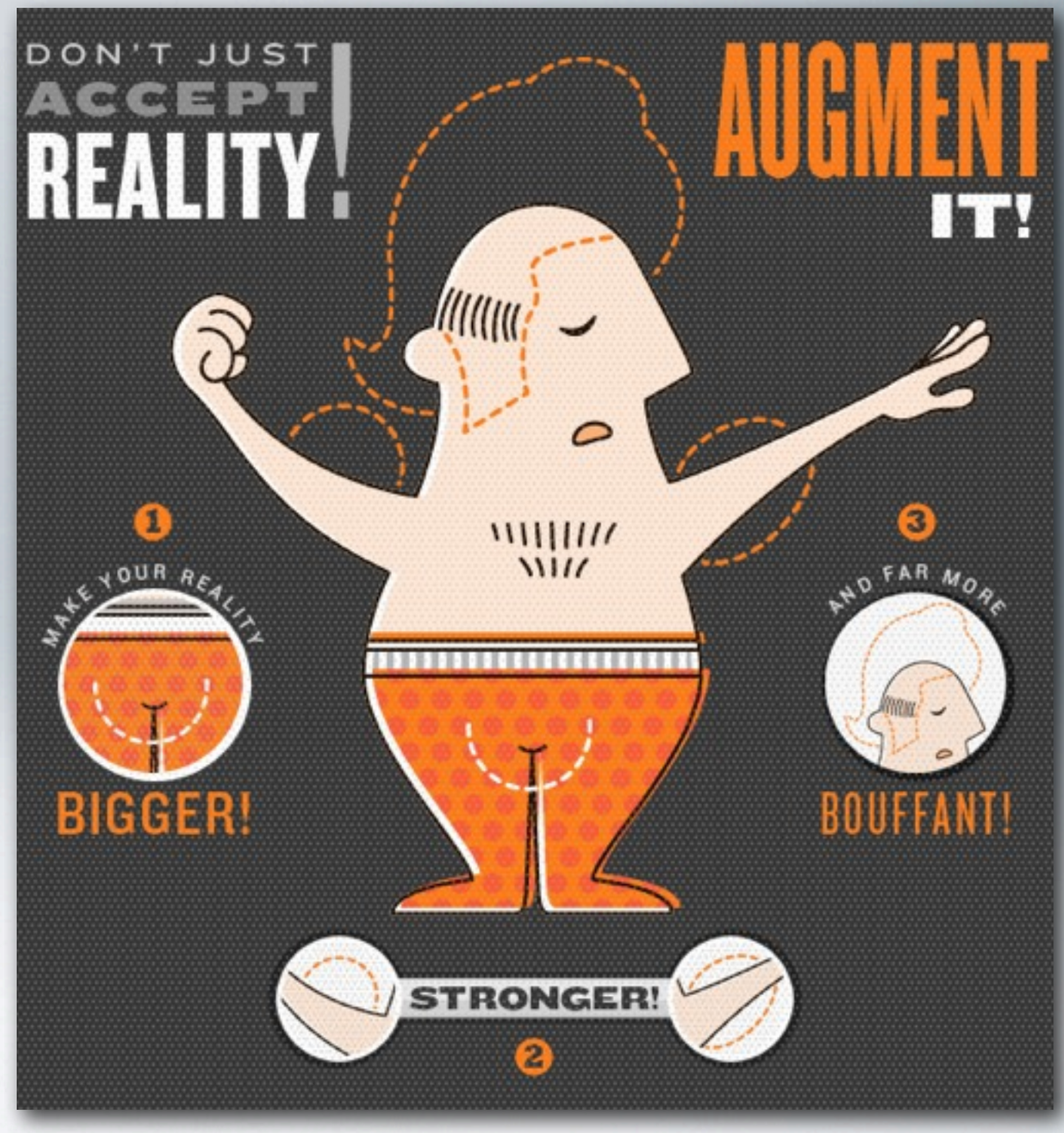
WHAT IS AUGMENTED REALITY?

The term AR is being used in all sorts of ways but the generally accepted definition is that it:

Combines the real and virtual

Is interactive in real time

Is registered in 3D



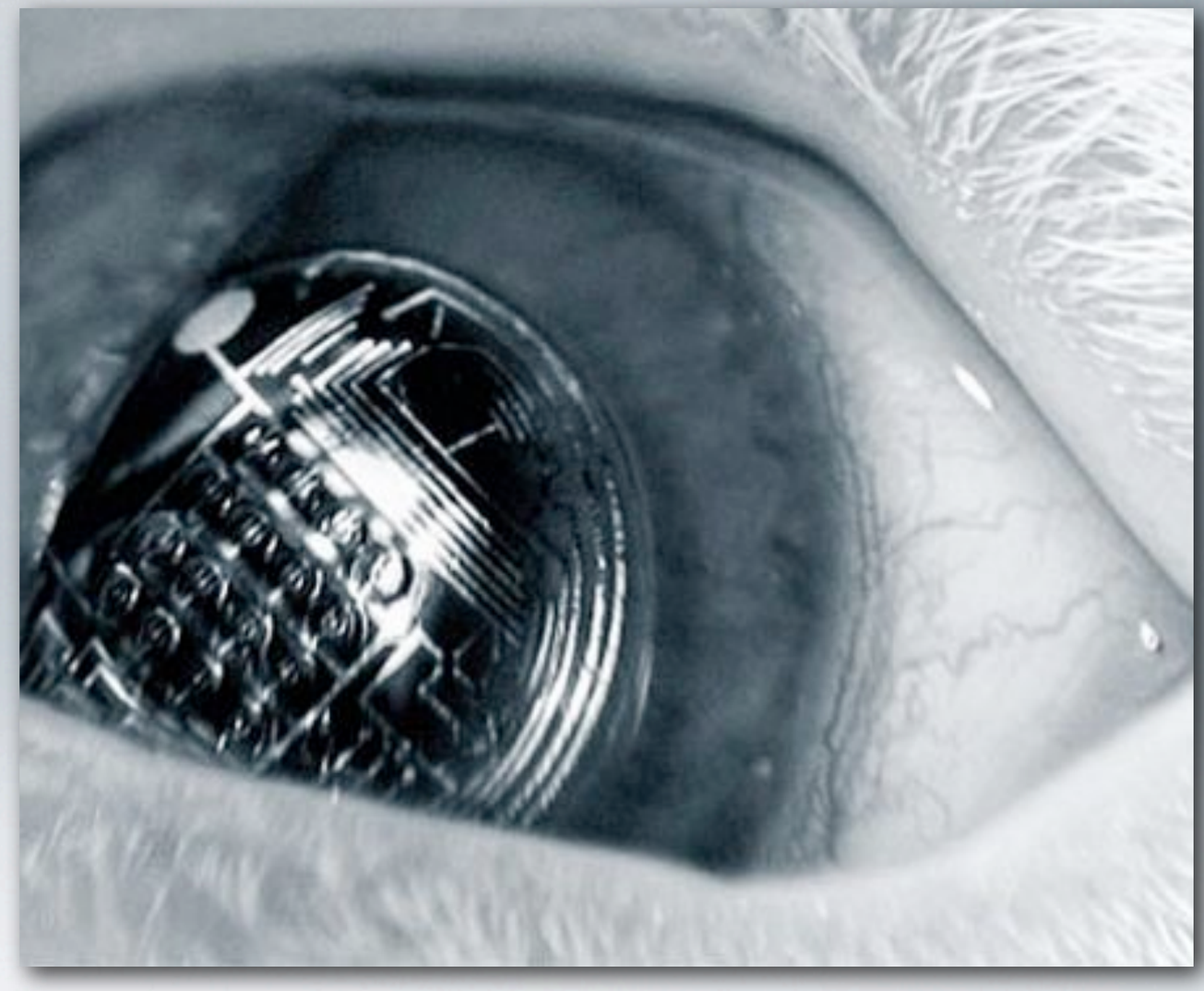
WHAT ISN'T AUGMENTED REALITY?

Location-based services
Barcode detection
(QR codes)
Augmenting still images
Special effects in movies
Photo-based object recognition
...

Alessandro Mulloni

Yu-Gi-Oh! Zexal

GENERAL CHALLENGES OF AR



Strict real time operation(30Hz)
High spatial precision (1cm, 1 degree)
Robustness for operation by human user

Alessandro Mulloni

CHALLENGES OF MOBILE AR

Same level of performance as desktop AR

No unrealistic assumptions about hardware

Variable operating contexts

Layar

FLAVOURS OF MOBILE AR

WEARABLE AR

Wearable system
Head-mounted display
AR always in view
(immersive)

Image
Denno Coil

Demo
Sixth Sense

FLAVOURS OF MOBILE AR

HANDHELD AR

Mobile phone as platform

Phone acts as a “magic lens”

