

EZ Cookin'

A redesign of a microwave accessible to all

Problem Statement

The goal of this project is to make modifications to the design of an existing microwave to make it so easy to use that individuals of all abilities can use the machine. Major brand name designs have few or no accessibility features for less-able individuals, making it difficult or impossible for these people to use a microwave without buying an expensive, custom microwave. The purpose is not to design a microwave specifically for disabled individuals, but rather a microwave that is so easy to use and competitively priced, everyone will want to own one.

Background

It is estimated by the United States (US) Census Bureau that 19.4% of the 252.1 million non-institutionalized US citizens are disabled in some way. Thus, there is a large market for specialized consumer products for these individuals. Smaller products manufacturers that build their own devices or modify existing products are attending to this market. Although these products exist, they are considerably more expensive than off-the-shelf consumer products and are usually only geared toward a specific disability, i.e. blindness, deafness, etc... It will be the team's goal to design a product that will be comparable in price to off-the-shelf consumer goods, cater to all levels of ability in a single model without post-production modifications. Thus it would not appear to be made for all persons and not for persons with "disabilities." To accomplish this, one must first know what the abilities of the projected consumers are, in order to make a design.

The disabilities being considered will be broken up into four major categories. These categories include visual impairment, auditory impairment, cognitive impairments, and physical impairments and summarized in Figure 1. Of the total population, 5.16% has some sort of visual impairment, which includes total blindness, limited visual capability, and color blindness, the inability to distinguish between certain colors (2). 8.58 % of the US population suffers from an auditory or oratory disabilities such as total

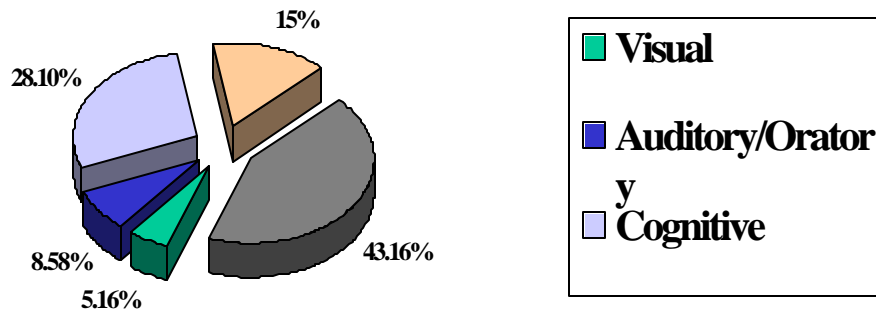


Figure 1. Disability By Type (3)

deafness, difficulty hearing in a normal conversation, and difficulty of others understanding what they are saying (1). People with cognitive disorders make up 28.1 % of the total population (3). The list of these disorders is extensive, ranging from mild retardation to total mental incompetence. Some of these disorders include Down’s syndrome and Alzheimer’s disease. 15 % of the population has a physical disability (3). Physical disabilities can be broken up into three subcategories. These categories are people limited in major physical activities (4.56 %), those limited in the kind or amount of physical activity (5.67 %), and those with physical limitations other than major limitations (4.72 %). A major physical activity is considered to be playing for ages 0-5 years of age, attending school for those ages 5-14, and work, housekeeping, bathing, eating, dressing, household chores, and daily errands for all other ages (3).

Solutions

Designing a microwave that is accessible to everyone is not a simple task. There are many requirements and standards that must be met. Along with this, the production cost of the microwave must be competitive with current lower priced models. Some of the standards that must be met are governmental standards, such as the Americans with Disabilities Act (ADA) **QUOTE SPECIFICALLY**, which protects the rights of individuals with disabilities to have access to public institutions. The ADA provides guidelines for appliance design in making them more usable for all. Other groups such as the Trace Center at the University of Wisconsin have taken these guidelines further and outlined design criteria for more accessible designs. One of their trademark ideas is the EZ Access concept. EZ Access allows individuals with visual impairments to operate

control buttons on devices by providing auditory cues to selected buttons. Based on these standards and our client requirements we have formulated a possible design concept.

