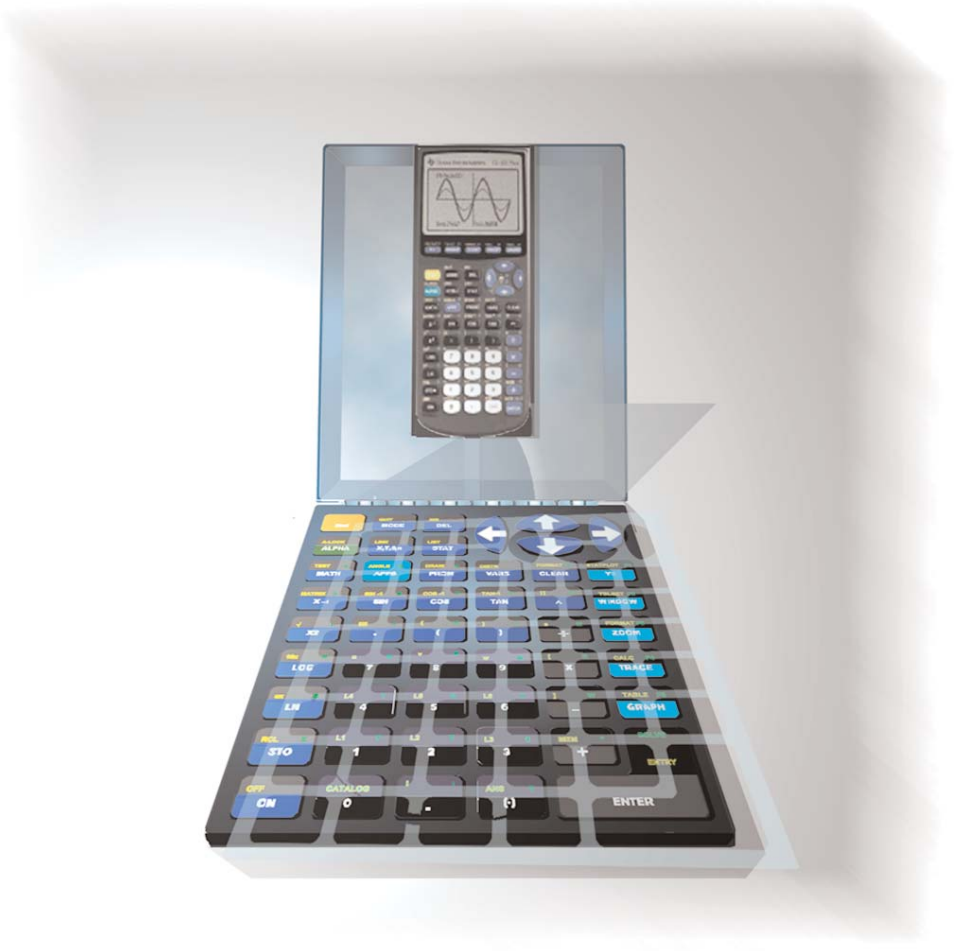
T² RERC

REHABILITATION ENGINEERING RESEARCH CENTER ON TECHNOLOGY TRANSFER

EXPANDED KEYBOARD



In Cooperation With:

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University at Buffalo

AZ*tech*

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National Institute on Disability and Rehabilitation Research

ACKNOWLEDGEMENT
This is a publication of the Rehabilitation Engineering Research Center on Technology Transfer, which is funded by the National Institute on Disability and Rehabilitation Research of the Department of Education under grant number H133E980024. The opinions contained in this publication are those of the grantee and do not necessarily reflect those of the Department of Education.

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Section A

Executive Summary

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EXECUTIVE SUMMARY

Product Description

The Expanded Keyboard is an external keyboard attachment for Texas Instrument calculators with internal Flash ROM (currently the TI-73, TI-83 Plus, and TI-89 models). It is an enlarged, lightweight, independently powered replica of the keyboard face of these calculators. The Expanded Keyboard is directly connected to the calculator through the calculator's serial port. It is designed primarily for middle school, high school, and college students who lack the fine motor skills to independently operate Texas Instrument graphing/scientific calculators.

Key Features

- Enlarged key size reduces an individual's need for fine motor control
- Tilt adjustable cover to improve display visibility
- Lightweight with physical dimensions similar to a laptop computer to ensure portability
- Battery powered operation
- Development support available from Texas Instruments Inc.

Target Markets

The Expanded Keyboard is targeted primarily at students, who lack the fine motor control skills necessary to operate a standard TI scientific calculator, but wish to take courses in chemistry and mathematics. People who would benefit from the Expanded Keyboard have disabilities including arthritis, cerebral palsy, multiple sclerosis, Parkinson's disease, and carpal tunnel syndrome. Professionals in science, mathematics, engineering, and business fields, who have acquired fine motor control limitations through illness or aging, provide a secondary market for the Expanded Keyboard. These professionals run statistical, regression, and graphical analyses, as well as complex financial and engineering calculations

Market Projections

The total potential market for the Expanded Keyboard, including both students and professionals, is projected to be over 1 million people who have fine motor control limitations. If in a given year, 3% (31,374) of the 1,045,800 consumers purchased the Expanded Keyboard, the potential annual sales, based on a conservative selling price of $125, would be $3,921,750. A manufacturer may choose to sell this product for 1/3 the price. Potential annual sales for the manufacturer of the Expanded Keyboard are projected to be about $1,333,395. Additional sales to educational and business facilities at the large-volume level would increase this sales estimate significantly.

Purchase Intent - Price Point

In focus groups and surveys conducted by the T^2 RERC, 100% of panelists stated they would purchase or recommend the purchase of the Expanded Keyboard at a competitive price between $100 and $150. This unusually large acceptance rate indicates a high likelihood of commercial success.

Section B

Overview

- **Background**
- **Current Situation**

Background

Public Law 94-142 in the Individuals with Disabilities Education Act provides a free and appropriate education for all children with disabilities in schools by setting minimum standards and regulations on how to place a student into the least restrictive environment possible. A committee on special education evaluates the child with a disability that is entering a school. This committee develops an Individual Education Plan (IEP) that outlines classes, therapies, and equipment to assist the student. This plan is monitored and periodically reviewed to ensure that the student's needs are met.

If assistive equipment is identified in the IEP, it then becomes the responsibility of the school to see that the appropriate assistive devices and assistance are provided. These decisions are made by the parents, advocates, therapists, and teachers, who review the student's progress and needs.

In some cases, colleges, universities, and private schools are subject to a similar process, but are regulated by Public Law 93-112 section 504 and the Americans with Disabilities Act in the provision of assistive technologies and services.

