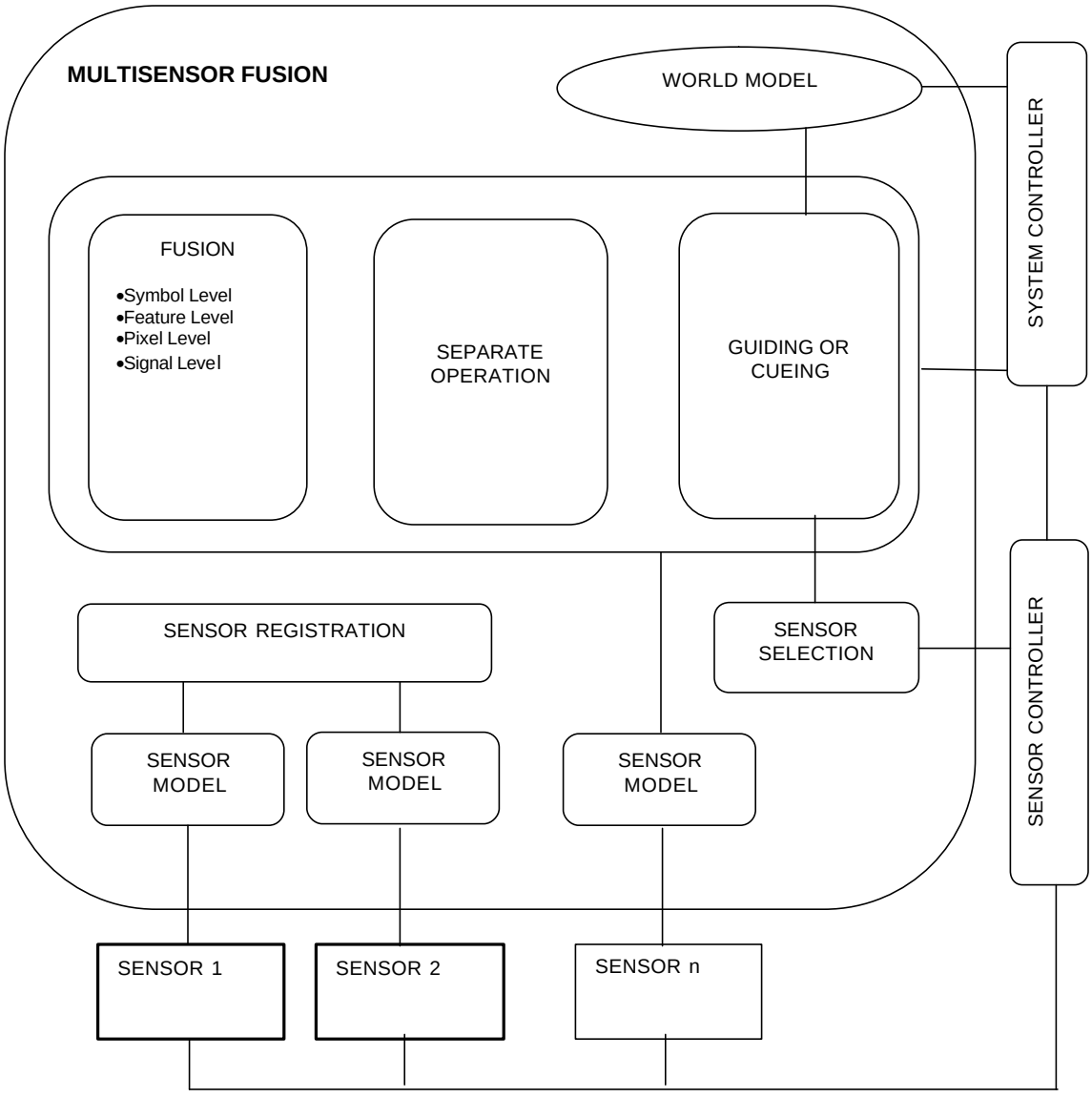
Multisensor Data Fusion

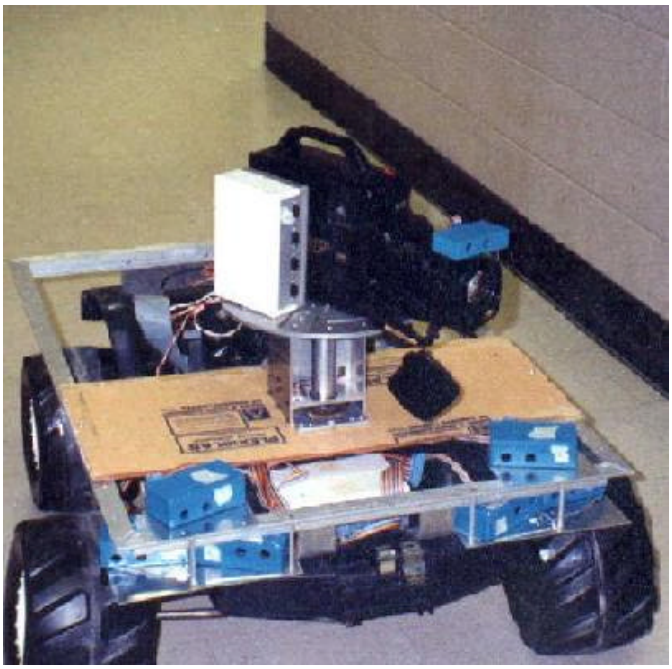


- ***Multisensor integration*** refers to the “synergistic use of the information provided by multiple sensors to assist the accomplishment of a task.”