The design criteria were described in the PDS and then prioritized by features that would be desirable in the final design, which are attached in the Appendix. High priority features are features that must be included in the design. Medium priority features shall be included only if they do not exceed the cost limitations of the final product. Low priority features will be included only if their cost adds little or nothing to the final cost of the microwave.

Upon analysis of the design requirements, it was determined that only one major design would meet all of the high level design requirements and remain a low cost model. From this base model, features can be added to make it more attractive to buyers looking for a higher end microwave, called the mid-range model. The features of the base model are shown in Table 1.

Base model features
<ul style="list-style-type: none">• Simplified control pad• Cooking function buttons that light up• Pre-programmed cooking buttons• EZ Access button• Rotating turntable that ensures food is cooked evenly

Table 1. Base Model Features



Figure 2. Base Model Control Panel

This design has a control panel that is as simplified as possible. Shown in Figure 2, the design concept is a top to bottom to control model. As the user enters commands, they will move from the top of the control panel to the bottom. Along the top of the control panel are the power level buttons. The user can select from three power levels: Defrost, Medium Cook, and High Cook. When pressed, these buttons light up and stay lighted throughout the control cycle. On the right side of the top row of buttons is the Set Clock button. This button allows the user to set the time of the built-in clock in the microwave. Next, the user will enter a cook time on the numeric pad. Time can be entered in multiple ways. For example, to enter a time of ten minutes, the user could enter “1-0-0-0” or could also press “1-0-Minute.” To cook, the user will press the green Go button. To cancel cooking, Cancel can be pressed to simply stop the cooking.

Other features that are included on the base model are the pre-programmed cooking buttons. If the user wants to simply cook a bag of popcorn, they can press the Popcorn button to automatically set the proper time and power level of the microwave. Pre-programmed cooking buttons will also be provided to cook beverages such as hot water or coffee with the Hot Beverage button and to cook frozen dinners with the Frozen Dinner button. Another added feature is the EZ Access button. When the user presses and holds the blue EZ button, the controls on the microwave will be audibly identified by a voice prompt to assist a user who is visually impaired instead of requiring the user to locate controls on the microwave by trial and error. The EZ Access feature can be extended to provide more help by pressing the button again to provide verbal information about the function of the control on the microwave. Like most comparable microwaves, the microwave will have an automatic turntable that will spin at approximately **TURNABLE RPMS** to ensure that the food is cooked evenly.

Some purchasers may desire more than just basic features in their microwave. For those individuals, those more desirable features have been added to the basic design to create the mid-range model. The possible features include: programmable preset buttons that can be programmed by the user, a smoke detector built into the microwave to detect burning food and alert the user, a door opening mechanism powered by a solenoid to aid users who might have difficulty opening the push button door, and a LCD display

that displays more information about the currently selected control and its function. These features are summarized in Table 2.

Mid-range model features
• Programmable preset cooking buttons
• Built-in smoke detector
• Solenoid-powered door
• Larger LCD display

Table 2. Base Model Features

For the rest of the semester, the goal is to do a cost analysis of both models to find their viability as a design. Once cost analysis is complete, the features in the models will be adjusted accordingly. Actual production of a working prototype is a lofty goal because it involves much reengineering of an existing microwave since we are not experts on the mechanism of cooking. The current goal for the project is to complete a detailed circuit diagram of the control module and develop a computer simulation for usability testing.

Potential Problems

A number of potential problems may arise in the implementation of our design. First, programmable buttons would require that the user be able to program the desired functions. If the user was cognitively disabled this would be difficult, even if instructions were provided. The program function would need to be very simple to use or a helper would have to do this for the user. Most likely a person with a cognitive disability would have someone to help him or her with this, but in designing this feature we should assume they do not. The LCD display is the biggest aid in helping the user use this feature. This type of display would guide the user through the process by displaying messages for what the user should do next.

There is also a potential problem with the application of the Braille stickers that could be placed over the buttons. When a blind person is attempting to apply these stickers, they are going to need a guide as to which button is which. In this case we are again assuming that they will have to do this task themselves. One way to address this problem is to provide a layout of the microwave interface with Braille labels on the

proper buttons. With the aid of the textured buttons, the user should be able to find which sticker goes on which button through feel.

