Fuzzy Logic Control for Autonomous Mobile Robots in Static and Dynamic Environments

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Abstract
Autonomous mobile robots have been widely used in many researches and applications. In this work, we develop collision avoidance and line following techniques for mobile robot navigation in static and dynamic environments with the integration of fuzzy logic fusion. Eight proximity sensors are used to detect different obstacles whereas three ground sensors are used to detect the line underneath the robot. The proposed method has been successfully tested in Webots Pro simulator and in real time experiment.

Proposed Method
A. Fuzzy Logic Controller Design for Line Following Mechanism
First, the difference (Δ) between the right and left ground sensors is calculated. The delta value (Δ) is an input to the fuzzy logic controller. Two outputs are generated which are LS and RS which adjust the robot speed to follow the line.

![Fig.1: The E-puck robot](image1)
![Fig.2: Input membership functions](image2)

B. Collision Avoidance Mechanism
Eight proximity sensors are used for obstacle detection. These sensors have a range from 0 to 2000 whereas 1000 or more means there is a close obstacle and the robot needs to adjust its speed to spin around the obstacle.

![Fig.3: Output membership functions](image3)

Simulation and Real Time Experimental Setup

![Fig.4: The simulation runs at different times.](image4)

![Fig.5: The real time experiment.](image5)

Performance Evaluation Results and Discussion

![Fig.6: Proximity sensors readings](image6)

![Fig.7: Ground sensors readings for Robots A and B](image7)

![Fig.8: Left and right speeds for Robots A and B](image8)

![Fig.9: Delta values (Δ) for Robots A and B](image9)

Conclusion
A fuzzy logic controller was designed with one input and two outputs. Membership functions and fuzzy rules are developed. The simulation and real time experiments validate the effectiveness and the robustness of the proposed method in static and dynamic environments.

References