Non-immersive view

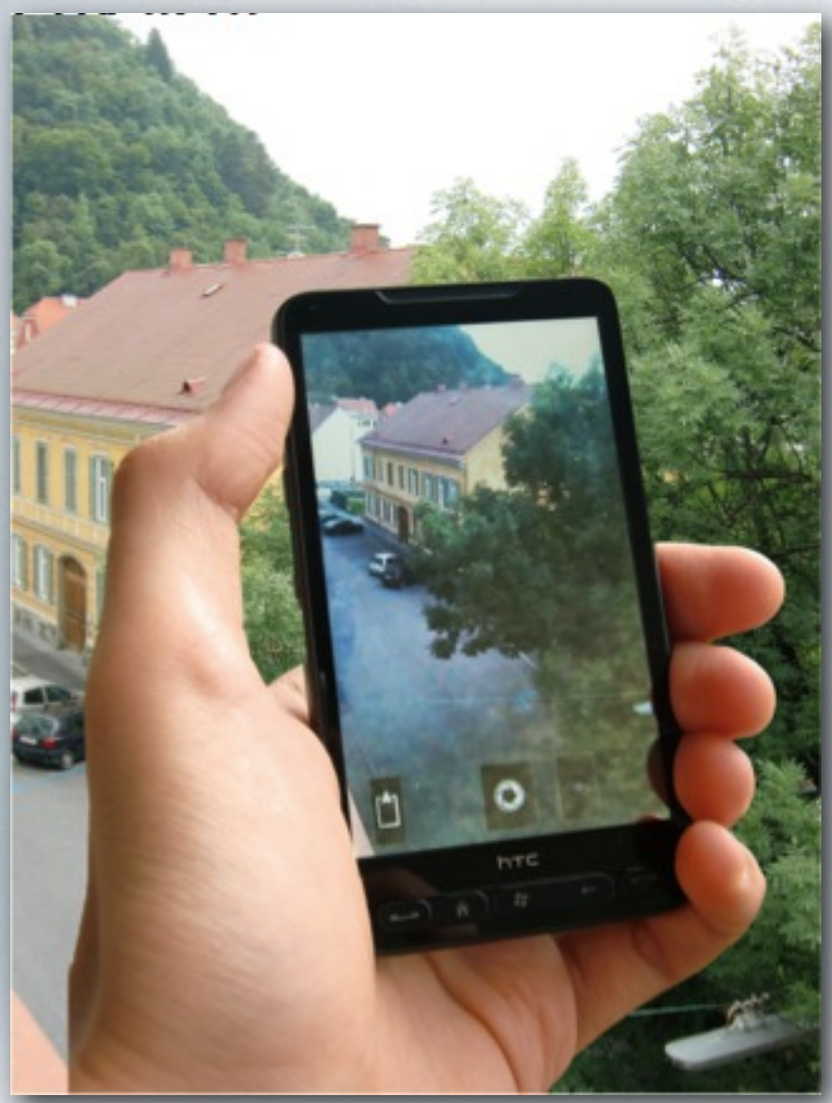
Tom’s Hardware

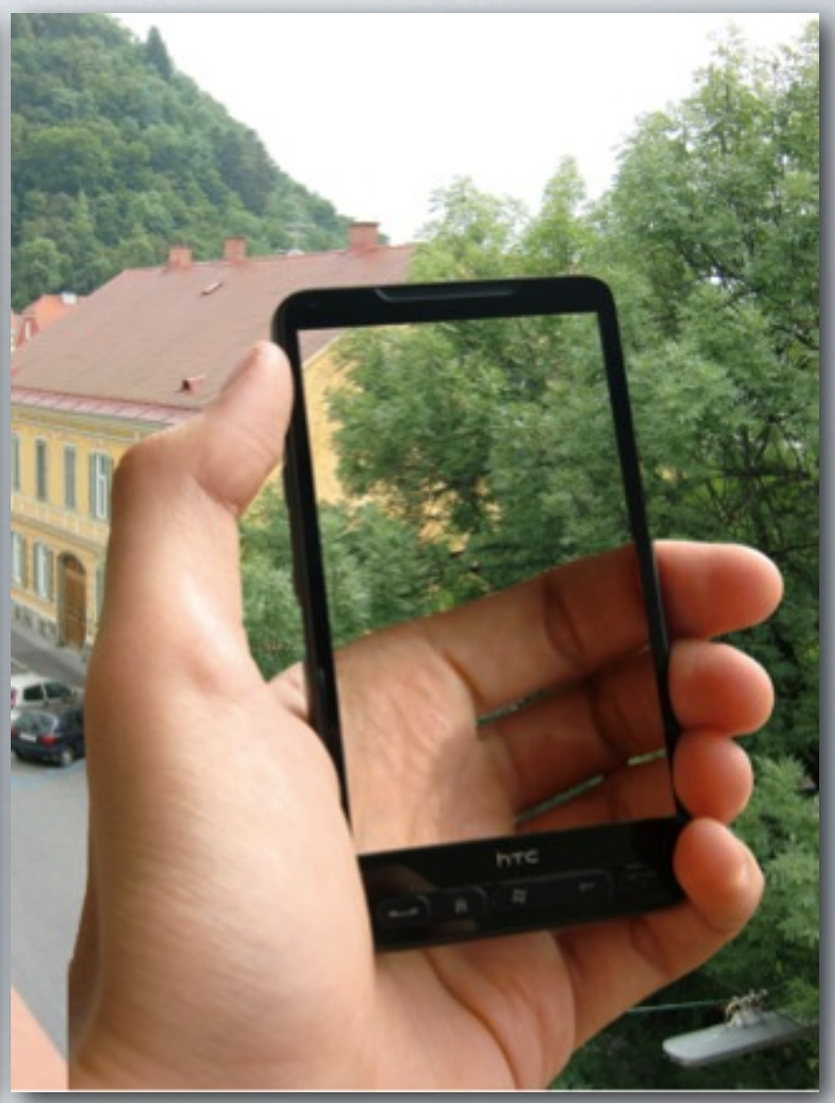
WHY USE PHONES?

Low cost, Ubiquity, Robust, Self Contained

WHY NOT USE PHONES?

