

CHAPTER 21

WAYNE STATE UNIVERSITY

College of Engineering
Department of Electrical & Computer Engineering
5050 Anthony Wayne Drive
Detroit, MI 48202

Principal Investigator:

Robert F. Erlandson, Ph.D., (313) 577-3900

rerlands@ece.eng.wayne.edu

GUIDELINES FOR DESIGNING AN ACCESSIBLE WEBSITE FOR SMART

Designers: Suhail Hirani, Web Site Design for SMART

Goran Jancevski, Hassan Taleb, Raymond Ryan, and Steven Weber, Web Site Accessibility SMART Web Site Guidelines

Client Coordinators: Mr. Ronald Ristau, Director of Service Development, SMART

Supervisor: Dr. Robert Erlandson

Department of Electrical and Computer Engineering

Wayne State University

Detroit, MI 48202

INTRODUCTION

SMART (Suburban Mobility Authority for Regional Transportation) is a public service organization, established by the State of Michigan, responsible for planning, acquiring, constructing, operating, maintaining, and contracting public transportation services in Wayne, Oakland, and Macomb counties. As a public website, SMART must provide an accessible website in compliance with the Americans with Disabilities Act (ADA). Furthermore, Section 508 of the Rehabilitation Act requires that information technology used, developed, and procured by the Federal government and agencies that contract with it must be as accessible to people with disabilities as it is to people without disabilities.

The evolving guidelines for web site accessibility derive from the World Wide Web (W3) Web Accessibility Initiative (WAI) accessibility guidelines. For example, web sites must be compatible with assistive technologies, such as text-to-speech readers used by individuals with

disabilities. The ability to access a website by people with disabilities as effectively as by people without disabilities is referred to as Web Content Accessibility. An accessible web site allows all users to access it, regardless of their browser, resolution, settings, eyesight, hearing, or motor skills.

The transformation of the Internet from a text-based medium to a robust multi-media environment has created a crisis – a growing digital divide in terms of access for people with disabilities. Previously, people with visual disabilities were able to access the Internet with their screen readers audibly reading aloud the text on a web page. Today, graphical web pages are a barrier if they do not incorporate accessible web design. It is a paradoxical twist that as web technologies advance and incorporate more multi-media in websites to titillate mainstream users, such technologies can deny access to users with disabilities.

Thus, public website designers should create accessible websites that are in compliance with WAI

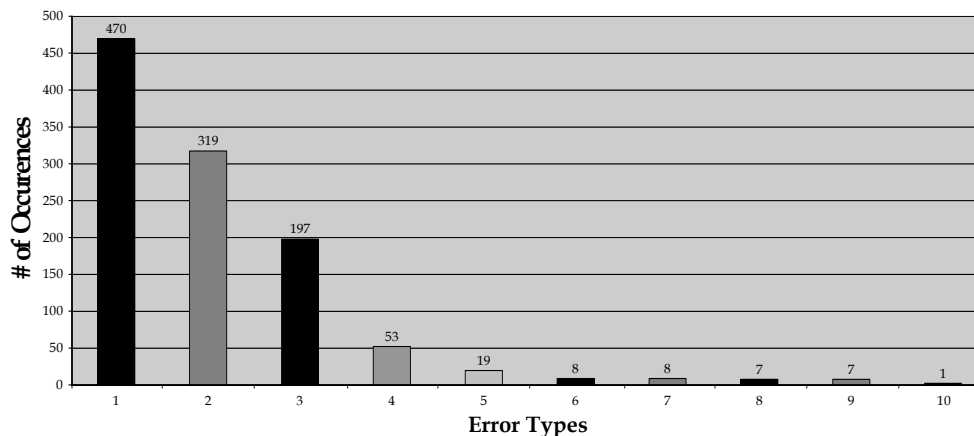


Figure 21.1. Chart of Priority 1 Accessibility Errors.

guidelines thereby reducing the risk of ADA-related legal action against them. Unfortunately, the majority of web designers and their clients are not aware of the specifications of Web Content Accessibility criteria. Among those who are aware of the guidelines, many have misconceptions about accessible web pages, such as: they must be written in HTML 2.0; they must cater to the lowest common denominator; they must be dull, text-only, designs.

SMART will be contracting with a consulting firm to design their web site. The consulting firms thus far contacted are either not aware of the guidelines, unfamiliar with handling the various elements of accessible website design, or believe that they need not comply with WAI guidelines. The goals of both student research projects were to research the need and criteria for accessible websites, provide examples of accessible and non-accessible web sites, and then provide references to guidelines for SMART's website, which will be forwarded to the selected web design consulting firm.

