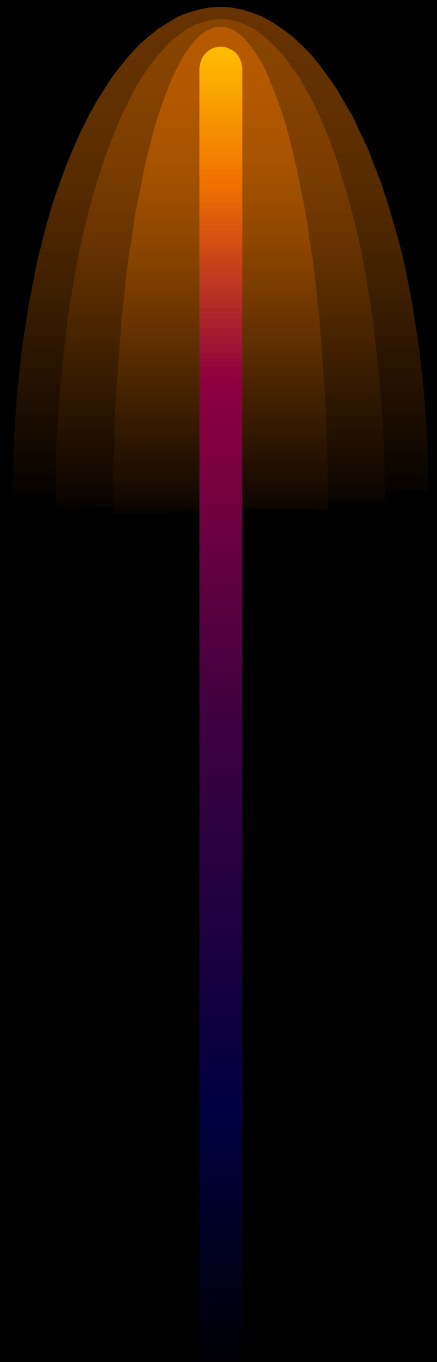
Hardware Implemented Reactionary Robotic Algorithm



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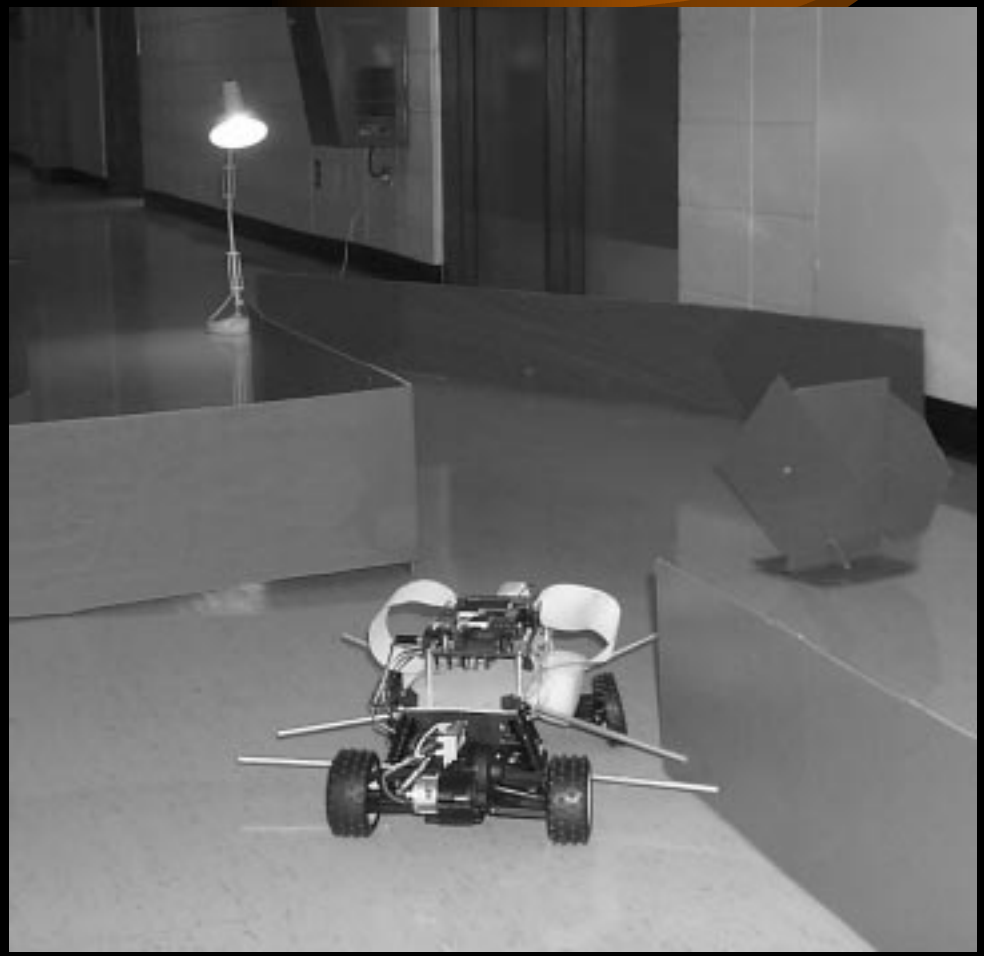
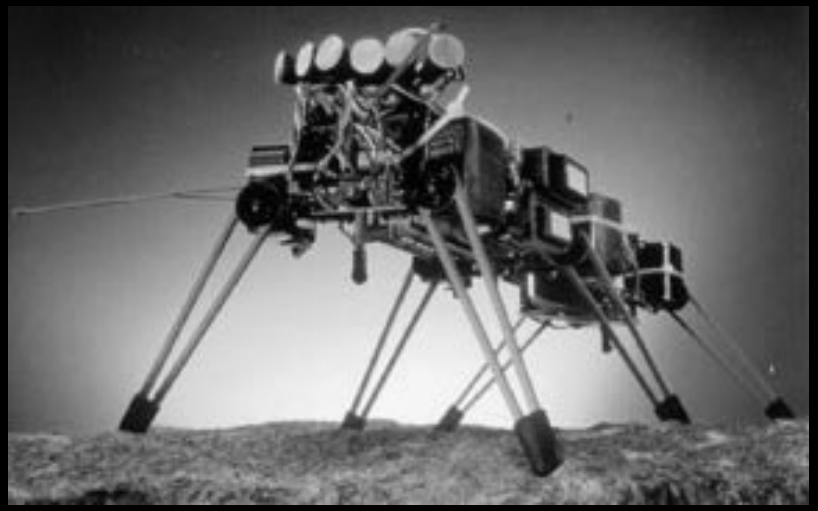
Overview