Low memory, Limited power, Small Screen, Limited Inputs available, Fragmentation



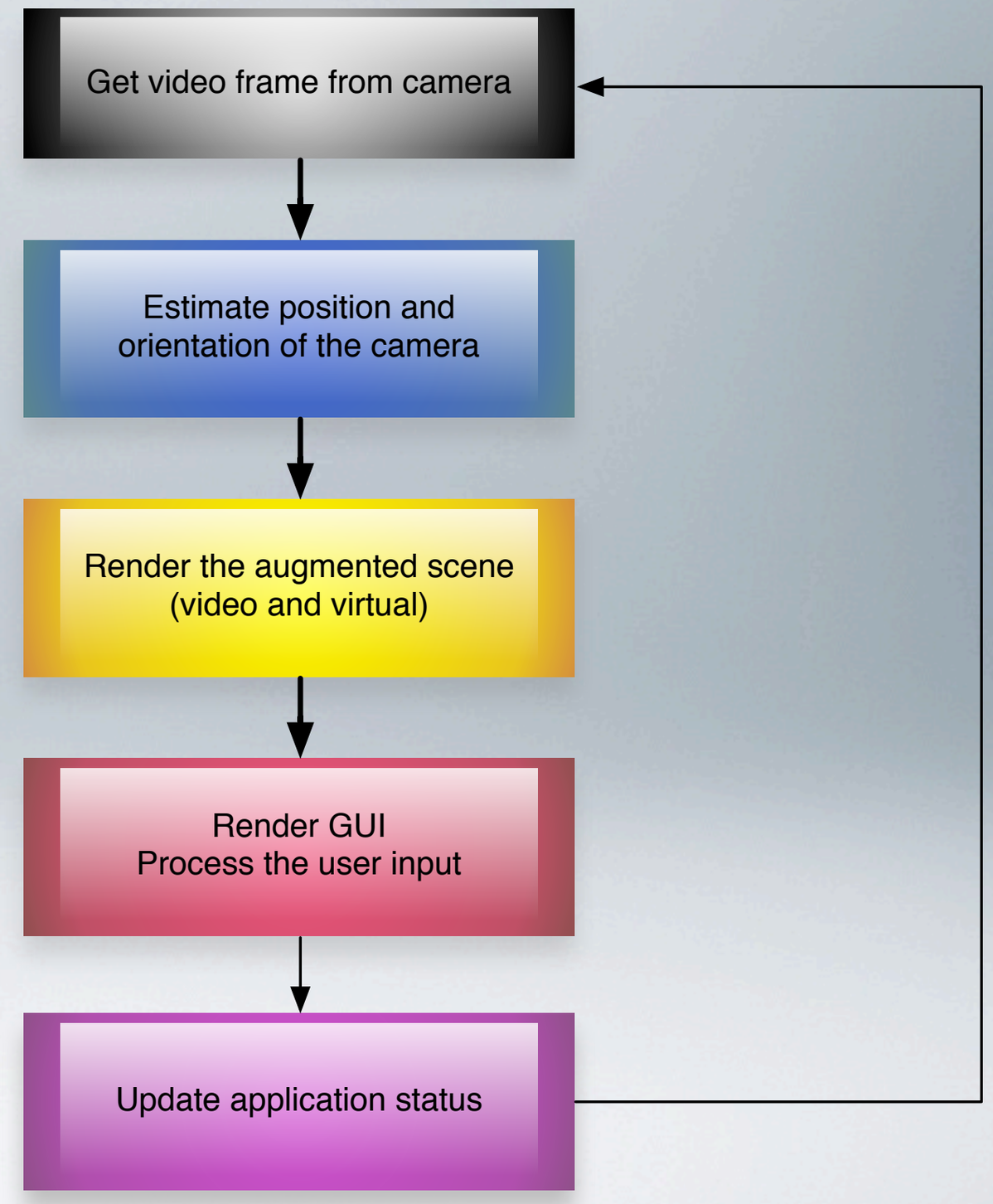


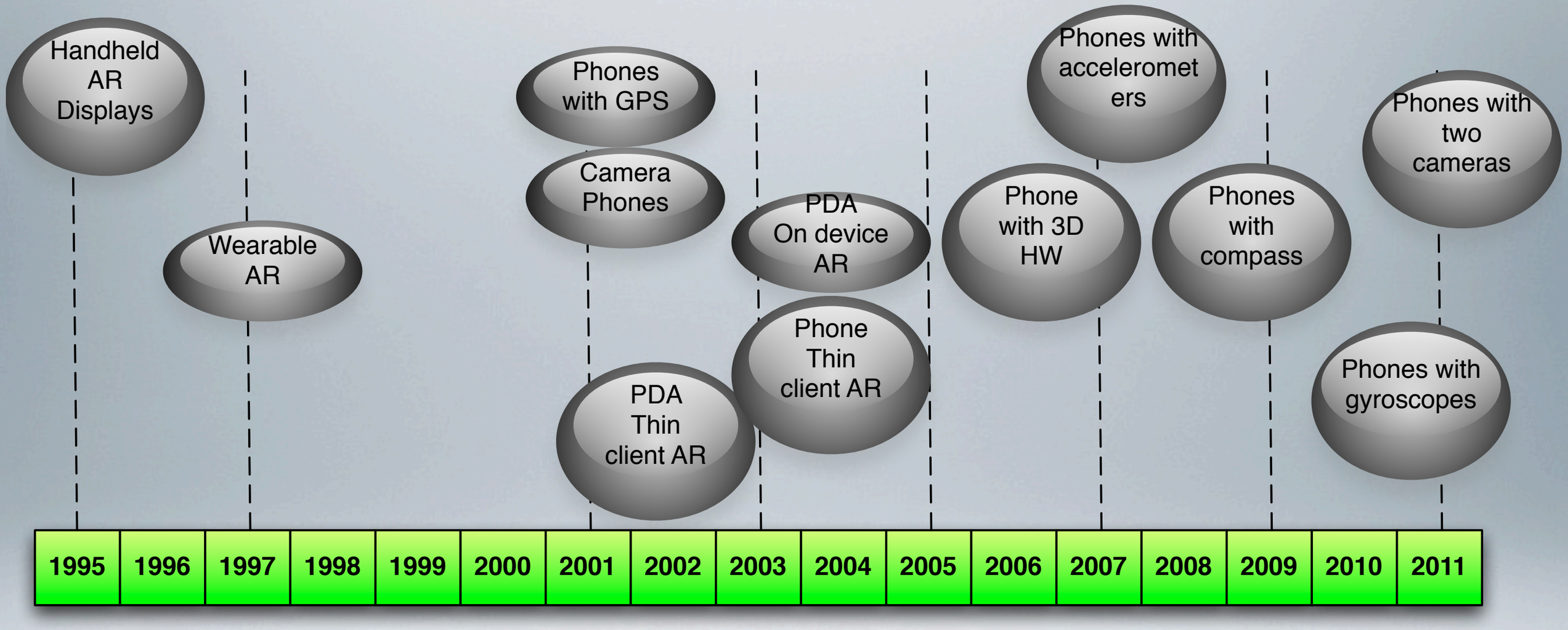
PERCEPTUAL PROBLEMS

You see through the camera not the phone!

DEVELOPING AR APPLICATIONS

What is involved in the process?



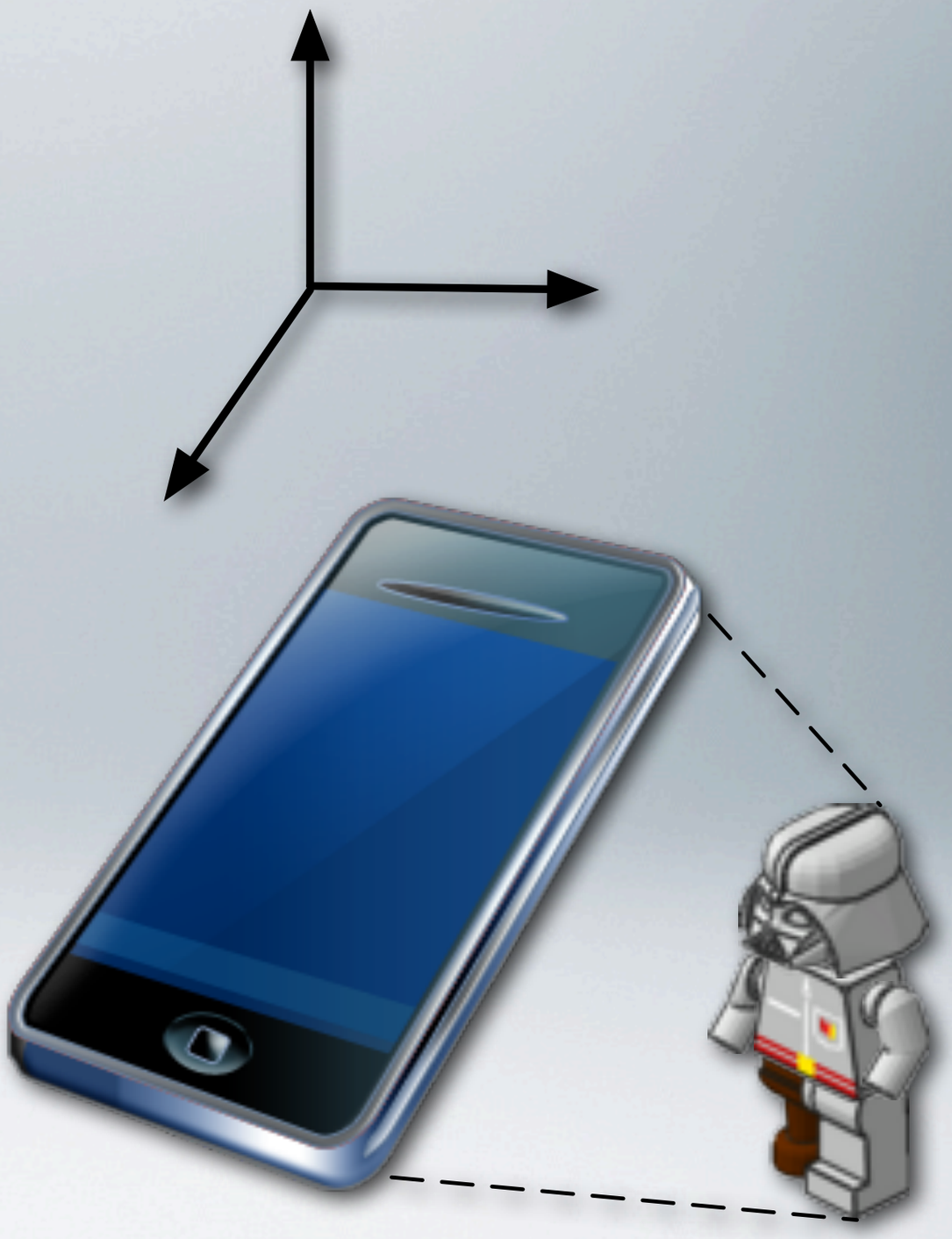


EVOLUTION OF MOBILE AR

ESTIMATING THE DEVICE POSE

Sensor tracking

Vision-based tracking

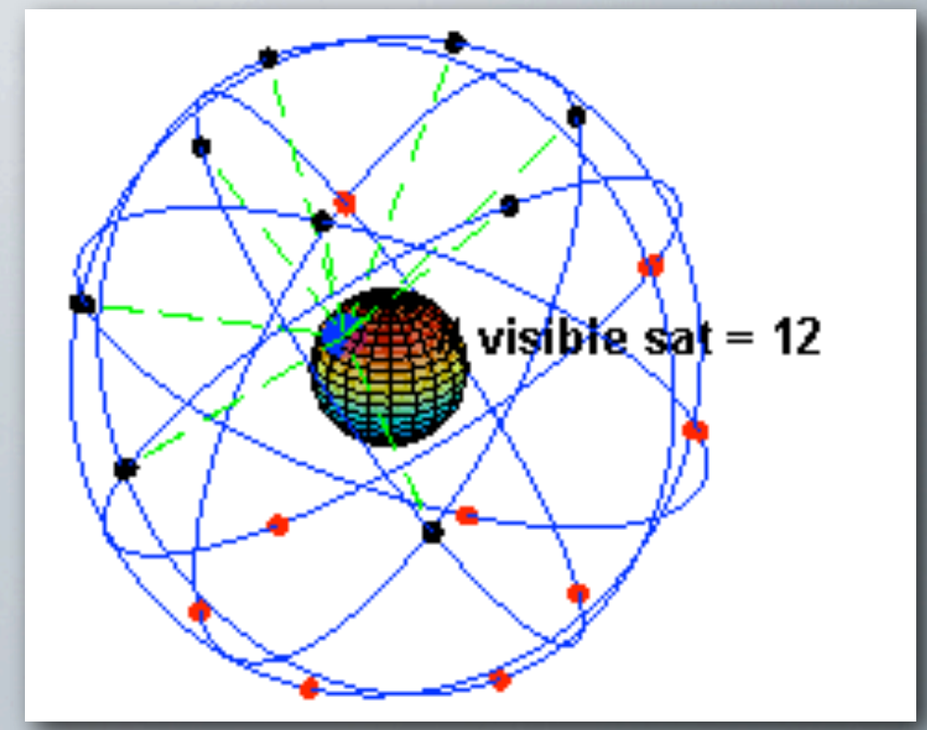


SENSOR BASED

Used by many commercial "AR browsers"
GPS, Compass,
Accelerometer, (Gyroscope)

