09:27:26 OCA PAD AMENDMENT - PROJECT HEADER INFORMATION 05/20/91

Active

Project #: B-10-F12 Cost share #: Rev #: 1
Center # : 10/24-6-R7189-0A0 Center shr #: OCA file #:
Work type : RES
Contract#: AGMT DTD 910429 Mod #: ADMINISTRATIVE Document : AGR
Prime #: Contract entity: GTRC

Subprojects ? : N CFDA: N/A
Main project #: PE #: N/A

Project unit: OIP Unit code: 03.010.200
Project director(s):
DYER F B OOD (404)894-3539

Sponsor/division names: NCR / ATLANTA, GA
Sponsor/division codes: 263 / 011

Award period: 910429 to 910829 (performance) 910829 (reports)

Sponsor amount	New this change	Total to date
Contract value	(2,000.00)	22,416.00
Funded	(2,000.00)	22,416.00
Cost sharing amount		0.00

Does subcontracting plan apply ?: N

Title: INVESTIGATIONS OF MULTIMEDIA TECHNOLOGY & SYSTEMS

PROJECT ADMINISTRATION DATA

OCA contact: Don S. Hasty 894-4820

Sponsor technical contact

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(404)853-2937

NCR CORPORATION
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Sponsor issuing office

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NCR CORPORATION
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500 TECH PARKWAY
ATLANTA, GA 30316

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N
Defense priority rating : N/A N/A supplemental sheet
Equipment title vests with: Sponsor X GIT

Administrative comments -
REVISION ISSUED TO REDUCE CONTRACT VALUE AND FUNDED AMOUNTS BY $2,000 AS A CORRECTION OF A TYPO IN THE AGREEMENT

SR682.2

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 11/18/91

Project No. B-10-F12_____ Center No. 10/24-6-R7189-0A0_

Project Director DYER F B_____ School/Lab OIP_____

Sponsor NCR/ATLANTA, GA_____

Contract/Grant No. AGMT DTD 910429_____ Contract Entity GTRC

Prime Contract No. _____

Title INVESTIGATIONS OF MULTIMEDIA TECHNOLOGY & SYSTEMS_____

Effective Completion Date 910829 (Performance) 910829 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	N	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	N	_____
Other _____	N	_____

Comments_____
_____

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

TOUCH INTERACTION TECHNOLOGY INVESTIGATIONS

FINAL TECHNICAL REPORT

prepared for

Human Interface Technology Center
NCR Corporation

by

R. Michael O'Bannon & William E. Price

October 29, 1991

Multimedia Technology Laboratory
Office of Interdisciplinary Programs
GEORGIA INSTITUTE OF TECHNOLOGY
Atlanta, Georgia 30332

Touch Interaction Technology

In this investigation Georgia Tech looked at ways of extending the 3D touch technology already developed at Tech, and at other aspects of touch technology in general. There are several different technologies used in touch screen systems, from traditional resistive, capacitive and infrared to newer technologies like Surface Acoustic Waves. There are also other possibilities becoming available through piezoelectric, robotic and more exotic technologies. A short summary is attached discussing all of the possible technologies showing their advantages and disadvantages, as well as their potential for adaptation to a 3 dimensional surface. A bibliography of information gathered about these technologies is also attached.

The main justification of this investigation was to try and find a better way to do the touch input on NCR's kiosk. The largest problem is in the algorithms. With the current system there is not enough horsepower or data gathering bandwidth to use but a very simple algorithm. With improved hardware, it should be possible to develop a very sophisticated algorithm that takes into account such differences as the angle at which the touch was applied and the difference between touch with different pressure levels as well as the variation in the surface area of the touch (ie 1 small finger versus 3 large fingers). All of these cause some amount of error in the current system. One type of algorithm could look at the pressure waveforms of different touches and attempt to judge what type of touch it is, and then use the proper set of formula constants to try and get a close "triangulation" of the finger position. Attached are the specifications and prices of our recommended system. This system should allow us to take a closer look at how people touch the kiosk and how to best analyze that touch for a more accurate input device.

Recommended Data Acquisition Board for Touch Panel Upgrade

DAP800 Data Acquisition Processor Board

From: Microstar Laboratories
2863 152 Ave., N.E.
Redmond, Washington 98052

(206) 881-4286

Parts required:

DAP 800	1195.00
Termination Board	135.00
Cable	45.00
DAP View Option Software	95.00
Advanced Development Toolkit	295.00
Total	1765.00

Requires Microsoft C compiler.