SUMMARY OF IMPACT

SMART's staff has reviewed the material provided in the student reports. Of particular benefit were the

detailed comparisons of apparently similar web sites, one satisfying CAST's Bobby Priority 1 (Center for Applied Special Technology) accessibility criteria and the other not satisfying these criteria. The student reports provided URLs to demonstrate versions of IBM's Home Page Reader and the Lynx text browser. With these readily available packages SMART staff has been able to experience accessibility issues, problems, and solutions greatly enhancing their understanding and appreciation of the WAI guidelines. (Figure 21.1)

The reference material provided in the student projects has helped SMART staff educate the consulting companies they are contacting as to the needs and resources available to design accessible web sites (Table 20.1). CAST's Bobby web evaluation system provides a tool for simple web site evaluation and links to the WAI guidelines for more detailed evaluations if required. Also, with the IBM Home Page Reader and the Lynx browser they will be able to experience the web site and thereby assess its accessibility firsthand.

Table 21.1. Examples of Web Based Material on Accessible Design.

Example	URL	Content
The US Access Board	http://www.access-board.gov	Laws, regulations
Center for Applied Special Technology (CAST)	http://www.cast.org	Bobby web evaluation tool
TRACE Center	http://trace.wisc.edu	General Information
The Enabling Technologies Laboratory	http://www.ece.eng.wayne.edu/etl	General Information
IBM Accessibility Center	http://www-3.ibm.com/able	Home Page Reader
Microsoft Accessibility	http://www.microsoft.com/enable	General Information
W3C Web Accessibility Initiative (WAI)	http://www.w3.org/wai	Web Accessibility Guidelines

PAPER CUTTER/SWITCH OPERATED PRESS

Designers: Robert Chen, Ahmad Hammoud, Vlad Iliescu, Jose Mabesa Jr., and Mohamed Mansour

Client Coordinators: Kathy Vordburg, Kennedy Center in Pontiac, Michigan and Cathy McQuillan, Torrent Center, Jackson, Michigan.

*Supervisors: Dr. Robert Erlandson, Enabling Technologies Lab, Department of Electrical and Computer Engineering and Dr. Eugene Rivin, Department of Mechanical Engineering
Wayne State University
Detroit, MI 48202*

INTRODUCTION

The Ellison Embossing System consists of a press fitted with steel dies that make paper cutouts that teachers use for various classroom activities. While the Ellison press itself is not expensive, the complete die set is expensive, thus making it difficult for each school to own a complete system. It is common practice for a school district to have only one complete embossing system, usually kept at the school district headquarters. In order to use it, teachers must invest additional time after school hours to travel to the facility and to use the press. Teachers at one special education school had created a unique program that eliminates this problem while providing students requiring special education with meaningful work. Another school requested a similar program.

The hand-operated Ellison press is difficult to use for all but the most able-bodied students. Students place pre-cut paper in the press, then place a die on top and push down on a lever that applies force on the die and cuts through the paper. Many students find it difficult to align the paper and die within the press. Exerting the necessary amount of force onto the lever to cut the paper is also problematic for many students with physical impairments (Figure 20.2). The staff at both centers wished to create a process that can be expanded to include students with more severe physical and or cognitive disabilities.

SUMMARY OF IMPACT

Now teachers at both schools can order cutouts and have them delivered to their classrooms. The device was well received by both students and staff. Students use the device to produce cut-outs for teachers.



Figure 21.2. Student Using the Old Ellison Press System.

TECHNICAL DESCRIPTION

The Switch Operated Press is designed to incorporate redundant mechanical and electrical safety systems. Mechanical safety design considerations include the following:

- A mechanism to that isolate the workings of the press from unauthorized physical contact,
- A means of preventing the tray from being pulled out while the press is in operation, and
- A physical barrier to the press to prevent injury should students place their hands or some other body part within the path of the press.

Electrical safety design considerations include the following:

- Systems that prevent the press from operating while the tray is pulled out,
- Clearly visible visual signals that indicate the operational status of the press,

- Systems that prevent accidental static discharge from activating the motor, and
- An activation button that can be placed at a safe distance from the press.

The system consists of the following: reversible AC motor with thermal protection, a screw press, a plastic drawer plate, electrical and mechanical safety features, a control box, and Plexiglas casing.