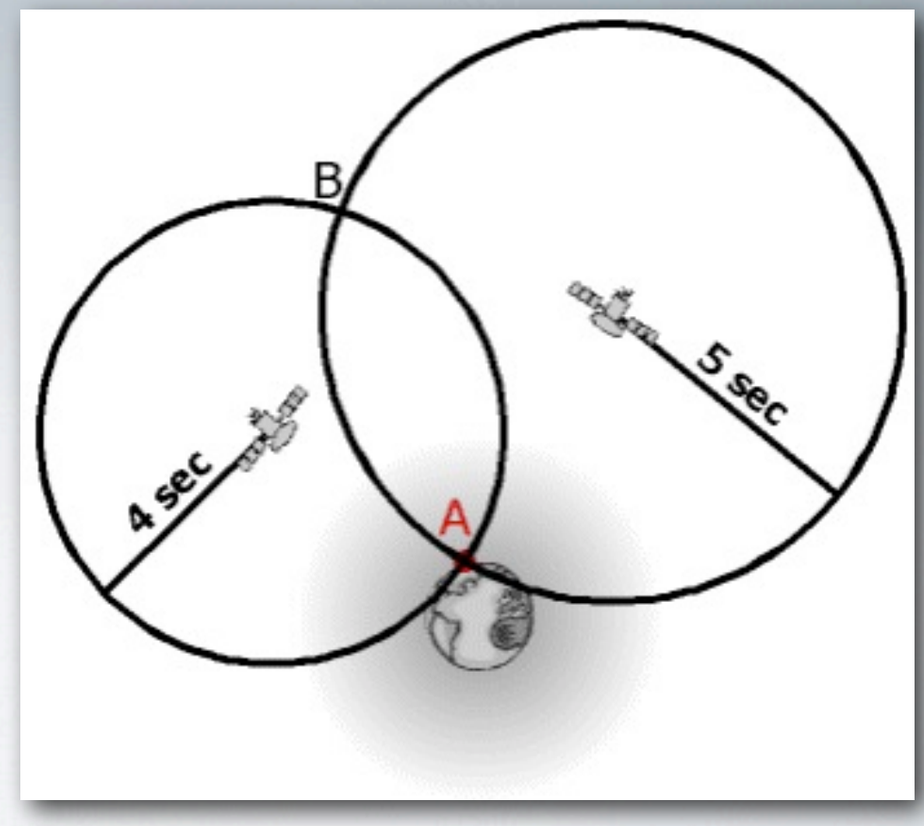
Demo
Wikitude

GPS



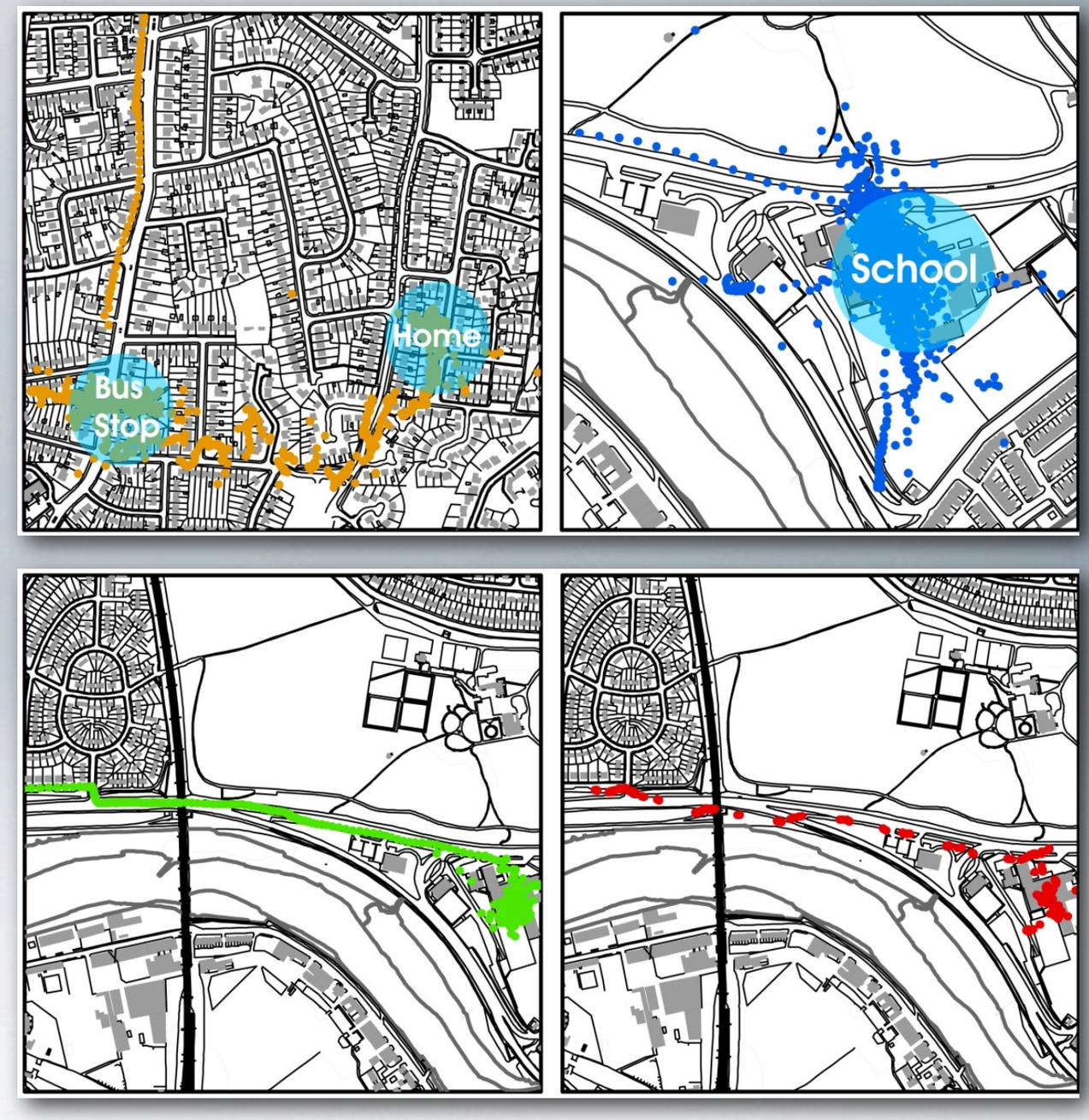
Originally 24 satellites but 31 as of 2008