Eight analog inputs
Multitasking operating system
lOMhz 80186 processor with 256K RAM on board
75 Khz sample rate

Touch Screen Technology Approaches

Infrared Beam Interruption

Advantages

- Ruggedness
- Transparency

Disadvantages

- Limited resolution
- Potential for high error rates
- Difficulty of installation
- High parts count (for higher resolutions)

Potential for 3-D use

- Require careful placement of IR emitters and detectors
- Difficulty with irregular objects

Capacitive Touch Sensing

Typical design

Two transparent condutive coatings are applied to either side of a glass panel,creating a capacitor. This capacitor is part of the frequency-determining circuitryof four oscillators at the corners of the panel. Touch adds body capacitance,shifting the frequency of the oscillators differentially.

Advantages

- Easy to install

Disadvantages

- Must be shielded from electrical and magnetic signals
- Reduced optical transmission

Potential for 3-D use

- Sensitive to electrical and magnetic fields in the primary device.
- Require careful placement of oscillators, generally in a rectangular array.

Resistive Membrane Touch Sensing

Typical design

Two pieces of conductive film are separated by elastic transparent dots. Voltage travels alternately along the X and Y axes, creating a uniform voltage gradient across the screen. A touch causes electrical contact. Measurement of voltage levels identifies location.

Advantages

- Straightforward installation
- Highest resolution

Disadvantages

- More succeptible to physical damage
- Reduced optical transmission

Potential for 3-D adaptation

- Moderate. Currently not immediately compatible with severe deformation requirements to accommodate irregular surfaces.
- Has potential for further development.

Surface acoustic wave (SAW)

Typical design

High frequency acoustic waves are propagated across a surface in straightlines. Interruption of the wave is detected and translated into position and area of contact.

Advantages

- Transparency
- Rugged
- High resolution
- Senses pressure as well as location

Disadvantages

- Degradation of performance due to foreign matter

Piezoelectric, pressure, or force transducer

Advantages

- Low parts count
- Transparency
- Difficulty of installation

Disadvantages

- Calibration
- Succeptibility to vibration

Potential for 3-D applications:

- Requires careful placement of acoustic emitter, reflectors and receiver. Not likely to have widespread applicability.

Robotic touch sensing

Contact closure

Point pressure transducers (piezoelectrical or resistive schemes)

"Robotic skins"
- Resistive
- Capacitive

Advantages

- Recognize need to sense over large surface area
- Recognize need to deal with irregularity of base surface

Disadvantages

- Have not recognized the need for optical transparency
- Often take advantage of space beneath the surface (inside), i.e. not thin.

Appears to have long-term potential, but no current approach is ready yet.

Alternative approaches:

Sheathing

Construction of a transparent and pliable sheath that covers the device and senses touch may be possible with current resistive membrane approach. Does not allow the user access to the internal mechanism.

Seems awkward and limited in applicability.

Optical sensing of location codes (Help Pen)

Coded areas are placed at key points on the device and sensed by an optical device similar to a bar code scanner pen.

Advantages:

- Very small bulk
- Easy of application

Disadvantages

- Reliability
- Permanence
- Density (Resolution)
- Requires user to deal with pen sensing device

Wireless help buttons

Advantages

- Ease of application

Disadvantages

- Reliability
- Density (Resolution)

Bibliography of Touch Technology Investigation

AUTHOR(S): Ronchi, L.
AUTHOR AFFILIATION: Philips SpA, Monza, Italy.
TITLE: Integrating touch control into computer-based machines.
JOURNAL: Automazione e Strumentazione.
VOLUME/PAGES: vol.38, no.9 p.177-81.
DATE/YEAR: Sept. 1990.
ISSN/ISBN: 00051284.
RECORD TYPE: Journal paper.
LANGUAGE: Italian.
CLASSIFICATION CODES: C3210B. C5610.
SUBJECT TERMS: computer interfaces. touch sensitive screens.
ABSTRACT: For years, touch control technology has offered the potential of greater machine-operator efficiency, but the process of installing a touch sensitive overlay was too expensive for most machine builders. The recent availability of fully integrated touch sensitive interface subsystems from Fluke has now eliminated time and cost barriers to designing touch control into computer based machines.

