144-20-9
Copy / of 4
25X1

CONFIDENTIAL

Declass Review by NGA.

[redacted]

Subject: PROPOSAL FOR AUTOMATIC IMAGE RECOGNITION
BY COHERENT OPTICAL TECHNIQUES

Dear Dick:

Attached is a Technical Discussion of the work program which we are proposing on the subject above. From the standpoint of content, I believe it is responsive to the items we have discussed. From the standpoint of completeness, I believe it is a good first cut at the major questions that we have current knowledge of. Successful completion of the proposed work program will not answer all of the questions that any of us can pose. Rather, it is a look at the most important real-world problem areas. Together with this first try, we are proposing work which will enable us to get understanding and appreciation of the nature of the process as it relates to your end use. We will not manipulate all of the conceivable variables in all of their possible permutations and combinations. The expense of such an exhaustive experiment is not warranted at this time. We will gain an appreciation which will permit you and your associates to assess the potential of the concept and be able to make a hard-headed judgment as it relates to your next step.

The estimated costs for this program are described in the attached Exhibit A. The option described as Part 2 is that relating to the use of the image orthicon camera chain. The pricing which is shown for Part 2 assumes that the image orthicon chain which is in-house will be furnished free-of-charge to your program. I am hopeful that the experimental results detailed in the Appendix of the attached Technical Discussion will provide the graphic evidence to result in a favorable decision on the inclusion of Part 2.

The output of our work will be reports as described in the attachment. The final report will be delivered thirty (30) weeks after contract authorization is received. We would also assume that this work, if authorized, would be a task under our basic agreement.

Sincerely,

[redacted]

25X1

Enclosure
"Automatic Image Recognition by Coherent Optical Techniques" dated 27 August 1964

GROUP 1

Next 16 Page(s) In Document Exempt

Approved For Release 2005/05/02 : CIA-RDP78B04770A002300020012-3

25 August 1964

Research Objective

Automatic Image Recognition by Coherent Optical Techniques

1. Introduction

Research is proposed to investigate the feasibility of utilizing coherent light techniques to automatically or semiautomatically recognize photo images.

This investigation would be one of several being performed by the intelligence community to evaluate various techniques which may be applicable to the development of automated devices which would aid the interpreter in performing his image recognition tasks. Many of these techniques under investigation are primarily linear processes based on the sequential examination (by an electro-optical system) of each bit of data in the total image and the subsequent comparison of these bits to a previously learned prototype image of a target. Foremost of this type of image processing are the adaptive-memory devices such as the Perceptron and other similar computers. Although these types of devices can automatically identify targets, they seem to have several serious deficiencies:

1.1 Linear processing techniques are very bandwidth-limited -- e.g., the time of processing per unit of image area per image-packing density is very long. In other words, an electro-optical, adaptive-computer system requires more time to identify an image than does a poor or mediocre human interpreter. A human interpreter does not examine an image bit by bit but by integration of many hundreds or thousands of image bits simultaneously.

1.2 Adaptive memory techniques have shown little capability to "generalize" from a learned prototype image. They are unable to recognize an image which differs appreciably from the learned prototype due to shadow, perspective, and incomplete or distorted image detail.

It is primarily because of these two deficiencies that it is necessary to investigate completely different concept which might be applied to image recognition.

Recent research has demonstrated that certain types of optical filters for specific images will permit recognition of only that image when it is viewed in a scene containing other "unwanted" objects. This type of filter is essentially a diffraction image of the object, more commonly called a hologram. These types of spatial filters, or holograms, permit the entire image to be "processed" simultaneously; therefore, the speed of recognition would be reduced considerably over that of linear recognition systems. There is also some indication from laboratory work that recognition with these filters is little affected by perspective and incomplete image detail.

Although the basic concepts of spatial filtering have been demonstrated, there are many questions remaining that must be solved before the technique can be fully evaluated and related to a possible automatic recognition system. The purpose of the proposed research is to investigate these more salient unresolved problems.

2. Concept

2.1 Purpose

Although there are a number of questions relative to the implementation and operational use of holograms in a recognition system, the basic purpose of the proposed research is to acquire more knowledge about structure and variations in the hologram itself and its limitations in image recognition techniques. This additional knowledge should allow a more comprehensive evaluation of the potentials of holograms and provide insight into the feasibility of further development of a recognition system based on holograms.