Bill Clinton cleared GPS for commercial use in 1996

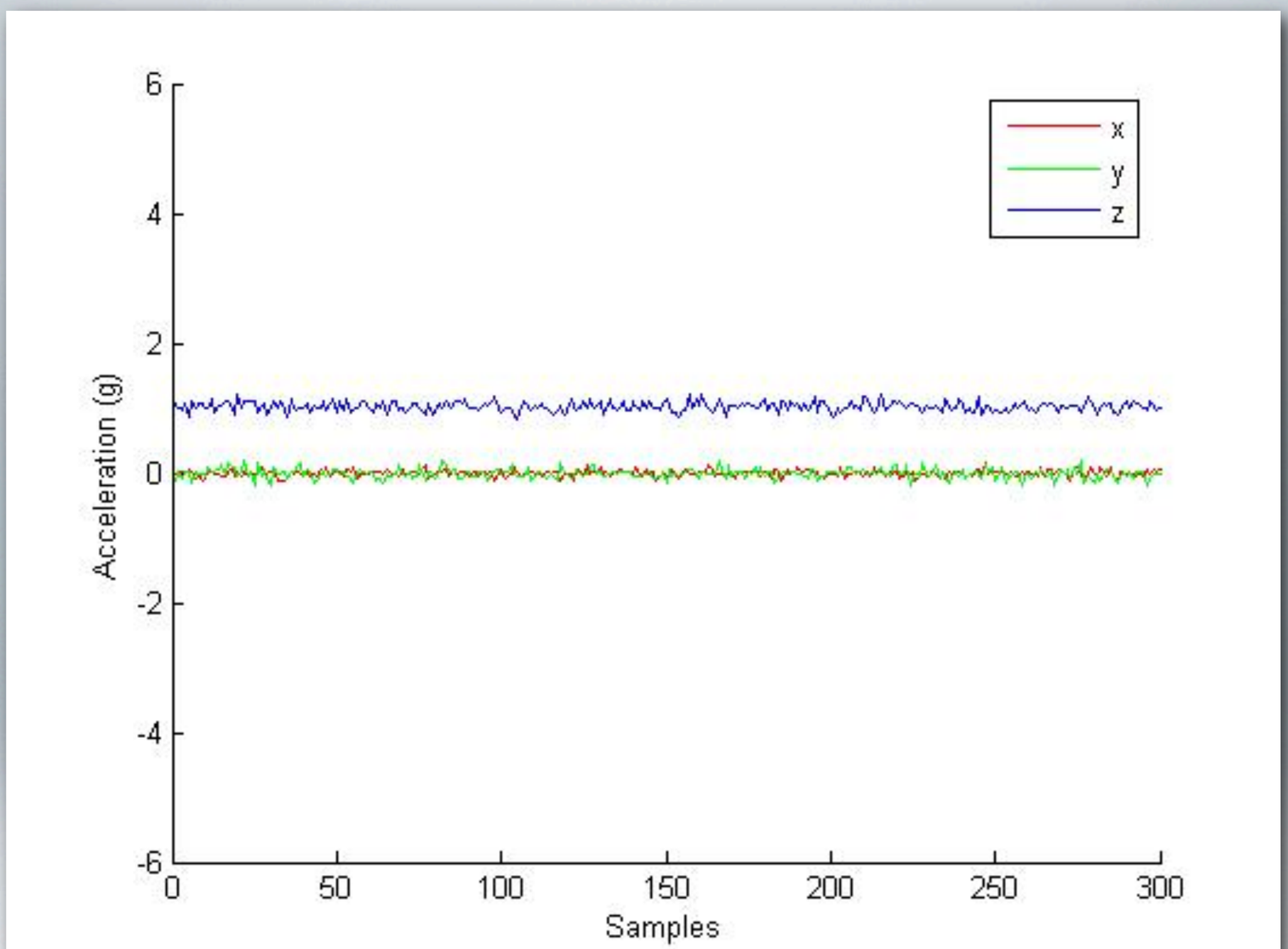


GPS

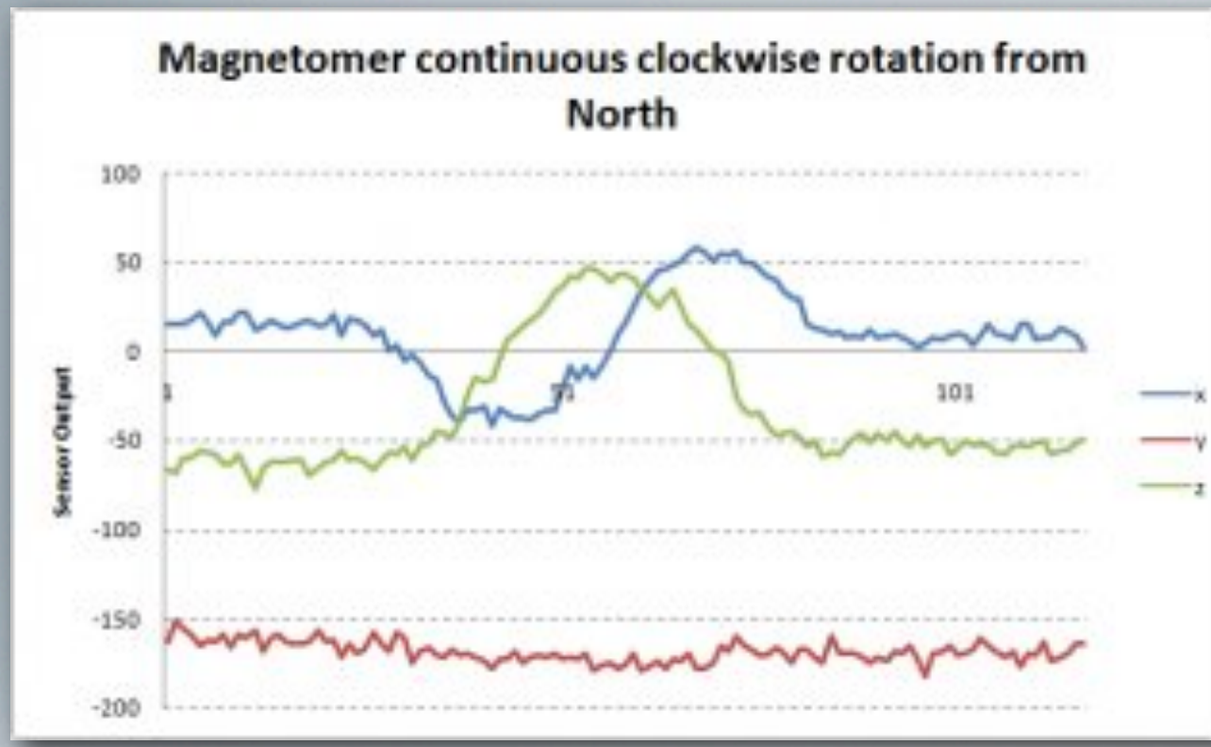
Spatial Scattering System and Environmental Effects

