Topic 3

The Case of the Killer Robot

Contents

Learning Objectives

- *Appreciation of the importance of the case study to this unit*

- *Familiarity with the background to the case study*

- *Awareness of the differences between the printed and electronic versions*

- *Appreciation of the need to undertake further reading in support of studies*

A robot may not injure a human being, or through inaction allow a human being to come to harm.

The first of Isaac Asimov's Three Laws of Robotics. See Asimov (1968) for example.

3.1 Background to the case study

You should have read the Background materials and Article 1 of "The Case of the Killer Robot" before starting on this topic. The list of topics which are being investigated for Assignment 1 all relate to the case study.

"The Case of the Killer Robot" (henceforth to be abbreviated to CKR) was originally conceived by Richard Epstein in 1989 as a teaching aid. He subsequently made the materials freely available on the WWW for use by other academics and there are copies in a number of places. See for instance Gehringer (undated), Melamed (1998) and Taylor (2002). In 1997 an expanded version was published by John Wiley & Son. You are advised to refer to either the book (Epstein 1997) or the website maintained by the author of the Praxis unit (Taylor 2002).

The book differs from the web-based materials not only in being much longer but also in other, important, details. There are more articles in the book and they are not presented in the same order as the web-based materials. If you are working from the book, use the web-based materials to identify the relevant articles.

References to article numbers in this unit refer to the web-based materials.

Some of the characters have been given different names in the book. The name changes (from book to WWW) are as follows -

Book	WWW
CyberWidgets Inc.	Cybernetics Inc.
George Cuzzins	Sam Reynolds
Hiram Milton	Sharon Skinner
Pam Pulitzer	Mabel Muckraker
Silicon Techchronics	Silicon Techtronics

Names in this unit will be taken from the web-based materials.

3.2 Issues raised in the case study

The reason CKR has been chosen as a unifying theme to run through this unit is that it raises many pertinent, but potentially dull, issues in a very entertaining form. Hopefully, by the time you complete this unit, you will agree that Epstein is to be applauded for this achievement.

The issues raised by CKR are many and various so we shall attempt to impose some order onto them by classifying them into four broad categories, as follows -

1. Requirements Analysis and Specification

   Was the solution proposed the correct one for the customer?

   Did the system specified actually produce that solution?

2. System Design and Development

   Was the design method employed appropriate for the specified system?

   Did the development methods and team suit the design?

3. System Testing and Usability

   Was the system thoroughly tested?

   Were the users of the system considered/involved?

4. Ethics and Culpability

   Did everybody concerned act with the best of motives?

   Who should be held responsible for the fatality?

In subsequent topics we shall be looking into these general categories in more detail and you will be researching specific ideas and methodologies in even more detail. Eventually we shall amass sufficient information to attempt an answer to the question of culpability in this case.

For now we shall confine ourselves to a few explanatory remarks relating to the topics which you and your fellow tutees are investigating for Assignment 1.

3.3 Robots and artificial intelligence

The Robbie CX30 robot is an industrial manipulator. It is not a human-looking android such as one might find in a science fiction film. Industrial robots come in a number of forms ranging from wheeled vehicles to various types of mechanical arms equipped with assorted controllers and end effectors to do the actual work. The CX30 isn't mobile; it is a mechanical arm bolted securely to the floor within a cage to reduce the potential hazard to human operators. It has a programmable controller which increases its versatility and thus makes it applicable to a variety of different tasks.

Nor should you expect too much of the robot's artificial intelligence. The Robbie CX30 cannot think. Its "intelligence" manifests itself as an ability to react to a variety of sensor inputs thus providing it with a more adaptive control system than its predecessors. Asimov's Three Laws of Robotics (Asimov 1968) hardly apply to such a primitive device. The field of Artificial Intelligence is vast but those areas most relevant to the Robbie CX30 are sensor processing and decision making based on the information gleaned from that processing.

3.4   Usability and safety critical systems

User interfaces are often the last thing on the minds of system developers who are much more interested in the technical details of their products than the end users of them. However Human Computer Interaction (HCI) or Man Machine Interaction (MMI) should not be considered as an after-thought. Poor interfaces can be unfriendly, inefficient and downright dangerous. The evaluation of what constitutes a good or a bad interface is clearly dependent on who the users are and what they are used to. Involving users in the evaluation is clearly sensible. Involving users earlier on, at the specification, design and development stages, can save time and effort in the long run. Usability engineers have devoted considerable study to understanding how people interact with machinery and computers and there is much guidance available to the designer who is prepared to seek it out.