The Baby Boom population is aging, so consequently the professional workforce is also aging. People age into disabilities through illness and injury, and such disabilities may affect the older worker's ability to perform their job. Assistive devices are increasingly being used to maintain a valued employee's productivity and to protect the firm's investment in human resources.

Current Situation

To assess current calculator use, we conducted two focus groups, which included students, teachers, teaching assistants, and occupational therapists. During open discussion in our consumer focus groups, all of the panelist members stated that they believed students are never willfully excluded from taking a specific course due to a lack of fine motor control skills. Each member of the group, however, knew of situations, on both the high school and college level, in which students were dissuaded from taking a class because it would be difficult for them to meet the course requirements.

Students need computational and graphing calculators for course work in mathematics, chemistry, accounting, and Business (quantitative math). Schools will provide standard calculators for student use in most cases. If a student is unable to operate a calculator, a teaching assistant works with the student to operate the calculator for them. Students are not allowed to take school calculators home with them. If the calculator is not an accessible version, aides will set time aside during the school day or directly after school to assist students with their homework. However, this is not comparable to full-time access.

Purchases of accessible equipment are paid for through funds allocated in the school budget or alternative sources such as state vocational agencies. High school personnel said that the local School Board would authorize the purchase of accessible equipment for their schools. Colleges would request authorization from the Department Chair or the Dean of the school.

Focus group participants suggested that students first use calculators in fifth or sixth grade, with scientific calculators coming into play when algebra and graphic functions are introduced in high school.

The most common brand of scientific calculator used is the Texas Instrument (TI 83), followed by the Casio line, and a more difficult to operate Hewlett Packard. All participants stated that square roots, graphic functions, linear equations, matrices, etc., are tasks usually performed on these calculators.

The participant responses varied on how often calculators are used. Some estimated calculator use at a minimum of a few minutes a day in class, while others cited a significant portion of class time designated for calculator use, as students progress in their studies. Teachers use class time to instruct students on how to use the calculators. Some teachers only spend a minimal amount of time for instruction, while others spend a significant amount of time (if the calculator is used often and for more difficult coursework). Still others mentioned that they spend a few days early on in the course for calculator use instruction and then teach new functions as the course work progresses.

All focus group participants were familiar with alternative approaches to direct calculator use. In some classrooms, a teacher's aide may assist the student with calculator use. Other participants mentioned the possibility of students using a calculator with larger keys, or an alternative interface (finger pointer). Some mentioned potential computer software development that would accommodate a student's disability.

All participants agreed that alternative approaches to the student using the calculator independently worked to some degree. Some participants, however, had concerns about the practices currently in place, such as:

- the assistant might not understand what the student is asking him/her to enter;
- the student with the disability has to verbalize his/her thoughts;
- the student has to come in for extra help after class time ;
- self-esteem is lowered by relying on assistants or on other students for help.

Section C

Expanded Keyboard Technical

- Device Description
- Ergonomics
- Environmental Factors
- Additional Product Features
- Keyboard Features Needed By Consumers
- Texas Instrument Calculators Using Flash ROM
- Hardware and Software Considerations
- Power Supply
- Development Support from TexasInstruments, Inc.

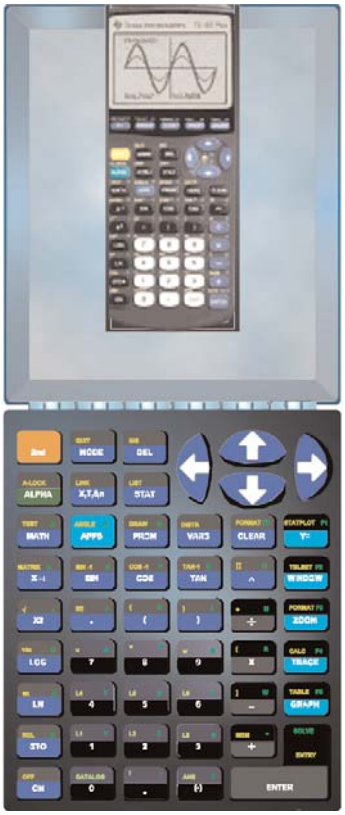
Device Description

The Expanded Keyboard is an external keyboard attachment to TI calculators having internal Flash ROM (TI-73, TI-83 Plus, and TI-89). The Expanded Keyboard is an enlarged, lightweight, and independently powered replica of the calculator's keypad directly connected to the serial port of the calculator. The Expanded Keyboard meets the needs of middle school, high school, and college students, as well as professionals, who lack the necessary fine motor skills to independently operate a standard calculator keypad.

Ergonomics

Persons in the target markets are often characterized as having reduced fine motor control. They also express a broad range of other physical (e.g., strength, reach, endurance, etc.), sensory (e.g., vision, hearing, tactile, proprioception, etc.), and cognitive abilities (e.g., memory, abstract thinking, etc.). In order to meet the needs of these target markets minimally, the keyboard must:

- Be operable with low force.
- Be operable with low precision operations.
- Be intuitive to operate.
- Be easy to learn to use (during initial operation).
- Provide appropriate visual, auditory and tactile cues.
- Provide appropriate visual, auditory and tactile feedback.
- Accommodate right- or left-handed access and use.



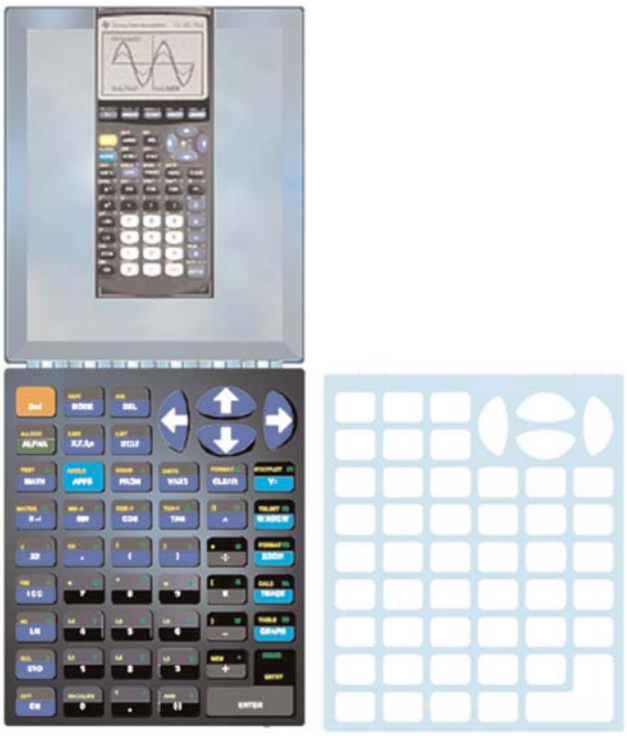
Environmental Factors

The Expanded Keyboard will be used on desktop tables, wheel chair trays, the user's lap, and in reclined positions (e.g., in bed, chair, or on the floor).