The system uses a reversible AC motor with thermal protection. Thermal protection is required so that the motor will shut down without being burned out in case the system experiences a jam. Reversible action is required because the press first moves down to cut the paper and then moves up; this change in direction must occur without interruption.

Two major safety features, one electrical and one mechanical, ensure that if one fails the other works. First, a safety switch turns on when the drawer is completely closed and turns off when the drawer is pulled out. This switch ensures that the motor

cannot run and the press cannot move when the drawer is open. Second, a steel pin extends down from the ram plate, which fits in a small hole drilled in the wooden part of the drawer. As the press goes down, the pin locks the drawer, preventing it from being opened. The drawer does not open until the press reaches its highest position.

Incorporating an activation switch eliminates the need for students to physically push or pull on a handle; instead, students simply press a button. The system accepts the full range of switches used in a special education environment. Enclosing the press in Plexiglas casing ensures that fingers and hands stay clear of the press at all times.

Loading the paper and die no longer involves squeezing them into the press. With the new design, students use the handle to pull out the tray, load the paper, place the die sideways on top of the paper, and push the tray back in. This process is reversed to remove the paper and die once the press makes the cut-out. (Figure 21.3)

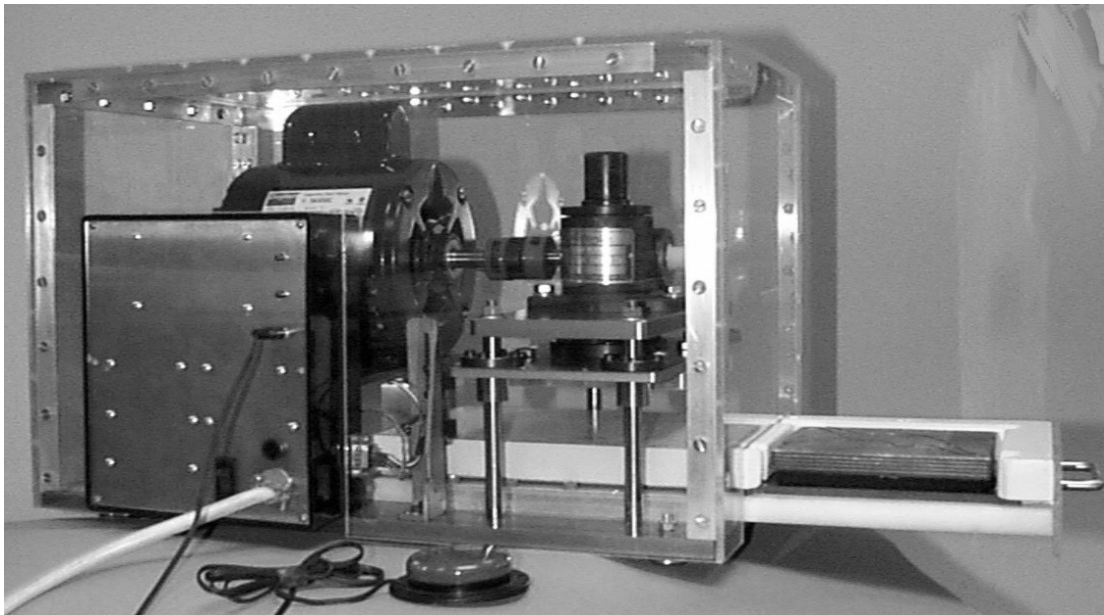


Figure 21.3. Paper Cutter/Switch Operated Press Compatible with the Ellison Die Embossing System.

FORCE FEEDBACK MOUSE USED FOR A PHYSICS EXPERIMENT

Designers: Brian Farrell

Client Coordinator: David D. Baldyga, Junior, Mechanical Engineering Student who is legally blind.

Supervisor: Dr. Robert Erlandson

Department of Electrical and Computer Engineering

Wayne State University

Detroit, MI 48202

INTRODUCTION

Teaching science involves hands-on experiments that are often difficult to modify for students with visual impairments. This project explores the use of the Logitech Wingman Force Feedback Mouse in a computer simulated physics experiment. This mouse is a commercially available device commonly used in video games to provide more realistic user interaction with computer generated characters and environments. The intent is to use the force feedback capabilities of the Wingman to provide additional feedback to the user.

