NASA CR-166755

University of Wisconsin-Madison

NASA

Biomedical Applications Team

Advisory Center for Medical Technology and Systems
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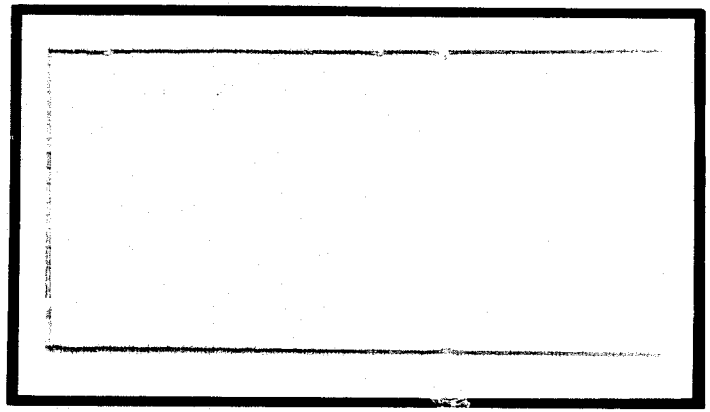

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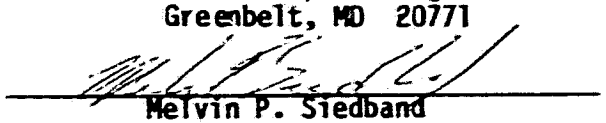
FINAL REPORT ON

Contract NAS5-26454

February 1981 through May 1981

Sponsor: The National Aeronautics
and Space Administration
Technology Transfer Division
Code ETT-6
Washington, DC 20546

Technical Monitor:
Donald S. Friedman
Goddard Space Flight Center
Greenbelt, MD 20771



Melvin P. Siedband
Principal Investigator
May 28, 1981

TABLE OF CONTENTS

SUMMARY 1

COMPLETED OR INACTIVATED PROJECTS
Biomedical Manufacturers Awareness Program 3
Clinical Ophthalmic Ultrasound Improvements 6
Magnetic Cell Sorter 9

TRANSFERRED PROJECTS
Hand and Foot Warmers for Patients with Raynaud's Syndrome 13
Hyperthermia Treatment for Cancer 15
Joystick Driving Control for the Handicapped 16
Quantitative Coronary Artery Imaging (MIPS) 19
Speech Autocuer. 22

OTHER TOPICS
Trips and Conferences 25
Team Roster 26

SUMMARY

This report presents the final status of projects carried by the UW-BATeam during the contract period February 1981 through May 1981. Projects for which no further activity is planned have been inactivated. Responsibility for projects which require continuing technology transfer support has been assumed by either another Team, a field center, or NASA Headquarters.

This is the final report to be issued by the Biomedical Applications Team operated by the Advisory Center for Medical Technology and Systems at the University of Wisconsin-Madison, under Contract NAS5-26454.

COMPLETED OR INACTIVATED PROJECTS

BIOMEDICAL MANUFACTURERS AWARENESS PROGRAM

BATeam Personnel: J. C. Behrens-Tepper

Problem

Unfamiliarity with the NASA TU Program on the part of biomedical manufacturers has been perceived by the BATeam as an obstacle to successful transfer of aerospace technologies.

Solution

The current project facilitates BATeam objectives by informing biomedical firms about NASA services and establishing channels of communication between BATeam and biomedical companies.

NASA Technology

The BATeam may initiate a limited number of RECON literature searches in an attempt to identify NASA technology appropriate to current interests of participating biomedical companies.

Principals

Melvin P. Siedband, Assoc. Prof. of Radiology, Director, ACMTS
J. C. Behrens-Tepper, Biomedical Engineer, UW-BATeam

Cost to NASA

During the last calendar year, approximately two man-months of BATeam time has been spent supporting this activity. A more detailed accounting will be provided in the summary report now being prepared.

Cost Sharing

User cost is expressed in man-hours spent meeting with BATeam personnel and reviewing NASA literature.

Commercialization Strategy

The goal of this project is to establish joint technology transfer efforts with biomedical firms--to get these manufacturers to consider the BATeam as an integral part of their new product innovation program. The first step is to identify firms interested in learning about NASA technology through the BATeam. The second is to arrange a meeting at which a detailed presentation of current NASA efforts and BATeam services available can be made to a top management group. This presentation must convince management that collaboration with the BATeam provides an effective means of obtaining new technologies at reduced costs in time and money.