The surfaces on which the keyboard will be used may be relatively small (e.g., wheelchair tray, lap). Surface texture may be slippery (e.g., vinyl, hardwood, wet or polished surfaces). The keyboard should have rubber feet to reduce slippage during use.

The user will be within easy reach of the calculator. All labels and the display must be easily visible at this distance.

The light may be low or occluded due to the position of the light source in a room, relative to the calculator and person using the calculator. Light may shine on the Expanded Keyboard with a high incidence angle, potentially causing glare. This suggests that the Expanded Keyboard surface should use high-contrast colors with matte finish.

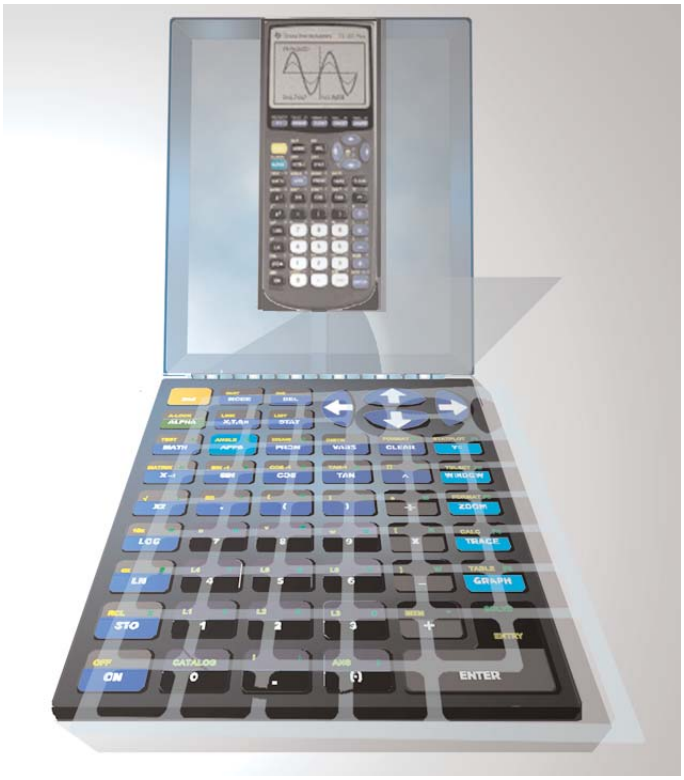


Multiple users may use the Expanded Keyboard, so it must be easy to clean. The keys and electronics should be sealed to prevent damage from cleaning solvents. Cracks and "dirt traps" should be avoided on the keyboard.

The keyboard labels should be undamaged by hot water, cleaning solvents and frequent use. The keyboard should also not have any sharp or pointed edges. Both the calculator and the Expanded Keyboard should resist damage due to falls.

Additional Product Features

There are a number of additional design features that are important to the performance, maintenance, durability, portability, and safe use of the Expanded Keyboard and docked calculator. These features include the hinged cover, keypad overlay, sealed membrane switches, non-slip base, cover latch, and carrying handle. These design features do not directly impact the usability of calculator through the Expanded Keyboard. These features are important for market acceptance nonetheless. A product that is not durable or easily cleaned, for example, cannot be successful in a harsh educational setting.



Expanded Keyboard features are summarized in Table 1.

Texas Instrument Calculators Using Flash ROM

Flash Read-Only-Memory (Flash ROM) is a programmable, non-volatile storage media for data and program code. Modern Texas Instruments calculators (TI-73, TI-83 Plus, TI-89) use Flash ROM to store Operating System Code. Operating system functionality can be extended by downloading additional code segments into the Flash ROM from a PC via the calculator's external port.

In the current application, the TI Operating System would be augmented to allow the calculator and Expanded Keyboard to communicate with each other and to access the built-in functions of the calculator. All featured TI graphing calculators that will be used with the Expanded Keyboard have Flash-ROM. The TI-83 Plus calculator utilizes the popular Zilog Z-80™ microprocessor.

Hardware and Software Considerations

The hardware and software to be developed has two principal functions: First, to provide communication between the Expanded Keyboard and the TI Flash ROM calculator; Second, to provide access to the calculator functionality normally accessed through the standard calculator keypad.

The Keyboard electronics hardware is likely to include the key switch matrix, micro-controller, communication interface hardware, power supply electronics and power level indicator. Keyboard software will mediate key press detection, key press coding, handshaking, and communication. Expanded Keyboard hardware and software development will depend upon the interface parameters (e.g., voltages, currents, timing, etc.) and communication protocols of the calculator and the performance characteristics of the external hardware components (e.g., type of micro-controller and key switch matrix).

Software downloaded onto the calculator's Flash ROM will mediate port polling, handshaking, key press decoding (from Expanded Keyboard), and emulate standard keypad functionality. Software development for the TI calculator will depend upon its operating system implementation and hardware characteristics (e.g., port, Flash ROM access, etc.).

Power Supply

Batteries are utilized as the power source for the built-in electronics of the Expanded Keyboard. A low battery indicator is provided on the keyboard for the power source. Keyboard control and communication electronics should have very low power consumption. Power Consumption and battery technology should be matched so that the keyboard can run at least as long as the calculator does before battery replacement is required.

Development Support from Texas Instruments Incorporated

Technical support from Texas Instruments is critical to the successful development of the Expanded Keyboard. Texas Instruments has verbally committed to the following:

- **Provide TI 83 - Plus Operating System Source Code**
  Operating system modifications are required for the Expanded Keyboard in order to communicate with the calculator and emulate standard keypad functionality.

- **Provide TI 83 - Plus Debugger/Simulator**
  Simulation and debugging capabilities support the rapid development and testing of the modified calculator operating system and communication software. The TI 83 Debugger/Simulator runs on a PC platform.

- **Provide Professional Development Kit/Developer's Certificate (free)**
  The Professional Development Kit provides the best-possible software development environment. The kit provides a hardware and software interface to the calculator. This interface is needed to in order to download software onto the calculator's Flash ROM. The kit also provides the "developer identification" necessary to download any application onto the calculator Flash ROM. The Cost of the Professional Development Kit is normally $300.

- **Provide electrical, communication and handshaking parameters for the calculator's communication port**
  These parameters are essential for the both hardware and software development.