A blind mechanical engineering student participated in the project as a consultant and collaborator. The experiment explores the relationship between a spring's length, applied force and spring constant. The experiment is designed as a gaming system that includes voice feedback, tactile feedback, and sound feedback (an auditory homing signal); this design provides a media-rich simulation environment. In addition to demonstrating a physics principal, the Force Feedback Mouse experiment demonstrates the feasibility of simulating experiments for individuals with visual impairments.

SUMMARY OF IMPACT

Field-testing of this program was conducted by a student who is legally blind. The following is an excerpt from his written analysis: "The computer simulation has advantages for students with visual impairments and fully sighted students. Equipped with voice-assisted instructions, it provides an added dimension to a classic physics experiment. Students with visual impairments can benefit by performing it with little or no assistance. The feel of the spring being compressed adds reality to the simulation that goes far beyond simply crunching numbers in standard computer simulations. Fully

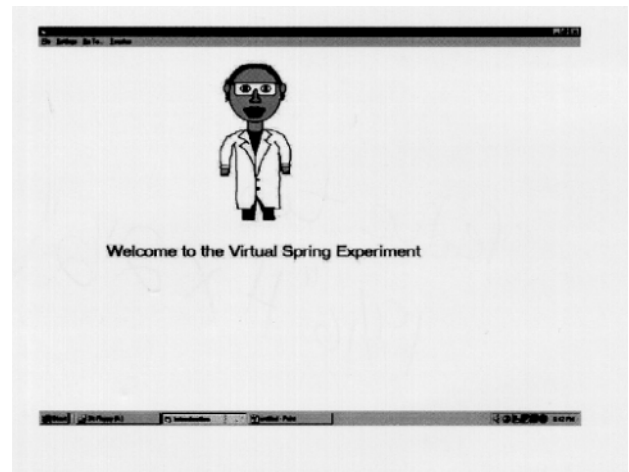


Figure 21.4. Main User I/O Screen.

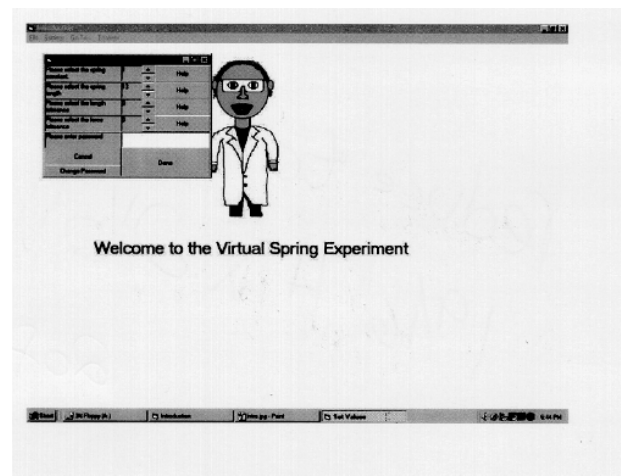


Figure 21.5. Set Value Screen.

sighted students can also benefit by experiencing the feel of the spring being compressed."

TECHNICAL DESCRIPTION

The spring experiment was created using Visual Basic 6.0. An immersion web type library ActiveX controller was installed to control the force feedback mouse. The spring experiment uses Microsoft's Speech Software Development Kit (Speech SDK 4.0), which can be downloaded from Microsoft's web site. The Microsoft Voice Text ActiveX controller was added to the Visual Basic package for text to speech control. The spring dynamics were simulated using Visual Basic.

The spring experiment application window consists of a pull down menu bar, a "lab helper", bar graphs for spring length and force applied, and a simulated spring (Figure 21.6). When the application is launched, a voice is heard that walks the user through the menu selections. The software will read through all of the available choices to assist users.

The first menu selection is located under the File heading. Available options include a Play command that begins the experiment or a Quit command that ends the application (Figure 21.8). The second menu selection is labeled "Settings". Available options under "Settings" include the ability to turn the lab helper on or off, to turn the voice on or off, and to assist the user with finding the spring on the screen. A third menu selection is labeled "Go To..." Available options include "Overview" where the user is instructed as to the significance of Hooke's

