



# Αναγνώριση Δραστηριότητας από Αισθητήρες για την Υποστήριξη της Ανεξάρτητης Διαβίωσης

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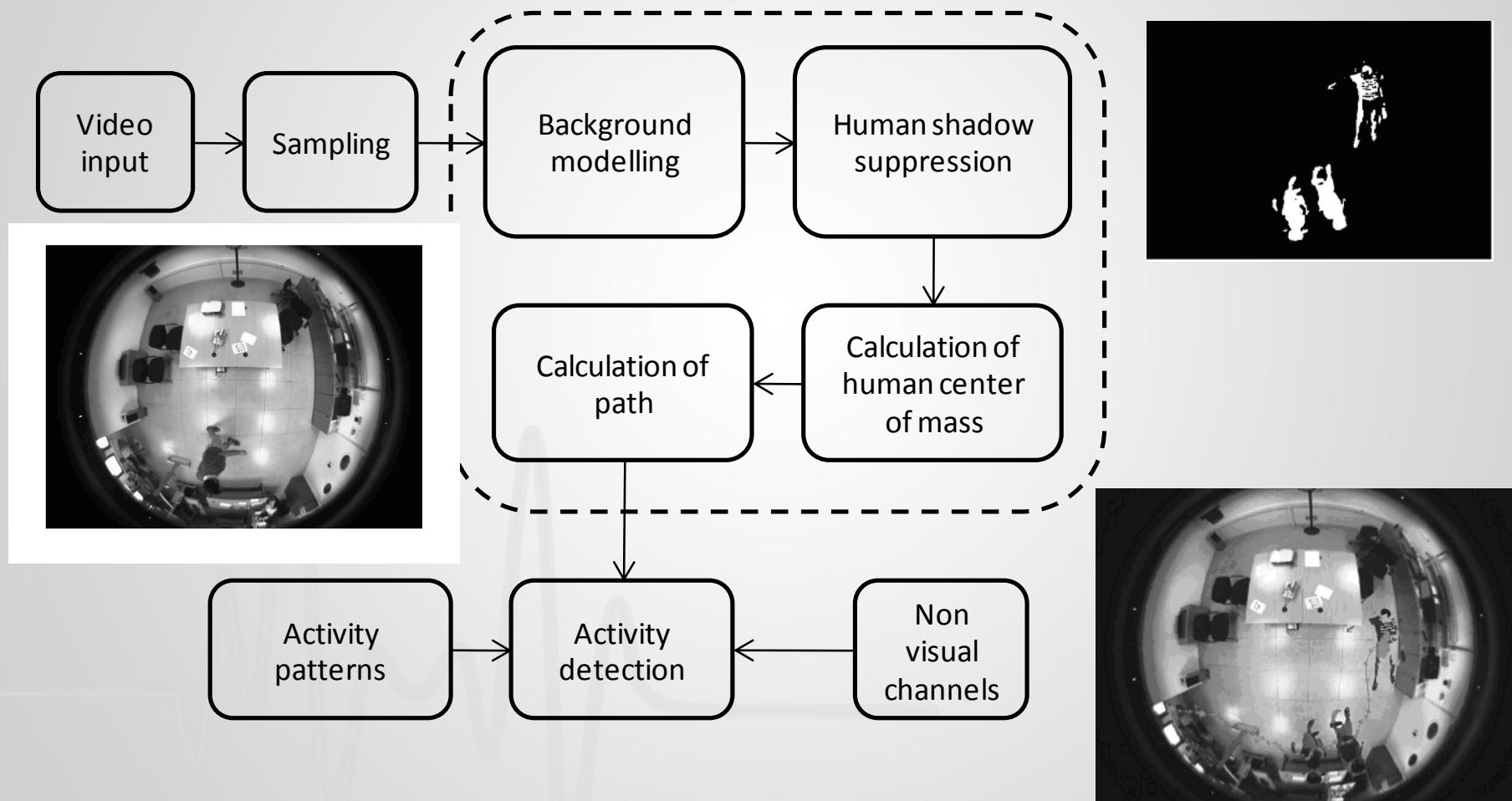


# Εισαγωγή

- Διάχυτα συστήματα για την παροχή υπηρεσιών που υποστηρίζουν την ανεξάρτητη διαβίωση (Ambient Assisted Living Systems – AAL)
- Αναγνώριση της δραστηριότητας και της κατάστασης του χρήστη/ασθενή/ηλικιωμένου – Επείγοντα Περιστατικά
- Η υπολογιστική όραση είναι ιδιαίτερα ελκυστική επιλογή καθώς δεν προϋποθέτει επαφή με τα υπό επίβλεψη άτομα.
- Ανάλυση βίντεο -> παρακολούθηση του ανθρώπου-στόχου -> εξαγωγή της συμπεριφοράς



