**HANDY 1: A ROBOTIC SYSTEM TO ASSIST THE SEVERELY DISABLED**

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The Handy 1 is a rehabilitation robot designed to enable people with severe disability to gain/regain independence in important daily living activities such as: eating, drinking, washing, shaving, teeth cleaning and applying make-up. Dependency upon health care staff, particularly in public institutions, where volume dictates the level of personal attention, can have a significant effect on the well being and quality of life of the individual. The introduction of systems such as Handy 1 has a dual purpose: it enables greater personal activity for persons with severe disabilities, thus leading to an increased level of independence; and helps to reduce the demand on caretakers for individualized, intensive assistance.

**The Many Functions of Handy 1:**

**Eating System** – The ability to eat independently is a major challenge for persons with severe disabilities and, therefore, is one of the first concerns in the development of Handy 1. A scanning system of lights designed into the tray section of Handy 1 (see Figure 1) allows the user to select food from any part of the dish. Briefly, once the system is powered up and food arranged in the walled columns of the food dish, a series of seven lights begin to scan from left to right behind the food dish. The user waits for the light to scan behind the column of food that he/she wants to eat, and then presses the single switch that sets the Handy 1 in motion. The robot proceeds onto the selected section of the dish and scoops up a spoonful of the chosen food, presenting it at the user’s mouth position. The user may remove the food at his/her own speed, and by pressing the single switch again, the process can be repeated until the dish is empty. The onboard computer keeps track of where food has been selected from the dish and automatically controls the scanning system to bypass empty areas. The use of walled dishes ensures that the food does not escape when the spoon scoops it into it.

![Figure 1. Handy 1 Eating System](image)

**Drinking System** – During early trials, it emerged that, although Handy 1 enabled users to enjoy a meal independently, many users stated that they would also like to enjoy a drink with their meal. Thus the robot’s design was revised to incorporate a cup attachment. The cup is selected by activating the single switch when the eighth light on the tray section is illuminated.

**Washing, Shaving and Teeth Cleaning System** - The Handy 1 self care system enables people with little or no arm or hand movements to achieve independence in important personal daily living activities, such as washing, shaving and cleaning their teeth. The self care system’s human machine interface is based upon the Handy 1 eating and drinking protocol, i.e. a single switch input used in conjunction with a scanning control methodology. With this practical device, users are able to instruct Handy 1 to pick up a sponge, move it into the bowl of water, remove excess liquid, apply soap and bring it to the face position, rinse their face and dry it using a warm air dry option to complete the task. The system is fitted with an electric shaver, toothbrush and drinking cup. All can be picked up and manipulated by the user in any order. Once chosen, the shaver or toothbrush can be moved by the user to any part of the face or mouth to allow shaving or dental hygiene to be performed in an efficient manner.

**Makeup Tray** - A questionnaire sent to one hundred women with motor neuron disease found that the activity they most wished to regain was applying their own cosmetics. In many cases the women commented that their caretakers were unable to apply their makeup to their taste and their inability to present themselves well left them with a feeling of frustration and loss of self-esteem. The Handy 1 makeup attachment (see Figure 2) is designed to enable women to choose from a range of different cosmetics. Briefly, the system works as follows: when Handy 1 is powered up, a series of lights adjacent to each type of cosmetics begins to scan. When the light is lit adjacent to the cosmetic that is required, the user simply activates the single switch. At this point the Handy 1 selects the correct brush or applicator and applies the correct amount of blusher, foundation, lipstick, eye shadow, etc. Once the make-up has been applied to the appli-
The prototype was mounted on an adjustable stand to facilitate its use with children or adults sitting in chairs of different heights (see Figure 3). Briefly the system can be described as follows: around a conventional shaped artists pallet were placed eight different colored felt tip pens which were housed in special holders. A light was positioned alongside each holder to facilitate any color pen being chosen and picked up. On each of the four edges of the drawing paper a light was positioned in order to allow directional control of the pens once they were in position on the paper. Also on the pallet were three further light displays labeled “up”, “down” and “new pen.” Their function when selected was to lower and lift the pen from the drawing paper and to enable a new color pen to be chosen. Users were able to draw by activating the single switch when the light adjacent to the pen color they wished to choose was lit.

The “Artbox” prototype was tested successfully in schools for children with physical disabilities. There was a high level of user and teacher satisfaction with the Artbox and it was concluded that the system could have the potential of being a useful educational aid for children with severe disability. However, several areas for improvement were highlighted, particularly the time delay encountered with the linear scanning lights and the viewing angle of the drawing board, which proved difficult for some of the more severely disabled children. A second prototype is now under construction incorporating the feedback gained from the pilot study.

Conclusion

The necessity for a system such as Handy 1 is increasing daily. Improvements in medicine and the changing age structure in the world means that fewer able-bodied people are caring for an even greater number of people with special needs. The simplicity and multi-functionality of Handy 1 has heightened its appeal to all disability groups and their caretakers. The system provides people with special needs a greater autonomy, and enhances their chances for a more productive and fulfilling life.

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