Final Status

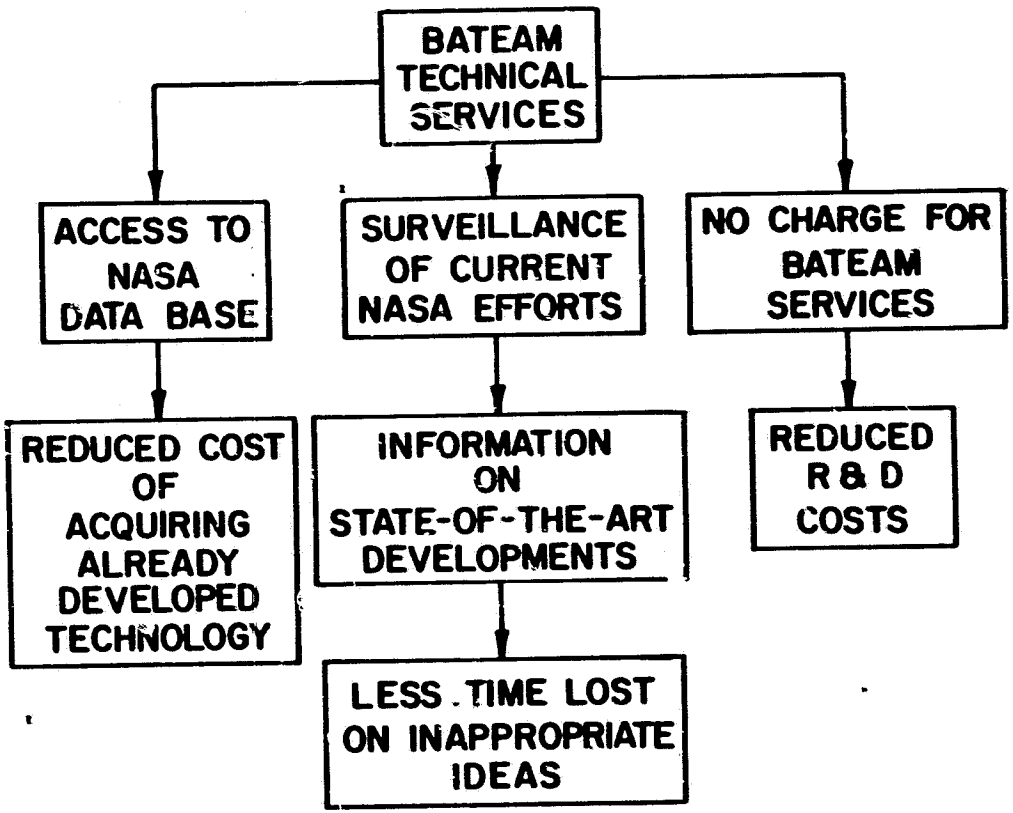
The BATeam established contact with 55 biomedical firms since the program was initiated in January 1979. A comprehensive report summarizing this project's activity was submitted to Headquarters on February 18, 1981.

A letter advising those companies with active files of the final disposition of the UW-BATeam was sent out at the contract's close (May 1981). The letter stated that, after June 1, 1981, parties seeking further information about NASA technology should contact either the RTI BATeam or Headquarters, directly. No further activity is planned.

BIOMEDICAL MANUFACTURERS AWARENESS PROGRAM

- INCREASED VISIBILITY OF BATEAM AS SOURCE OF NASA TECHNOLOGY
- RESPONDING TO INQUIRIES FROM INDIVIDUAL BIOMEDICAL FIRMS
- COMPUTER SEARCH OF NASA DATA BASE
- UW-BATEAM EMPHASIZING MID-WEST COMPANIES

BENEFITS TO COMPANIES



CLINICAL OPHTHALMIC ULTRASOUND IMPROVEMENTS

BATeam Personnel: Dr. William N. Fetzner.

Problem

Resolution limitations of currently available commercial ultrasound systems restrict the usefulness of images formed of the eye and surrounding tissues. In particular, pathologies occurring at the retinal-vitreous interface cannot be well defined. Abnormalities in the orbit behind the eye are almost impossible to identify from ultrasonic images due to the loss of resolution associated with attenuation of ultrasonic energy as it passes through the globe of the eye.

Solution

It is well known that increasing the aperture of an imaging system increases its resolution capability. Besides using a physically large transducer, it is possible to simulate, by computer, a synthetic aperture of large dimensions and thereby achieve resolution improvement. This approach, along with the technique of coherent integration to reduce noise are being considered as possible solutions to the problem stated above.

NASA Technology

Special purpose data acquisition and recording equipment was assembled by APL for the SEASAT program. The equipment was part of a system designed to obtain high resolution radar images of the ocean's surface by means of synthetic aperture techniques. This work was performed under contract to the NASA Goddard Space Flight Center. No patents are yet involved but inventions are expected to occur from the proposed study.

Principals

Philip A. Piro, M.D., Dept. of Ophthalmology, Johns Hopkins University.
John B. Garrison, Ph.D., Physicist, Applied Physics Lab, Johns Hopkins University.
Donald S. Friedman, Contracting Officer, GSFC.

Cost to NASA

A small scale technical feasibility study has been funded by NASA. The objective of this study is to demonstrate to the National Eye Institute that the synthetic aperture technique is applicable despite eye movement.

Cost Sharing

None at this time although the NEI has indicated a willingness to fund the medical aspects of the project if it can be demonstrated that eye movement will not prevent the acquisition of high resolution images.

