The First Truly Modular Robot

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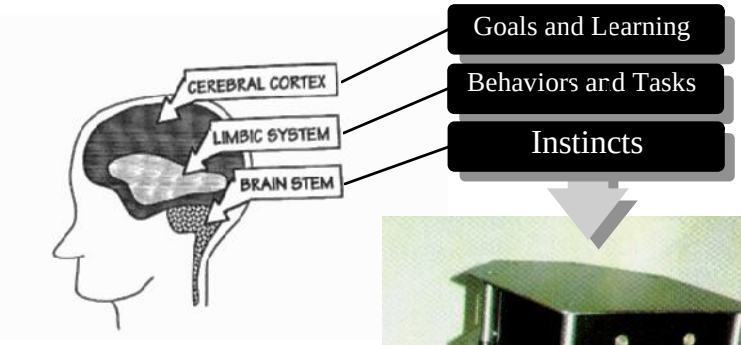

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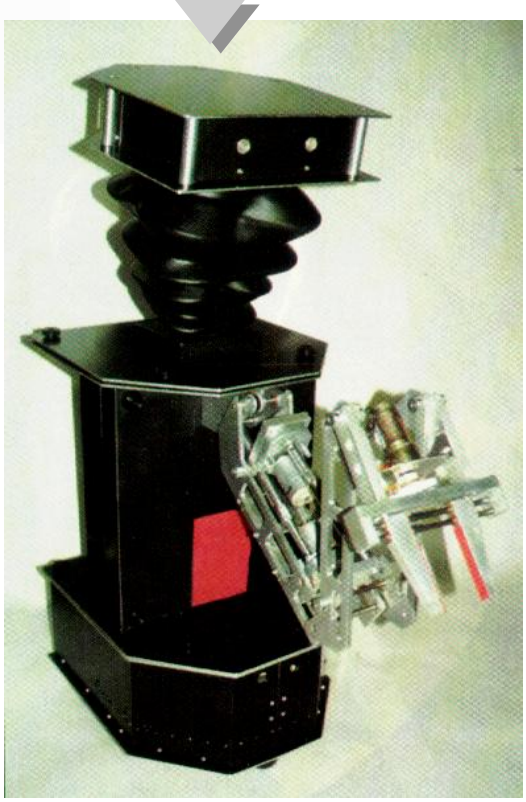
Each section has a dedicated 68HC11 Processor for *real-time distributive* control

Optional PC Compatible computer is configured for user requirements including:

- ***Speech Recognition***
- ***Vision System***



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- **Robotics Research**
- **Service Robotics**
- **Military Research**
- **Commercial Research**
- **Custom Designs Available**

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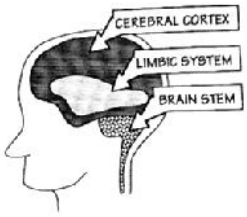
The Software Architecture is based on the three levels of intelligence found in the human brain



Cerebral Cortex-Physically the outer layer of the brain, which is characterized by the folds just under the skull. Functions include: Decision making, analysis, and dreaming. This is called the Goal Level in the Triune Operating System.

Limbic System-The gray matter found in the center of the brain, controls human behavior such as breathing, hunger, etc. This is called Behavior Level. Real-time decisions are made when simple or complex actions are triggered.

Brain Stem-The base of the brain is connected to the spinal cord and nervous system. This controls our critical responses and instinctive behaviors. It is analogous to the Instinct Level which gives the machine common sense. Motor/sensor fusion allows the machine to instantly react to its environment. The Behavior and Goal levels can alter the Instinct's reaction at any time.

Consider what happens when a person touches something *hot*. The nerve endings in the skin detects the heat and causes an immediate muscular response (*Instinct Level*). Additionally, a message (pain) is sent to the brains' Limbic System that activates a higher level behavior or set of actions based on *programmed behaviors* or *learned experiences*. This behavior or actions pre-empt the Cerebral Cortex (Goal Level) while the behavior is executing. When the action is finished, the Cerebral Cortex (Goal Level) regains control and continue where it left off or it may decide to change strategies or goals.

Moving-Two independent DC motors provide locomotion using an advanced pulse width modulation motor speed control. Speeds can be controlled from one to one hundred percent in one percent increments.

Seeing-Four independent optical sensor areas are mounted on the base using Light Emitting Diodes (LED) and phototransistor pairs. A proprietary narrow beam sonar system is mounted in the pan and tilt head section for navigation and long range sensor scans. The sonar can detect object distances to one eight of an inch. A single Visible Red LED sensor located in this section has the capability to see about three to four feet. Two optical sensor arrays are located along side the head for additional object detection.

Feeling-A force feedback system is used to monitor wheel load. Force is measured continuously to monitor the surface type or load. It is sensitive enough to determine whether the robot is operating on carpet of hard flooring.

Thinking-The processor in the base section performs real-time collision avoidance while the head processor navigates and scans the environment, simultaneously. The two computers are networked together. This allows them to cooperate in solving the navigation problem.

Learning-The language used for programming the onboard computers is English. No prior programming experience is necessary to create new commands (words) for this robot. However, the very tools used to create this easy to use and powerful language is always available to the user. The user words actually become part of language. The potential for this robot is limited only by the users imagination.

Basic Specifications (without arm)

Onboard Computers

One PC compatible based on user needs (consult factory for prices)

Two Motorola 68HC11 High Integration microcomputers with resident operating system and language onboard:

- 32 Kilobytes PROM
- 32 Kilobytes of battery backed RAM
- RS-232 Communication port ties PC to 68HC11 Processors
- One megabit per second network port for 68HC11 Processors

Sensors

Four Optical Sensor Arrays in the base covering 360 degrees
Two independent motor load sensors in the base
One speaker for sound effects and music
Two Optical Sensor arrays on the sides of the head
One IR Optical Sensor in the head
One narrow beam sonar subsystem in the head

Physical and Electrical

Size: 17 x 17 38 inches tall
Aprox Weight 60 pounds

Sonar Subsystem

Range: 20 feet
Distance accuracy: ± .0625 inch
Effective beam width is 3 to 40 degrees
Beam width is software selectable
Software controlled acoustic power
Sampling rates of 10 per second for 20 foot range
Sampling rates of 20 per second for 10 foot range

Includes:

20 foot communication cable
Charger
Technical manual
Curriculum
Software disk

Note: The arm shown in the photo is an experimental one. An arm option is due the fourth quarter of 2000.