# Γενική Αρχιτεκτονική



# Μέθοδοι μοντελοποίησης / αφαίρεσης υποβάθρου (background modeling)

## – Μη αναδρομικές τεχνικές

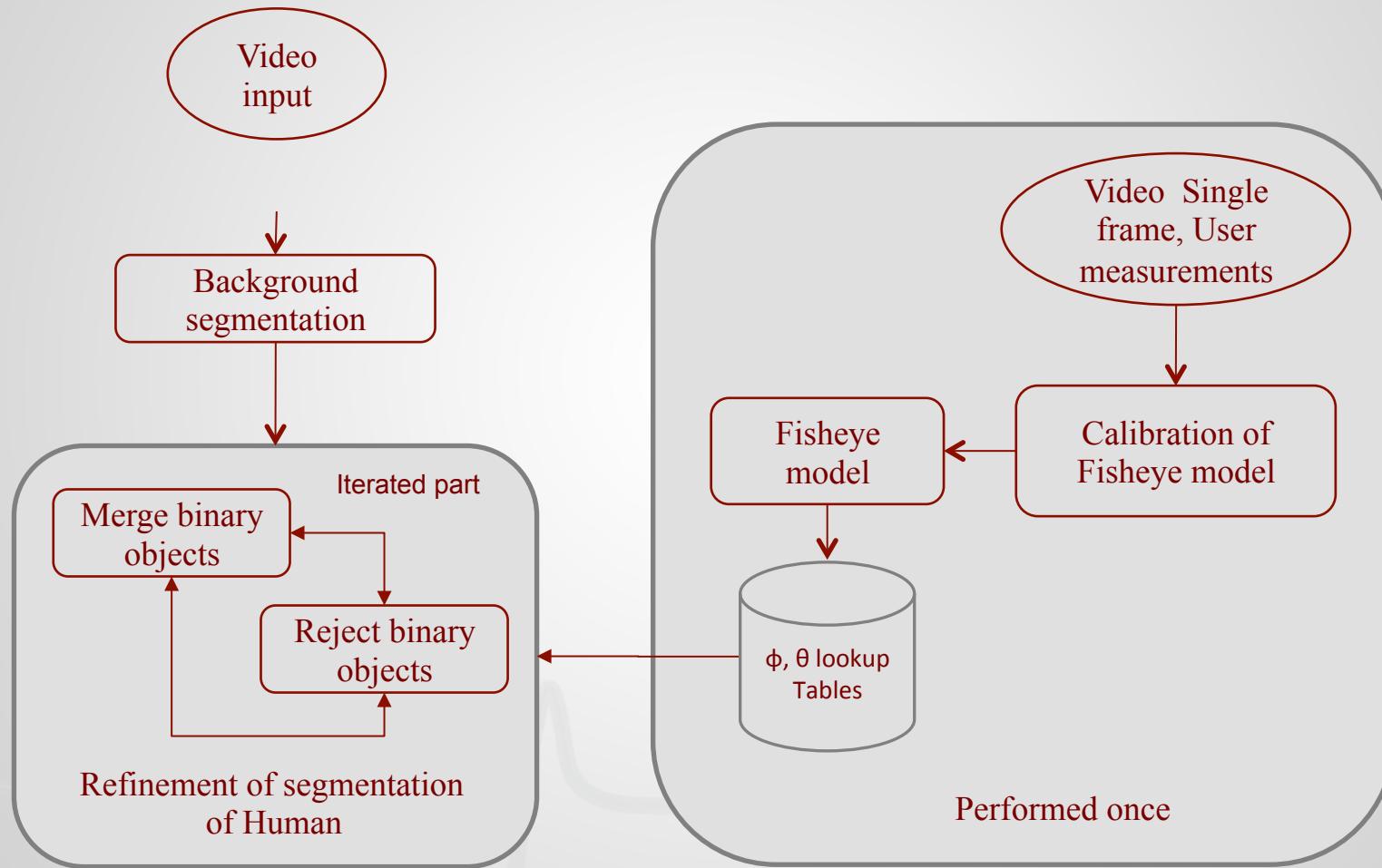
- Χρησιμοποιούν ένα είδος χρονικού κινητού παραθύρου
- Χρήση buffer για την αποθήκευση ενός αριθμού πλαισίων από το οποίο θα γίνει μια εκτίμηση για το φόντο
- Απλές και προσαρμοστικές αλλά δεν απαιτητικές σε υπολογιστικούς πόρους
- Frame differencing, Median filtering, Linear predictive filter

## – Αναδρομικές τεχνικές

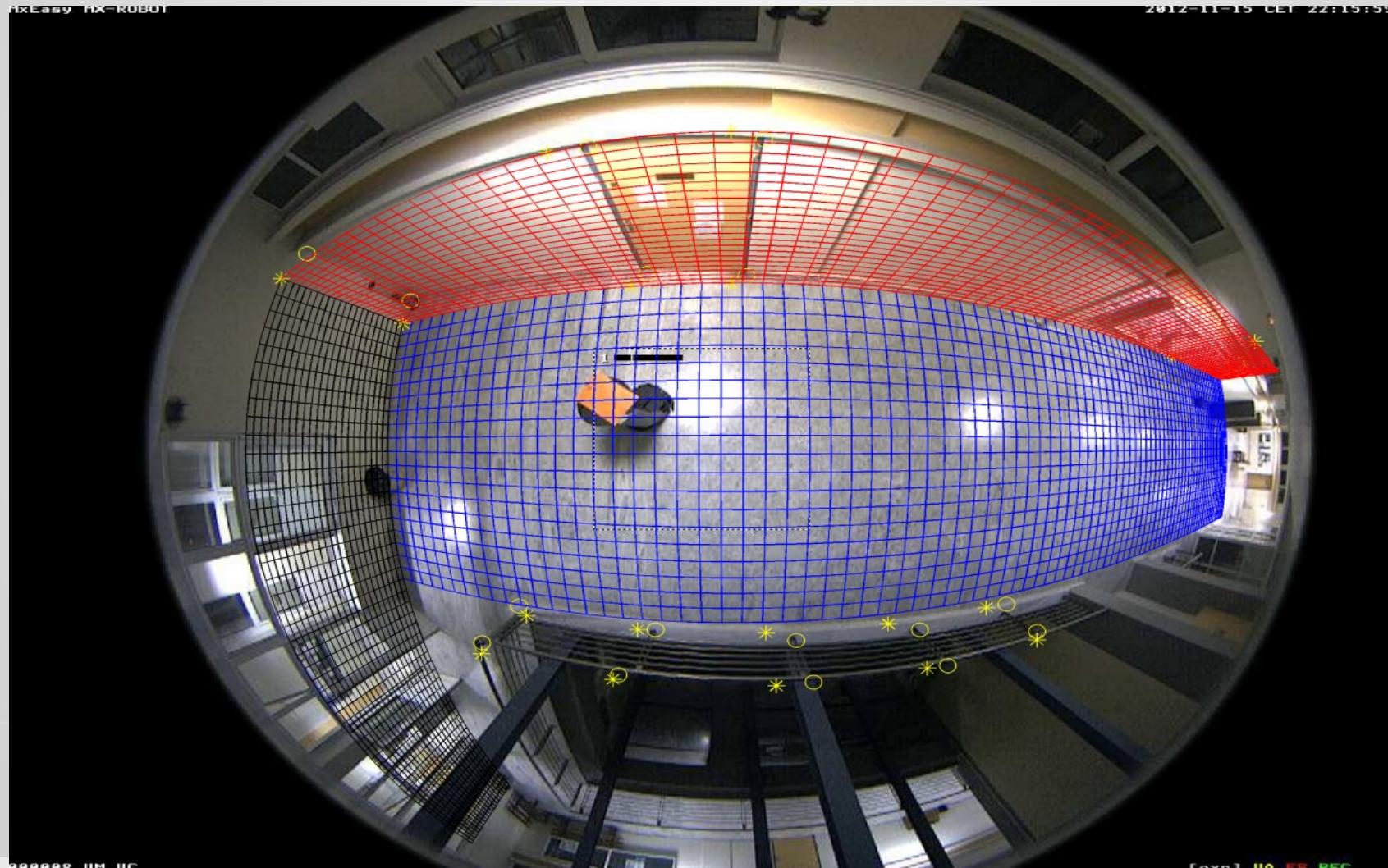
- Δεν χρησιμοποιείται buffer, η εικόνα / εκτίμηση του υπόβαθρου ενημερώνεται συνέχεια
- Αποθηκεύεται μόνο ένα πλαίσιο
- Λιγότερο προσαρμοστική τεχνική αλλά πολύ πιο γρήγορη
- Running average, Approximated median filtering, Kalman filtering, Mixture of Gaussians, Self-Organizing Background Subtraction (SOBS), Illumination Sensitive Background (ISB)