- **Provide technical point of contact**
  TI staff will assist in resolution of specific design problems.

The hardware, operating system, port parameters, and communication protocols vary somewhat across the four TI Flash ROM calculators. The TI-83 Plus is by far the most common of these calculators. Hardware and software developed for the TI-83 Plus will require some modification in order to be ported to the other TI calculator platforms.

Section D

Marketing Potential

- Target Market
- Market Projections
- Market Growth
- Competing Products & Manufacturers
- Opportunity for the Expanded Keyboard
- Marketing Strategy
- Sales Projection

TARGET MARKET

The Expanded Keyboard for the Texas Instruments TI-73, TI-83 Plus, and TI-89, is designed primarily for middle school, high school, and college students who lack the fine motor skills to independently operate these graphing/scientific calculators. This includes people with arthritis, cerebral palsy, multiple sclerosis, Parkinson's disease, and carpal tunnel syndrome. By allowing him/her to operate the graphing/scientific calculator independently, the student will effectively learn to use the calculator and be able to fully participate in class activities involving the calculator. This creates the opportunity for the student to explore new subjects, such as higher mathematics and sciences, requiring the use of a graphing and/or scientific calculator.

Professionals in the fields of science, mathematics, engineering, and business who have fine motor control limitations provide a secondary market for the Expanded Keyboard. These professionals frequently run statistical, regression, and graphical analyses, as well as complex financial and engineering calculations. Professionals who must perform such calculations find not being able to effectively use a standard scientific/graphing calculator a hindrance on their work. The Expanded Keyboard makes several standard Texas Instrument graphing/scientific calculators accessible to these individuals.

MARKET PROJECTIONS

The total potential market for the Expanded Keyboard, including both students and professionals, is projected to be over 1 million people with fine motor control limitations.

Students

As of 1999, there were 22 million students in grades 7-12[3], with 224,000 high school (grades 9-12) and 105,000 middle school (grades 7 and 8) students having some form of disability affecting fine motor skills[4]. The U.S. Department of Education estimates that 99.6% of high school and 35.4% of middle school students take mathematics and/or science courses beyond the basic level[5], making the potential market among these students approximately 260,000.

There were approximately 92,000 students in undergraduate and 9,200 students in graduate/first professional programs[6] with motor skill limitations as of 1996[7]. Of all

[3] U.S. Department of Education, National Center for Education Statistics, Statistics in Brief, April 1999.
[4] U.S. Department of Education, National Institute on Disability and Rehabilitation Research, *Disability Statistics Report*, Disability in the United States: Prevalence and Causes, 1992. Table 6a, PP.90-94.
[5] U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress, The 1994 High School Transcript Study Tabulations. Table 138.
[6] U.S. Department of Education, National Center for Education Statistics, "The 1995-96 National Postsecondary Student Aid Study."

disabled students, 27.9% of Undergraduate and 20.6% of Graduate and First-Professional students studied Business/Management, Engineering/Computer Science, and Life/Physical Sciences[8]. This brings the total potential graphing/scientific calculator market for the higher educational levels to about 27,600 students with fine motor control limitations.

Professionals

According to the National Institute on Disability and Rehabilitation Research, there were more than 16 million people with disabilities employed in the United States in 1998[9]. Of people with disabilities affecting fine motor skills, approximately 758,200 worked in occupations utilizing scientific and/or graphing calculator capabilities.[10]

MARKET GROWTH

Between 1986 and 1996 the percentage of students with disabilities in regular classrooms increased by nearly 20 percentage points[11]. With the recent push by the Individuals with Disabilities Education Act (IDEA) for the inclusion of students with disabilities in general education classrooms[12], the number of students who would be required to have access to a graphing/scientific calculator is expected to increase in coming years.

It is expected that by increasing access to certain course subjects requiring the use of graphing/scientific calculators, the number of people with fine motor control limitations who will be able to enter professional fields requiring the use of a graphing and/or scientific calculator will expand as well.

COMPETING PRODUCTS AND MANUFACTURERS

There are no accessible scientific/graphing calculators currently on the market. However, there are products encompassing scientific calculator capabilities for persons who are blind or have low vision. Computerized calculator programs and web sites are also available, but are difficult to utilize when portability is an issue. Standard, scientific and/or graphing calculators are available from Texas Instruments, Hewlett Packard, and Sharp Electronics, but generally have small buttons, making them hard for a person with limited fine motor control to use without assistance. There are also several standard (no graphing or scientific capability) calculators on the market with large screens and/or keypads.

7 U.S. Department of Education, National Institute on Disability and Rehabilitation Research, *Disability Statistics Report*, Disability in the United States: Prevalence and Causes, 1992. Table 6a, PP.90-94.
8 U.S. Department of Education, National Center for Education Statistics, "The 1995-96 National Postsecondary Student Aid Study."
9 U.S. Department of Education, National Institute on Disability and Rehabilitation Research, "Chartbook on Work and Disability in the United States, 1998". Section 2. www.infouse.com/disabilitydata/workdisability_2_7.html
10 U.S. Department of Education, National Institute on Disability and Rehabilitation Research, "Chartbook on Work and Disability in the United States, 1998". Section 2. www.infouse.com/disabilitydata/workdisability_2_7.html
11 U.S. Department of Education, Office of Special Education Programs, Data Analysis Systems. nces.ed.gov/pubs99/condition99/Indicator-20.html
12 ACCESS ERIC, U.S Department of Education's Office of Educational Research and Improvement, "The ERIC Review," Volume 4, Number 3, Fall 1996.

Adaptive Calculator Units

The VisAble Scientific Calculator, from Betacom Corporation, is an oversized scientific calculator with a large screen and keypad[13]. Although specifically designed for people with low vision, the larger keypad buttons and screen make it accessible for people with other disabilities. This product does not perform graphing calculator functions. It is available for $295.

Notex is a portable Braille note-taking device and comes with a built in scientific calculator, but has no graphing capability. This device is portable with a rechargeable battery. It is available from Adhoc Reading Systems for $5800-7900. TFI Engineering has a voice output notebook computer designed with an IBM screen reader and Braille mode translator. The unit's personal organizer includes a scientific calculator, without graphing capability. This unit sells for $1995.

The American Printing House for the Blind offers a scientific calculator program designed to provide scientific functions with voice output. This product does not have graphing capabilities. It is available for $36.00.

Braille 'n Speak and the Braille Lite product line are all available from Blazie Engineering. These units feature scientific calculator capabilities, but no graphing capabilities. Prices range from $1299 to $5495. Blazie also sells graphics programs called Graph IT and Graph IT PC for the Braille 'n Speak, as well as regular PCs, for $49.