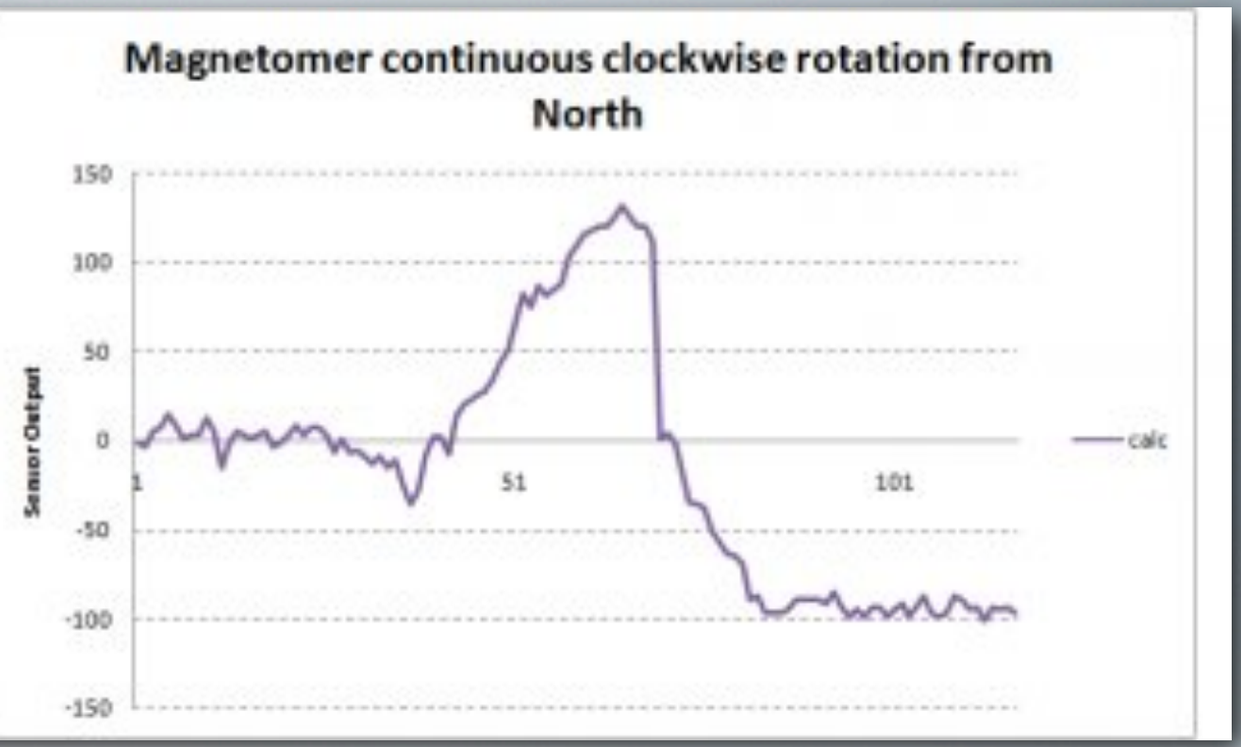


ACCELEROMETERS

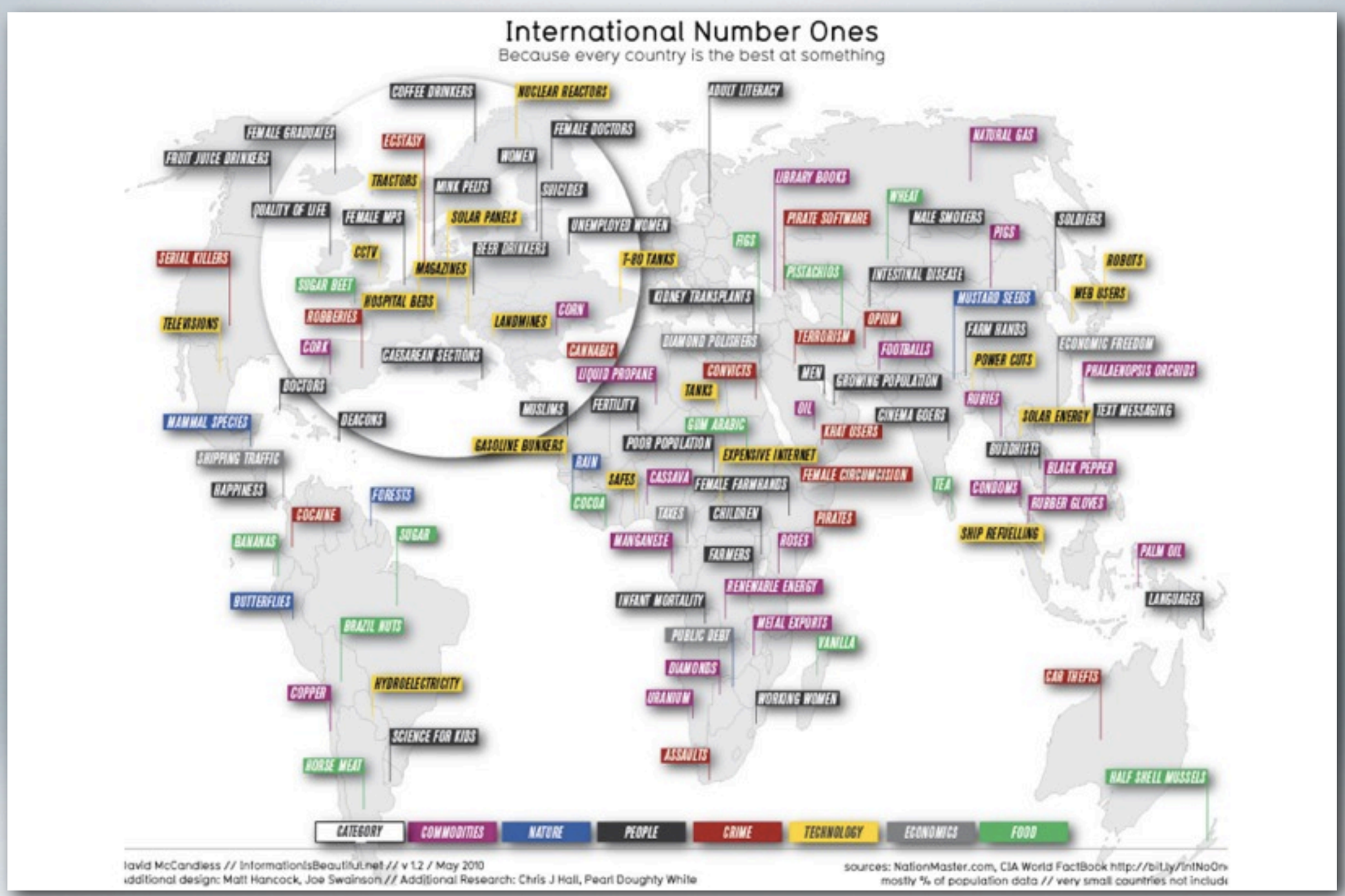


ACCELEROMETERS





MAGNETOMETERS



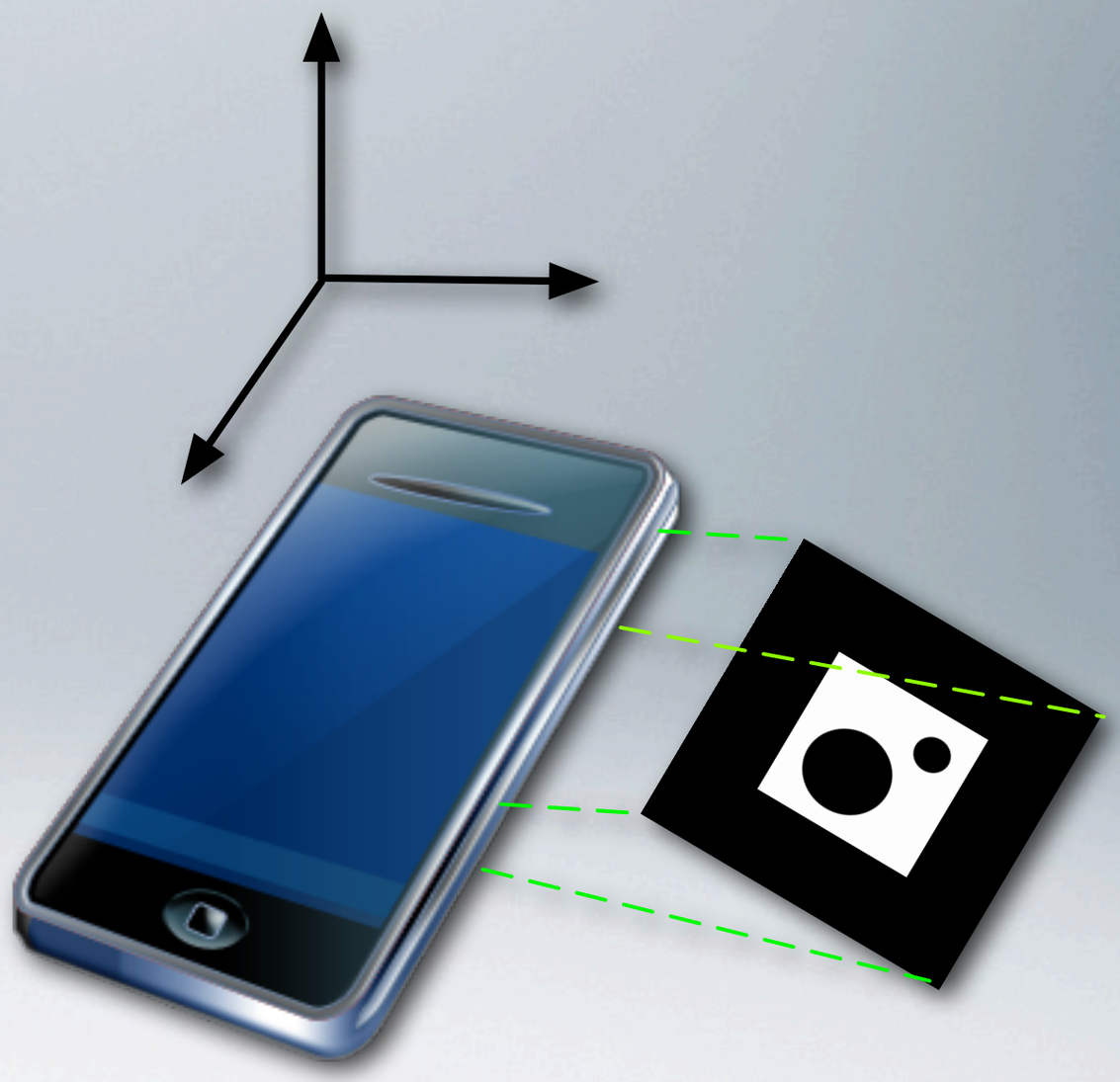
David McCandless
Information is Beautiful

DATA SOURCES

Quality, Availability, Crowd Sourcing

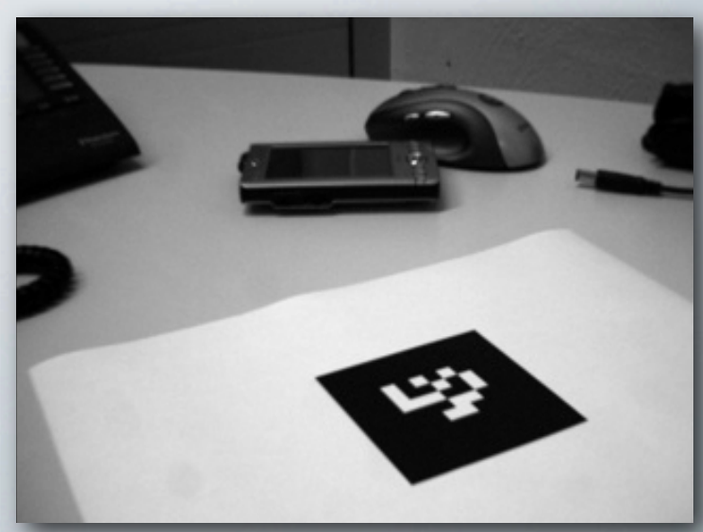
VISION BASED MARKER TRACKING

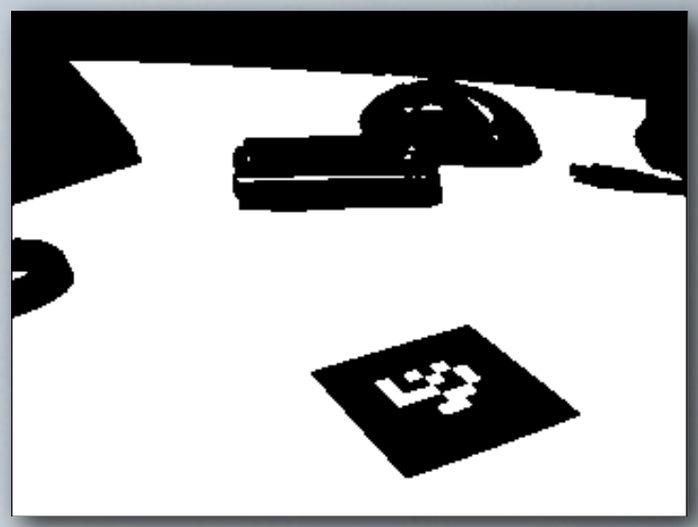
Standard Vision techniques
Marker provides 4 corners
from this we can get the pose

