R & D CATALOG FORM

DATE: 8 November 1965

1. PROJECT TITLE/CODE NAME: Automatic Focusing System

2. SHORT PROJECT DESCRIPTION: A study to determine the feasibility of utilizing automatic focusing systems on specific equipment.

25X1

5. CLASS OF CONTRACTOR: Manufacturer

6. TYPE OF CONTRACT: CPFF

7. FUNDS: FY 19 $; FY 1966 ; FY 19 $

8. REQUISITION NO.: N/A

9. BUDGET PROJECT NO.: NP-IO-9

10. EFFECTIVE CONTRACT DATE (Begin - end): January 1966 - June 1966

11. SECURITY CLASS. 25X1
A.A. - Confidential
T. - Unclassified
W. - Unclassified

12. RESPONSIBLE DIRECTORATE/OFFICE/PROJECT OFFICER TELEPHONE EXTENSION: DDI/NPIC/P&DS 25X1

13. REQUIREMENT/AUTHORITY

If the system that is presently being studied proves successful, the basic principles will have application in any device that requires critical focus.

14. TYPE OF WORK TO BE DONE

Engineering Development

15. CATEGORIES OF EFFORT

MAJOR CATEGORY	SUB-CATEGORIES
Miscellaneous	Interpretation/Analysis

16. END ITEM OR SERVICES FROM THIS CONTRACT/IMPROVEMENT OVER CURRENT SYSTEM, EQUIPMENT, ETC.

Breadboard and final report -- Current focusing systems are too costly and complex, require periodic calibration, and cannot be applied to a variety of lens systems.

17. SUPPORTING OR RELATED CONTRACTS (Agency & Other)/COORDINATION

By virtue of contacts throughout industry and the Intelligence Community, it is concluded that no equivalent devices are currently in existance or under development.

18. DESCRIPTION OF INTELLIGENCE REQUIREMENT AND DETAILED TECHNICAL DESCRIPTION OF PROJECT (Continue on additional page if required)

Automatic focusing will be an integral part of other programs currently under development by NPIC. The major items are automatic stereo scanning and rear-projection viewing systems. In addition, a relatively inexpensive automatic focusing device could be applied to existing viewing equipment and photographic enlargers.

Correlation systems now in general use require a scanning system, an electronic multiplier, an electronic integrator -- together with the associated power (Contd)

19. APPROVED BY AND DATE

OFFICE	DEPUTY DIRECTOR	DDCI

FORM 11-64 2338

(1-13)

18. supplies, deflection circuits, focusing circuitry, amplifiers, etc. Such equipment is too costly and complex to provide automatic focusing with typical reconnaissance viewers. Other systems in use, such as mechanical linkage devices, require periodic calibration, and these systems are designed to be used with specific lens systems. It would be extremely beneficial to develop a system that could be applied to a variety of lens systems.

This project will investigate the feasibility of automatic focusing systems for existing equipment. The basic technique has been investigated [redacted] and described in the Journal of the Optical Society of America, Volume 54, No 10, 1261-1266, October 1964. In this approach, the object is imaged on the face of a wide-area non-linear photocell which vibrates in the direction of the optical axis. By sensing the phase of the fundamental component in the output signal, and also certain harmonic content, it is possible to determine the state of focus, or de-focus of the system. 25X1

Results have been obtained for a three-dimensional "real world" object space involving a person approaching the optical system, which was fixed-focused for six feet. The successful results with three-dimensional object space, and with an optical system designed to operate over a considerable range of focus distances, indicate that the design of a system to operate on basically two-dimensional objects (photographic film), whose object distance varies over a relatively small range, has a high degree of feasibility.