- Background
- Description
- System
- Detail Control System
- Testing/Debugging
- Difficulties
- Demonstration



Background

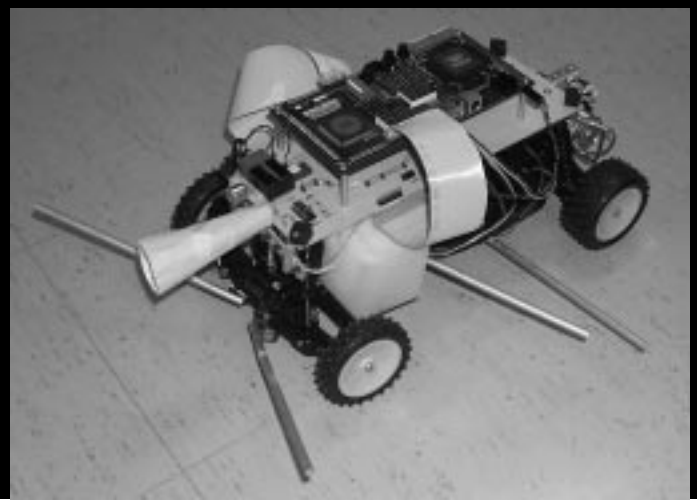


Courtesy of www.ai.mit.edu/projects/genghis/genghis.html

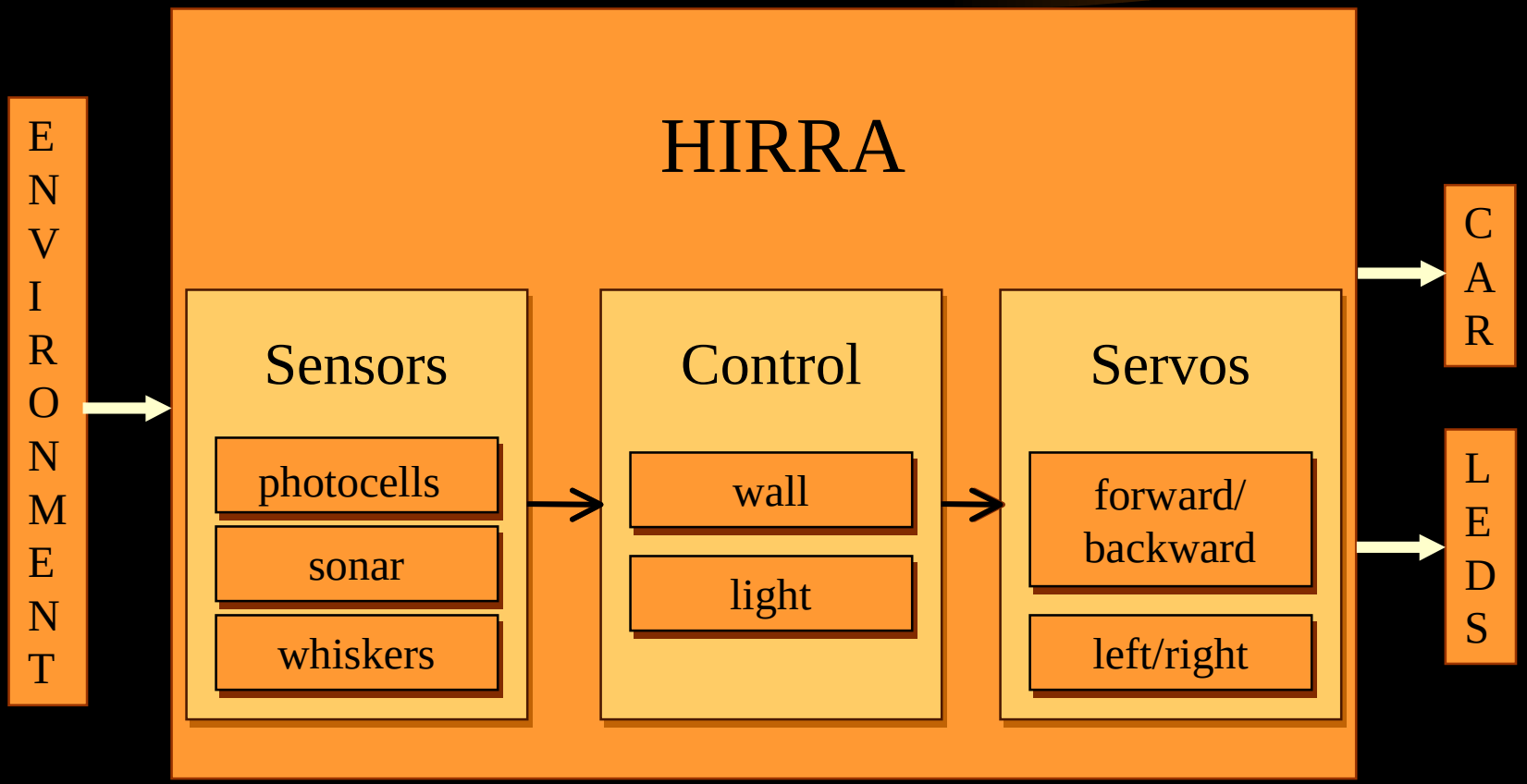
- Reactive robot
- Incorporates ideas from Behaviour-Based Robotics (1)
- Subsumption architecture (2)
  - builds simple behaviours and combines them to form a more complicated behaviour
