Artificial Neural Network-Based Control Architecture: a Simultaneous Top-down and Bottom-up Approach to Autonomous Robot Navigation

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Abstract. This paper presents an artificial neural network-based control architecture allowing autonomous mobile robot indoor navigation by emulating the cognition process of a human brain when navigating in an unknown environment. The proposed architecture is based on a simultaneous top-down and bottom up approach, which combines the *a priori* knowledge of the environment gathered from a previously examined floor plan with the visual information acquired in real time. Thus, in order to take the right decision during navigation, the robot is able to process both set of information, compare them in real time and react accordingly. The architecture is composed of two modules: a) *A deliberative module*, corresponding to the processing chain in charge of extracting a sequence of navigation signs expected to be found in the environment, generating an optimal path plan to reach the goal,computing and memorizing the sequence of signs [1]. The path planning stage allowing the computation of the sign sequence is based on a neural implementation of the resistive grid. b) *A reactive module*, integrating the said sequence information in order to use it to control online navigation and learning sensory-motor associations. It follows a perception-action mechanism that constantly evolves because of the dynamic interaction between the robot and its environment. It is composed of three layers: one layer using a cognitive mechanism and the other two using a reflex mechanism.
Experimental results obtained from the physical implementation of the architecture in an indoor environment show the feasibility of this approach.

Keywords: Neural control architecture, robot navigation, hybrid (top-down and bottom-up) approach, neural path planning

1. Rojas Castro, D. M., A. Revel, and M. Menard. "Document image analysis by a mobile robot for autonomous indoor navigation." Document Analysis and Recognition (ICDAR), 2015 13th International Conference on. IEEE, 2015.

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