AUTHOR(S): Mitra, B.S.
TITLE: Man-machine interface adding new dimension.
JOURNAL: Telematics India.
VOLUME/PAGES: vol.3, no.10 p.56, 58-9.
DATE/YEAR: July 1990.
ISSN/ISBN: 09703934.
RECORD TYPE: Journal paper.
CLASSIFICATION CODES: B7260. C5540B.
SUBJECT TERMS: touch sensitive screens. user interfaces.
ABSTRACT: More and more attention is being paid to the man-machine interface. Touch screen technology has heralded a new dimension to the user-friendly personal computer. The four basic touch screen techniques of soft keys, surface acoustic waves, IR beams, and thin-membrane switches are described.

AUTHOR(S): Krein, P.T.; Meadows, R.D.
AUTHOR AFFILIATION: . Tektronix Inc., Beaverton, OR, USA.
TITLE: The electroquasistatics of the capacitive touch panel.
JOURNAL: IEEE Transactions on Industry Applications.
VOLUME/PAGES: vol.26, no.3 p.529-34.
DATE/YEAR: May-June 1990.
ISSN/ISBN: 00939994.
RECORD TYPE: Journal paper.
CLASSIFICATION CODES: B7260. B5110. B7230.
SUBJECT TERMS: electric fields. electric sensing devices. electrostatics. position measurement. semiconductor thin films. touch sensitive screens.
ABSTRACT: The capacitive touch panel, a high-resolution position sensor intended for computer displays, must be safe and inexpensive and must sense position accurately in spite of electrical noise, dirt, or direct electrostatic discharge. The implementation discussed uses a quasi-static electric field, applied to a semiconducting coating on the panel surface. A touch draws current from the surface. This current can be used to compute position. If the computation is performed properly, the computed position is independent of touch current and panel coating resistivity. The electroquasistatic basis for position measurement with a capacitive touch panel and a system to implement it are described.

AUTHOR(S): McClelland, D.
AUTHOR AFFILIATION: Ellinor Technol., Reading, UK.
TITLE: Developments in touchscreen technology.
JOURNAL: Displays, Technology and Applications.
VOLUME/PAGES: vol.11, no.2 p.93-5.
DATE/YEAR: April 1990.
ISSN/ISBN: 01419382.
RECORD TYPE: Journal paper.
CLASSIFICATION CODES: B7260. B2860C. C5540B.
SUBJECT TERMS: surface acoustic wave devices. touch sensitive screens. user interfaces.
ABSTRACT: The author introduces a novel touchscreen technology based on surface acoustic waves by taking advantage of the ability of glass to transmit acoustic waves, SAW touchscreens provide a z-axis component and 100% transparency, along with rugged design features.

AUTHOR(S): Fillon, M.
TITLE: Getting out of the mousetrap (PC input devices).
JOURNAL: InformationWEEK.
VOLUME/PAGES: no.261 p.36-8.
DATE/YEAR: 12 March 1990.
ISSN/ISBN: 87506874.
RECORD TYPE: Journal paper.
CLASSIFICATION CODES: D5030.
SUBJECT TERMS: touch sensitive screens. user interfaces.
ABSTRACT: A number of makers of input devices are developing a variety of systems for communicating with PCs that aim to take the concept of intuitive use to new heights. Many of the devices seek to pick up where the mouse leaves off, by providing a hand-on feel with more functionality than the few buttons on a typical mouse provide. For example, Sensor Frame is working on gesture-sensing technology that interprets hand motions, permitting the user to directly manipulate computer-generated images as if they were real objects.