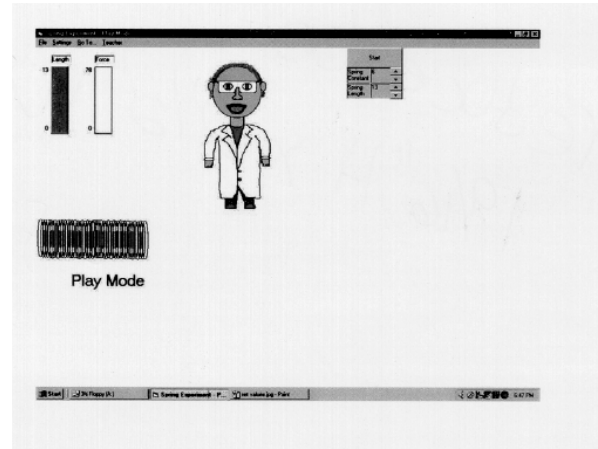


Figure 21.6. Play Mode Screen.

law as well as how the experiment is conducted and which parameters of Hooke's law are measured. Advice is also given to the user as to how to increase the accuracy of the experiment. A "Results" option allows the user to view the results of the experiment.

A final menu item labeled "Teacher" allows a password protected screen to appear (Figure 21.7). This allows staff to adjust the spring constant, length of spring, a length tolerance, a force tolerance, and the password. Help is also available for all of the parameter adjustments.

HVAC DISASSEMBLY PROCESS AND WORKSTATION DESIGN

Designers: Tomica S. Champion and Claudia Ricaurte

Client Coordinators: Ms. Jane Resutec, teacher Warren Woods Towers High School, Mr. Jim Resutec, Engineer, Delphi.

Supervisor: Dr. Robert Erlandson

Department of Electrical and Computer Engineering

Wayne State University

Detroit, MI 48202

INTRODUCTION

The HVAC Disassembly Process and Workstation Design project provides new job opportunities for high school students with learning disabilities and promotes recycling of damaged heating, venting, and cooling (HVAC) units. It combines the simultaneous efforts of process design, workstation design, material flow, and facilities layout for the entire disassembly process from incoming product to output of the final harvested parts. The project's objectives were to:

- Develop and build an efficient and safe workstation layout,
- Develop and implement an efficient and orderly storage area, and
- Develop and build an efficient and safe material handling system.

SUMMARY OF IMPACT

With this project, students disassemble HVAC units and store the parts. This experience allows them to gain technical skills and prepare them for the automotive workforce. It also teaches them general work skills such as following instructions, working with a supervisor, and working as a team player. The school previously did not have a workstation suitable for the disassembly process. A safe and ergonomically correct work environment was needed to disassemble HVAC units while attending to the students with disabilities.

TECHNICAL DESCRIPTION

A quality function deployment (QFD) model was used to assess and prioritize the client's wants, which included: student independence, ergonomics, cost effectiveness, and inventory control. The technical requirements were: process disassembly design, workstation design, material flow design,

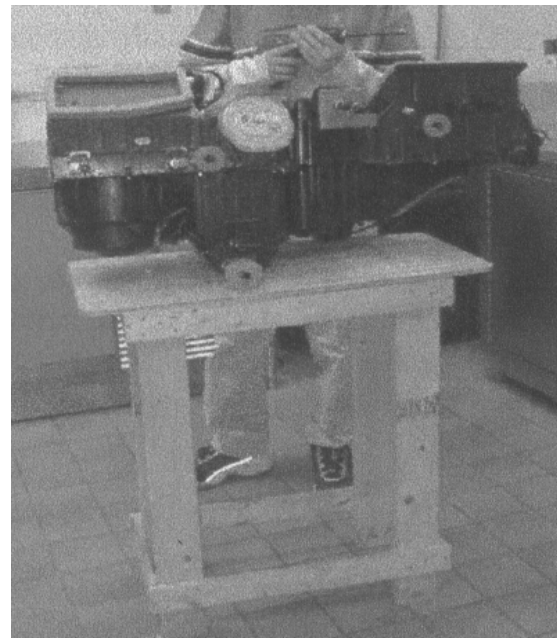


Figure 21.7. Original Workstation.

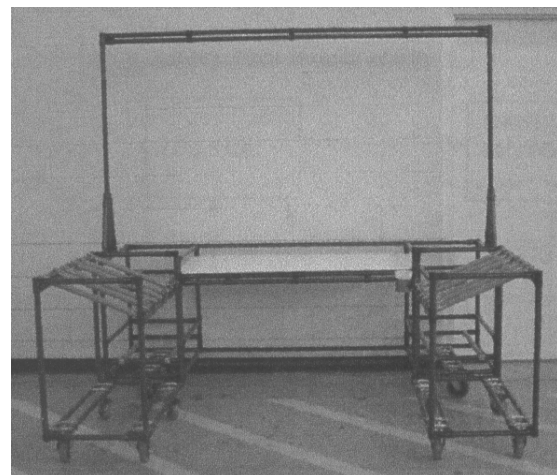


Figure 21.8. Completed Workstation.

and facility layout design. Workstation design was the first priority followed by the disassembly process design, material flow design, and facility layout design.

