

CHAPTER 16
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COUNTER REVOLUTION: THE AUDIBLE COUNTER

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INTRODUCTION

The audible counter was developed to provide audio and visual counting for individuals with physical and/or cognitive impairments who work at a supported employment center. There was a need for a counter to help an individual keep track of work accomplished. With audio feedback, this device is particularly valuable for individuals who are unable to read a numeric display, or for individuals who benefit from audio stimulation.

To use this device, the user presses a large button on the front of the counter every time he or she completes a task, such as stuffing an envelope. The device responds by incrementing the count shown on the LCD display, and announcing the count with an audio message. Additional audio messages provide encouragement every five counts, as well as prompts when the device is idle for a period of time. For employees needing a custom increment switch, the supervisor can plug in a commercial switch into a standard one-eighth inch jack on the unit. Additional buttons on the unit are used to reset the count to zero or place the device in "sleep" mode.

SUMMARY OF IMPACT

According to the client coordinator, "the counter will increase the employees' earning power and also increase their independence in their work by relying less on a supervisor to keep up with the count." When an employee finishes a task, he or she can press a button on the audible counter and the device will output the current count both visibly and audibly. The counter is designed to be simple to use, and will save the current count until the user presses a reset button.

TECHNICAL DESCRIPTION

The custom circuit is designed on a pre-printed circuit board that minimizes noise during recording and playback. It also makes the circuit more robust and less prone to wires breaking. The device is controlled by the PIC microcontroller (Microchip, Chandler AZ), which receives input from the increment switch and provides the current count visually on the LCD screen and audibly through a speaker. Custom digital recordings are stored in the ISD record/playback chip (Winbond, San Jose CA).

The program works using timer and input interrupts from the microcontroller itself. At start, the program initializes all variables and then enters an infinite while loop. The loop can be interrupted by the PIC timer, which increments the idle time, or by user inputs, which include the "sleep", "reset", and "increment count" buttons. Every time the count is modified, either by reset or increment, the count number is stored in flash memory on the PIC to prevent data loss via power failure. Upon power up, the count is loaded from the flash memory. The microprocessor PIC and ISD voice record/playback chip can go into a sleep mode where they draw microamps of current. The other components, such as the inverter, speaker, and amplifier, run off a 5V supply. The PIC turns the 5V regulator on and off, which saves battery life when the device is not in use.

For the numbers "one" through "ninety-nine", professionally recorded audio files were obtained from BeVocal Café (<http://cafe.bevocal.com/>). There are three custom recorded audio encouragement messages, including "excellent work," "good job," and "you're doing great." These messages play every five counts. There are three custom-recorded audio prompts, including "do another," "keep going," and "get back to work."

These messages are played every 30, 60 and 120 seconds without user input. There are also custom recorded messages for “hello” and “goodbye” when the supervisor presses the awake/sleep button.

The enclosure is a 9.92 inch x 4.76 inch x 2.75 inch project box with a cutout for the LCD display (EAI Enclosures International, Libertyville IL). The box has a battery compartment for four AA batteries. The LCD count display, increment button, and speaker are mounted on the top panel of the enclosure. The LCD cutout is wide enough to fit the 20 characters by four line display. The increment button, the only button that the employee will have

access to, is a green pushbutton switch. It has a 1-3/8 inch activation surface and activates no matter where it is pressed for easy access by employees who have limited motor control. The speaker is mounted on the inside of the enclosure and covered by a wire mesh. The supervisor controls the reset button, awake/sleep button, volume control, and alternate switch jack are mounted along the side of the enclosure. The reset and awake/sleep buttons are flush against the surface of the enclosure to prevent accidental pressing. An on/off switch to the battery is also mounted to the top of the enclosure.

The total cost of this project was \$261.



Figure 16.1. Audible Counter.

SMALL ITEM COUNTER

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INTRODUCTION

An agency employs individuals with cognitive and/or physical disabilities to perform tasks, including packaging of the PEP-R Autism Test Kit. This kit includes several jars filled with small items, such as blocks and dowels. In order to assist employees in packaging the kit, a device was designed to help the workers count and package these items. The device can be set to count a specific number of items and to indicate when the proper number of items has been counted.

To use this device, a supervisor sets the "goal count" to indicate the number of items, i.e., blocks or dowels, which should be packaged in the jar. Then the employee drops the items, one at a time, onto a slide. The item proceeds down the slide and passes over a transducer that detects its presence and increments the count; it then falls into the jar for packaging. The supervisor can place different templates over the opening of the slide to restrict which items can be inserted there.

SUMMARY OF IMPACT

This device will assist employees who have disabilities, such as autism or cerebral palsy, to package small items more accurately and efficiently. Because employees at the client agency are paid on a per-unit basis, increasing the speed and accuracy with which they perform will translate into increased pay. According to the client coordinator, "The small item counter will allow people with severe and multiple disabilities to assist with the configuration of the PEP Kits, increasing their independence and also [increasing] their pay."

TECHNICAL DESCRIPTION

The primary component of the device is a PIC microcontroller (Microchip, Chandler AZ), which is connected to the input switches, the LCD screen,

and an optical sensor that detects the passing of small objects down a slide.

In order to be counted by the optical sensor, each object must pass within close proximity to the sensor at a sufficiently slow rate to allow detection. Furthermore, the objects must follow a well-defined path, and be in such an orientation that they are recognizable by the sensor as they pass over it. An aluminum slide was created to accomplish these tasks. The proper orientation of each object is established by one of four different templates that are placed over the opening (see Figure 16.2), corresponding to the four different objects that are counted for the PEP kits. Because the slide is rectangular rather than cylindrical, the objects lie flush against the inner surface of the slide, thus maintaining the proper orientation. The angle of the slide also helps to maintain the proper orientation, so they cannot rotate freely during their progression down the slide. The resulting design ensures that the objects will be reliably detected by the sensor.

The optical sensor is a reflective photo-interrupter, which is sensitive enough to detect small and large, as well as translucent and opaque objects. Switches for Reset, Power, Up, and Down connect directly to the PIC.

One of the limiting factors of the PIC microcontroller is having it run fast enough to detect slight changes in signals from the photo-interrupter. To enhance the program's execution speed, the buttons are attached to interrupts that intervene in the program only when pushed. Additionally, in its current configuration, the LCD is updated only when the count or goal count is changed. The PIC is programmed in C.

The display and the buzzer are the two ways that the device indicates the goal has been reached. Since the device has no auxiliary lights to alert the user,

the incorporated LCD screen is capable of writing in large, bold letters to enhance visibility. When the goal count is reached, the display reads "DONE" in letters that consume the entire screen. This message is accompanied by a subtle beep. One of the requirements for the device is that it will be used in

a work setting, so it should not disturb or distract other workers. The display and the buzzer convey a clear message that the user is done in an appropriate manner for the working environment.

The total cost of the device is \$381.94.



Figure 16.2 Small Item Counter Device.



Figure 16.3 Assembled Small Item Counter with Templates Placed Over the Opening of the Slide.