Screen Emulator Programs

Screen emulation software programs for graphing calculators are available for the TI-82, TI-83, TI-83 Plus, and TI-86. All the features of the hand-held versions are found in these screen emulators. These programs can be downloaded for free from several internet sites in both PC and Mac compatible versions. Emulators can also be purchased as part of a CD ROM package called Interactive Math series from Houghton-Mifflin for $30.57 each.

Windows and Macintosh both come with scientific calculator programs, which are available from the accessories menu. These programs can run in both standard and scientific modes. Power Macintosh computers also come with a graphing/scientific calculator program (NuCalc).

WozGraph, a mathematics utility with graphing capabilities, is available for download. This utility does not have the full range of scientific capabilities. The program is Win95/98/NT compatible.

13 www.betacom.com

UCALC, another downloadable program, supports graphing and scientific calculations. The Windows 95 formatted version is available as shareware, and is $40 if purchased.

MathPad is a graphing/scientific calculator for the Macintosh. It uses a text window rather than simulating buttons on a hand held calculator. This program runs on a Mac 68020 or better (including PowerPC native). System 7.0 or higher is required.

Calctalk is a voice output and large print program that changes an Apple computer into a 24-function calculator. Scientific (but not graphing) functions are included, along with voice output. The program is available from GW Micro Inc. for $95.00.

Overlays

Intellikeys offers overlays using their Intellipics and an overlay maker via computer printer for attachment on their Intellikeys keyboard. Software purchasing and licensing fees for producing picture overlays are $69.95 for singles and $299 for five packs with up to 50 additional for multiple users.

Many overlays are homemade by the therapist via someone with access to a drill press. The therapist has holes drilled through a plastic sheet and this is laid over the keyboard or face of the communication device used by the client. The holes are positioned over the keys or buttons and the sheet is secured to the device.

OPPORTUNITY FOR THE EXPANDED KEYBOARD

Based on our research and contact with consumers through focus groups and surveys of a representative sample of our target markets, it is apparent that the Expanded Keyboard excels in meeting the needs of calculator users with fine motor control limitations.

There are currently no calculator accessories that are able to perform the functions of the Expanded Keyboard for a scientific/graphing calculator. Based on the uniqueness of this product, as well as the overwhelmingly positive response from consumers, it is evident that there is a significant opportunity for the Expanded Keyboard to capture a large portion of the projected market.

MARKETING STRATEGY

The best retail outlets in which to feature the Expanded Keyboard for individual sale would be in those places where compatible Texas Instrument Graphing Calculators are currently sold.[14] Retail stores such as Office Depot, Office Max, Staples, Circuit City, Service Merchandise, Radio Shack, Kmart, and Wal-Mart would be most appropriate, as they are widespread distribution outlets.

[14] www.ti.com/calc/docs/buygraph.htm

For sales at the larger volume level, such as to schools, the Expanded Keyboard should be sold through the same outlets that are used for traditional instructional products. It is assumed that if a school is going to buy this product for its students, the purchase will be going through a procurement department, making this outlet the most likely to attract large-volume orders.

SALES PROJECTION

In focus groups and surveys conducted by the Technology Transfer RERC, 100% of panelists stated they would purchase or recommend the Expanded Keyboard at a competitive price, between $100 and $150.

If in a given year, 3% (31,374) of the 1,045,800 potential consumers purchased the Expanded Keyboard, the potential annual sales, based on a conservative selling price of $125, would be $3,921,750. A manufacturer may sell this product for 1/3 the price. Potential annual sales for the manufacturer of the Expanded Keyboard are projected to be about $1,333,395. Additional sales to educational and business facilities at the large-volume level would increase this sales estimate significantly.

Section E

Consumer Focus Groups

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The T^2 RERC held two consumer focus groups on the Expanded Keyboard. The groups were comprised of a cross section of potential users - high school and college students lacking the fine motor control skills necessary to operate the current scientific calculators, teachers, teaching assistants, and occupational therapists. Participants were asked to participate in an open forum discussion led by a focus group moderator. The two primary topic areas included (1) the current status of each participant and their satisfaction level with current Scientific Calculators, (2) and a description of the ideal product.

(1) Current Status and Satisfaction Level

To determine the current status and consumer satisfaction levels with the use of scientific calculators by students with a disability, the participants in the two focus groups were asked to provide information on a variety of related topics. Their raw responses were as follows: (Full focus group details can be provided upon request.)

- All the panelists believed students are never willfully excluded from taking a course. However, they knew of situations on both the high school and college level in which students were dissuaded from taking a class because it would be difficult for them to meet the course requirements.
- The student with the disability has to verbalize his/her thoughts where other students do not, thereby bringing attention to themselves.
- Self-esteem is lowered for the disabled student if they rely on other students for assistance.
- If a student is unable to operate a calculator, a teaching assistant works with the student operating the calculator for the student. However, communication between the student and the teaching assistant disrupts class. In addition, the teaching assistant might not always understand what the student is asking them to enter.
- Students are not allowed to take the calculators home. If the calculator is not an accessible version, aides say a time is set aside to assist students with homework during school hours or directly after school.
- Students need these calculators in mathematics, chemistry, accounting, and Business Classes (quantitative math)
- Schools will provide standard calculators for student use in most cases
- Purchases of Accessible equipment are paid for through funds allocated in the school budget or alternative sources such as VESID or CBVH are approached.

- High school personnel said the School Board would authorize purchase of accessible equipment for their schools. Colleges would request authorization from the Department Chair or the Dean of the school.

- All panel members overwhelmingly said there is a need for the device. They believe the Expanded Keyboard would provide students with fine motor control limitations the ability to work more independently and efficiently.

(2) Description of the Ideal Product

For the purpose of brevity the following is a synopsis of the features required by the consumers to be present in the ideal Expanded Keyboard. Full focus group details can be provided upon request. The participants of the focus groups stated the Ideal Expanded Keyboard should:

- Be equal in total size to a standard clipboard
- Possess thickness is 1 inch or less
- Be rectangular with rounded corners
- Fold like a laptop computer without taking it apart
- Have a weight equal to the weight of the calculator
- Have key placement mimic that of key placement on the calculator
- Have keys that are recessed on keyboard surface (Lexan Overlay)
- Keys double the size of the calculator keys
- Possess a separate on/off switch
- Have a computer interface
- Possess an independent power supply (batteries) with a low battery indicator
- Have an adjustable tilt
- Be waterproof and easily cleaned

Purchase Intent - Price Point

Our focus groups and surveys showed that 100% of the surveyed participants indicated they definitely would purchase or recommend for purchase the Expanded Keyboard at a competitive price, between $100 and $150.

