



# 3D Indoor Location on Mobile Phones Using Embedded Sensors and Close-range Photogrammetry

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# Introduction

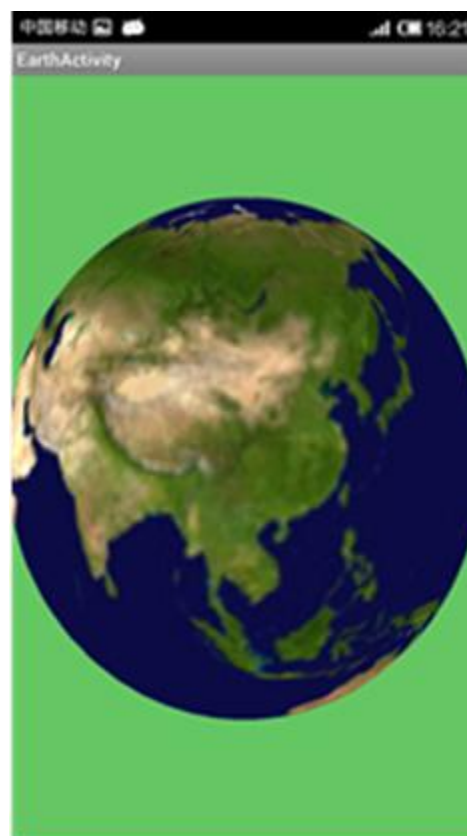
The paper proposed a sensor-based 3D positioning system on mobile phones.

- Combine inertial positioning system and vision based positioning system to improve the positioning precision.
- Visualize the user's location in 3D model of the building.

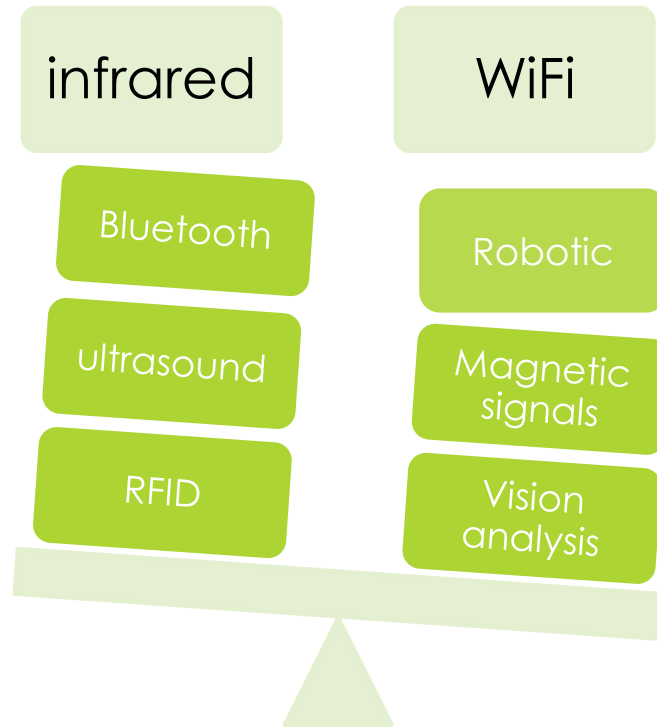


# 3D Indoor Visualization on Mobile Phones

- ▶ **Global Scene:** the visualization of the global image data organized with quad-tree pyramid structure.
- ▶ **AOI Scene:** the target building model which you'd like to enter.
- ▶ **Floor Scene:** the specific floor model in the building.