- Algorithm is well suited to a hardware implementation
  - parallel nature
  - fast reaction times

Description

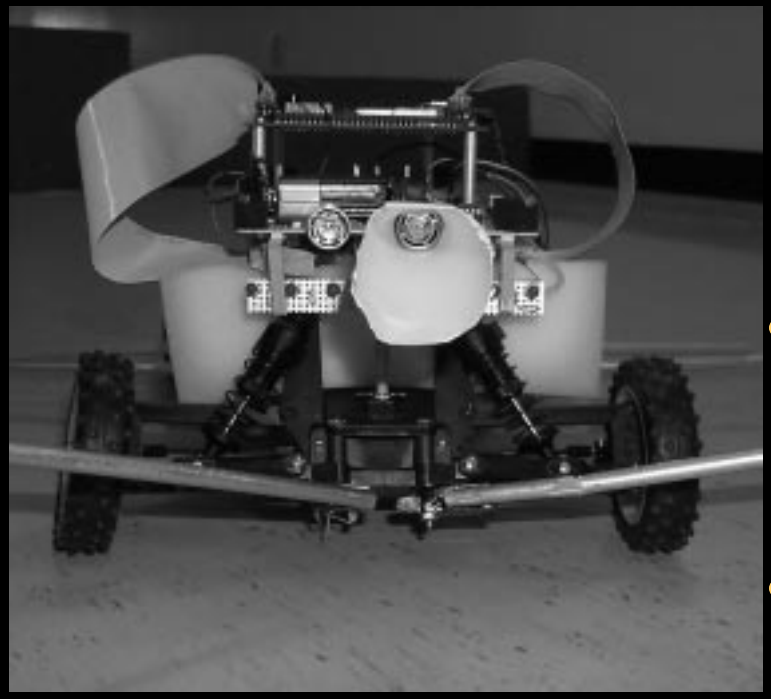
- Built from high speed radio controlled car
- travels towards light
  - photocells
- avoids obstacles
  - ultrasonic range finder -- sonar
- follows walls
  - whisker sensors
- flashing LEDs
  - direction of motion
  - light intensity