There were five different HVAC units, each a different size and weight and harvestable components. However, there was considerable similarity among HVACs, which allowed for a usable generic disassembly procedure. Based on this disassembly procedure and worker ergonomic needs, including wheelchair accessibility, the workstation was designed and assembled.

The workstation is built from Creform, a pipe and joint agile device technology. The pipe and joint technology allows for rapid proto-typing yet is strong enough to be used for the final product. The station is wheelchair accessible, yet it allows non-

wheelchair users to work comfortably. There is an overhead rack for support of disassembly tools and fixtures. A counter balance will support a power drill so that the worker does not have to accommodate the weight of the drill while involved in disassembly. There are two mobile detachable side carts with slanted racks. One holds the HVACs and the other holds the harvested parts in plastic containers placed on the tilted cart rack.

A facilities layout was provided along with suggested material flow and storage suggestions. These were preliminary and will be subject to re-evaluation in a subsequent project.

PAPER COUNTER AND DISPENSER

Designers: Vincent Alexander, Michael D. Kresbaugh, Vincent Palazzolo, and Jamie Waldrup

Client Coordinators: Ms. Lynne Hagmann, Western Wayne Skills Center

Supervisor: Dr. Robert Erlandson

Department of Electrical and Computer Engineering

Wayne State University

Detroit, MI 48202

INTRODUCTION

The Paper Counter and Dispenser will assist individuals with physical and cognitive disabilities in clerical work that involves paper sorting and bulk mailing. The electro-mechanical Paper Counter and Dispenser feeds sheets of paper, varying in size, into an output tray where the user may easily collect the sheets of paper. More specifically, the device accepts a stack of paper that is loaded into the machine. A supervisor sets the total number of sheets to be fed and the user activates the paper dispenser by pressing a portable switch pad. The mechanized rollers grab the paper, pull it onto the device, count the paper, and dispense it into the output tray. The device continues this cycle until it reaches the set number; then it automatically deactivates. The output tray is fitted with raised channels, which allow the user to easily remove the paper.

The dispenser must be safe for all possible users. The dispenser's drive mechanisms must be enclosed. The dispenser must also be operated by the push of a button. Multiple students at different workstations will use the dispenser, so it must fit on a tabletop for easy relocation.

SUMMARY OF IMPACT

The device will allow students with physical and cognitive disabilities to take part in the paper sorting, counting, and mailing tasks.

TECHNICAL DESCRIPTION

Low speed, low volume paper handling, sorting, and counting operations are common components in special education office skills classes. While high-speed office automation systems are commercially available, they are too expensive for classroom use. More critically, they are not designed for the low volume, low speed, person-based operations found in the special education setting. The design challenge is to find a low cost, safe, and reliable system for low volume, low speed, operator-

involved paper handling, sorting, counting, and dispensing system.

The client's major objective is to provide a technological intervention that will allow students with a range of physical and cognitive disabilities to participate in mailing, sorting, and counting tasks. Furthermore, the technological intervention should allow the students to work as independently as possible. Based on the client's specifications, the system was to handle single sheets of letter and legal sized paper in various sizes, folded single sheets, envelopes, and, if possible, small multi-page pamphlets and newsletters. In addition, the system was to be able to count the items and dispense them in a way that is easy for the students to retrieve. It must be easy for the students to place the sheets into the system. The system should be operable by a movable pad switch.

The essential components of the system include: an ergonomically simple input process or mechanism, a reliable sheet-separating mechanism integral with the paper grabbing and movement mechanism, an ability to count sheets electronically, and an ergonomically sound collection and operator retrieval process/mechanism. (Figure 21.9)

There is an input tray that slides out of its holder so that it is easy to place paper, envelopes, or newsletters into the tray. The tray has movable sides so that different sizes of paper can be accommodated. When the input tray is pushed into place, a pressure panel in the bottom front of the tray moves over a spring-loaded roller on the base of the unit. This spring loaded roller puts pressure on the bottom panel and forces the paper upward toward the drive roller. The persistent force between the top sheet of paper and the drive roller ensures that the roller will grab the paper and move it forward.