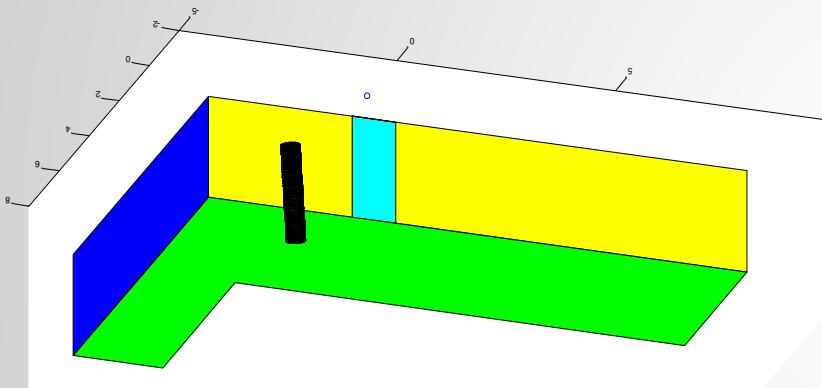
# Γεωμετρικές διορθώσεις χρησιμοποιώντας μοντέλα κάμερας



# Βαθμονόμηση Μοντέλου



# Πως λειτουργεί το μοντέλο



Example of a virtual vertical cylinder with  $R=0.2\text{m}$ ,  $H=2\text{m}$  in a 3D model of the imaged room.



The cylinder imaged by the fisheye simulator and embedded into the video frame.

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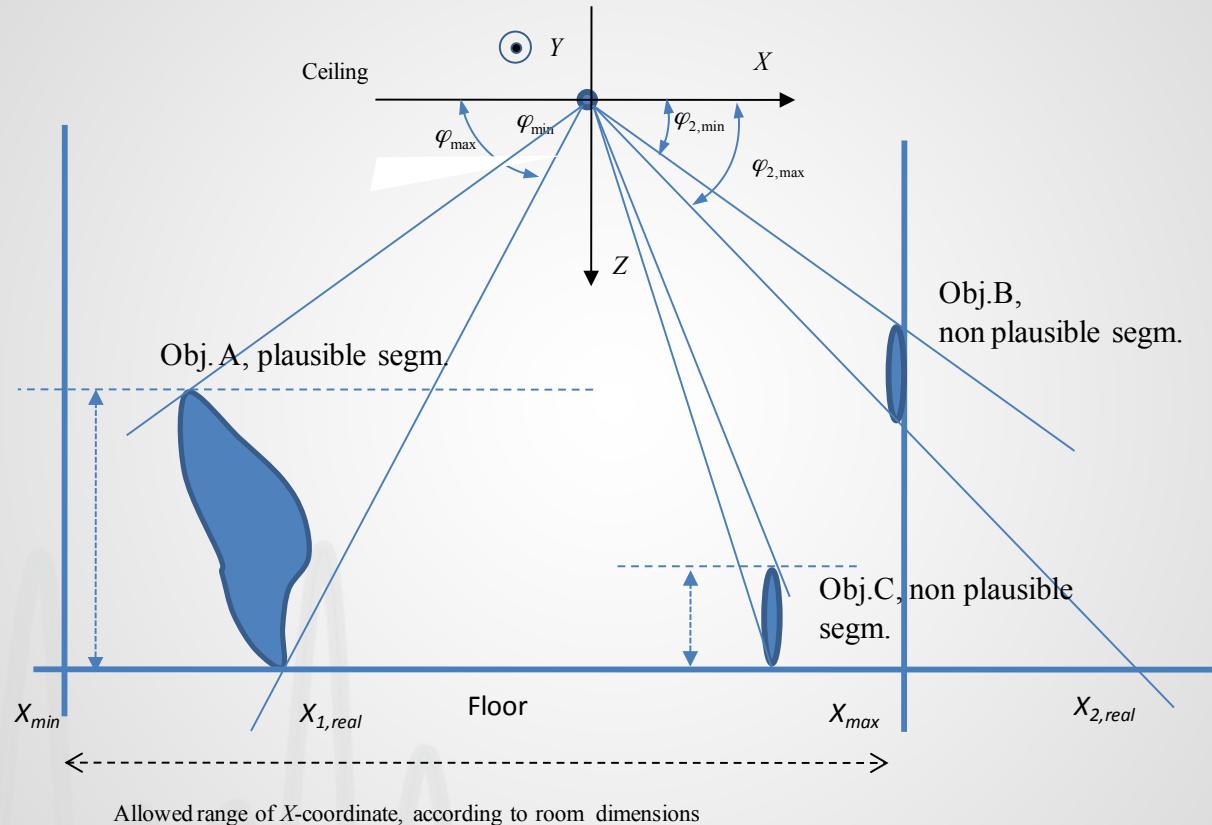


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# Διόρθωση της Τμηματοποίησης