# Indoor Positioning Methods

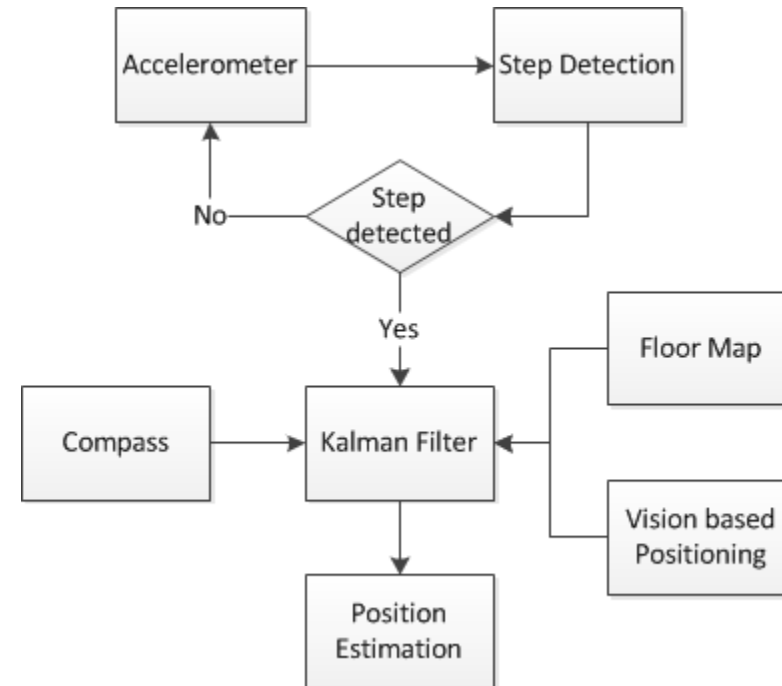


- ▶ **Offline training phase**  
useful location related data with respect to different places in the position estimation area is measured and collected
- ▶ **Online position determination phase**  
the location related data of a target object is measured and compared with the pre-measured data to make location estimation

# Inertial Sensors Positioning



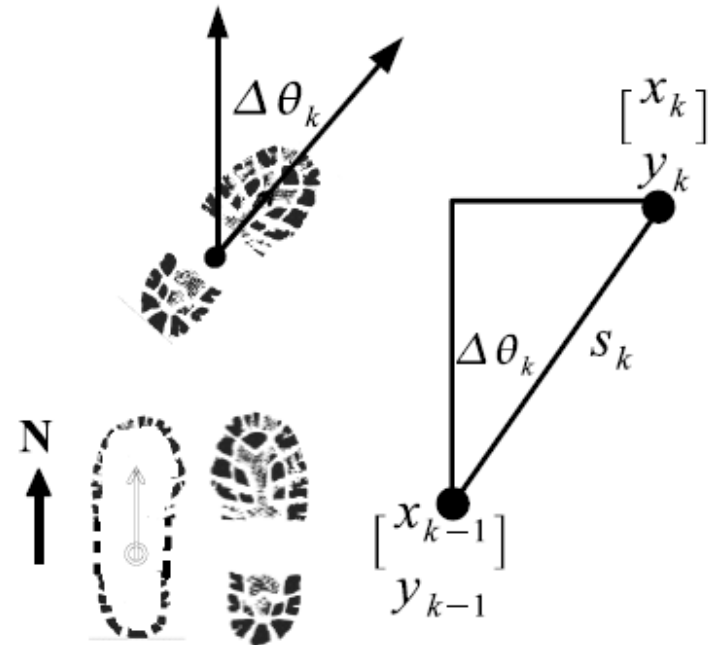
- ▶ The accelerometer and compass data are used to recognize the user's dynamic activities and walking directions.
- ▶ Integrate Kalman filter and the building floor map constraints to filter the impossible trends.
- ▶ Introduce a real-time step detection algorithm.





# Route Trajectory

- ▶ 
$$\begin{cases} x_k = x_{k-1} + s_k \sin \theta \\ y_k = y_{k-1} + s_k \cos \theta \end{cases}$$
- ▶ 
$$\begin{cases} s_k = s_{k-1} + \delta_s \\ \theta_k = \theta_{k-1} + \Delta\theta_k + \delta\theta_k \end{cases}$$



# Vision Positioning



At least  
four  
control  
points



Collinearity  
equation



The  
camera's  
six exterior  
orientation

$$x = -f \frac{a_1(X - X_s) + b_1(Y - Y_s) + c_1(Z - Z_s)}{a_3(X - X_s) + b_3(Y - Y_s) + c_3(Z - Z_s)}$$

$$y = -f \frac{a_2(X - X_s) + b_2(Y - Y_s) + c_2(Z - Z_s)}{a_3(X - X_s) + b_3(Y - Y_s) + c_3(Z - Z_s)}$$