This is nowhere more true than in the sphere of safety critical systems. Systems which have the potential to cause great damage if they go wrong are designed and developed to minimise the likelihood of a catastrophic failure. The one element of these systems which is always an imponderable is the actual human beings who interact with them. Interfaces to safety critical systems must be designed to eliminate the possibility of inappropriate user actions. This can be achieved in a number of ways ranging from disabling particular user options in certain states of the system to providing hardware interlocks that power the system down in the event of a user physically entering somewhere that would be dangerous to them.

3.5   Software negligence

Injuries and fatalities involving industrial robots have, in fact, been very rare. Unfortunately incidents in which poorly designed or developed software have led to loss of human life are becoming more common. A cursory search on the WWW will turn up all too many such incidents. In many countries nowadays, if the personnel or the company responsible for such software can be shown to have been negligent, criminal sanctions can be applied. Unfortunately the level of proof required by the courts is often unattainable but the law is catching up.

3.6   End of topic test

Q1:   Comparing it with the WWW material, Epstein's book is-

a) Easier
b) Longer
c) Simpler
d) Shorter

Q2:   Sharon Skinner in the WWW materials became who in Epstein's book -

a) George Cuzzins
b) Robbie CX30

c)   Hiram Milton
d)   Sam Reynolds

Q3:   Which of the following general categories will NOT be looked at in detail -

a)   Budgeting and financial control
b)   Ethics and culpability
c)   Requirements analysis and specification
d)   System testing and usability

Q4:   Who will be researching specific ideas in the greatest detail in this unit -

a)   Author of these materials
b)   Turina Babbage
c)   Robbie CX30 development team
d)   You

Q5:   The Robbie CX30 robot is -

a)   An android
b)   An industrial manipulator
c)   A program which seeks material on the WWW for a search engine
d)   A walking machine

Q6:   The part of a robot which does the actual work is called -

a)   An end effector
b)   A gripper
c)   A tool
d)   The tool centre point

Q7:   The Three Laws of Robotics are due to -

a)   Isaac Asimov
b)   Arthur C. Clarke
c)   Mary Shelly
d)   Star Wars

Q8:   Which of the following is NOT an alternative name for the field of interface design-

a)   HCI
b)   MMI
c)   Usability engineering
d)   User friendliness

Q9:   Safety critical systems are systems which -

a)   Are complicated
b)   Can cause great damage
c)   Are expensive
d)   Mustn't stop

Q10: Software negligence is becoming -

a)   Less common

b) Less expensive
c) More common
d) More dangerous

3.7 Assigned task

Assigned task

- Read "The Case of the Killer Robot" Article 5 (Epstein 1997 or Taylor 2002) before embarking on Topic 4.

Time taken?Time taken? min

- You should now turn the notes you made on the topic assigned to you in Topic 2 into a 1000 word submission for Assignment 1. This assignment should be submitted at your next tutorial. It will be assessed and the mark will account for 33% of your final mark in the Praxis Unit.

Reminder of Assigned Topics 1-9 -

• Industrial Robots	- Types	1st Tutee
	- Controllers	2nd Tutee
• Artificial Intelligence	- Sensing	3rd Tutee
	- Control	4th Tutee
• User Interfaces	- Design	5th Tutee
	- Evaluation	6th Tutee
• Safety Critical Systems	- Examples	7th Tutee
	- Interlocks	8th Tutee
• Software Negligence	- Examples	9th Tutee

3.8 References

Asimov, I., 1968, I, *Robot*. Granada.

Epstein, R.G., 1997, *The Case of the Killer Robot*. John Wiley & Son.

Gehringer, E., undated, Risks: *Software Safety: Killer Robot* [online]. North Carolina State University [cited 7th July 2003]. HTML. Available from:

http://courses.ncsu.edu/classes-a/computer_ethics/risks/safety/killer_robot/

Melamed, M., 1998, *Online Ethics Center: The Story of the Killer Robot* [online]. Case Western Reserve University [cited 7th July 2003]. HTML. Available from:

http://www.onlineethics.org/cases/robot/robot.html

Taylor, N.K., 2002, *The Killer Robot* [online]. Heriot-Watt University (MACS), 16th December 2002 [cited 7th July 2003]. SHTML. Available from:

http://www.macs.hw.ac.uk/˜nkt/praxis/epstein/index.sht

Answers to questions and activities

3 The Case of the Killer Robot

Answers from page 4.

Q1: b) Longer

Q2: c) Hiram Milton

Q3: a) Budgeting and financial control

Q4: d) You

Q5: b) An industrial manipulator

Q6: a) An end effector

Q7: a) Isaac Asimov

Q8: d) User friendliness

Q9: b) Can cause great damage

Q10: c) More common