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Urban Pedestrian Behaviour Modelling using Natural Vision and Potential Fields

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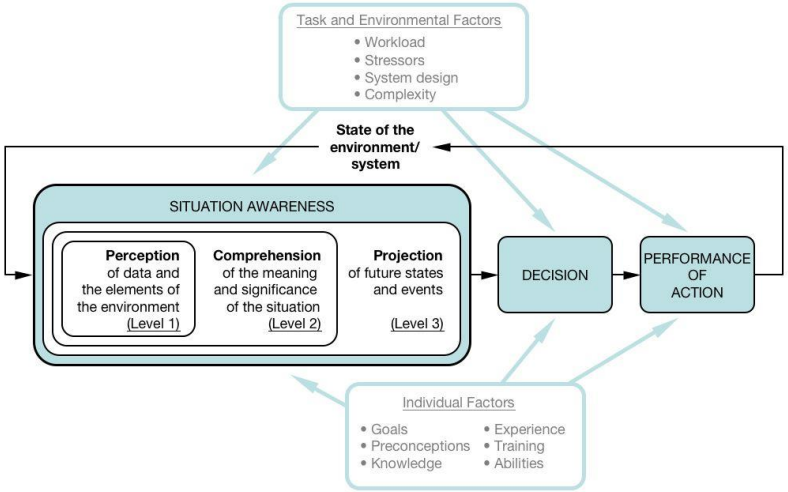
Why do we need this?

Increasing situational awareness on an urban street – getting to level 3



Natural Vision?

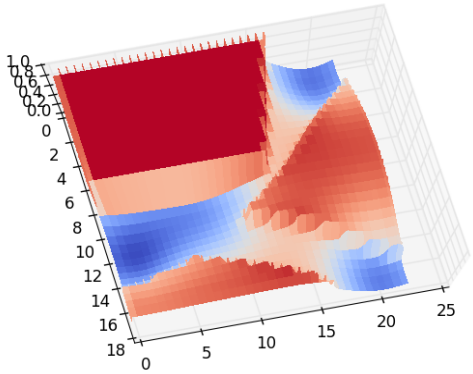
- Natural Vision – ***"..human behaviour in wanting to move in a direction that interests them the most in their field of view …" [3]***
- Pedestrian behaviour is a function of the built environment made up of positive and negative attractors
- Points of Interest (POI) – "…Monuments, places of public interest, public transportation…stores, restaurants, etc…" [3]

How do we model this?

Potential fields [4]

- In a structured urban environment, for legal crossings to occur, certain assumptions are made:
  - > The edges of the road repel pedestrians.
  - > A cross-walk acts as a conduit between the two sides of the street
  - > The road acts as a barrier for crossing, repelling pedestrians towards the side-walks.
  - > Static and Dynamic obstacles in the scene are repulsive in nature.
  - > Side-walks offer no resistance to pedestrian movement.
  - > Points of Interest are a reason for pedestrians to cross

3D representation of a scene



Dataset Used for Testing

Activity modeling and abnormality detection dataset [6]

- Contains Points of Interest at (1), (2), (3) and (4)
- Dynamic obstacles in the form of cars and bicycles
- Captures pedestrian movement

Scene from the Dataset

Results

TABLE I: Quantitative analysis of trajectories within predicted regions

Case	Nb Trajectories	A* Predicted zone		Extended zone (40cms)	
		Inside zone (%)	Outside zone (%)	Inside zone (%)	Outside zone (%)
1	10	84.11	15.88	96.88	3.11
2	2	30.07	69.92	88.17	11.82
3	1	29.10	70.89	51.49	48.50
4	9	68.48	31.51	77.43	22.56
5	7	72.38	27.61	83.26	16.73
6	9	39.63	60.36	50.26	49.73
7	12	76.79	23.20	83.28	16.71
8	10	64.67	35.32	69.98	30.01

Problems it will help solve

- Recognizing danger areas in the observed scene
- Better prediction of pedestrian behaviour
- Illegal pedestrian crossings

For more information…

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References:

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[2] B. Hillier, A. Penn, J. Hanson, T. Grajewski, and J. Xu, “Natural movement: or, configuration and attraction in urban pedestrian movement,” *Environment and Planning B: planning and design*, vol. 20, no. 1, pp. 29–66, 1993.
[3] J. J. Gibson, “The ecological approach to visual perception.” 1979
[4] M. T. Wolf and J. W. Burdick, "Artificial potential functions for highway driving with collision avoidance," *2008 IEEE International Conference on Robotics and Automation*, Pasadena, CA, 2008, pp. 3731-3736.
[5] P. Vasishta, D. Vaufreydaz, A. Spalanzani, “ Natural Vision Based Method for Predicting Pedestrian Behaviour in Urban Environments”, *IEEE 20th International Conference on Intelligent Transportation Systems,* Yokohama, Japan, 2017.
[6] J. Varadarajan and J-M. Odobez, “Topic models for scene analysis and abnormality detection”, *2009 IEEE12th International Conference on Computer Vision (ICCV Workshops),* 2009