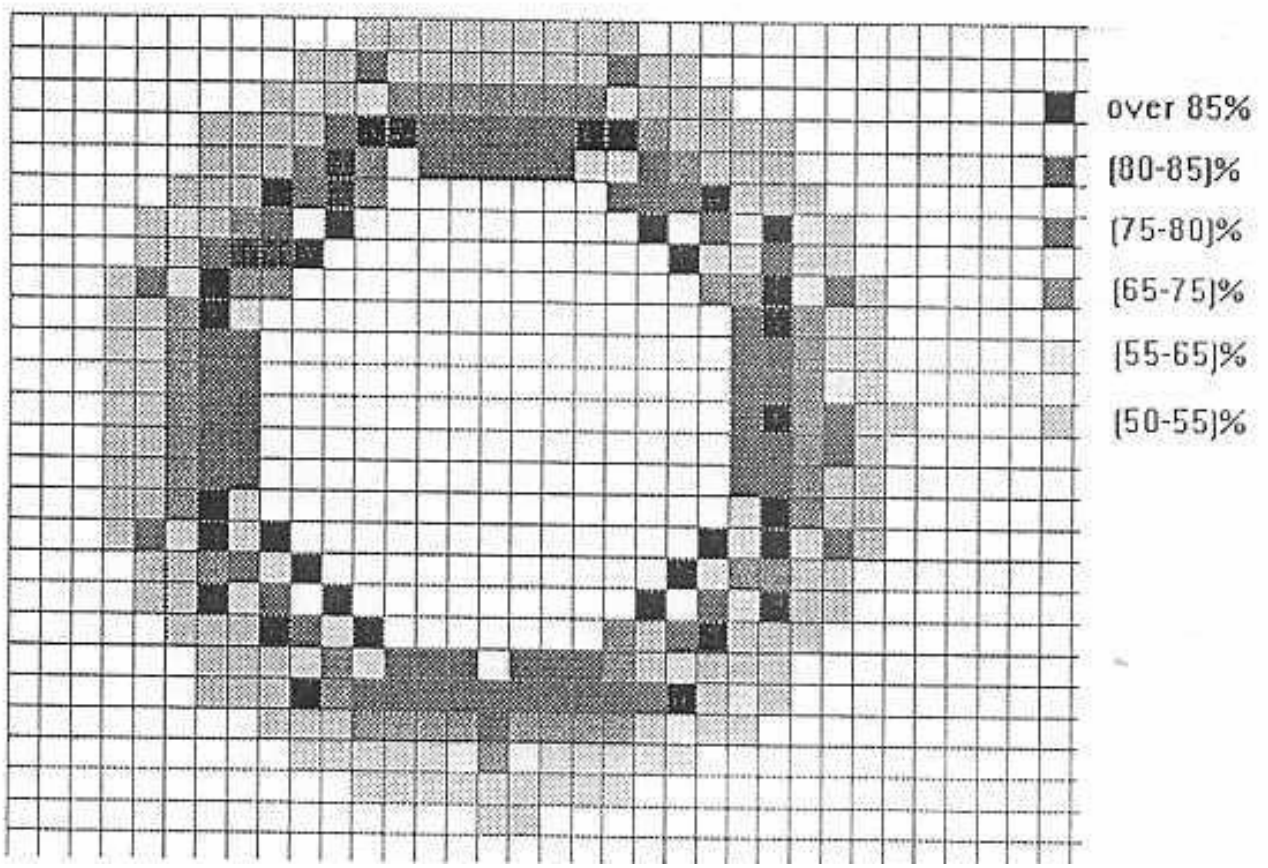
- ***Multisensor fusion*** refers to “any stage in the integration process where there is an actual combination (or fusion) of different sensor information into a unique representational format”.