Χρησιμοποιώντας την γωνία ανύψωσης φ αναγνωρίζουμε μη επιλέξιμες περιοχές

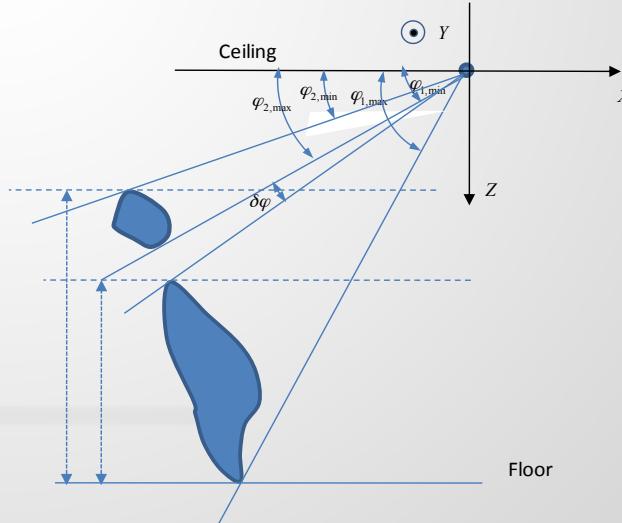
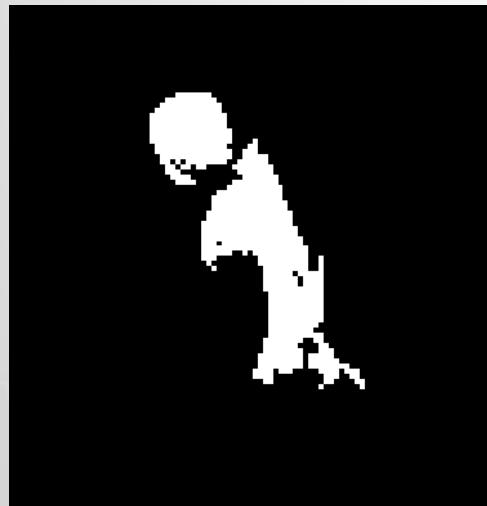
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# Ένωση περιοχών

- Εγγύτητα περιοχώβ στο χώρο ( $\theta, \phi$ )

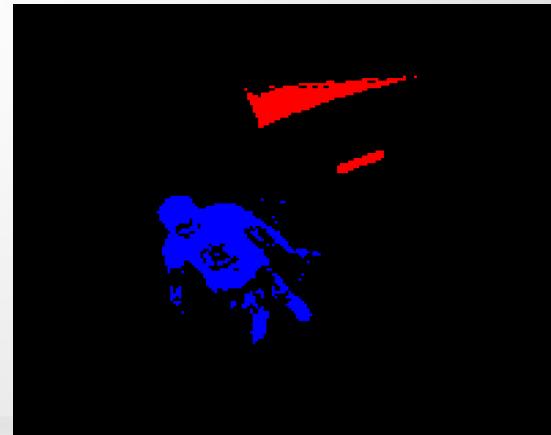
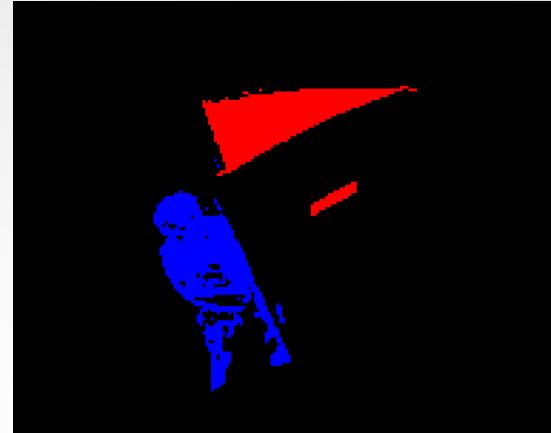
$$\begin{aligned} & \left( (\theta_{1,\min} < \theta_{2,\min} \text{ AND } \theta_{1,\max} > \theta_{2,\max}) \text{ OR } |\theta_{1,\max} - \theta_{2,\max}| < \delta\theta \text{ OR } |\theta_{1,\min} - \theta_{2,\min}| < \delta\theta \right) \text{ AND} \\ & \left( (\varphi_{1,\min} < \varphi_{2,\min} \text{ AND } \varphi_{1,\max} > \varphi_{2,\max}) \text{ OR } |\varphi_{1,\max} - \varphi_{2,\max}| < \delta\varphi \text{ OR } |\varphi_{1,\min} - \varphi_{2,\min}| < \delta\varphi \right). \end{aligned}$$