Commercialization Strategy

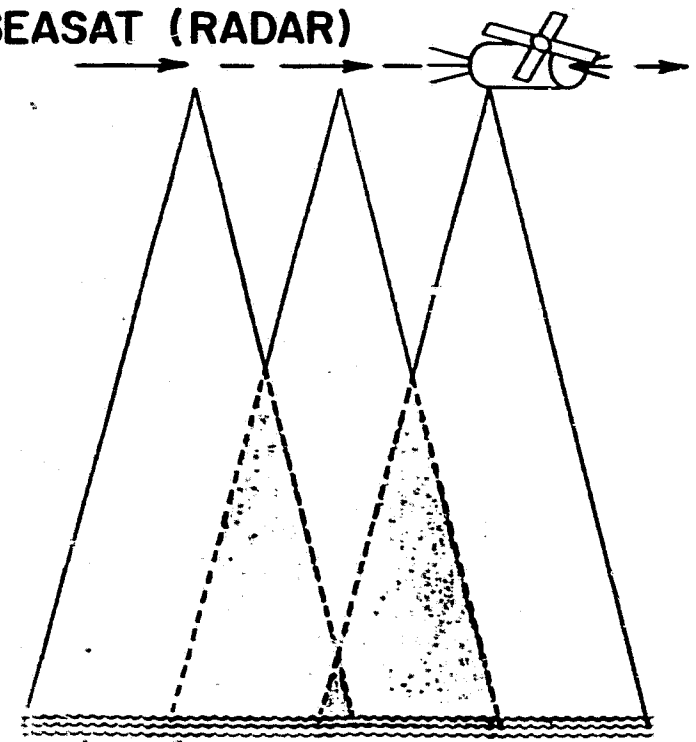
(a) Build a prototype system
(b) Field test with NEI support
(c) File for patents
(d) Demonstrate an operational system to manufacturers

Final Status

The National Eye Institute study section voted against approval of the proposal. Since approval and funding by NEI was considered a precondition to NASA support of the project, no further efforts on behalf of the project by NASA are planned. Accordingly, we are inactivating this project from BATeam records.

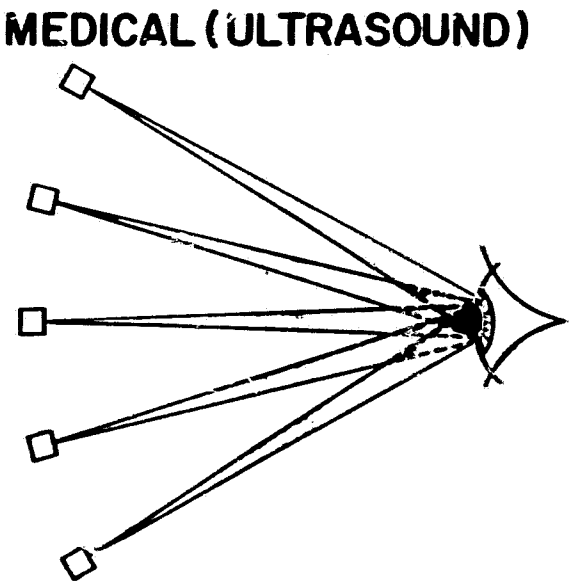
CLINICAL OPHTHALMIC ULTRASOUND IMPROVEMENTS

- HIGHER RESOLUTION IMAGES OF THE EYE AND ORBIT
- MORE ACCURATE DIAGNOSIS OF DEEP-LYING EYE DISORDERS



HIGHER RESOLUTION OCEAN SURFACE IMAGING (TRANSDUCER MOVING IN SPACE)

- SYNTHETIC APERTURE TECHNOLOGY DEVELOPED FOR SEASAT
- JOHNS HOPKINS UNIVERSITY: THE APPLIED PHYSICS LAB AND WILMER EYE CLINIC



HIGHER RESOLUTION EYE TISSUE IMAGING (SEQUENTIALLY OPERATED TRANSDUCER ARRAY)

MAGNETIC CELL SORTER

BATeam Personnel: Dr. William N. Fetzner.

Problem

Cell separation is needed for diagnostic and therapeutic purposes. At present, there are no satisfactory techniques to achieve cell separation of relatively large numbers of cells. An economical device is needed to monitor diseases, such as leukemia, or for biological processing of hormones and enzymes.

Solution

As part of the microsphere R&D carried out by JPL for NIH, a magnetic microsphere was developed. It was proposed that the magnetic microsphere be used as a cell separating device by causing it to be selectively bound to certain cells in a mixture of cells. Then, as the mixture is passed through a magnetic field, the tagged cells can be separated from the rest.

NASA Technology

Hardware and methodology developed under the JPL/NASA program on "Non-Metallic Superconductors"--specifically that applied to the synthesis of organic model compounds and functional polymers and for investigation of their electronic transport properties.

Principals

Alan Rembaum, Ph.D., Group Supervisor, JPL.

Cost to NASA

An RTOP for three years, 1978-80, has been funded to JPL at the level of $113,000.