Advantages of Multiple Sensors

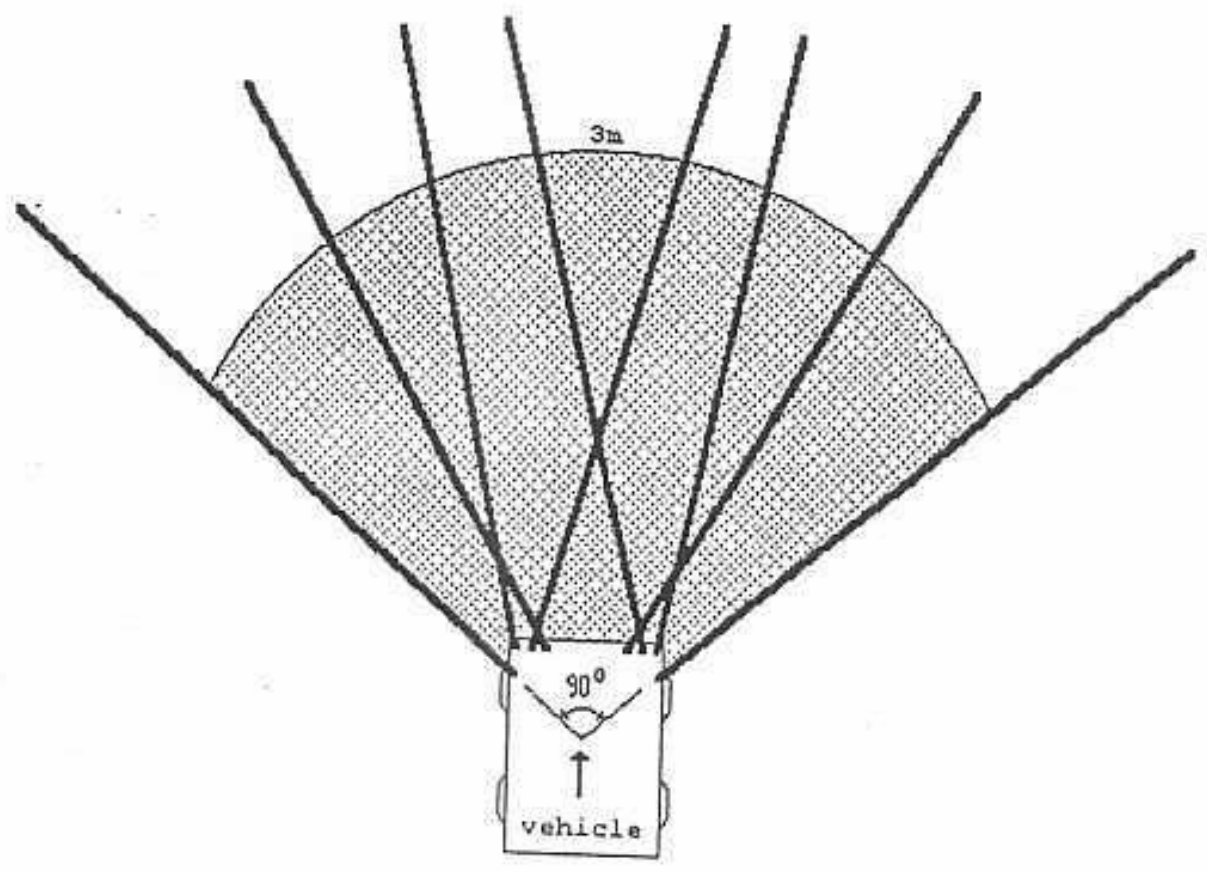
- ***Redundancy -*** Redundant information is provided from a group of sensors or by a single sensor over time when each sensor observes (possibly with different fidelity), the same features of interest
- ***Complementarity -*** Complementary information from multiple sensors allows for the perception of features that are impossible to be observed using just the information from individual sensors operating separately.
- ***Timeliness -*** More timely information may be provided by multiple sensors due to the actual speed of operation of each sensors, or to the processing parallelism that is possible to be achieved as part of the integration process.
- ***Cost*** - Integrating many sensors into one system can often use many inexpensive devices to provide data that is of the same, or even superior quality to data from a much more expensive and less robust device.