As the feed rollers grab a sheet of paper a friction based separation pad works to separate the top sheet from other sheets that may be attached. Next, a second feed roller that rotates faster than the lead feed roller catches the top sheet. This speed differential is created by the geared belt drive mechanism. The speed differential causes the top sheet to advance faster than any other sheets. A slip gear drives the initial feed roller so that when the second faster drive grabs the top sheet and pulls it forward, the increased reverse force on the initial feed roller causes it to slip. This slippage further enhances the sheet separation process in that sheets

not caught by the second roller slow or stop forward movement.

A photoelectric sensor is mounted just beyond the second roller. As the sheets exit the roller and drop into the output tray, there is a separation that can be sensed and a signal transmitted to an electronic controller unit. When the controller senses the required number of sheets it stops the feed rollers. The student can then remove the specified number of pages from the output tray.

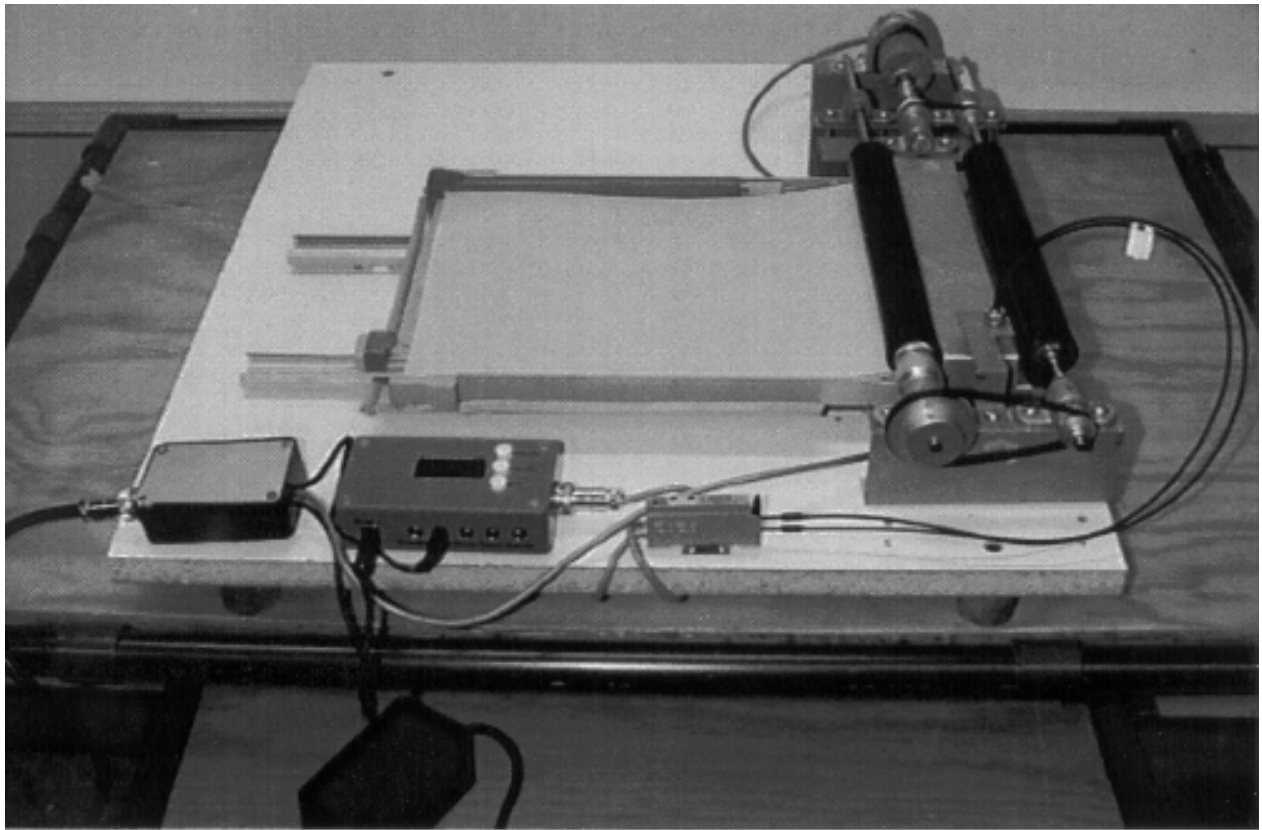


Figure 21.9. Paper Counter and Dispenser.