Cost Sharing

The Tumor Biology Division of NIH awarded $136,400 to JPL for the three-year period to cover costs associated with the development of a class of polymeric reagents and new biochemical and immunological techniques.

Commercialization Strategy

The legal office at Caltech is vigorously pursuing patenting and licensing efforts involving the microsphere technology. Already, several patents are issued and are licensed. It is expected that the magnetic microspheres will receive the same promotion. Commercialization of the cell sorter will be promoted through a demonstration of the hardware to prospective manufacturers.

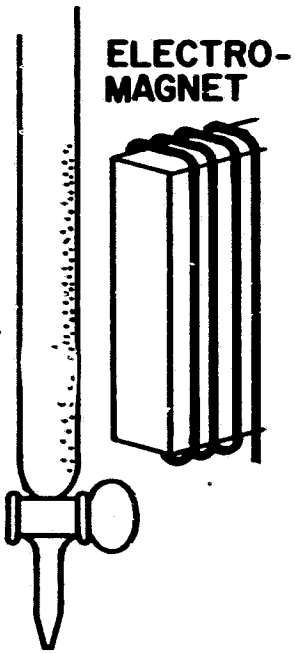
Final Status

Along with the final report on the project, JPL notified NASA Headquarters in January that a license on "cell-sorting apparatus" has been acquired from JPL/CIT by Becton-Dickinson and Company. The company is proceeding to develop a sorter based upon research carried out by Dr. Alan Rembaum at JPL under the NASA TT Division contract.

Since the transfer of the NASA technology to a commercial enterprise is now complete, the UW-BATeam is closing its file on this project.

MAGNETIC CELL SORTER

- CELLS CAN BE SEPARATED USING MAGNETIC MICROSPHERES
- USEFUL FOR SMALL CONCENTRATIONS, REMOVING LEUKEMIC CELLS, LARGE SCALE HARVESTING OF SPECIFIC CELLS
- DERIVED FROM NASA PROGRAM ON NON-METALLIC SUPERCONDUCTORS
- THE JET PROPULSION LABORATORY



IN THE BATCH TECHNIQUE, MAGNETICALLY LABELED CELLS MIGRATE TO THE SIDE CLOSEST TO THE MAGNET.

TRANSFERRED PROJECTS

HAND AND FOOT WARMERS FOR PATIENTS WITH RAYNAUD'S SYNDROME

BATeam Personnel: Bakki V. Kudva.

Problem

When hands and feet of patients with Raynaud's Syndrome are exposed to cold, the peripheral blood vessels go into a reflex contraction cutting off the blood supply completely. Unless protected from cold, excess tissue damage can occur. Passive insulation does not help due to impaired circulation which, unlike in normal persons, transfers very little heat from within the body.

Solution

The solution is to externally heat the hands and feet to prevent any further reduction in blood flow.

NASA Technology

Thermal laminates developed for deicing fuel cells and space suit fabrication technology will be used in the design of a lightweight, highly insulated, low energy consuming hand and foot warmers.

Principals

Dr. Don Warren, Clinical Convenience Products, Madison, WI.
Dr. Frederic Dawn, Materials Expert, NASA Johnson Space Center.

Cost to NASA

An RTOP totalling $35K was submitted in 1978. It was approved in full.

Cost Sharing

The manufacturer, Clinical Convenience Products, Inc., Madison, WI, will contribute $65K in direct costs.

Commercialization Strategy

The manufacturer will try various designs using different materials and fabrication methods in consultation with Dr. Frederic Dawn of NASA JSC. Clinical trials will be performed by the company following the one-year project. Local exposure was provided by news spots on local NBC affiliate WMTV Channel 15. The University-Industry relations department has publicized the project through its newsletter. Persons with Raynaud's syndrome have been calling in response to the publicity. The manufacturer will maintain a roster of such persons and will keep them informed through a periodic newsletter.

Final Status

This project continues to proceed according to schedule. The contract has been awarded by JSC to the co-funding manufacturer, Clinical Convenience Products, Inc. The patent waivers sought by CCP, Inc. have been granted by NASA Headquarters. Contract monitoring will be conducted by JSC, with the responsible party being Mr. Art Mandell. No further BATeam support is required at this time.

HAND AND FOOT WARMERS FOR PATIENTS WITH RAYNAUD'S SYNDROME

DESIGN OBJECTIVES:

