Engineering students in their senior year are anxious to translate theory into application. Most engineering curricula require a design course that accords senior students this practical experience, and design course faculty strive to offer a variety of projects to their students. Most of these projects, however, are not directly related to human needs; therefore, suggestions for projects that stress human factors in engineering are welcomed.

Through their work with patients, occupational therapists encounter a variety of situations where technological innovation plays a role in the solution of problems, many of which would make excellent engineering student projects. In addressing these problems, students gain practical experience in design, the opportunity to work with a variety of people, and the chance to solve the challenges they present. The patient benefits from the students’ knowledge of engineering science and expertise in the form of ideas and devices.

Because of frequent contact with the occupational therapy staff, the Biomedical Engineer (BME) at Montebello Center in Baltimore was exposed to a number of problems that could be alleviated with the application of appropriate technology. The BME then sought engineering students as additional manpower to help solve several of these patients’ problems.

The school of engineering at a local university was contacted to discuss the feasibility of senior-level students working on design projects at the hospital center. The idea was enthusiastically received by the Department of Mechanical Engineering, which then requested a list of possible design projects for the students.

The BME and occupational ther-
apy staff met and compiled a list of projects. This list was subsequently reduced to four projects selected on the basis of their anticipated level of complexity, engineering content, patient contact, estimated construction time (less than 3 months), and the availability of a therapist willing to assist with the endeavor. These four were submitted to the school with the hope that at least two would be chosen by the students for their projects.

**Results**

All four projects submitted were chosen by the students. A total of 17 students participated and were divided into four groups, one for each project. At the end of the semester, two groups presented completed working devices (Figures 1 and 2), whereas the other two groups proposed designs on paper. Brief descriptions of each of the four projects are given below.

**Group 1.** Five students designed and constructed an aluminum hinge (Figure 1) for use with an upper extremity extension system. To assist in the treatment of contractures, the hinge is used with half casts or Velcro straps and padding. It is adjustable for the different lengths and circumferences of the extremity. Allen bolts were used for adjusting and fitting to avoid further adjustments by the patient.

**Group 2.** Five students designed and constructed an ingenious typewriter platen reverse mechanism (Figure 2). The device attaches to the platen in place of the right knob and is activated by a round pushbutton mounted on the keyboard. An individual who cannot grasp and roll back the platen can now do so as easily as hitting one of the keys.

**Group 3.** Five students tackled the problem of quadriplegic arm supports that help position the arms in a defined area for long periods of time, such as for typing. Their proposed design entailed a C-shaped metallic rod placed in a bearing that can be bolted to a table top. Springs and cuffs would support each arm and give mechanical advantage to existing muscle function within a limited working range.

**Group 4.** Two students were given a reacher designed and manufactured locally and they asked several patients to evaluate the device. Modifications were made to increase the power transmitted to the grasping device at the distal end of the reacher. The students took this effort a step further and proposed a new reacher incorporating many of the features the patients thought appropriate. Their results were forwarded to the designer and distributor of the reacher.

**Discussion**

The students' progress on the projects was monitored by the therapists and engineer in their areas of expertise—medical and technical, respectively. Although the engineer served as faculty advisor for the 17 students and met once a week with each of the four groups, the students arranged additional meetings with occupational therapists as needed.

The time the BME and the therapists gave to the projects, approximately 40 and 20 hours, respectively, was donated by the hospital. The BME carefully followed design methodologies and kept the groups within monetary constraints and the limits of available facilities. The occupational therapists assessed patient compatibility, usefulness, and acceptance of the devices. In return, the students contributed to the hospital 500 to 700 hours of research and development work.

The two working devices will be used and modified as needed and the efforts of the two groups that did not produce working models will serve as stepping stones for future endeavors. Furthermore, the students enjoyed the opportunity to work directly with patients and believed they contributed positively to the patients' quality of life.

In conclusion, with good communication between hospital and university, a program that encourages engineering students to work on projects in a hospital environment produces results and benefits for both the patients and the students.