2.2 Scope

This project would incorporate, essentially, two levels of experimentation:

2.2.1 Investigation of the interrelationships of hologram structure and image variables.

2.2.2 Investigation of problems relating to the optical system and the recording medium.

3. Requirements

3.1 This project would include optical experimentation and analysis leading to answers for at least the following unresolved questions:

3.1.1 How obscure can a target be and still be recognized? e.g., low contrast targets and partially hidden targets.

3.1.2 How much information can a hologram contain before the desired target information is "lost"? e.g., how much of a photograph can be searched in the field of view?

3.1.3 What are the effects of shadows?

3.1.4 What are the effects of image scale?

3.1.5 What are the effects of target perspective?

3.1.6 What are the effects of image packing density?

3.1.7 What are the effects of target orientation?

3.1.8 What are the effects of multiple, identical targets in the same field of view?

3.1.9 How many different types of targets can one hologram accommodate?

3.2 There are probably other image variables which may affect the basic structure of holograms. It is expected that these will be investigated when they come to light.

3.3 In addition to these basic questions of target variables and their effect upon holograms, there are other related problems for which investigation is desired. These are primarily concerned with the optical system, filters and the recording medium. These problems include, but are not limited to:

3.3.1 How do glass plates affect the optical path?

3.3.2 Are liquid gates necessary?

3.3.3 How seriously does vibration affect the optical system performance?

3.3.4 What are the potentials and limitations of recording on photoplastic film?

3.3.5 How precisely must the filter be located and aligned in the optical system?

3.3.6 What are the relative merits of phase and amplitude filters?

3.3.7 What are the expected resolution limits of the hologram system?

3.3.8 What are the predicted time constants associated with the scaling and orientation variables?

3.3.9 What is the optimum modulation transfer function of such a system?

3.3.10 What is the optimum signal to noise ratio?

3.3.11 What are the relationships between system processing time, working area, and the resolution of the photograph?

3.3.12 What is the feasibility and complexity of real-time filter generation?

3.3.13 What are the best techniques for reducing amplitude of the reference beam of a two-beam interferometer without changing the characteristics of the interference pattern in order to achieve interference in the desired order.

Approved For Release 2005/05/02 : CIA-RDP78B04770A002300020012-3

25X1 [redacted] 8/9/6 [redacted] 25X1

I have discussed the question of your use of the T.O. chain in general terms with

25X1 [redacted] [redacted] (guess) was 25X1

generally agreeable but was not specific because I was not specific as to your identity 25X1

You were merely addressed as being in the [redacted]

25X1 [redacted] If you desire I feel it would be appropriate to make a direct contact 25X1

with Bill. [redacted]

25X1 Tentative OK from [redacted] 9 Sept 64 [redacted] m)

Will call this afternoon if I have a chance.

SECRET
(When Filled In)

TECHNICAL BACKGROUND PROCUREMENT INFORMATION

I. Contractor

A. Name and address: [redacted] 25X1

25X1 [redacted]

B. Evaluation of previous performance: Excellent work being performed on a concurrent contract.

II. Brief description of this procurement: A study project involving Automatic Image Recognition by Coherent Optical Techniques.

Estimated total am[redacted] 25X1

A. Deliverable items: Reports only

B. Is this procurement for other than a standard, "off the shelf" or slightly modified commercial item? _____ If "yes", is it anticipated that any more of this unit will be procured? _____ If so, a complete set of directly reproducible manufacturing drawings and specifications would normallybe included in this procurement. Comments:

This is an R & D feasibility study

C. Will contract cover a period of more than 90 days? yes
If "yes", are progress reports desired? yes If so, indicate frequency, content and number of copies desired:

Monthly informal progress reports (3 copies)

D. Is any Government-owned property to be provided to the contractor?

yes If so, list and indicate its availability (where, when, etc.) Eutony Image Orthocon System will be utilized in this study. This

SECRET
(When Filled In)

25X1 system was developed by [redacted] for D/DS&T/ORD. However, it will remain at

25X1 [redacted] for a time. NPIC has permission from ORD to utilize this equipment for this project.

E. Is any special tooling involved? NO.

F. Security:

1. Association with the Sponsor is SECRET

2. The specifications and/or drawings are Unclassified

3. The item is Unclassified

4. Contractor personnel known to be aware of this proposed procurement:

25X1 [redacted]

5. Other security information [redacted] 25X1 has a basic contract with the agency.

III. Reasons for selection of this source. If other sources were considered, indicate results. If no other sources were considered, list the reasons why this firm is considered to be uniquely qualified to perform this work.

25X1 [redacted] has developed certain techniques and information which are considered proprietory. In addition, they are the most advanced group in the applications of this overall concept.

25X1

IV. Technical contact [redacted]

In the event additional space is required, use the reverse side(s) of this form, with a reference to the item number to which the comment applies.