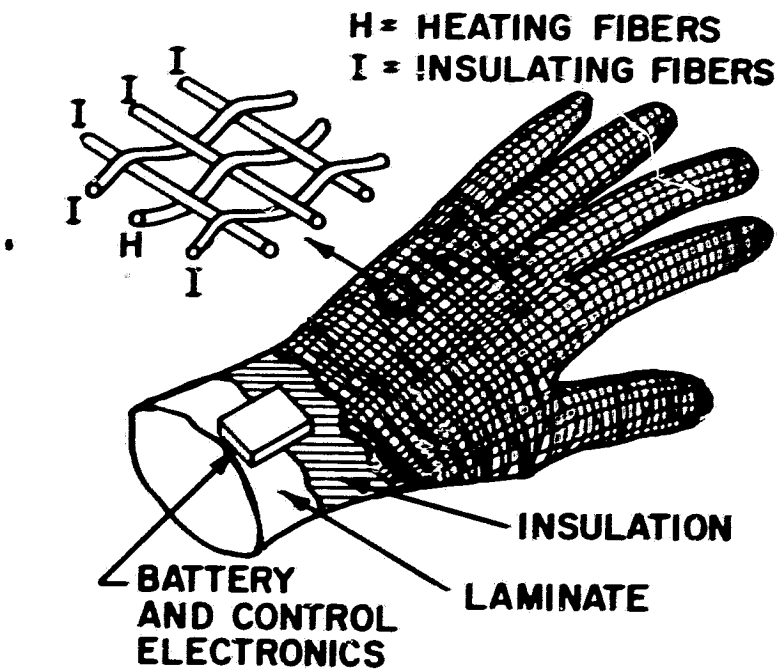
- ADJUSTABLE THERMOSTATIC TEMPERATURE CONTROL
- CONTROLLED HUMIDITY/VENTILATION
- LIGHTWEIGHT, FLEXIBLE
- COSMETIC APPEARANCE
- HIGH RELIABILITY

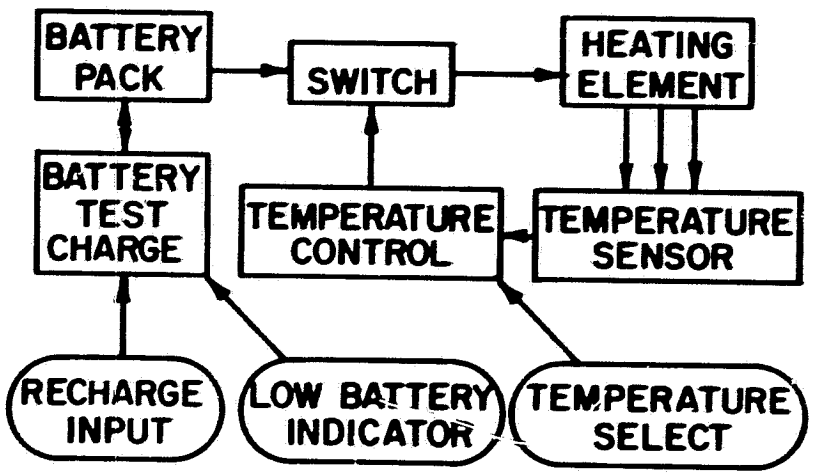
PERFORMANCE SPECIFICATIONS:

- INTERNAL TEMPERATURE 68–99°F
- MINIMUM 2 HOUR OPERATION AT 98°F GLOVE TEMPERATURE AND -20°F OUTSIDE TEMPERATURE

NASA TECHNOLOGY:

- ADVANCED INSULATION MATERIALS
- SPACE SHUTTLE FUEL TANK DEFROSTING THERMAL LAMINATES
- ANTHROPOMETRIC DATA





HYPERTHERMIA TREATMENT FOR CANCER

BATeam Personnel: Bakki V. Kudva

Problem

Because of an interest in hyperthermia as a therapeutic mode for cancer treatment, many techniques of selective heating, such as microwaves, ultrasound, convection, regional perfusion, etc., are being developed and clinically tried by many independent research groups. Due to the variety of techniques and the variables associated with different types of hardware, the results have been mixed and the validity of hyperthermia itself as a therapeutic tool is being questioned. There is a need for standardization in hardware and clinical protocols so that the data can be better understood.

Solution

Thorough analysis of literature, surveying of current techniques and subsequent application of systems theory to the established data base should help develop uniform guidelines for design, fabrication, and evaluation of hyperthermia devices.

NASA Technology

Dr. Kumar Krishen and Mr. Robert Span of Johnson Space Center, both experienced in writing "requirements documents" and specifications for space communications systems, will apply similar analytical techniques for developing hyperthermia devices.

Principals

Dr. Stehlin, Stehlin Foundation, Houston, Texas

Cost to NASA

$40K

Cost Sharing

Being negotiated with National Cancer Institute.

Commercialization Strategy

None at present.

Final Status

This project will continue as planned; management will be the responsibility of field center personnel. Projected goals include developing a joint proposal with the National Cancer Institute. Final input by the UW-BATeam included establishing contact between JSC engineers and Dr. Bhudatt Paliwal, Assoc. Prof. of Radiology and Human Oncology, at the University of Wisconsin-Madison. No further BATeam support is required at this time.

JOYSTICK DRIVING CONTROL FOR THE HANDICAPPED

BATeam Personnel: Dr. William N. Fetzner.