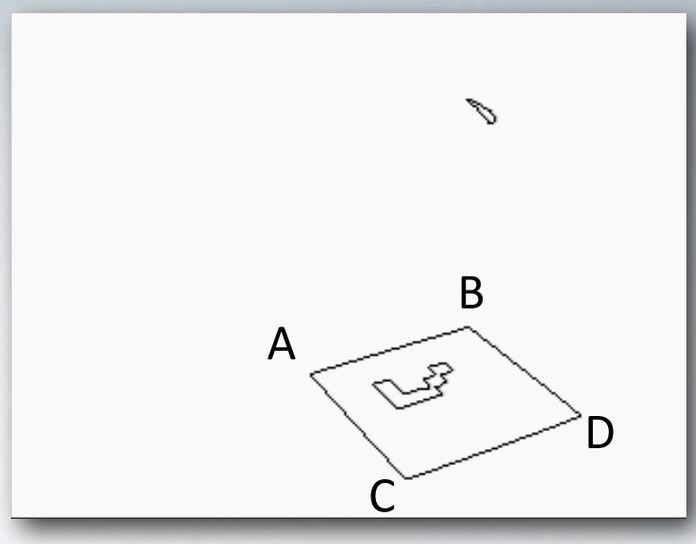


VISION BASED MARKER TRACKING

1. Convert image to black and white
2. Search for edges
3. Follow edges
4. Find rectangle corners



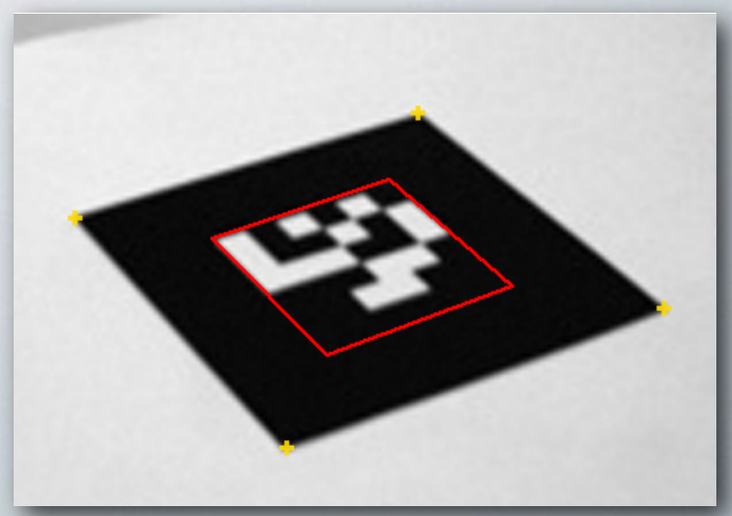


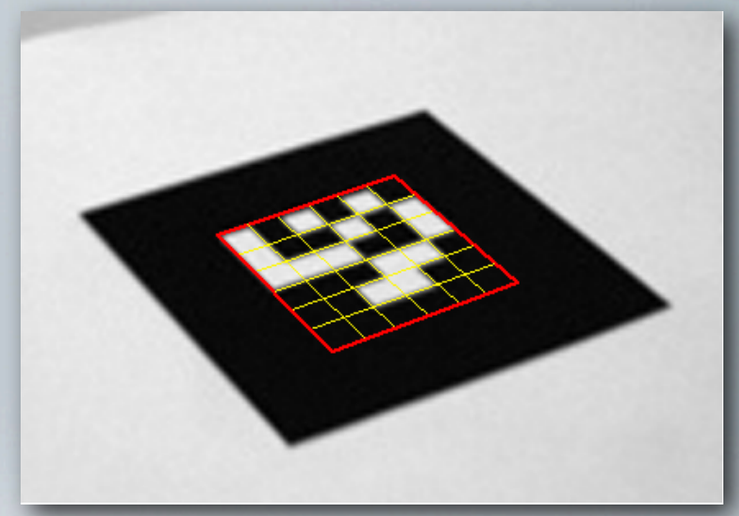


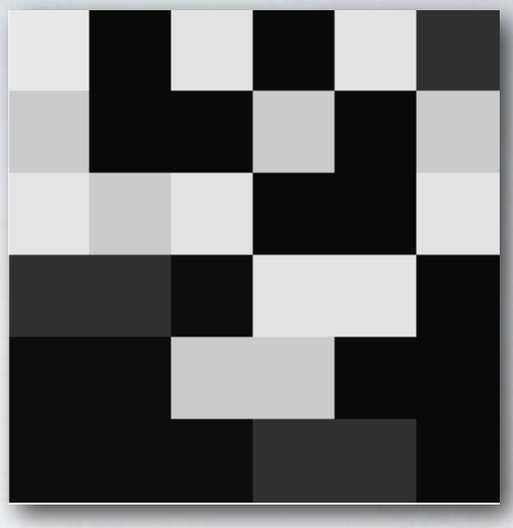
Daniel Wagner

VISION BASED MARKER TRACKING

5.Estimate homography using 4 corners
6. Extract pattern by sampling
7. Check Pattern







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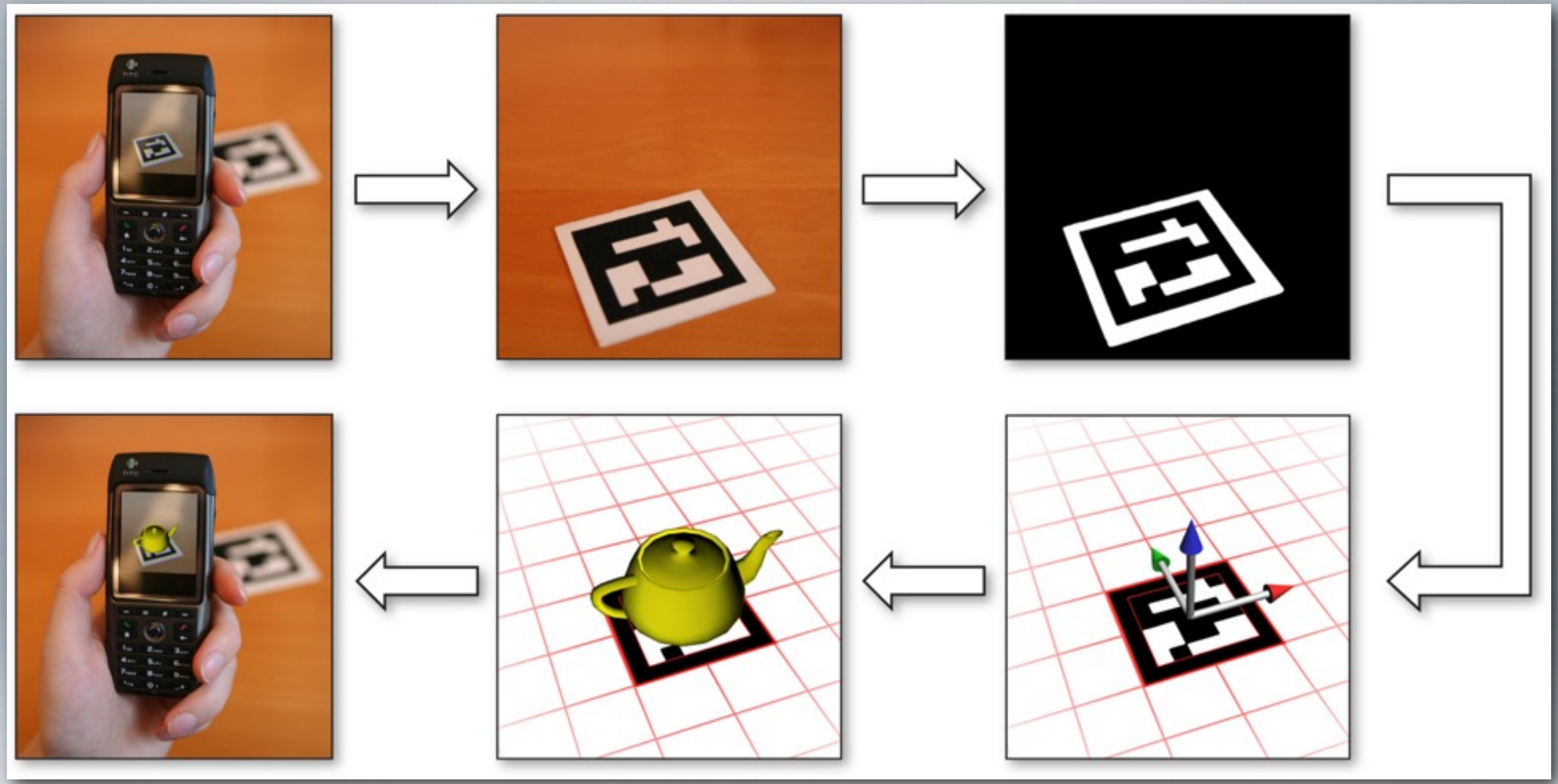