Section F

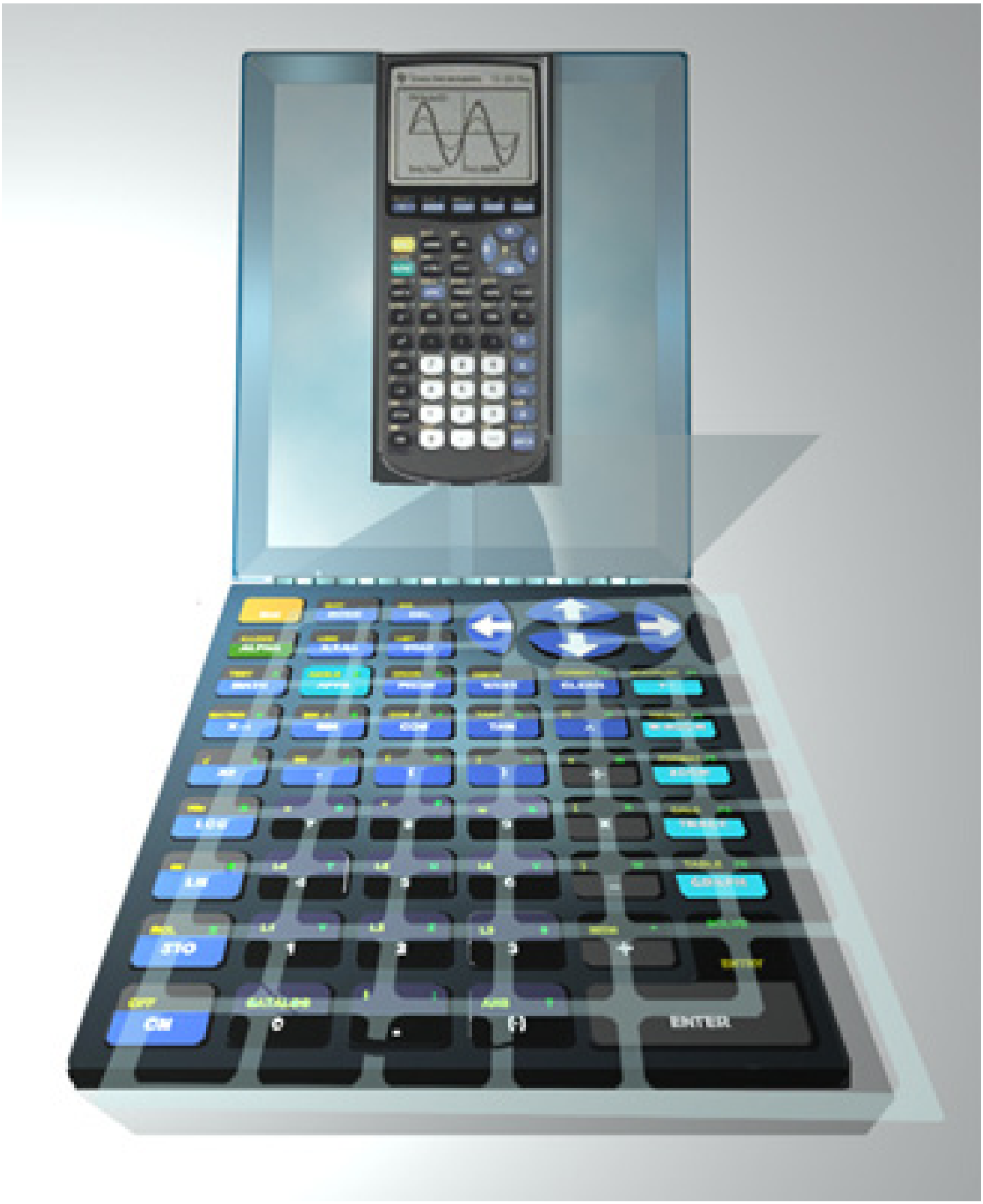
APPENDICES

Appendix A: CAD Representations

Appendix B: T² Project Overview

Appendix A

CAD Representations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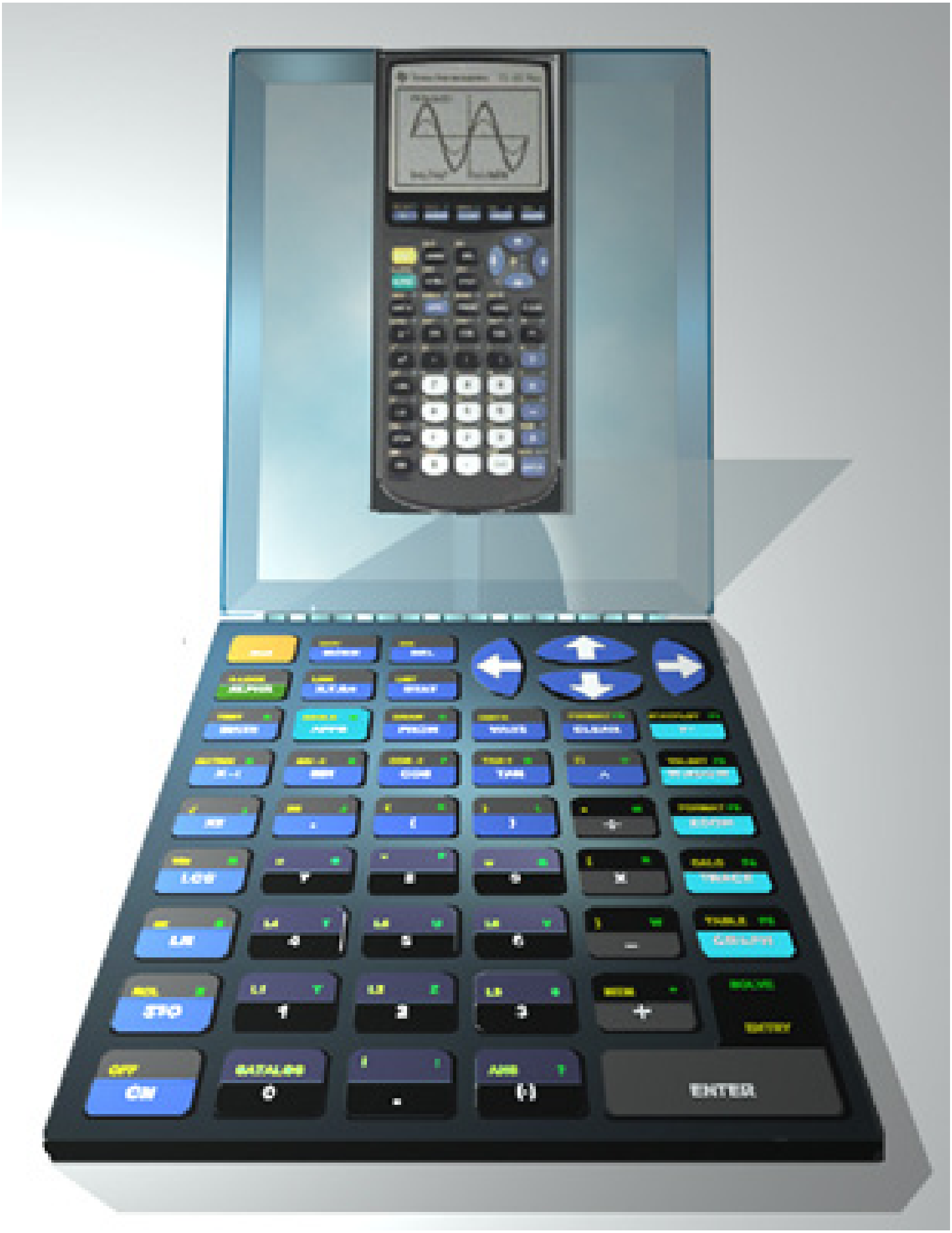