# Παραδείγματα Διόρθωσης



Αρχικά frames



Μη επιλέξιμες περιοχές με  
κόκκινο χρώμα



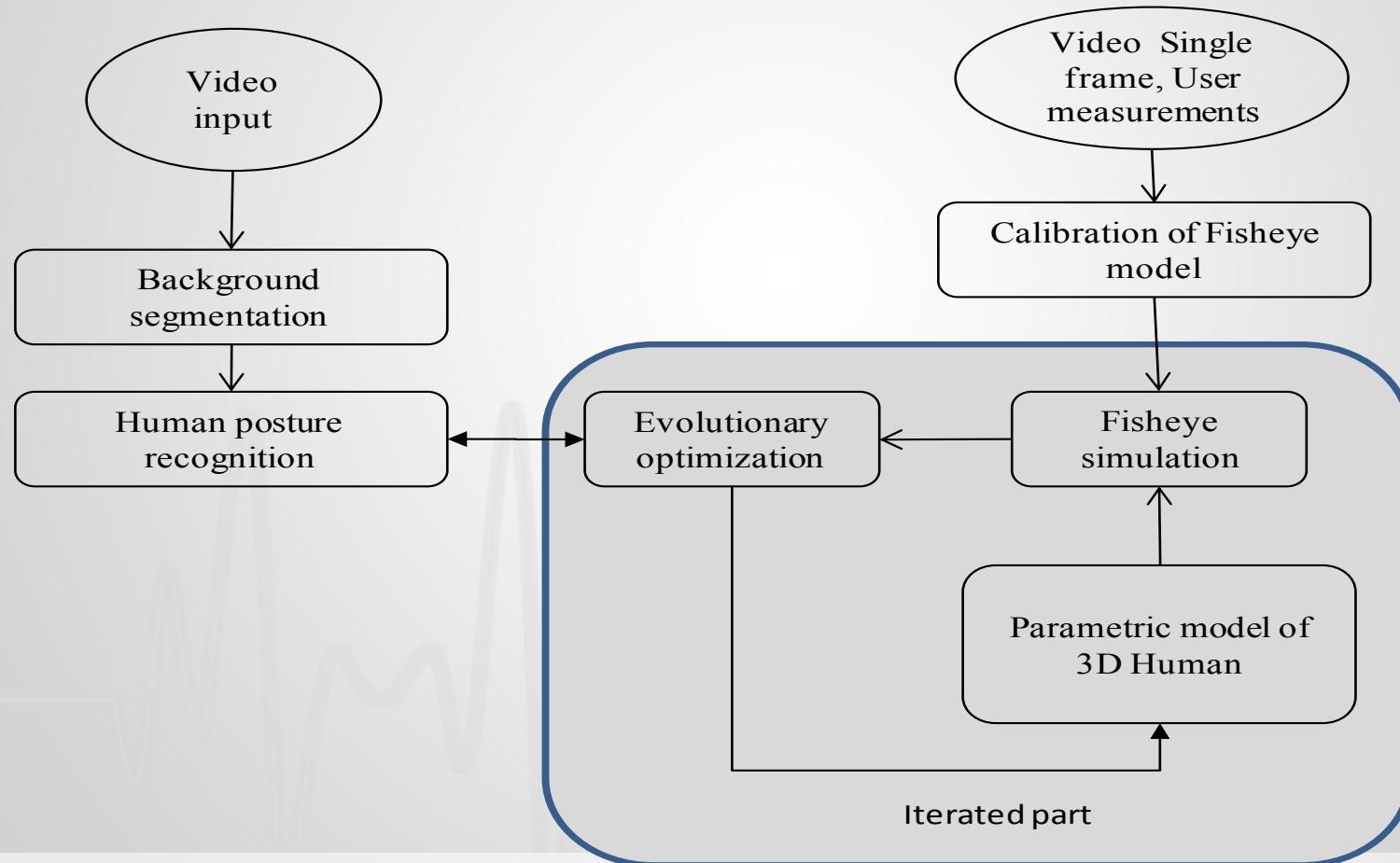
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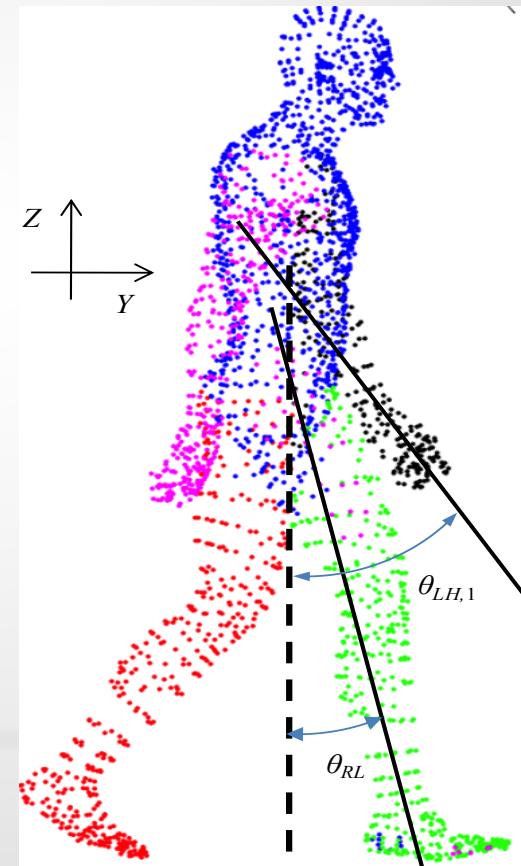
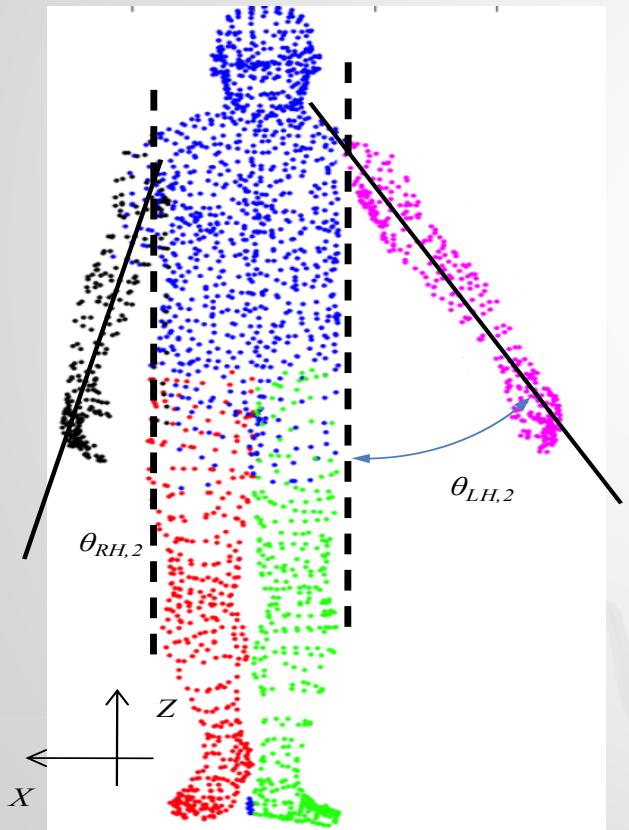