Problem

Being quadriplegic no longer automatically disqualifies a person from operating a motor vehicle. Along with private and other governmental agencies, the Veterans Administration has been teaching the physically handicapped, including quadriplegics, to drive for several years. During a four-year period ending September 1980, for instance, VA Drivers' Training programs taught over 500 quadriplegics how to drive specially equipped vehicles and also subsidized the purchase of their vehicles. Still, however, the vast majority of the 105,000 quadriplegics in the United States are unable to master the skills needed to operate the highly specialized equipment. New control system designs that minimize force and movement requirements, that are sufficiently simple to operate, and that will enable the handicapped driver to operate his vehicle safely are still needed.

Solution

Many investigators, including researchers at the Ford Motor Company, General Motors, foreign auto companies, domestic special vehicle manufacturers, and university and government researchers have built driving control systems that incorporated acceleration, braking and steering functions into a single system. Examples are a wrist-twist device built by Ford, a joystick control demonstrated by GM, an aircraft style approach, and the NASA lunar rover control system. None have emerged from R&D for use either by the general public or by severely handicapped individuals. Major problems identified are cost, reliability, and safe operation by drivers. Many people believe, however, that some version of a joystick control system can be developed to solve these problems and meet the need.

NASA Technology

The lunar rover vehicle, built by General Motors under contract to NASA, was used successfully by astronauts on the moon. In order to simplify controllability, the LR was operated by means of a joystick that controlled the three driving functions: acceleration, braking, and steering. The LR joystick control system has been adapted to a van for use by physically handicapped people. Initial tests were promising and the Veterans Administration has decided to fund a more intensive study of the joystick control system.

Principals

Ed Peizer, Ph.D., Deputy Director of the VA Prosthetics Center
Art Mandell, Biomedical Applications, NASA Johnson Space Center

Cost to NASA

NASA has agreed to manage and monitor a three-year project for the Veterans Administration. Costs for the project, with the exception of work by the UW-BATeam are being fully borne by the VAPC.

Cost Sharing

Phase I of the three-phase project has been estimated to cost in the neighborhood of $100K. This money will be transferred by the VA to NASA.

Commercialization Strategy

One or more contractors will be selected by NASA to carry out tasks identified in a statement of work. The final product of the work will be an operable and tested driving control system, mounted in a vehicle. It is intended that the contractor who develops and installs the hardware will be selected partly on the likelihood that he will be able to continue on with production of the system. The Veterans Administration is also eager to promote the finished concept to American auto makers. They have indicated an intention to do this personally.

Final Status

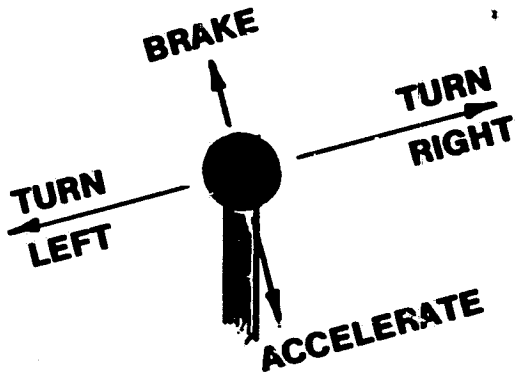
Five proposals to conduct Phase I of the 3-phase project have been received by the Johnson Space Center's Contracts Office. These are being evaluated in-house. According to one source, the selection of one of these and the completion of negotiations leading to a contract could be completed by June or July 1981. Phase I will run for six months and result in a study of needs, technologies, and optimal designs, which will become the basis for a decision on proceeding with the second phase of the project.

At the present stage of processing, no request of the BATeam for help or consultation is being made. In accordance with a prior agreement between the two Teams, a documentation package is being transferred to the RTI BATeam which will assume responsibility for monitoring this project.

LUNAR ROVER

JOYSTICK DRIVING CONTROL FOR THE HANDICAPPED

- REPLACES ACCELERATOR, BRAKE AND STEERING WITH A SINGLE CONTROL
- EASIER TO USE, SAFER, WILL ENABLE MORE HANDICAPPED PEOPLE TO DRIVE
- NASA LUNAR ROVER VEHICLE
- VETERANS ADMINISTRATION PROSTHETICS CENTER



FEB 1981

QUANTITATIVE CORONARY ARTERY IMAGING (MIPS)

BATeam Personnel: Dr. William N. Fetzner.

Problem

Many studies have been reported of attempts to assess the degree of arterial stenosis and intimal damage from radiographic images, using visual and planimetric techniques. Measurement variations between readers typically range between 15-20%. More accurate clinical assessments of atherosclerosis are needed to reduce morbidity and mortality. The problem is especially severe for coronary vessels due to the greater risk to survival and difficulties with radiographic imaging of the moving heart.

Solution

The Jet Propulsion Laboratory has shown that low-contrast images of the heart can be analyzed by digital computer to locate coronary vessel profiles. These profiles are overlaid on the image. Quantitative measures of roughness to detect lesions and tapes to quantify extensive atherosclerosis are used. A further development is to use an array processer to process the images from cineangiograms in real time. A semi-automated system is being developed for use by physicians.