SECRET

997095

R & D CATALOG FORM

DATE: 5 January 1965

1. PROJECT TITLE/CODE NAME: Automatic Focusing System

2. SHORT PROJECT DESCRIPTION: A study to determine the feasibility of developing an automatic focusing system

4. LOCATION OF CONTRACTOR: 25X1 25X1

5. CLASS OF CONTRACTOR: Manufacturer

6. TYPE OF CONTRACT: CPFF

7. FUNDS: FY 1965 ; FY 1966 ; FY 19 $

8. REQUISITION NO.: NA

9. BUDGET PROJECT NO.: NP-S-9 25X1

10. EFFECTIVE CONTRACT DATE (Begin - end): March 1965 - October 1965

11. SECURITY CLASS.: A. A. - Conf. T - Uncl. W - Uncl

12. RESPONSIBLE DIRECTORATE/OFFICE/PROJECT OFFICER TELEPHONE EXTENSION: DDI/NPIC/P&DS 25X1

13. REQUIREMENT/AUTHORITY

If this system proves to be feasible, the basic principles will have application in any device that requires critical focus.

14. TYPE OF WORK TO BE DONE

Applied Research

15. CATEGORIES OF EFFORT

MAJOR CATEGORY	SUB-CATEGORIES
Special Techniques and Development Studies	Interpretation/Analysis

16. END ITEM OR SERVICES FROM THIS CONTRACT/IMPROVEMENT OVER CURRENT SYSTEM, EQUIPMENT, ETC.

Breadboard and final report/Current focusing systems require periodic calibration and cannot be applied to a variety of lens systems

17. SUPPORTING OR RELATED CONTRACTS (Agency & Other)/COORDINATION

By virtue of contacts throughout industry and the intelligence community, it is concluded that no equivalent devices are currently in existence.

18. DESCRIPTION OF INTELLIGENCE REQUIREMENT AND DETAILED TECHNICAL DESCRIPTION OF PROJECT (Continue on additional page if required)

Correlation systems now in use generally require a scanning system, an electronic multiplier, and an electronic integrator -- together with the associated power supplies, deflection circuits, focusing circuity, amplifiers, etc.

Such equipment is too costly and complex for automatic focusing with typical reconnaissance viewers. Other systems in use, such as mechanical linkage devices, require periodic calibration, and these systems are designed to be (Cont'd)

19. APPROVED BY AND DATE

OFFICE	DEPUTY DIRECTOR	DDCI

FORM 2229 SECRET (1-13)

used with specific lens systems. It would be extremely beneficial to develop a system that would not require periodic calibration and could be applied to a variety of lens systems.

This project would prove the feasibility of an automatic focusing system for potential development. Essentially, the program would establish the feasibility of: (1) detecting image sharpness by using the autocorrelation of the image as an indicator of sharpness; (2) using a solid-state correlator as the image sharpness sensor; and (3) developing a signal for driving the projection lens to the position of best focus. The study is intended to show that an automatic focusing system, which can be linked to present projectors by the appropriate servo loops, can be produced. The automatic focusing system will consist of the solid state correlator for obtaining the autocorrelation function of the image; an optical system for projecting two identical images on the sensor; and the required electronic circuits for converting the autocorrelation signals into a form for controlling a servo motor to, in turn, drive the projection lens to the position of best focus. Moreover, the study would determine (1) the sensitivity of the auto-correlation function to focus and, (2) the sensitivity of the [redacted]-developed correlation sensor. [redacted] effort should yield designs for a compact, economical system for achieving and maintaining focus on various projection and direct-viewing devices. 25X1

Basically, a correlator can be used to sense image sharpness because the cross-correlation of two images, both in sharp focus, is substantially higher than the cross-correlation of two defocused images. Plotting light intensity vs position, it can be shown that a focused image will have a higher value on the intensity scale at a given point than the defocused image. This is because the total energy under the curve must be conserved. In the defocused case, the light is spread over a wider position so the intensity must be lower. The correlation function is obtained by multiplying the intensities of the image, point by point, and adding the contributions from all the image points. It is clear that the peak of the correlation curve is lower for the defocused image.

The use of the correlation technique is not new but its application to automatic focusing has been limited because of the cost, size, weight and power required by the implementation. With the use of the solid state correlator developed [redacted], it should be possible to implement an automatic focusing system that would overcome the problems cited above. 25X1