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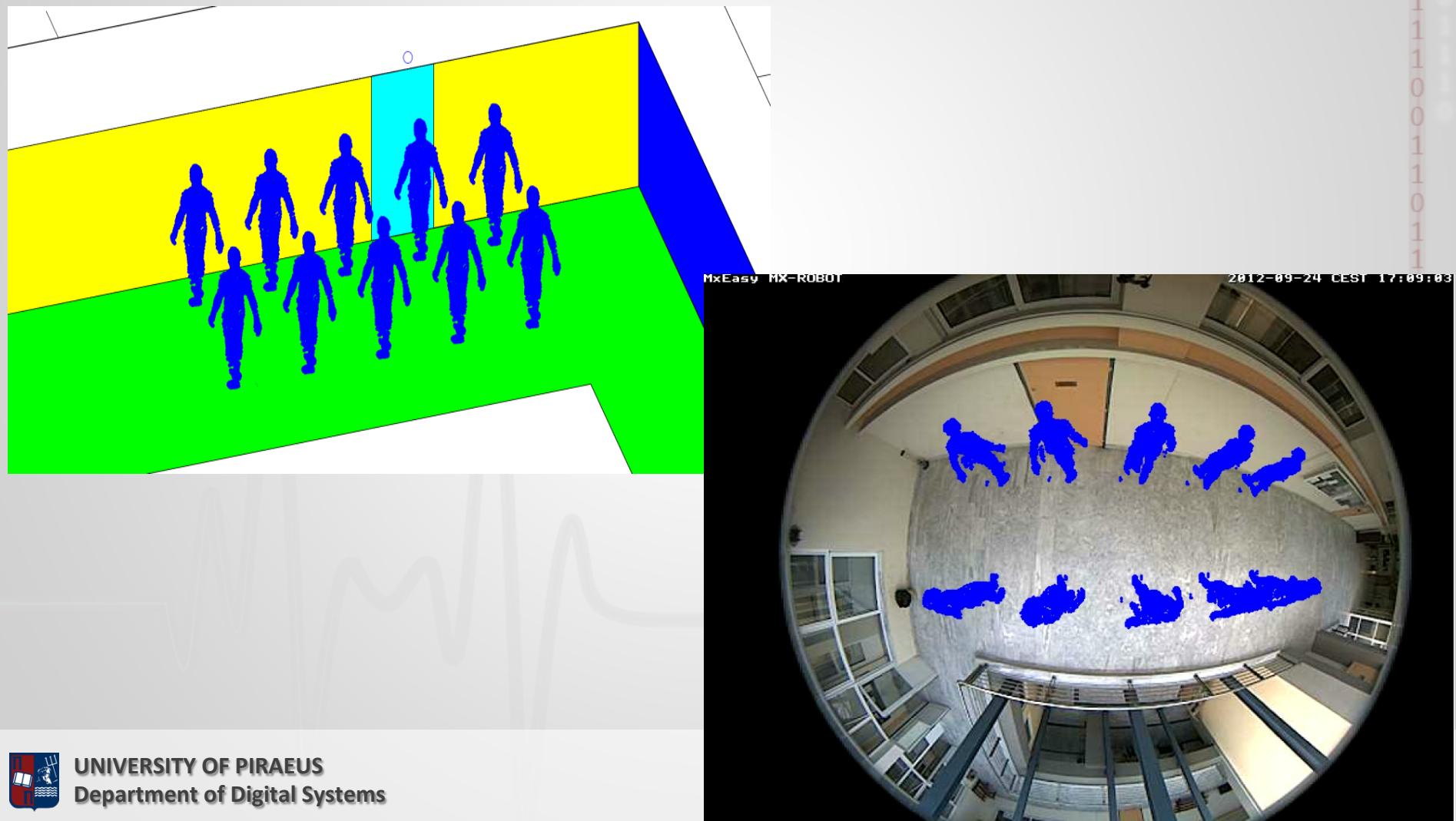
# Αναγνώριση Στάσης



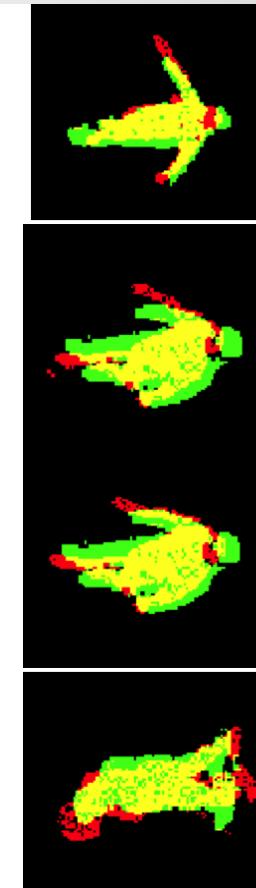
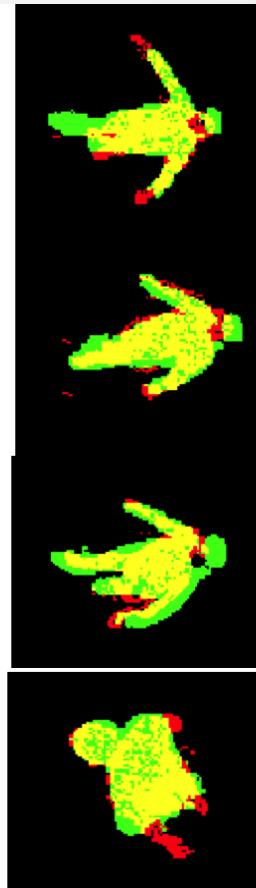
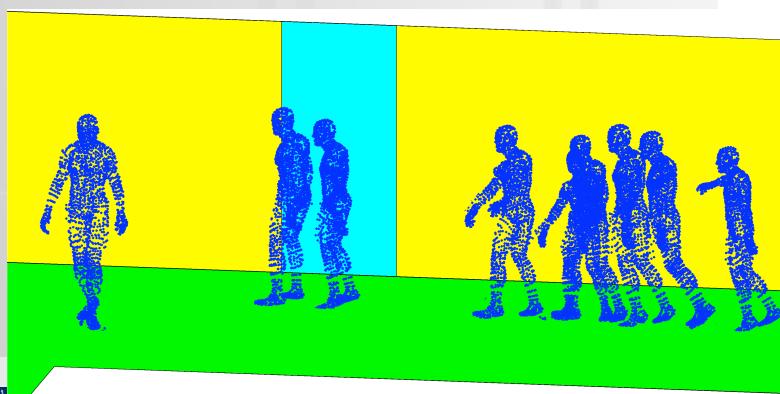
# Ανθρώπινο μοντέλο



The 3D model of a standing man scaled to height=1.8 m, touching the floor and reproducing the model at several locations of the imaged room



The fisheye-rendered parametric 3D human models fitted to the segmented frames and the recovered 3D human models in the Cartesian space.