AUTHOR(S): Beringer, Dennis B.
AFFILIATION: New Mexico State Univ, NM, USA.
TITLE: Target size, location, sampling point and instructional set. More effects on touch panel operation.
JOURNAL TITLE: Proceedings of the Human Factors Society.
SOURCE: Proceedings of the Human Factors Society. Publ by Human Factors Soc Inc, Santa Monica, CA, USA. p 375-379.
DATE: 1990.
ISSN/ISBN: 01635182.
RECORD TYPE: CA (Conference Paper).
CONFERENCE INFO: Proceedings of the Human Factors Society 34th Annual Meeting Orlando '90 Orlando, FL, USA 19901008-19901012.
CONFERENCE CODE: 13987.
SPONSOR(S): Cent Florida Chapter.
LANGUAGE: English.
CLASSIFICATION CODES: 722. 723. 461.
SUBJECT: COMPUTER INTERFACES. Human Factors. SYSTEMS SCIENCE AND CYBERNETICS - Man Machine Systems. HUMAN ENGINEERING - Subjective Tests. DISPLAY DEVICES - Testing. TOUCH PANELS. CENTRAL COMPOSITE DESIGN.
ABSTRACT: Accuracy of input using touch panel devices is affected by a number of variables which include device type, target size, and target location. It was also hypothesized that instructional set should influence performance. A screening experiment using a central-composite design (CCD) was conducted to further examine the effects of target position and size upon accuracy of the touch input. Results suggest that error for right-handed users is least near the resting position of the hand (lower right corner of display) and that shortest response times could also be obtained there. Variations in size were more likely to affect error in the y axis and quadratic effects were present. It was also found that although instructions requiring higher precision of input from the operator

did not substantially affect bias error, they did produce a reduction in variable error. It is recommended that for applications having established key input areas, positions along the lower and right-hand borders of the control/display unit should be used to minimize activation time and error. Use of the lower border exclusively can accomodate users with either a right-hand or left-hand preference. Some comments are also provided on the limitations which bound the interpretation of results in several studies and inferences thus drawn. (Author abstract) 9 Refs.

AUTHOR(S): Dixon, Dan; Hoehener, Remy.
AFFILIATION: Micro Switch, Freeport, IL, USA.
TITLE: Inductive prox: an old sensor with new wrinkles.
JOURNAL TITLE: Chilton's I&CS (Instruments & Control Systems).
SOURCE: Chilton's I&CS v 62 n 10 Oct 1989 p 55-58.
DATE: 1989.
ISSN/ISBN: 01640089.
RECORD TYPE: JA (Journal Article).
LANGUAGE: English.
CLASSIFICATION CODES: 732. 943.
SUBJECT: SENSORS. CONTROL, MECHANICAL VARIABLES - Position. REMOTE SENSING. PROXIMITY SENSORS. INDUCTIVE SENSORS.
ABSTRACT: A proximity sensor is a no-touch alternative to physically actuated switches. A number of proximity sensor technologies are available today including Hall-effect, reed, ultrasonic, capacitive, and inductive-each of which has its own advantages and disadvantages. This article provides an update on inductive sensor technology. Inductive technology is sometimes referred to as ECKO, an acronym for Eddy Current Killed Oscillator. Subjects covered include target and mounting considerations, proximity sensor limitations, types of products, and others.

AUTHOR(S): Cameron, A.; Daniel, R.; Durrant-Whyte, H.
TITLE: Tactile sensing and the photoelastic tactile sensor.
DATE/YEAR: 1989.
RECORD TYPE: Report.
RECORD NUMBER: OUEL 1758/89.
REPORT PUBLISHER: Univ. Oxford, UK.
CLASSIFICATION CODES: C3240. C3390.
SUBJECT TERMS: photoelasticity. robots. tactile sensors.
ABSTRACT: The report consists of two papers describing research performed in the field of tactile sensing for robotics applications within the Robotics Research Group. Both papers make reference to the photoelastic tactile sensor, which has been developed within the group to aid with research into various aspects of tactile sensing. The first paper, 'Tactile Geometry for Images and Normals', provides an overview of currently available tactile sensors, and discusses their limitations. The second paper, 'Touch and Motion', develops

mathematical models to describe the mechanisms of the photoelastic tactile sensor. These models are necessary to determine the relation between the data provided by the sensor and the sensed environment, and hence to reconstruct the environment from the sensory output.