NASA Technology

The Jet Propulsion Laboratory proposes to construct a Medical Image Processing System (MIPS) expressly designed to implement the above solution. The MIPS is an extension of work previously carried out by JPL under contract to NIH to automatically detect arterial contours from angiograms. Work by JPL in this area is based on its widely recognized expertise in the computer processing of images transmitted from space probes.

Principals

David H. Blankenhorn, M.D., USC School of Medicine, Los Angeles.
E. S. Beckenback, Ph.D., NASA/JPL

Cost to NASA

A short feasibility study has been approved by the Technology Transfer Division, at a cost of $30K.

Cost Sharing

DeAnza Systems of San Jose, CA has agreed to lend an array processor for the development. In addition, a three-year NIH-funded study began in 1979, with the objective being to assess the accuracy of the technique on coronary arteries. This grant will provide support for animal studies and clinical testing for an assessment of the clinical value of the MIPS.

Commercialization Strategy

Plans on this are tentative due to the newness of this project. A reasonable approach seems to be to allow time for prototype development and the acquisition of some clinical data before promoting the concept to manufacturers very diligently. Then, an attempt can be made to "fold in" an interested manufacturer so that he can proceed rapidly to commercialization once the NIH-sponsored tests are completed.

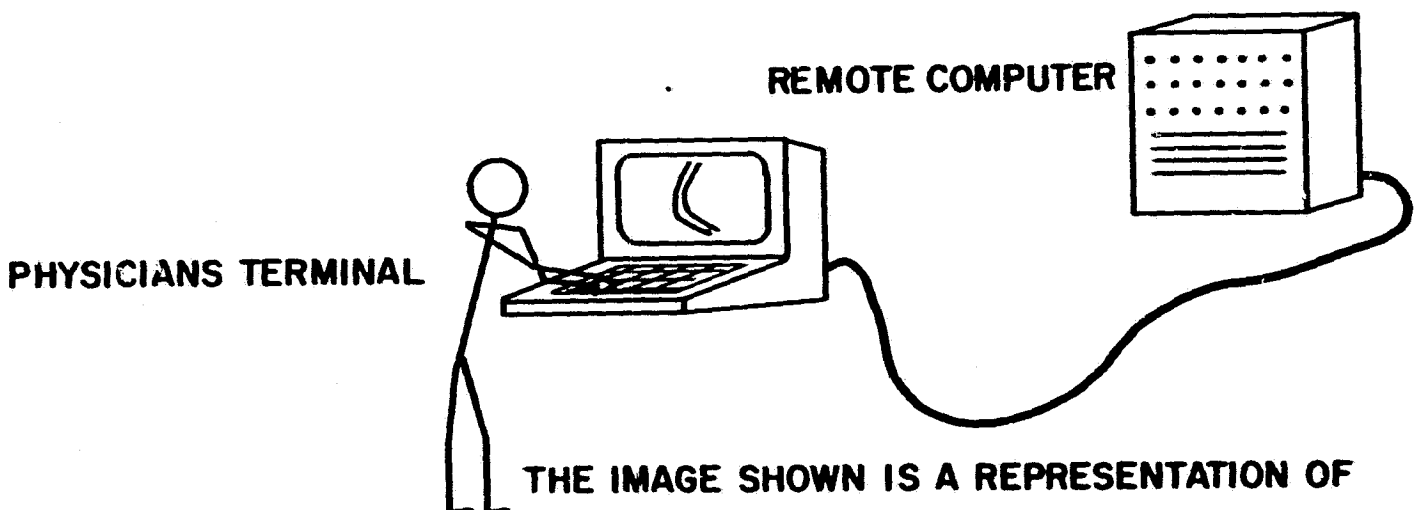
Final Status

A feasibility study of the MIPS concept was completed. It met all objectives. A market study conducted by ECON found evidence that the need is genuine although the market must be stimulated because the concept is novel. Further work on the MIPS was included in a diversified technology transfer program submitted by JPL to NASA Headquarters for research funding. Headquarters turned the request over the Civil Systems Group for their consideration. At present, JPL is preparing an amended proposal to submit to the Headquarter's Civil Systems Group. The possibilities for funding appear strong.

In accordance with an arrangement made between the two BATeams, we are preparing a documentation package for the RTI BATeam. They will assume full responsibility for ongoing BATeam monitoring of this project upon receipt of the package.

QUANTITATIVE CORONARY ARTERY IMAGING (MIPS)

- ASSESSMENT OF ATHEROSCLEROSIS AND STENOSIS FROM ANGIOGRAMS
- SEMI-AUTOMATIC, MORE ACCURATE, REPEATABLE, EFFECTIVE AT EARLIER STAGE OF DISEASE
- IMAGE PROCESSING TECHNOLOGY, DEVELOPED TO ANALYZE SPACE PROBE IMAGES AND SUPPORTED BY N.I.H. FOR MEDICAL APPLICATIONS
- U S C SCHOOL OF MEDICINE, LOS ANGELES



THE IMAGE SHOWN IS A REPRESENTATION OF THE AUTOMATIC DETECTION OF ARTERY BORDERS

SPEECH AUTOCUER

BATeam Personnel: James C. House

Problem

The ability of deaf and hearing-impaired individuals to function in a normal environment would be greatly enhanced by the availability of a means of receiving and decoding accurately speech from individuals not trained in signing or other compensatory mechanisms to assist the deaf. There are approximately 13.4 million hearing-impaired persons in the United States. The cost impact of the disabled population for increased care and loss of hearing ability is estimated to exceed $130 million annually. Manually cued speech has been shown to greatly increase the intelligibility of speech when used in conjunction with speech reading (lip reading), because it eliminates the ambiguities or multiple sounds associated with similar lip shapes. An automatic device would remove the necessity of the speaking person possessing the ability to cue speech as they talked.