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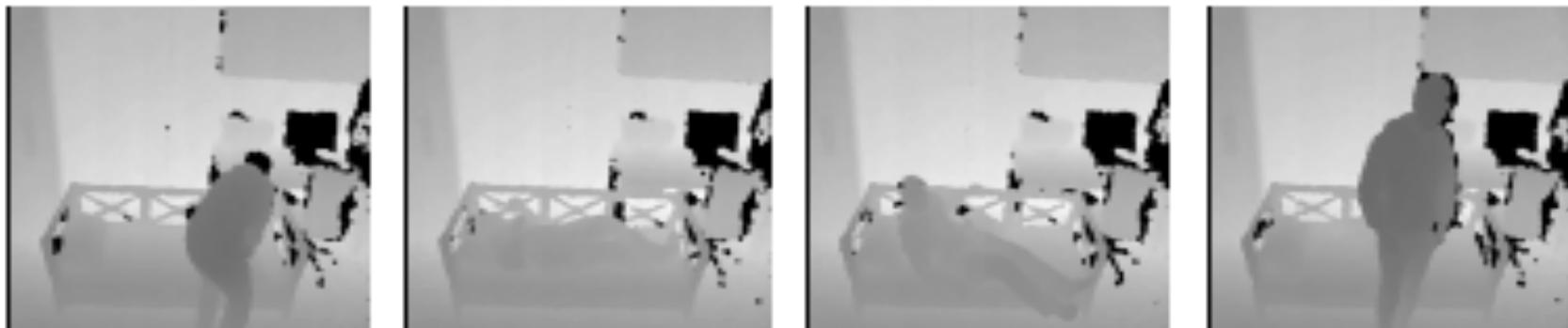
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# Σύντηξη με Εικόνες Βάθους



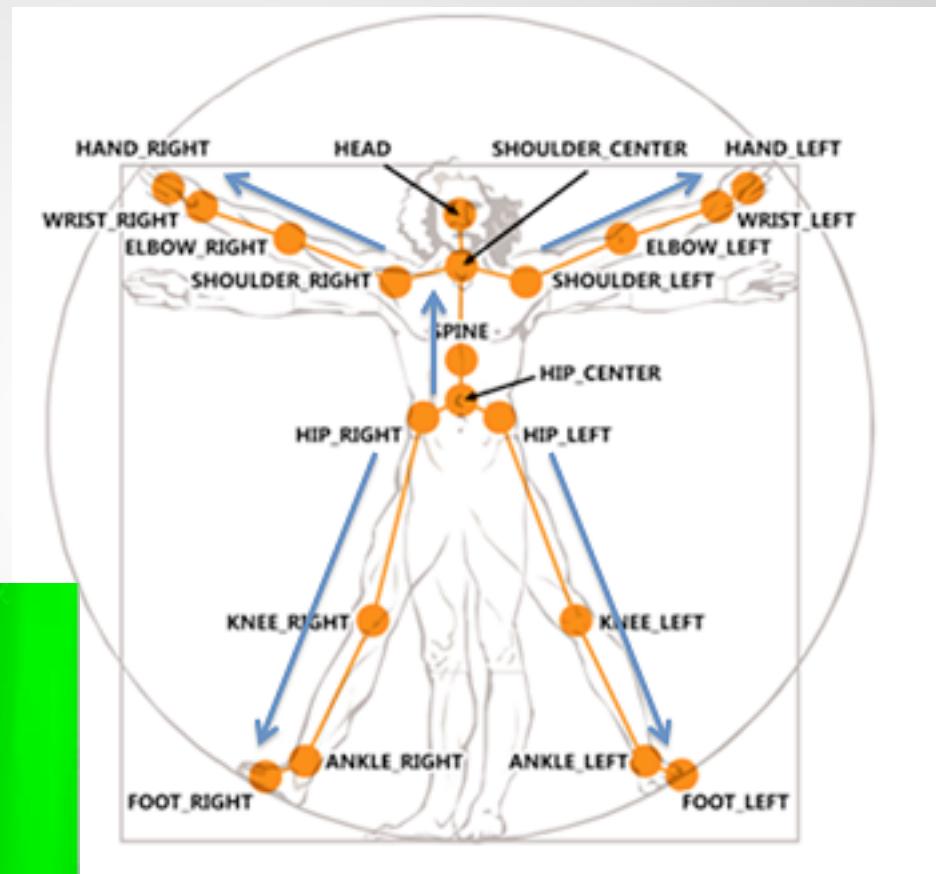
(a) Color images



(b) Depth images



# Kinect Skeletal Tracking



# Αναγνώριση με μη Οπτικούς Αισθητήρες



H/W: Arduino wearable sensors +  
3axis accelerometer, Bluetooth  
module for communication with  
Android device



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# S/W features

- Storing sensor data from the Arduino
- Visualizing data history
- Creating alerts (SMS and Email) based on events
- API for sending motion data to Fall-Detection applications



# Activity Classification

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- Activities based on motion analysis have been classified into three categories:
  - high activity (like running),
  - medium activity (like walking) and
  - low activity (e.g., lying on bed or sitting).
- The features utilized for building the classification models are the acceleration changes in the X, Y and Z axis, the input from the gyroscope (tilt) sensors (a tilt value for each axis) and the average heartbeat rate (beats per minute).