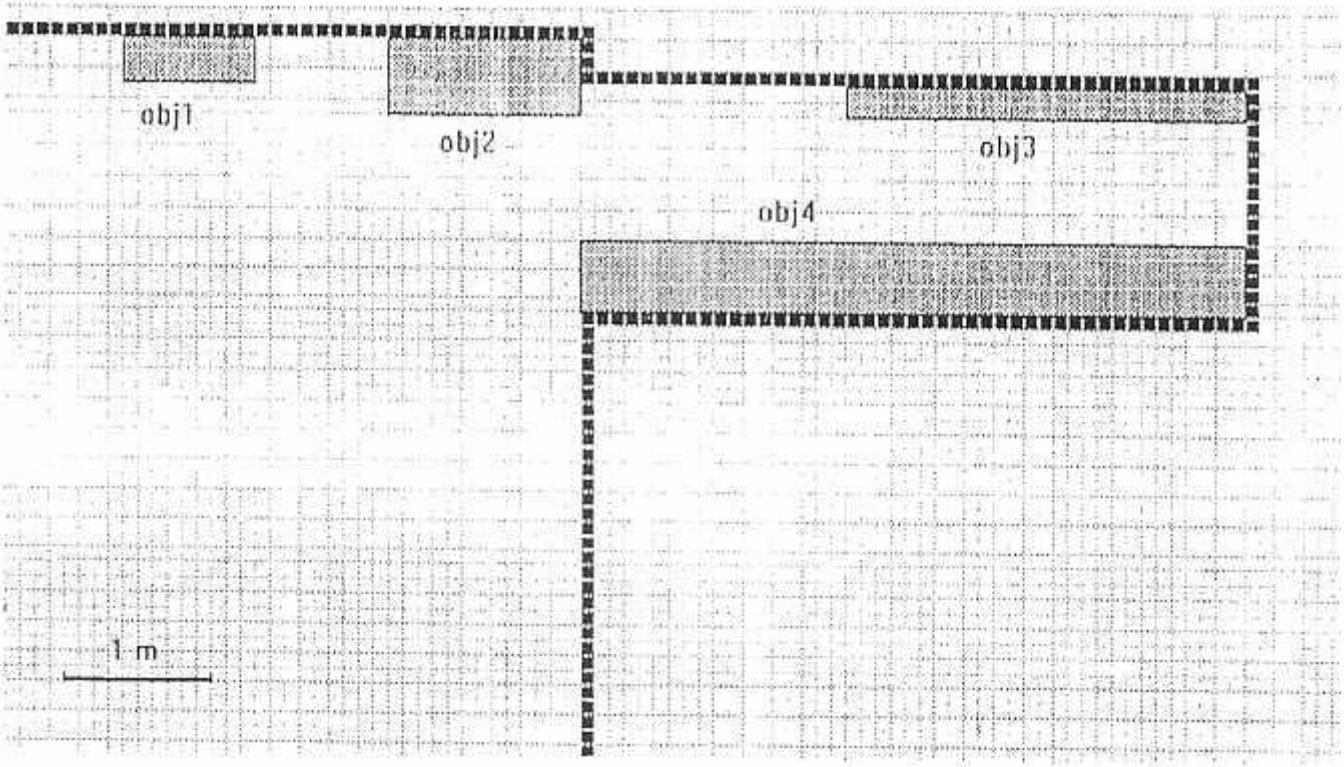
Mobile robot navigation using multiple IR sensors and vision