Management Planning

Project Schedule

Week of:

Feb. 12 - finish gathering information and begin conceptualizing design - **done**

Feb. 19 - brainstorm design - **done**

Feb. 26 - finalize design alternatives - **done**

Mar. 5 - prepare for presentation and present preliminary design

Mar. 12 - Spring Break

Mar. 19 - select a design and begin realization of design

Mar. 26 - work on circuit diagram of design and computer simulation

Apr. 2 - work on circuit diagram of design, do usability testing with simulation

Apr. 9 - finish circuit diagram of design, do usability testing with simulation

Apr. 16 - rework design with test results, contact major manufacturers

Apr. 23 - continue work with major manufacturers

Apr. 30 - prepare for final presentation

May 7 - final presentation

Cost Estimate:

As long as fabrication does not occur, the only costs incurred will be the cost of the IE 662 textbook (approximately \$25). Development of the circuit diagram and computer simulation will not cost anything.

References

- 1) www.cdc.gov/nchs November 14, 2000
- 2) www.census.gov April 1995
- 3) www.dinf.org March 1997

for further information please consult the project binder

Appendix

Attached to this document is:

Prioritization of design features

PDS

Prioritization of design features

High Priority Features

- Distinct auditory tones for different input control types: functions, numbers, and preprogrammed keys. May include auditory feedback of either tones or speech output for function keys, numbers, and alerts
- Incorporation of EZ Access features
- Wording on the control panel is simple and self-explanatory. No abbreviations are used.
- In case of conflicting commands, microwave defaults to most recent command.
- Auditory signals within the range of 500 and 2500 Hz so that they are easily heard
- LED cues appear when functions are selected and set, when the microwave is performing certain functions, and when cooking is finished
- Frequency of visual display flashing is about 1 Hz. This feature increases accessibility for individuals at risk for seizure disorders.
- Push button door requires minimal physical force to open.
- Door push button is large and located at oven lower right to provide a visual cue and to be easily reached and pushed.
- Oven door swings wide open. Oven opening is large
- Number pad is in standard “telephone style” layout
- Tactile location bump on number 5 of number pad
- Keys are grouped according to type and shape
- Keys are large
- Horizontal and vertical arrangement of keys corresponds to sequencing of keys when setting the microwave
- Lettering on control panel, displays, and in documentation is sans serif and highly contracted with background. Size, width, and spacing of lettering is chosen for maximum legibility

Medium Priority Features

- The microwave will accept cooking time, defrost time, and power level in various orders and default to first defrosting, then cooking at a given level
- “Minute” function button allows entry of a time in minutes with fewer selections. Conventional entry of time in minutes is also accepted.
- Oven will accept entry of cook time and “Start” with or without use of “Cook Time” function key.
- Volume control to change volume of tones
- Output speaker placed on the bottom of the microwave, near the front
- Turntable eliminates need to turn or stir food during cooking.
- Documentation contains a quick reference card with step-by-step directions for most common cooking tasks.
- Smoke detector monitors food in oven.
- Snap on cover facilitates access to oven light for changing the bulb.
- Keys have raised outlines
- Keys have central indents
- “Start” and “Stop” buttons are color coded
- Braille stickers that can be placed over the buttons on the control panel
- Buttons that light up when pressed

Low Priority Features

- Programmable cook keys for commonly prepared items. These keys provide a preset cook time and power level with only two input selections
- Programmable functions require several sequenced commands to reduce the possibility of accidental reprogramming.
- Re-positional plastic pocket keeps guides for microwave use readily available.
- Spiral bound manual lies flat when opened. Pages are non-glossy finish and heavy enough to be turned easily.
- Manual includes Table of Contents, Index, numbered pages, and indexing tabs

- Manual and quick reference card provide step by step instructions accompanied by illustrations
- Safety information is presented at the front of the manual
- Manual includes trouble-shooting information and directions for accession customer service and optional material
- Audiocassettes of the full manual and quick reference guide are available. A Braille diagram of the control panel is available.
- Border of oven opening is dark and provides contrast with light oven interior.
- A headphone jack in the front of the microwave