System Diagram



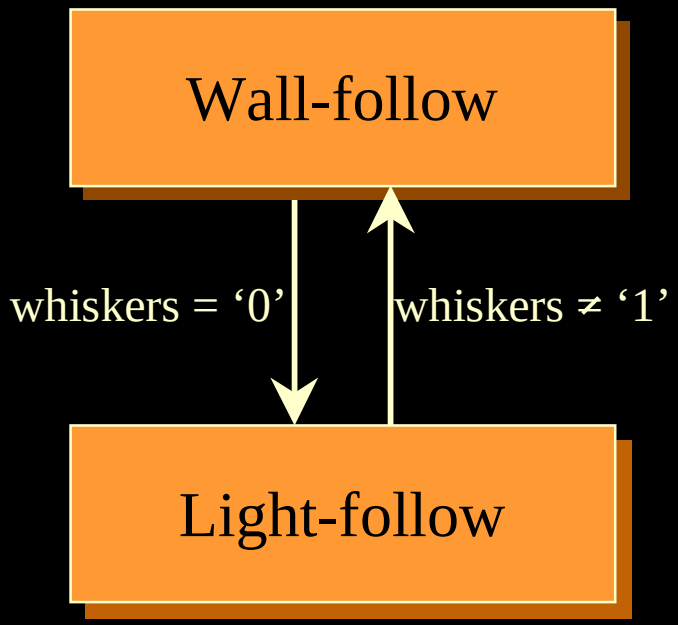
Sensors



- Ultrasonic range finder
  - transmitter and receiver
  - slows down the motor when object in range
  - turns the wheels to avoid obstacles
- Whisker Sensors
  - microswitch and pull down resistor
  - control the wheels and motor speed
- Photocells
  - ADC converts signals from photocells to digital output
  - the direction of brightest light is determined

Control System

- Follow Light Mode
  - none of the whiskers are in contact
  - robot seeks brightest light
  - includes sonar information to avoid obstacles
- Follow Wall Mode
  - robot follows side walls
  - disregards direction of light
  - makes corrections when too close

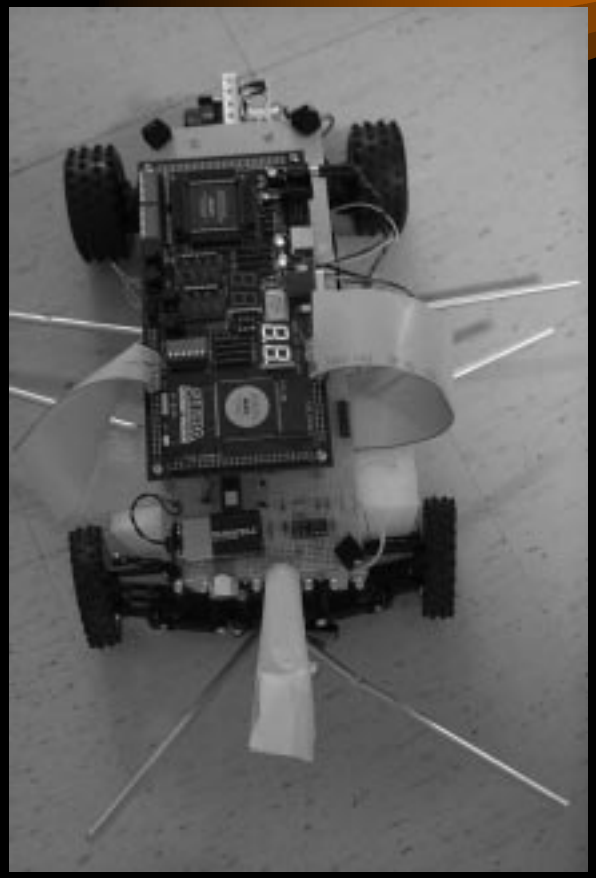


Servo Control

- Uses Pulse Width Modulation to control position of servo motors
  - Forward/Backward velocity
  - Right/Left direction
  - Trim of servos is set internally