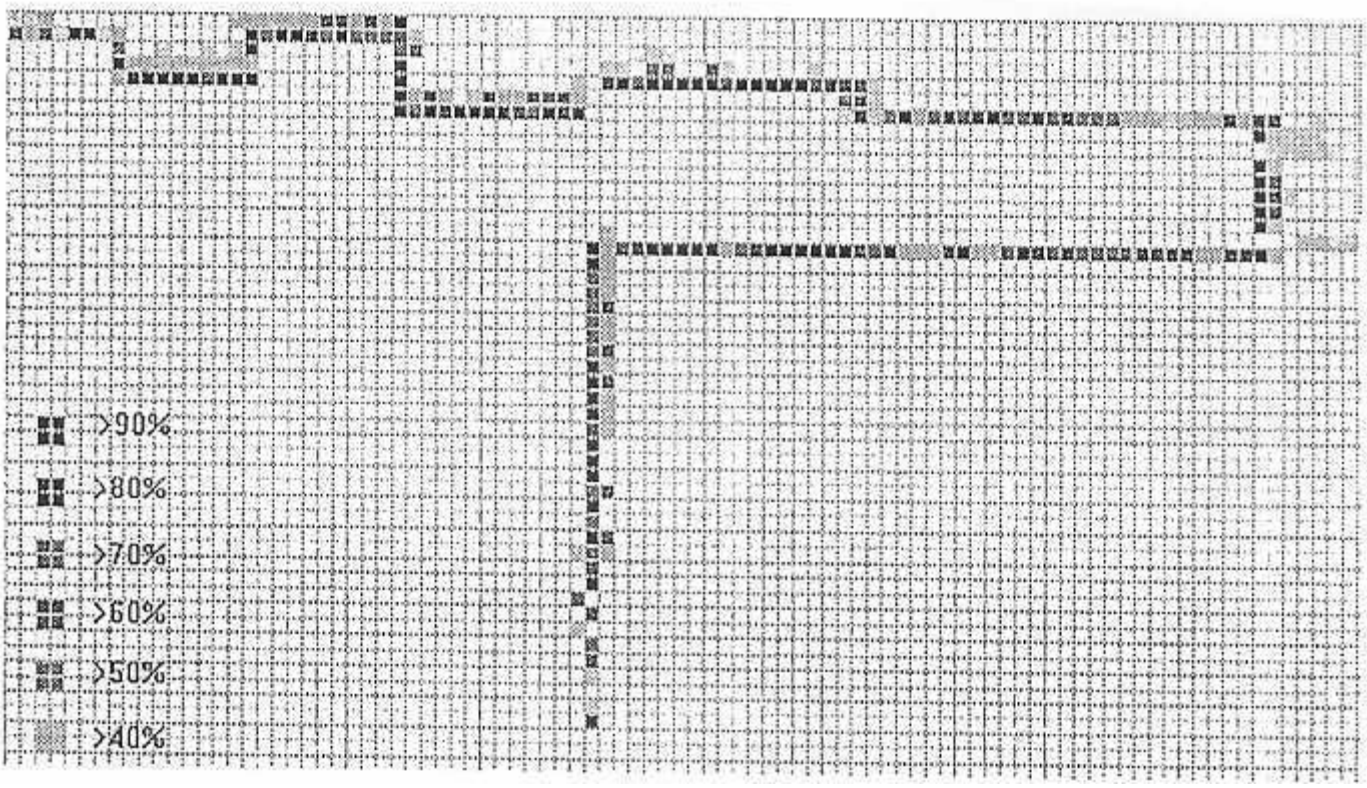
Occupancy grid map of of a round wall around the rotating IR sensor after ten turns