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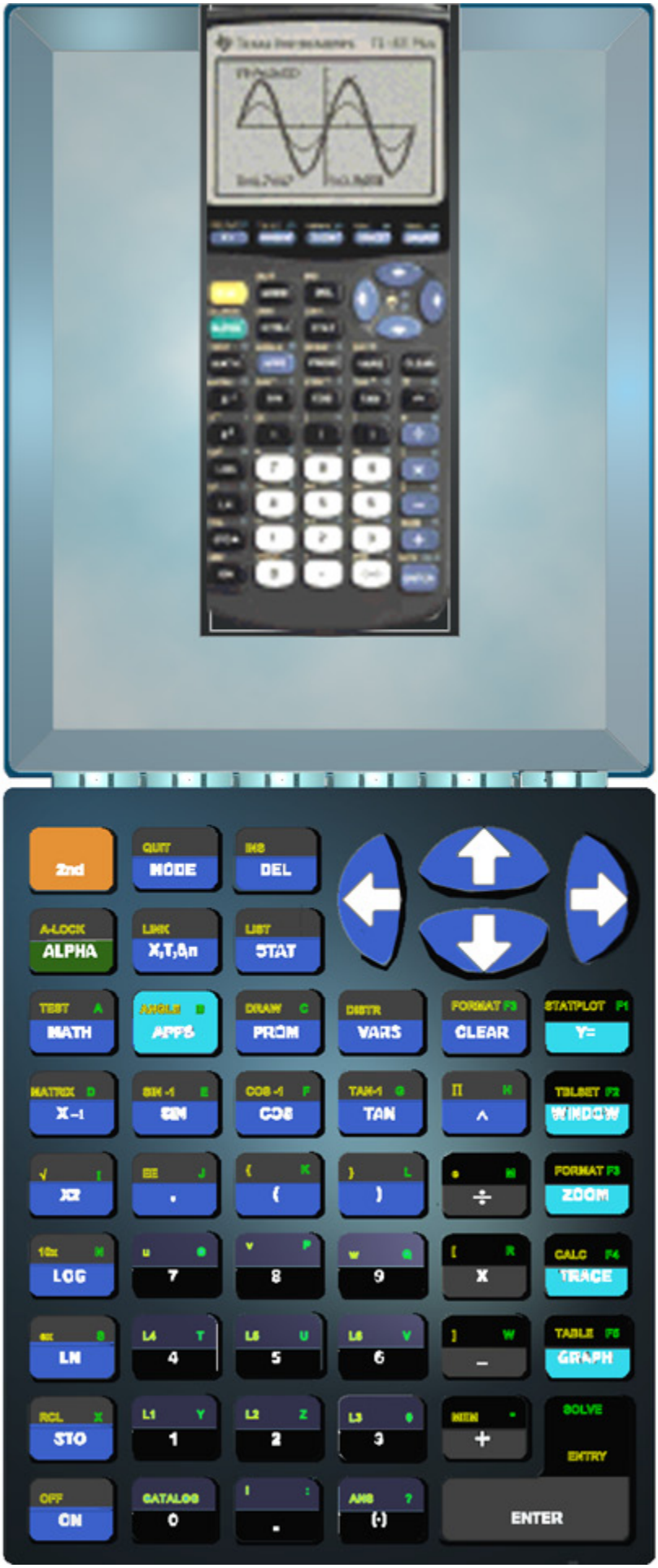
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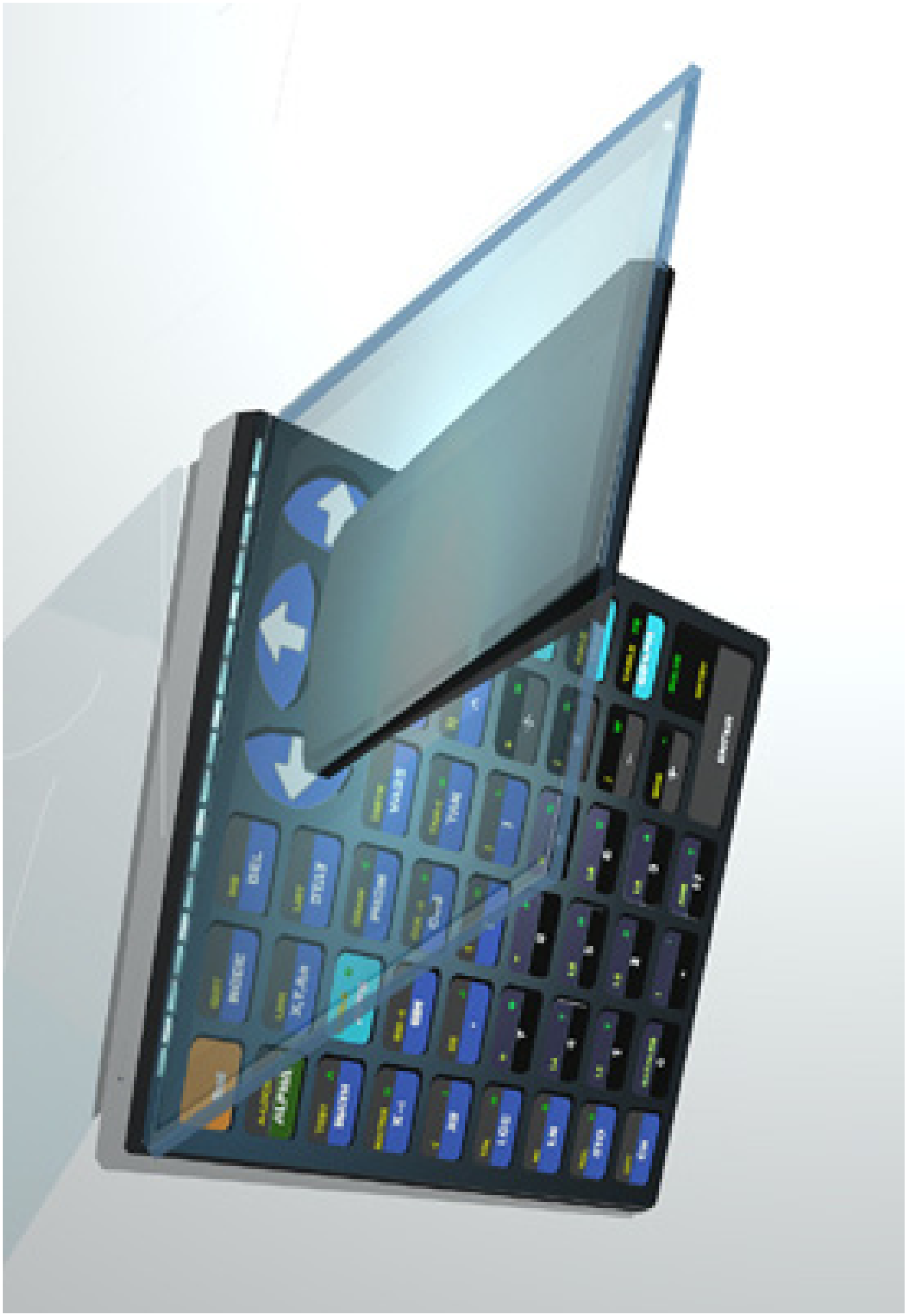

