Chapter 23. DARPA's Strategic Computing Program

The Quest for Artificial Intelligence, Nilsson, N. J., 2009.

Lecture Notes on Artificial Intelligence, Spring 2012

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Overview of Chapter 23

- DARPA?
  - Defense Advanced Research Projects Agency
  - is an agency of the United States Department of Defense responsible for the development of new technology for use by the military.
- AI technology in DARPA
  - Computer Vision
  - Speech Recognition and Natural Language Processing
  - Expert Systems

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23.1 The Strategic Computing Plan

Strategic Computing

- Robert Kahn, who had become Director of DARPA's Information Processing Techniques Office (IPTO) in 1979, began thinking that DARPA should sponsor a major research and development program that would integrate efforts in all of computer science areas to create much more powerful computer systems.
  - Kahn began planning what would come to be called the “Strategic Computing" program.
- Kahn thought that AI, especially expert systems, could play a major role in SC.

Figure 23.1: Robert E. Kahn.

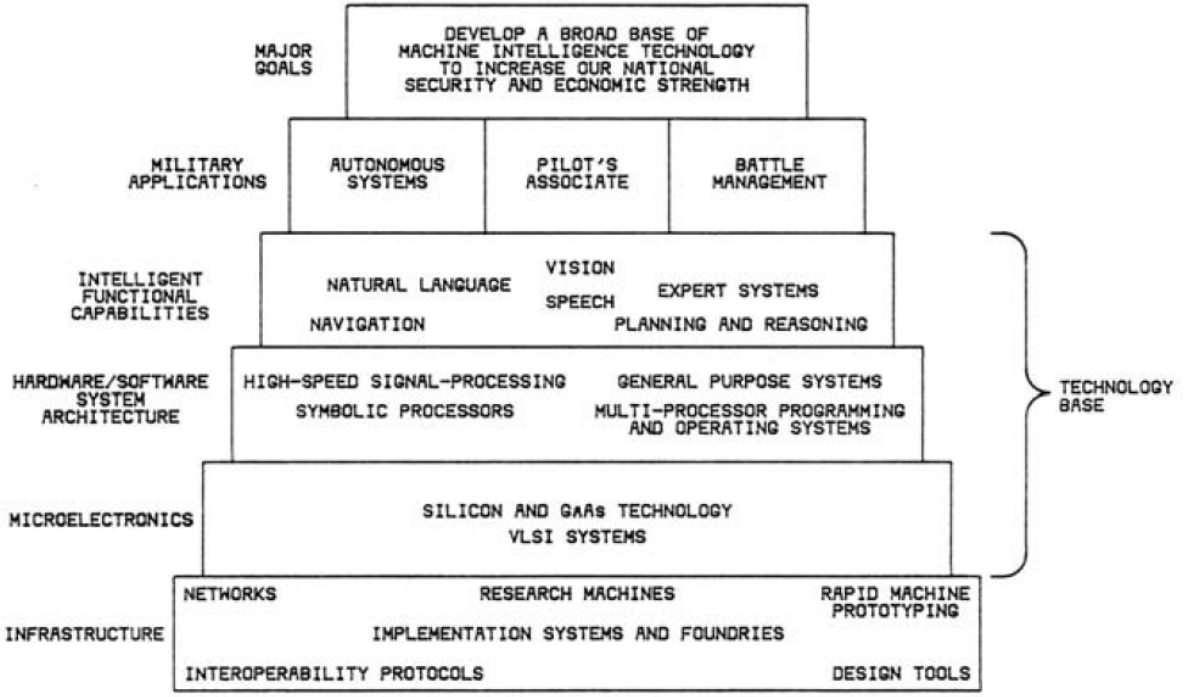

Figure 23.2: The SC program structure and goals.