# Result

中国移动 11:04

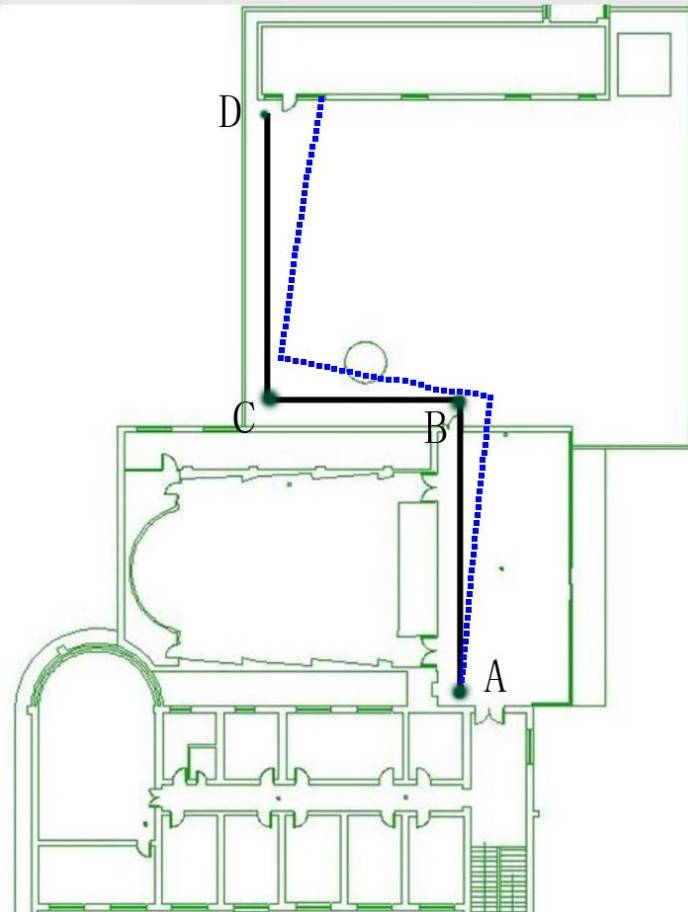
IMULocation

InitR StepLength Sensitivity

0.65 10.00

Yes Yes Yes Stop

角度: 23.74  
步数: 98



中国移动 11:17

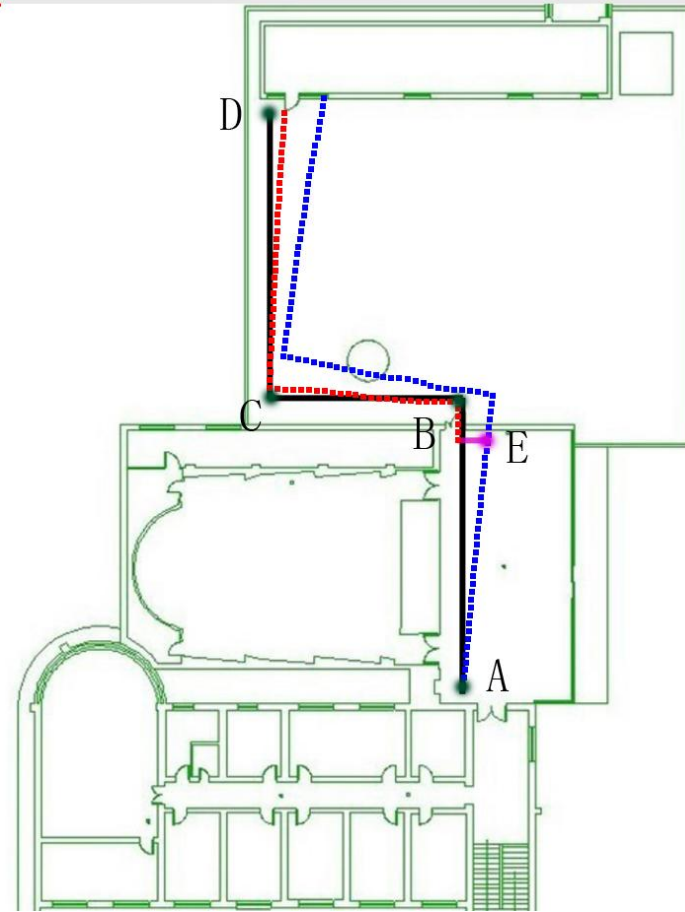
IMULocation

InitR StepLength Sensitivity

0.65 10.00

Yes Yes Yes Stop

角度: 6.47  
步数: 96







# Thank You!

Any Questions?