AUTHOR(S): Gungl, K.P.
AUTHOR AFFILIATION: IBM Lab. E+F, Boeblingen, West Germany.
TITLE: Computer interface and touch sensitive screens.
JOURNAL: Proceedings. VLSI and Computer Peripherals. VLSI and Microelectronic Applications in Intelligent Peripherals and their Interconnection Networks (Cat. No.89CH2704-5).
VOLUME/PAGES: p.2/98-100.
DATE/YEAR: 1989.
ISSN/ISBN: 0818619406.
RECORD TYPE: Conference paper.
PUBLICATION INFO: Washington, DC, USA: IEEE Comput. Soc. Press.
CONFERENCE INFO: Hamburg, West Germany 8-12 May 1989.
CLASSIFICATION CODES: B7260. C5540B.
SUBJECT TERMS: touch sensitive screens. user interfaces.
ABSTRACT: The motivation for the use of touch screens is presented. Aspects of their specific human factors are discussed. An overview of current touch-screen technologies is given, including resistive membranes, capacitive panels, LED arrays, and piezoelectric touch panels. The implementation of the piezoelectric touch technology used in the IBM 4737 self-service banking machine is illustrated.

AUTHOR(S): Qin Jirong.
AUTHOR AFFILIATION: Shanghai Inst. of Mech. Eng., China.
TITLE: On-line measurement of length and automatic classification of objects.
JOURNAL: Proceedings of 2nd IMEKO TC14 International Symposium on Metrology for Quality Control in Production (Extended Abstract) ISMQC/IMEKO 89.
VOLUME/PAGES: p.129-33.
DATE/YEAR: 1989.
ISSN/ISBN: 0080375154.
RECORD TYPE: Conference paper.
PUBLICATION INFO: Beijing, China: Int. Acad. Publishers.
CONFERENCE INFO: Beijing, China 9-12 May 1989.
CLASSIFICATION CODES: B7320C. B7210B. B7230C. C3350. C7410H. C3240D. C3120C.
SUBJECT TERMS: computerised instrumentation. computerised pattern recognition. length measurement. microcomputer applications. photodetectors.
ABSTRACT: Photoelectric non-contact method is one of many on-line measuring methods. Because the instrument does not touch the detected object, the former does not affect the working condition of

the latter, and vice versa. Hence, the photoelectric detecting method is very suitable for on-line measurement. The author discusses three aspects: on-line length measurement with a microcomputer; the detected objects into M groups according to length; and automatic classification of measures to improve the precision of on-line measurement.

AUTHOR(S): Adler, Robert; Desmares, Peter J.
AFFILIATION: Zenith Electronics Corp, Glenview, IL, USA.
TITLE: SAW TOUCH SYSTEMS ON SPHERICALLY CURVED PANELS.
JOURNAL TITLE: Ultrasonics Symposium Proceedings.
SOURCE: Ultrasonics Symposium Proceedings 1986. Publ by IEEE, New York, NY, USA. Available from IEEE Service Cent (Cat n 86CH2375-4), Piscataway, NJ, USA p 289-292.
DATE: 1986.
ISSN/ISBN: 00905607.
RECORD TYPE: CA (Conference Paper).
CONFERENCE INFO: IEEE 1986 Ultrasonics Symposium - Proceedings. Williamsburg, VA, USA 19861117-19861119.
CONFERENCE CODE: 10043.
SPONSOR(S): IEEE, Ultrasonics, Ferroelectrics & Frequency Control Soc, New York, NY, USA.
LANGUAGE: English.
CLASSIFICATION CODES: 752. 751. 722.
SUBJECT: SURFACE MOUNT HYBRID. ACOUSTIC SURFACE WAVE DEVICES. Applications. SURFACE WAVES - Absorption. DISPLAY DEVICES. COMPUTER PERIPHERAL EQUIPMENT - Graphics. TOUCH SYSTEMS. SAW ABSORPTION.
ABSTRACT: A touch system uses SAW absorption to locate a touch and determine finger pressure. Reflector arrays along the edges direct SAW pulses along three-segment paths linked by two right angle turns. On curved surfaces, SAWs travel along great circles. Great circles do not necessary intersect at right angles. The authors present several solutions to remedy this problem. The first places the two arrays on great circles but modifies reflector orientation and spacing to achieve the required reflection angles. A second solution uses arrays with a transverse phase velocity gradient which forces the SAW to follow a parallel rather than a great circle, thus restoring the right angle turns. A third solution takes advantage of the waveguide action of the reflector arrays to achieve a similar result. 1 ref.