NASA Technology Applicable to Solution

The successful development of the wearable autocuer requires a combination of high speed at low power integrated circuit technology developed by GSFC for use in various spacecraft applications. Due to the complexity of the autocuer, GSFC expertise in automate checkout/design verification will be exploited.

Principals

Dr. R. Orin Cornett, Research Prof. and Director, Cued Speech Program, Gallaudet College, Washington, DC.
Mr. Robert Beadles, Manager, Biomedical Engineering Dept., Research Triangle Institute, NC.
Mr. Michael Peck, GSFC.

Cost to NASA

The project was co-funded by NASA and Veterans Administration with $497,000 provided for the period August 1979 to August 1982. During the fourth quarter 1980, a six-month, no-cost contract extension was requested and received.

Commercialization

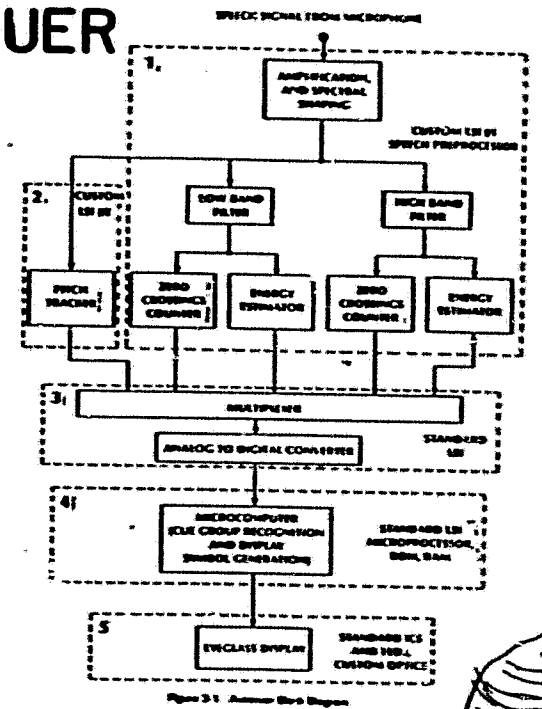
During the fourth quarter 1980, negotiations were completed and an agreement executed with Telesensory Systems Incorporated (TSI). TSI participation will begin with construction of field test units.

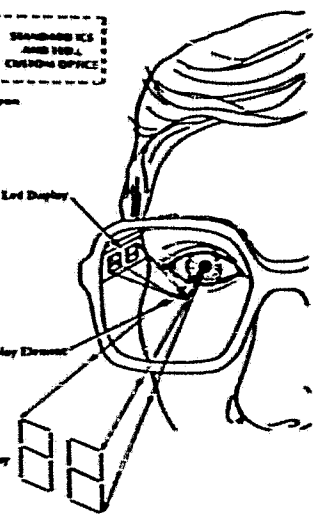
Final Status

At the present stage of development, no request of the UW-BATeam for help or consultation is being made. In accordance with a prior agreement between the two Teams, a documentation package will be prepared and transferred to the RTI-BATeam which will assume responsibility for monitoring this project.

SPEECH AUTOCUER

- MEANS TO PERMIT DEAF PERSONS TO UNDERSTAND SPEECH FROM THOSE NOT TRAINED IN SIGNING
- MINIATURE WEARABLE DEVICE TO AUTOMATICALLY PROVIDE CUES TO DEAF PERSON AND ALLOW GREATLY IMPROVED INTELLIGIBILITY
- G S F C HIGH SPEED, LOW POWER INTEGRATED CIRCUIT TECHNOLOGY
- AUTOMATIC CHECKOUT DESIGN VERIFICATION TECHNOLOGY
- GALLAUDET COLLEGE, WASHINGTON, D.C.





OTHER TOPICS

Trips and Conferences

On May 9-12, 1981, William Fetzner attended the 1981 Meeting of the Association for the Advancement of Medical Instrumentation in Washington, DC. He chaired an invited session entitled: Has Technology Transfer Come of Age? This session was organized under UW-BATeam and NASA auspices.

Moving Along

Dr. William N. Fetzner, Director of the UW-NASA Biomedical Applications Team accepted a position with the Wisconsin Alumni Research Foundation (WARF) effective May 1, 1981. He will be involved with technical evaluation of UW invention disclosures and licensing for patents.

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