MARKER TRACKING PIPELINE

Daniel Wagner

VISION BASED MARKER TRACKING

Nintendo 3DS AR

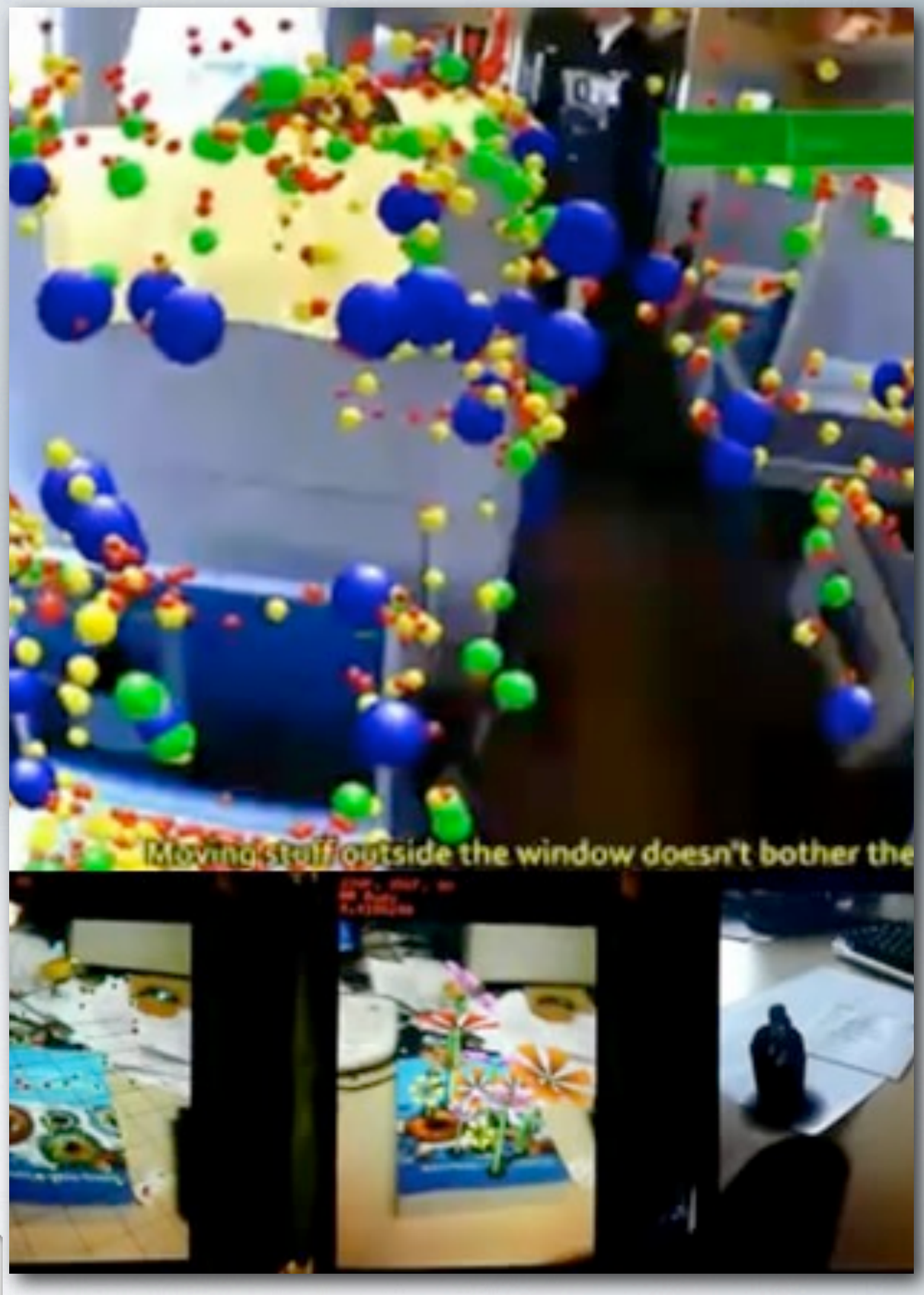
VISION BASED NATURAL FEATURE TRACKING

Tracking features from natural environment

More difficult than marker

Less established techniques

Slower than marker based



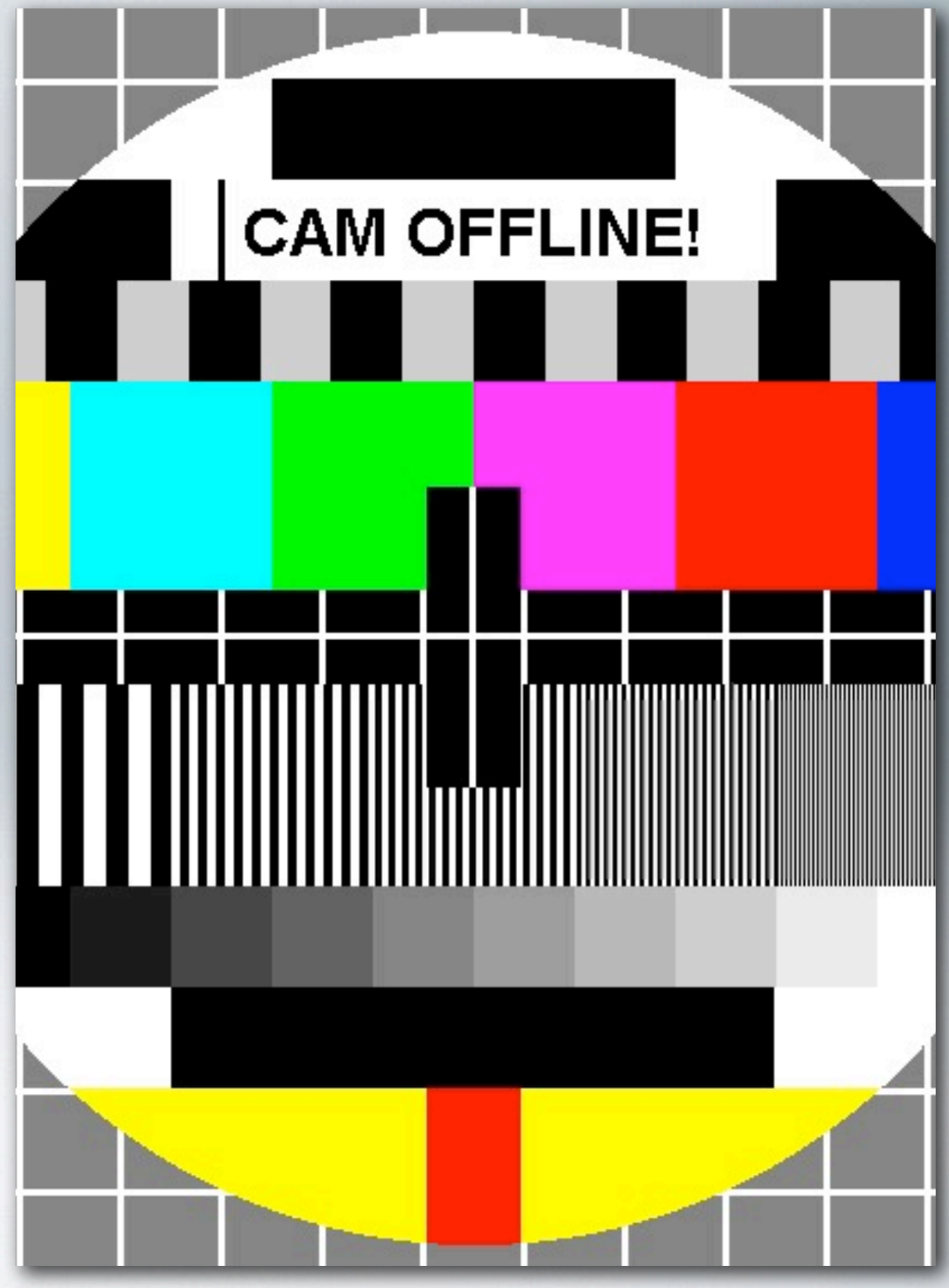
PTAM

VISION BASED NATURAL FEATURE TRACKING

Edges - boundaries
Corners - local 2D structure
Blobs - regions rather than points
Ridges - elongated structures

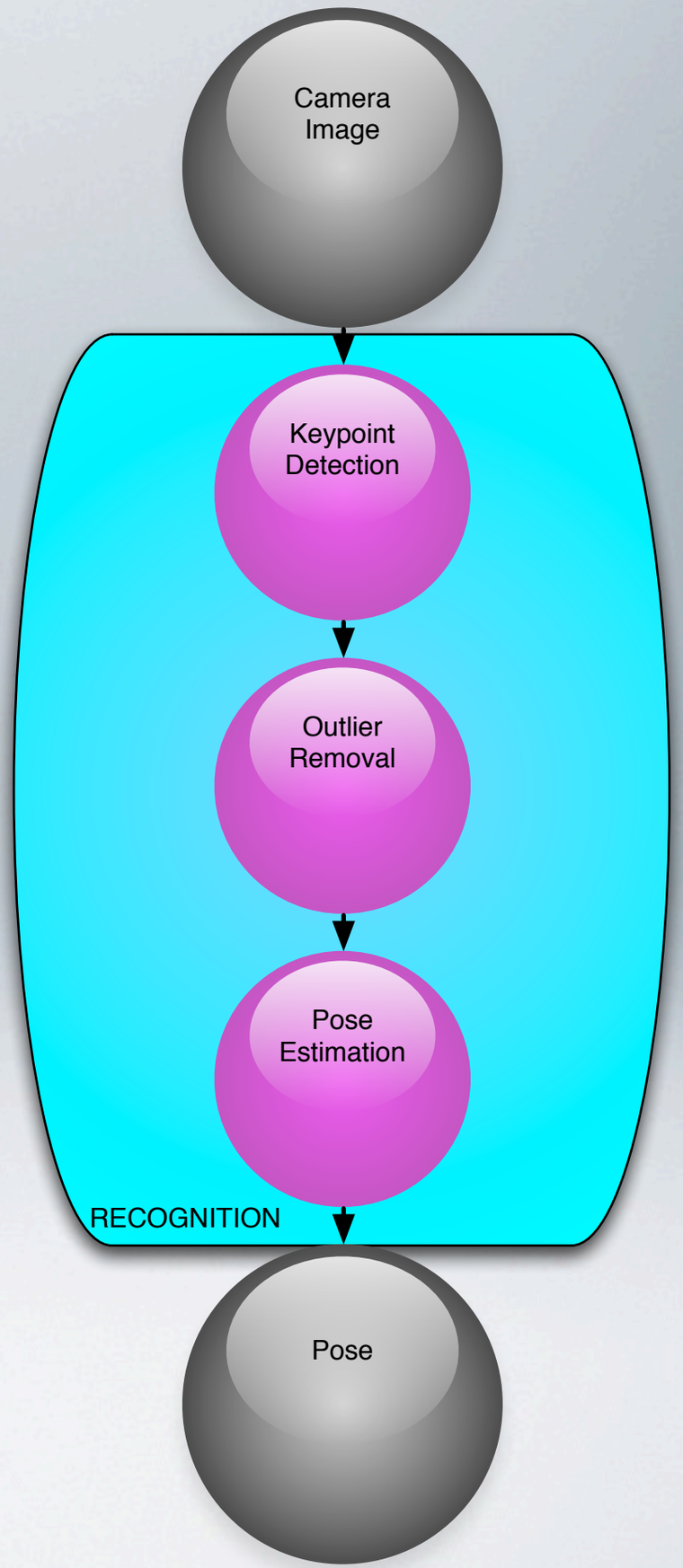
VISION BASED NATURAL FEATURE TRACKING

Offline
Use still images to build data base of features



VISION BASED NATURAL FEATURE TRACKING

Online
Creating maps are markers online
Real-Time Pipeline



VISION BASED NATURAL FEATURE TRACKING

Online

- SENSORS
  - Noise Output
  - Low Accuracy
  - Global Pose
  - Works when nothing to track

- VISION
  - High Accuracy
  - Local Pose
  - Memory Intensive
  - Works only when Objects to Track

HYBRID TECHNIQUES

CONCLUSIONS

- Augmented Reality is currently the hot topic from a continuum of possible systems.
- Mobile phones provide the most obvious platform for the widespread adoption of AR.
- Majority of current commercial offering are sensor based which gives crude contextual sensitivity but this may be fine for your application. These solutions generally are dependant on quality of the data source.
- Marker based solutions give greater accuracy although we aren't likely to cover the world with markers work well for advertising.
- Marker-less systems offer the 'dream' of AR but currently present considerable technical challenges.
- If your considering AR ask what benefits it gives the user apart from being 'cool'.

LINKS

- http://www.youtube.com/watch?v=wKyQhriOrD0
- http://www.youtube.com/watch?v=y79hW3mrbzE
- http://www.youtube.com/watch?v=EtpNx7Y14d0
- http://www.youtube.com/watch?v=Q4Z9sOtiWUY
- http://www.youtube.com/watch?v=8EA8xlicmT8
- http://www.youtube.com/watch?v=fiWuB1q3c5g
- http://www.youtube.com/watch?v=Y9HMn6bd-v8
- http://www.youtube.com/watch?v=fh0eN6oIGtY
- http://www.youtube.com/watch?v=pBI5HwitBX4
- http://www.youtube.com/watch?v=nNMiUWF-QbU
- http://www.youtube.com/watch?v=EucpO64-wBM

- http://www.youtube.com/watch?v=V3KrFV0-WFw
- http://www.youtube.com/watch?v=N64IQN1MtdI
- http://www.youtube.com/watch?v=7JWk_JIE3Ow
- http://www.guardian.co.uk/science/2010/nov/30/dinosaurs-david-attenborough-natural-history
- http://www.youtube.com/watch?v=A5W43iocj_c