AUTHOR(S): Benel, R.A.; Stanton, B.C. Bullinger, H.-J.; Shackel, B.; Kornwachs, K.
AUTHOR AFFILIATION: IBM Federal Syst. Div., Rockville, MD, USA.
TITLE: Optimal size and spacing of touch screen input areas.
JOURNAL: Human-Computer Interaction - INTERACT '87. Proceedings of the Second IFIP Conference.
VOLUME/PAGES: p.581-5.
DATE/YEAR: 1987.
ISSN/ISBN: 0444703047.
RECORD TYPE: Conference paper.
PUBLICATION INFO: Amsterdam, Netherlands: North-Holland.
CONFERENCE INFO: Stuttgart, West Germany 1-4 Sept. 1987.
CLASSIFICATION CODES: C5540B.
SUBJECT TERMS: human factors. interactive systems. standards. touch sensitive screens. user interfa.
ABSTRACT: Touch sensitive displays have usually been implemented as the simple interface to menu systems in information kiosks, but have the potential for use as the main interface to complex systems. The human factors necessary to design and optimal touch sensitive human-computer interface have not been derived from an extensive base of empirical research. The available standards appear to have been developed originally for mechanical pushbutton switches. Two experiments were designed to evaluate the adequacy of the current standards for defining the size and spacing of the touch areas. The irst experiment employed a Fitt's Law paradigm to evaluate distance, size and touch accuracy. The second employed a telephone-type touch entry keypad allowing input speed and accuracy to be evaluated with the differing size and spacing. Active touch areas were manipulated in conjunction with the variations in size and spacing. The results of these experiments are compared to the existing standards and the validity of the current standards are discussed.

AUTHOR(S): Weber, G. Bullinger, H.-J.; Shackel, B.; Kornwachs, K.
AUTHOR AFFILIATION: Inst. fur Inf., Stuttgart Univ., West Germany
TITLE: Gestures as a means for the blind to interact with a computer.
JOURNAL: Human-Computer Interaction - INTERACT '87. Proceedings of the Second IFIP Conference.
VOLUME/PAGES: p.593-5.
DATE/YEAR: 1987.
ISSN/ISBN: 0444703047.
RECORD TYPE: Conference paper.
PUBLICATION INFO: Amsterdam, Netherlands: North-Holland.
CONFERENCE INFO: Stuttgart, West Germany 1-4 Sept. 1987.
CLASSIFICATION CODES: C5540B. C7890.
SUBJECT TERMS: handicapped aids. interactive systems. touch sensitive screens. user interfaces.
ABSTRACT: A new input channel in man-computer communication especially for blind computer users is opened. Fingers are used to form gestures on a touch sensitive input device. An implementation in a computer-aided dialogue to recognize gestures is described.

AUTHOR(S): Kumar, K.; Gandher, S.P.; Verma, M.K.
AUTHOR AFFILIATION: Small Ind. Service Inst., Bhiwani, India.
TITLE: Role of sensors in robot intelligence.
JOURNAL: CSIO Communications.
VOLUME/PAGES: vol.14, no.1-4 p.45-54.
DATE/YEAR: Jan.-Dec. 1987.
ISSN/ISBN: 03049841.
RECORD TYPE: Journal paper.
CLASSIFICATION CODES: C3355. C3240. C3390. C3320.
SUBJECT TERMS: artificial intelligence. computer vision. distance measurement. industrial robots. tactile sensors. torque measurement.
ABSTRACT: The authors discuss the developments of 'smart', 'intelligent', and 'adaptive' robots by artificially developing a sensory system of touch, hear and sight. They describe different types of sensors including touch sensors, torque sensors, proximity detectors, range finders, vision sensors etc.

AUTHOR(S): Adler, Robert; Desmares, Peter J.
AFFILIATION: Zenith Electronics Corp, Glenview, IL, USA.
TITLE: SAW TOUCH SYSTEMS ON SPHERICALLY CURVED PANELS.
JOURNAL TITLE: Ultrasonics Symposium Proceedings.
SOURCE: Ultrasonics Symposium Proceedings 1986. Publ by IEEE, New York, NY, USA. Available from IEEE Service Cent (Cat n 86CH2375-4), Piscataway, NJ, USA p 289-292.
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CLASSIFICATION CODES: 752. 751. 722.
SUBJECT: SURFACE MOUNT HYBRID. ACOUSTIC SURFACE WAVE DEVICES. Applications. SURFACE WAVES - Absorption. DISPLAY DEVICES. COMPUTER PERIPHERAL EQUIPMENT - Graphics. TOUCH SYSTEMS. SAW ABSORPTION.
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