# Visualization

**CloudHealth - Dashboard**

Welcome Admin Username | Logout

Main

**Dashboard**

HeartBeat

Live HeartBeat data

Value

150

100

50

19:06 19:07

BPM

HeartBeat History

Average BPM

150

100

50

21. Nov 5. Dec

CO2 Level

CO2 Levels

CO2

1,000

750

500

250

0

Series 1

Recent Events

- Fall Event detected at: Thu, 09 Feb 2012 19:05:30 +0200
- Fall Event detected at: Mon, 12 Dec 2011 16:51:20 +0200
- Fall Event detected at: Mon, 12 Dec 2011 16:51:11 +0200
- Fall Event detected at: Mon, 12 Dec 2011 16:51:02 +0200
- Fall Event detected at: Mon, 12 Dec 2011 16:50:52 +0200

Activity

MEDIUM

The dashboard displays two main sections: HeartBeat and CO2 Level. The HeartBeat section contains a live chart from 19:06 to 19:07 showing BPM values fluctuating between 80 and 120. It also includes a history chart from November 21 to December 5 showing average BPM values ranging from 50 to 100. The CO2 Level section shows CO2 levels in Series 1, with values ranging from 0 to 1,000. A sidebar lists recent fall events. An activity section indicates a 'MEDIUM' level.

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Main

**Dashboard**

Sensor Data

Average Rate

1,000

500

0

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Sensor Values

Sensor History

History of Sensor Data (Sample)

Average Rate

150

100

50

0

1. Oct 15. Oct 29. Oct

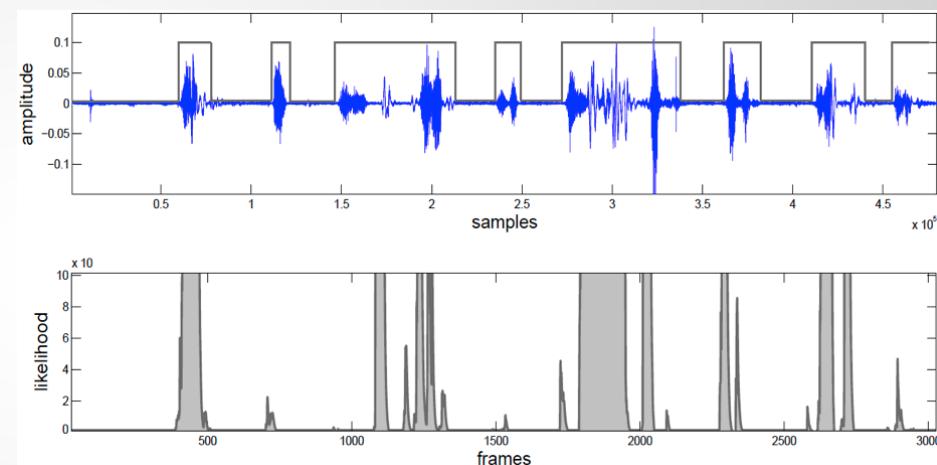
Recent Events

View all news items

Activity

This dashboard features two main sections: Sensor Data and Sensor History. The Sensor Data section contains two scatter plots of sensor values over 25 time points, with one plot showing values from 0 to 1,000 and the other from 0 to 500. The Sensor History section shows a line graph of average rates from October 1st to 29th. A sidebar lists recent events and news items, and an activity section includes a floor plan with sensor locations marked.

# Παρακολούθηση Ύπνου



# Αναφορές

- C. Doukas, I. Maglogiannis, "Emergency Fall Incidents Detection in Assisted Living Environments Utilizing Motion, Sound and Visual Perceptual Components" IEEE Transactions on Information Technology in Biomedicine 15 (2): 277-289 (2011)
- C. Doukas, T. Petsatodis and I. Maglogiannis, "Automated Sleep Breath Disorders Detection utilizing Patient Sound Analysis" Biomedical Signal Processing & Control Vol. 7, Is. 3 May 2012, pp. 256–264 Elsevier
- A. Christodoulidis, K. Delibasis, I. Maglogiannis, "Near real-time human silhouette and movement detection in indoor environments using fixed cameras", In Proc of 5th ACM International Conference on Pervasive Technologies Related to Assistive Environments (PETRA 2012), Crete, Greece ACM
- I. Maglogiannis and C. Doukas Bringing IoT and Cloud Computing towards Pervasive Healthcare Extending Seamlessly to the Internet of Things (esIoT) Workshop in Conjunction with IMIS-2012 International Conference Palermo Italy 2012
- K. Delibasis, T. Goudas, V. Plagianakos, I. Maglogiannis, "Fisheye Camera Modeling for Human Segmentation Refinement in Indoor Videos" In Proc of 6th ACM International Conference on Pervasive Technologies Related to Assistive Environments (PETRA 2013), Rhodes, Greece ACM
- Dimitrios I. Kosmopoulos, Paul Doliotis, Ilias Maglogiannis: Fusion of Color and Depth Video for Human Behavior Recognition in an Assistive Environment. HCI (25) 2013: 42-51
- K. Delibasis, T. Goudas, V. Plagianakos, I. Maglogiannis, "Real Time Indoor Robot Localization using RGB Video from a Stationary Fisheye Camera" In Proc AIAI 2013 (1) 2013: 245-254



Τμήμα της έρευνας χρηματοδοτείται από το έργο ΘΑΛΗΣ «Πολυδιάστατη έρευνα στη συναισθηματική υπολογιστική για την αναγνώριση καταστάσεων φυσιολογίας και βιολογικών δραστηριοτήτων σε βοηθητικά περιβάλλοντα – ΣΘΕΝΟΣ <http://www.sthenos.gr/>

The screenshot shows the homepage of the STHENOS website. The header includes the logo 'ΣΘΕΝΟΣ' and the subtitle 'Πολυδιάστατη έρευνα στη συναισθηματική υπολογιστική'. The menu bar features links for 'File', 'Edit', 'View', 'History', 'Bookmarks', 'Window', 'Help', and the URL 'sthenos.gr'. Below the menu is a search bar with placeholder 'Αναζήτηση' and a magnifying glass icon. The main content area has a dark header 'ΣΘΕΝΟΣ - Κεντρική σελίδα'. On the left, there's a 'Είσοδος' (Login) form with fields for 'Username or e-mail' and 'Συνθηματικό', and a 'Είσοδος' button. A note below the form says '• Ανάκτηση νέου συνθηματικού εισόδου'. To the right of the login form is a section titled 'Σύντομη περιγραφή έργου' containing text about affective computing and its applications. Further right is a 'Κύριες δράσεις' (Key Activities) section listing five numbered points. A small portrait photo of a man is visible on the right side of the page.



- Ευχαριστώ για την προσοχή σας.