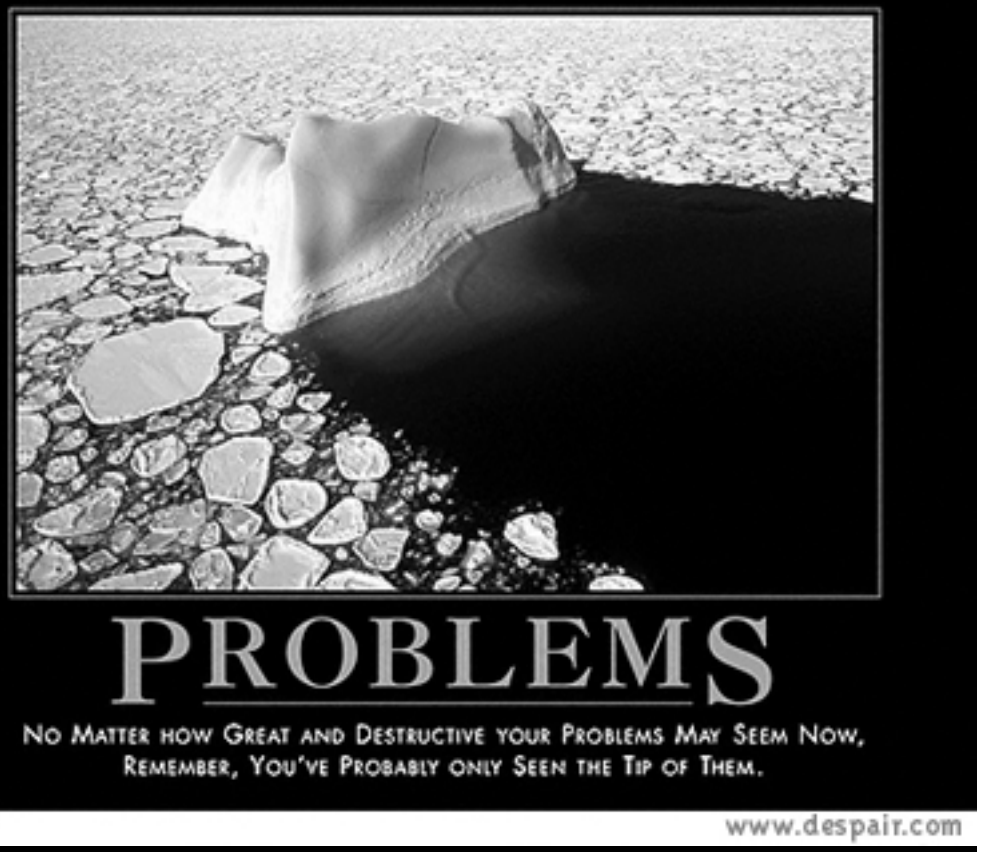
Testing and Debugging

- Knight Rider style LEDS represent state of car
- Does not require car to be moving to know its response to different stimulus
- Also tested range of SONAR, working operation of light detection, and whiskers



Difficulties

- **SONAR**
  - interference from the transmitter, servos, and the motor
  - solved using an opto-isolator, and vibration damping material
  - sonar takes a reading when both the servos and the motor are off
- **ADC**
  - interfacing with a chip designed for micro-controllers



Conclusion

- Summary
  - implemented a reactionary robotic algorithm
  - many simple behaviours
    - finds brightest light, follows walls, avoids obstacles
  - ultimately travels a course towards a goal
- Possible Improvements
  - laser in place of sonar
  - brakes
  - flexible whiskers
  - battery monitor circuit

References

1. Arkin, R. C. 1998. *Behaviour Based Robotics* MIT Press, Cambirdge, Massachusetts, 1998.
2. Brooks, R. 1989a, “A Robot That Walks: Emergent Behaviours from a Carefully Evolved Network”, Proceedings of the IEEE International Conference on Robotics and Automations, May, pp. 692-94.

Web References:

3. www.csndianna.edu/robotics/stiquito.html
4. www.frc.ri.cmu.edu/robotics-faq/8.html
5. www.robotstore.com
6. www.national.com/ads-cgi/viewer.pl/an/AN/AN-247.pdf
7. www.ee.ualberta.ca/~elliott/ee552/projects/98f/2-Dmapper/
8. www.despair.com

Demonstration and Questions