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23.2 Major Projects

23.2.1 The Pilot's Associate

- Goal: development of an interactive computer system that would aid a combat aircraft commander.
  - Interaction with the system would be through a graphics user interface, voice recognition (capable of working under noisy and stressful conditions), and speech synthesis.
- PA would prepare and revise mission plans, advise the pilot about targets, assess threats, help the pilot to take evasive action against interceptor missiles, and take over routine tasks.

23.2.2 Battle Management Systems

- Goal: to produce a system that would ". . . Assist the commander-in-chief of the U.S. Pacific Fleet (CINCPACFLT) in planning and monitoring the operation of nearly 300 ships in the Pacific and Indian ocean regions."

- Expert systems were planned to play a major role
  - expert systems made extensive use of natural language understanding and generation abilities.
  - This was hosted on Symbolics Lisp machines and written using commercial expert-system "shells."

23.2.3 Autonomous Vehicles

- Goals of the project
  - using autonomous vehicles in logistics
  - supply operations, in search and rescue, and even in combat.

- The ALV was built on a Standard Manufacturing eightwheel hydrostatically-driven all-terrain vehicle capable of speeds of up to 45 mph on the highway and up to 18 mph on rough terrain.
  - a color video camera and a laser scanner that returned a 64 by 256 pixel range image at 1~2 second intervals.
  - Video and range data processing modules produced road-edge information.
  - Higher level reasoning was performed by goalseeker and navigator modules.

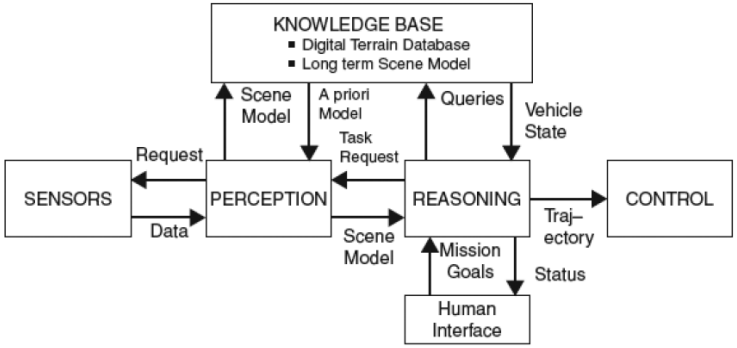

Figure 23.3: Martin Marietta's ALV (top) and its system configuration (bottom).

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23.3 AI Technology Base

23.3.1 Computer Vision

- DARPA focused on four main areas of computer vision
  - visual modeling and recognition
  - dynamic scene and motion analysis
  - vision-based obstacle avoidance and path planning
  - implementation of vision algorithms using parallel computing architectures

23.3.2 Speech Recognition and Natural Language Processing

- Speech recognition was needed by the Pilot's Associate, and both speech recognition and text understanding were needed by the Battle Management projects.
- SPHINX
  - Using HMMs and statistical information
  - Can recognize 10,000 words of natural language spoken by anyone
- JANUS
  - with a vocabulary of 4,500 words and 1,200 domain concepts
  - received a favorable response in 1986 when it was installed in a Battle Management Program test bed.

23.3.3 Expert Systems

- Because expert systems appeared to be so promising in the late 1970s and early 1980s, they were slated for a prominent role in the Strategic Computing (SC) program.

- They were to be the reasoning agents that would give “intelligence” to the SC applications.
  - BBN: Ohio State University
  - KEE, OPUS: IntelliCorp
  - ABE: Teknowledge, Inc.
  - KBS: Frederick Hayes-Roth and Neil Jacobstein

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23.4 Assessment

Assessment

- Most commentators doubt that the SC program achieved its goal of pulling new AI technology into the SC applications.
  - Developing the kinds of capabilities envisioned by the SC applications required AI inventions, and the atmosphere needed for invention is not conducive to tightly programmed milestone demonstrations.
- Even though the program itself disappeared, its accomplishments, along with those of the other “new-generation" projects, were many.
  - Progress made during the 1980s established artificial intelligence as a technology that was capable of taking on a wide variety of real-world applications.