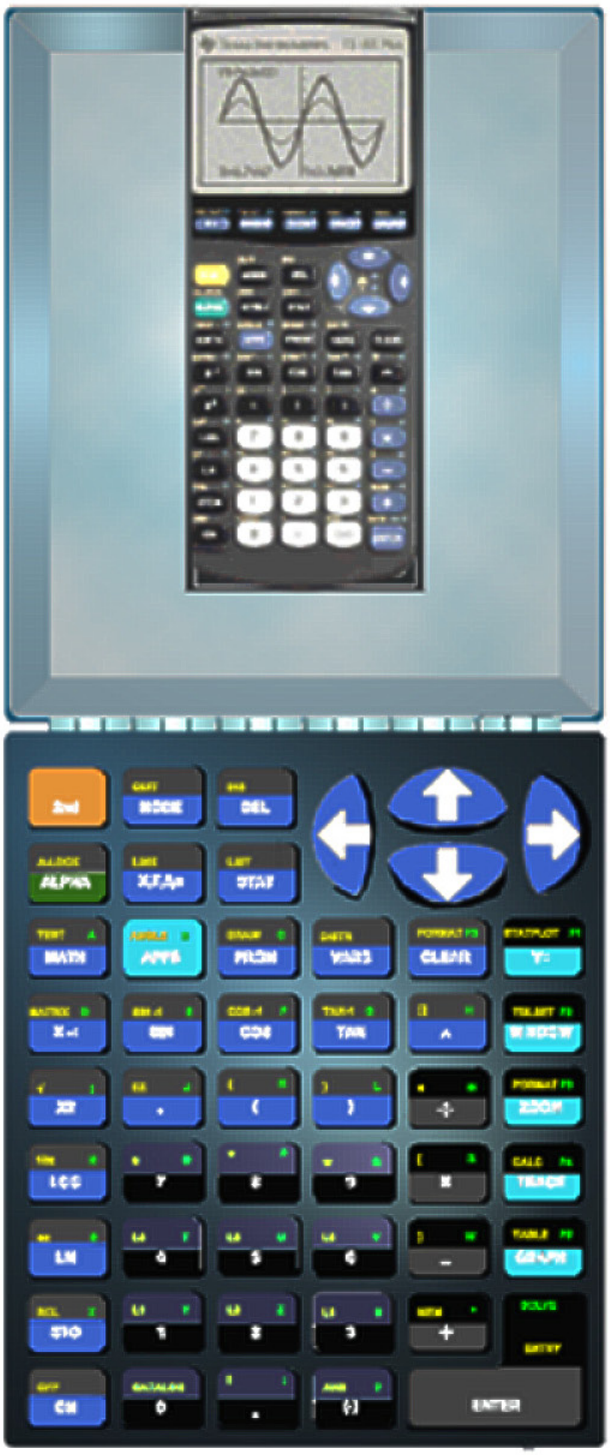

Appendix B

T² Project Overview

T² RERC

Rehabilitation Engineering Research Center on Technology Transfer
Overview

"The Tech Transfer RERC advances the methods, technologies and products of technology transfer, through collaboration with all stakeholders, to improve assistive technology devices and services. The goal is to improve the quality of life for people with disabilities."

To fulfill this Mission Statement, the Tech Transfer RERC:

- advances the methods of technology transfer through research;
- transforms technologies into products through development; and
- facilitates the commercialization of new and improved assistive devices.

Research will develop, validate and disseminate a comprehensive model of technology transfer. Development will identify and transfer up to three breakthrough technologies to industry annually through a demand pull model, and will identify and transfer three to five useful new inventions to the marketplace annually through a supply push model. Facilitation through training, dissemination and technical assistance, will benefit the various stakeholders in the field. Dissemination includes state-of-the-practice conference in 2001, and training includes an instructional program available for presentation at other conferences.

The Tech Transfer RERC is designed to function as an intermediary and a catalyst, improving the process while expanding the network of stakeholders participating in the field of assistive technology. Accomplishing the mission requires close collaboration with academic, industrial, clinical, consumer and government stakeholders.

The Tech Transfer RERC is a partnership of technical, marketing and consumer agencies experienced in assistive technology evaluation, transfer and commercialization. The partnership, led by the Center for Assistive Technology, University at Buffalo, includes the Western New York Independent Living Center, AZtech Inc., and the Research Triangle Institute. The Tech Transfer RERC is funded by the National Institute on Disability and Rehabilitation Research of the Department of Education under grant number H133E980024.

For additional information on the mission of the T^2 RERC and the services the agencies of this partnership provide, contact James A. Leahy, Project Administrator, T^2 RERC at jimleahy@acsu.buffalo.edu or by telephone at 716-829-3141.

T^2 RERC