The system could easily have been designed to present the user with these part numbers and so forth without requiring the user to recall these things from his or her own memory. This greatly increased to memory burden upon the user.

Finally, and this is really unforgivable, incredible as it may seem, there was no on-line, context-sensitive help facility! Although I was taken through the training course offered by Silicon Techtronics, I often found myself leafing through the reference manuals in order to find the answer to even the most basic questions, such as: "What does this menu choice mean? What will happen if I make this choice?"

5. A reconstruction of the 'killer robot' tragedy

Police photographs of the accident scene are not a pleasant sight. The operator console was splattered with a considerable amount of blood. However, the photographs are of exceptional quality and using blow-up techniques, I was able to ascertain the following important facts about the moment when Bart Matthews was decapitated:

1. The NUM LOCK light was on.

The IBM keyboard contains a calculator pad which can operate in two modes. When the NUM LOCK light is on, it behaves like a calculator. Otherwise, the keys can be used to move the cursor at the screen.

2. Blood was smeared on the calculator pad.

Bloody fingerprints indicate that Bart Matthews was using the calculator pad when he was struck and killed.

3. A green error message was flashing.

This tells us the error situation in force when the tragedy occurred. The error message said, "ROBOT DYNAMICS INTEGRITY ERROR - 45 ".

4. A reference manual was open and was laid flat in the workstation reading/writing area.

One volume of the four volume reference manual was open to the index page which contained the entry 'ERRORS / MESSAGES'.

5. A message giving operator instructions was also showing on the screen.

This message was displayed in yellow at the bottom of the screen. This message read "PLEASE ENTER DYNAMICAL ERROR ROBOT ABORT COMMAND SEQUENCE PROMPTLY!!!"

On the basis of this physical evidence, plus other evidence contained in the system log, and based upon the nature of the error which occurred (robot dynamics integrity error - 45, the error which was caused by Randy Samuels' program), I have concluded that the following sequence of events occurred on the fateful morning of the killer robot tragedy:

10:22.30. "ROBOT DYNAMICS INTEGRITY ERROR - 45" appears on the screen. Bart Matthews does not notice this because there is no beep or audio effect such as occurs with every other error situation. Also, the error message appears in green, which in all other contexts means that some process is proceeding normally.

10:24.00. Robot enters state violent enough for Bart Matthews to notice.

10:24.05. Bart Matthews notices error message, does not know what it means. Does not know what to do. He tries "emergency abort" submenu, a general purpose submenu for turning off the robot. This involves SIX separate menu choices, but Mr. Matthews does not notice that the NUM LOCK light is lit. Thus, the menu choices aren't registering because the cursor keys are operating as calculator keys.

10:24.45. Robot turns from acid bath and begins sweep towards operator console, its jagged robot arms flailing wildly. No one anticipated that the operator might have to flee a runaway robot, so Bart Matthews is cornered in his work area by the advancing robot. At about this time, Bart Matthews retrieves the reference manual and starts looking for a reference to ROBOT DYNAMICS INTEGRITY ERROR - 45 in the index. He successfully locates a reference to error messages in the index.

10:25.00. Robot enters the operator area. Bart Matthews gives up on trying to find the operator procedure for the robot dynamics integrity error. Instead, he tries once again to enter the "emergency abort" sequence from the calculator keypad, when he is struck.

6. Summary and conclusions

While the software module written by Randy Samuels did cause the Robbie CX30 robot to oscillate out of control and attack its human operator, a good interface design would have allowed the operator to terminate the erratic robot behavior. Based upon an analysis of the robot user interface using Shneiderman's eight golden rules, this interface design expert has come to the conclusion that the interface designer and not the programmer was the more guilty party in this unfortunate fiasco.

7. References

1. Gritty, Horace (1990). The Only User Interface Book You'll Ever Need. Vanity Press, Oshkosh, WI, 212 pp.
2. Gritty, Horace (1992). "What We Can Learn from the Killer Robot", invited talk given at the Silicon Valley University International Symposium on Robot Safety and User Interfaces, March 1991. Also to appear in Silicon Valley University Alumni Notes.
3. Gritty, Horace (expected 1993). CODEPENDENCY: How Computer Users Enable Poor User Interfaces, Angst Press, New York.
4. Shneiderman, Ben (1987). Designing the User Interface, Addison-Wesley, Reading MA, 448 pp.
5. Robbie CX30 INTELLIGENT INDUSTRIAL ROBOT REQUIREMENTS DOCUMENT : Cybernetics Inc. Version, Technical Document Number 91-0023XA, Silicon Techntronics Corporation, Silicon Valley, USA, 1245 pp.
6. Foley, J. P., Wallace, V. L., and Chan, P. (1984). "The Human Factors of Computer Graphics Interaction Techniques". IEEE COMPUTER GRAPHICS AND APPLICATIONS, 4(11), pp. 13- 48.