Multi IR sensor system on board the mobile robot



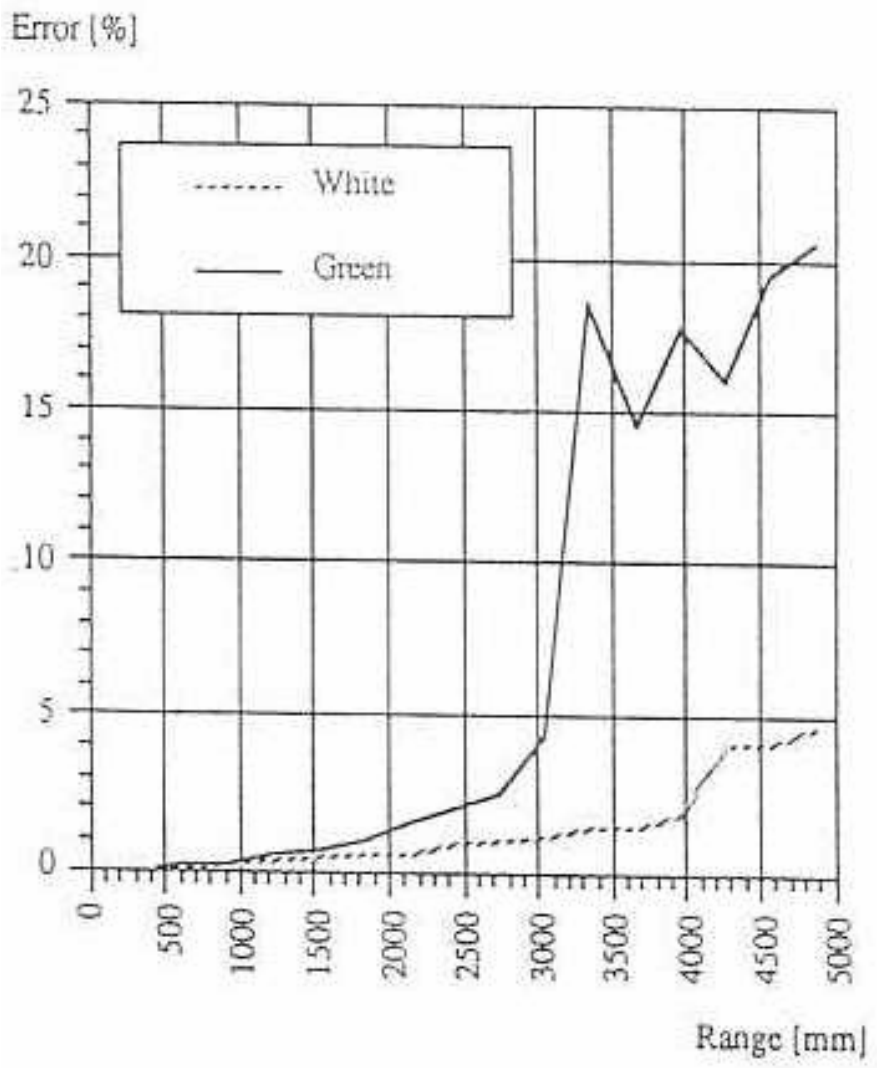
Layout of the room explored by the mobile robot with eight on board IR sensors



The recovered shape of explored room by fusing the data from the eight IR sensors using the probability occupancy grid method

Errors in Multisensor Systems

- ***Errors in the Integration and Fusion Process –*** a major source of errors when fusing redundant information from multiple sensors is the sensor registration
- ***Errors in the Sensory Information-*** usually are assumed to be caused by a random noise (uncorrelated in space or time, Gaussian and independent) that can be adequately modelled as a probability of distribution. The consistency of sensor measurements is increased by eliminating the spurious measurements so that they are not included in the fusion process.
- ***Errors in the System Operation -*** A multisensor system must have the ability to recognize and recover from sensor failure. Sometimes in unknown environments, it may be difficult or impossible to calibrate sensors. A solution would be the creation of a knowledge database for each sensor permitting an auto-calibration process of the system.



Error characteristics of the IR sensor for two colors of the targets