

ROME AIR DEVELOPMENT CENTER
GRIFFISS AIR FORCE BASE
NEW YORK

PR I-6-4769

Exhibit

18 November 1965

STATEMENT OF WORK

Title: APPLICATION OF INTELLIGENT AUTOMATA TO RECONNAISSANCE

OBJECTIVE:

Development of concept and techniques in artificial intelligence towards the performance of robot-like devices in realistic environments. These concepts shall be demonstrated by means of a breadboard mobile vehicle containing acoustic, tactile (touch) and visual sensors, signal processing and pattern recognition equipment, and computer programming. Primary goals shall be the solution of incompletely specified problems (requiring creation of intermediate strategies and goals) and improvement of performance with training experience.

BACKGROUND:

Research in such areas as adaptive systems and game theory have resulted in performance by machines of tasks which appear to require human intelligence. The term artificial intelligence or intelligent automata has been applied to devices which modify their performance in response to their environment or demonstrate complex responses to given situations. Numerous examples of this intelligence exist, and include computers which play games of checker or war, detect and classify visual, electromagnetic, and other patterns, hold conversations, meander through buildings, control intricate processes and prove theorems.

Development of high-speed memory and logic circuits, miniaturization, interrupt and multiple computer operations along with rapid compilers and time-sharing systems have made real-time operation of an intelligent automaton realizable. The application of several artificial intelligence concepts is required: strategy formulation, pattern classification, machine training, assimilation of environment information, data organization and management, and real-time operation.

CONTRACT REQUIREMENTS:

Item 1. STUDY AND FEASIBILITY demonstration to implement concepts in artificial (machine) intelligence as applied to a real environment. This effort shall be performed as follows:

Phase I. STUDY AND INVESTIGATION to implement concepts in artificial intelligence as applied to a real environment. This effort shall explore techniques to assimilate and utilize acoustic visual and tactile forms of input data towards the solution of

so-called "intelligent" problems. This effort shall include the following:

a. A survey shall be made of the field of artificial intelligence to adapt existing concepts and techniques to this effort. This investigation shall result in definition of the following major elements:

- (1) The framework for a comprehensive mathematical system model.
- (2) Constraints on goals and physical environment.
- (3) Signal processing and adaptive techniques required for pattern recognition and assimilation of sensor data.
- (4) The computer configuration and programming systems to be employed (see attachment 1). Use of existing or announced digital computers and peripheral equipment will be considered.

b. Computer programs required to investigate concepts and techniques shall be developed, consistent with specifications given in attachment 1 to this document. Data representation and programming techniques shall be based upon, but not limited to the following considerations:

- (1) Delayed real-time assimilation of environment data.
- (2) Operation of the system at a reasonable speed.
- (3) Incomplete specification of goals and problem constraints.

Documentation shall comply with the requirements of Exhibit RADC-3010 dated 17 January 1964.

c. Designs shall be made for a breadboard model of a mobile vehicle, based on the following factors:

- (1) Cable connections to external signal processing and control equipment.
- (2) Sensors mounted on the vehicle, to include: an electro-optical device similar to a vidicon, with provisions for variation of scan direction or field of view; microphones or other acoustic devices, with some directional sensitivity; and pressure transducers, microswitches or other tactile mechanisms to signal contact of the vehicle with other objects.

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Phase II TEST AND EXPERIMENTATION utilizing the techniques developed under Item 1 above, integrated into a complete system. This effort shall include the following:

- a. Fabrication of a breadboard mobile vehicle and associated cabling and interfacing between computers, signal processing equipment and the vehicle. (Note 1).
- b. Computer programs to implement elements of the system, consistent with requirements of Item 1 above. Maximum utilization of programs developed under Item 1 shall be made. Programming shall conform to attachment 1 below and to documentation standards of RADC Exhibit 3010 dated 17 Jan. 1964.
- c. Design of experiments to "train" and test the system, and suitable artificial environments shall be devised.
- d. Demonstrations of system performance, emphasizing the various areas investigated under this effort shall be prepared.

NOTE: The design and fabrication of a digital computer is not to be considered as part of this effort.

Item 2. CONTRACT STATUS REPORT. The contractor shall prepare a Contract Status Report in letter form and shall include, as a minimum, the following:

- a. A summary of the work performed during the reporting period.
- b. Conformance or nonconformance to projected work schedule.
- c. An analysis of work progress covering the reporting period.
- d. A short statement of work effort planned for the next reporting period.
- e. A statement describing significant changes in the contractors operating personnel.
- f. A positive statement regarding the number of engineering man-hours, by category, during the reporting period.
- g. A positive statement regarding the number of computer hours used during the reported period.

Item 3. TECHNICAL REPORT. The Technical Report shall be provided to record the technical efforts and achievements accomplished under this Contract. Each TR shall be prepared in accordance with the requirements of MIL-STD-847, entitled, "Preparation of Technical Reports", except for the following:

a. The Contractor shall submit a clean draft, typed on good quality offset paper (or equal) and one carbon copy (or suitable facsimile). Equations will be typed. Art and line work will be in final form. Continuous tone glossy prints will be furnished when photographs are required. Colors will not be used without approval of the RADC - responsible organization (EMLAP). The draft shall be forwarded to RADC (EMLAP) for technical evaluation, and editorial review. Corrections will be noted, appropriate notices selected, and returned to contractor for preparation and return of a reproducible copy to EMLAP.

b. Any technical article, pertaining to the effort being conducted under this contract, intended for publication in a professional journal shall be identified by a technical report number obtained from EMLAP. All proposed articles shall be approved by RADC for release as required in the ISM (Industrial Security Manual).

Note 1. BREADBOARD MODEL.- An assembly of preliminary circuits and parts to prove the feasibility of a device, circuit, or principle in its simplest possible form.

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ATTACHMENT #1

Computer Programming

1. To obtain maximum benefit from the results of this effort, it is advantageous to employ programming techniques which are as descriptive and concise as possible. Programs which implement "high level" decisions and algorithms relating to "intelligent" behavior or data organization shall be developed in a machine-independent manner. This will require the use of compiler-level languages, of which the following are examples:

ALGOL
LISP
FORTRAN

COBOL
PL/I

2. Compilers which implement these languages or subsets of them are numerous and well-known. Usage of supersets of these languages or of lesser known or unique compilers shall be justified by significantly increased simplicity, speed, flexibility or data storage utilization.