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Code of Ethics: A Transoral Robotic Surgery Case Study

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Abstract

Robotics is a high technology that integrates various disciplines such as computer engineering, artificial intelligence, mechanics, bionics, and so forth. Due to its interdisciplinary nature, multiple fields such as engineering, medical, computer and Human-Robot Interaction (HRI) are reviewed in order to satisfy the objective that to develop a code of ethics for robotics. For the main outcomes of the paper, a code of ethics that combines multiple fields is produced. In total, there are five essential ethical principles that are outlined in the code of ethics. In addition, the paper also proposes the idea that there can be a concise ethical risk assessment to apply to any robotic product or service in order for any stakeholders to intervene in time to calibrate its ethical value, such that the robotic technology can truly be beneficial to human society.

Keywords: Robotics; Interdisciplinary; Human-robot interaction.

1. Introduction

Robotics is widely used for replacing the manual labour by building automated machines which call the robot [1]. Depend on the situation, the robot is applied in various areas to do different things such as drive vehicles, manufacturing process, bomb detection etc. As mentioned in [1, 4], robotics rapidly grows from the earlier generation which is the pre-programmed robot that certain operations are repeated automatically through the predefined program, to the current generation that operations are made based on the judgement by the AI, which means it turns to the autonomous robot that will gather, identify, understand the information obtained from the environment to operate autonomously to achieve the predetermined goal. In addition, the appearance of robots is becoming more and more human-like depending on the preferences of their creators.

There is no doubt that the widespread use of robotic brings great benefits, but also brings the corresponding ethical dilemmas due to its autonomous and humanoid nature. For instance, your service robot makes a dinner for you by killing your lovely cat. It is the nightmare result due to the lack of ethics. To make robotic truly beneficial to human society, the ethical issues behind it must not be ignored.

1.1 Objective

The objective of this paper is to design and create our own code of ethics for the robotics and sum up several main principles. For evaluating the code, the framework is applied to a real-life ethical case is explored. Ideally, the code will guide the way forward for future robotics development.

2. Literature review

The purpose of this section is to provide an overview on the code of ethics from various literatures related to the robotics topic. Due to this topic should be addressed with the systematic and interdisciplinary approach [3], so the multiple fields will be analysed, and the focus is on engineering, medical, computer, Human-Robot Interaction (HRI). By evaluating those existing code of ethics, our own framework of the code can be drawn.

2.1. ENZ Code of Ethical Conduct

The ENZ code of ethical conduct [8] outlines 8 ethical principles with high standards that expect all New Zealand engineers should be adhering to. These principles specify the main idea that all engineers should act competently and carefully at all times. It is constructed based on the area of professional competence, personal integrity and social responsibility, cover both software and hardware engineering area which perfectly suit for the robotic field.

The first principle: "*Take reasonable steps to safeguard health and safety*" can be understand as bad effects that the robot might bring to the public. For instance, the cleaning robot lost control thus cause serious damage to users. It also works for the creator site, such as safeguard workers and engineering while working in the office and manufactory. Except that, the last principle of [8] propose that we should report breach of Code whenever and whatever. It supports us to work honestly with each other and fight against any existence of non-ethical behaviour. For instance, if your superior order you to add a feature that is not ethical to the robot, this principle can then be the justification to protect yourself and fight against with it.

2.2. WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects

This WMA declaration [9] outlines a set of ethical principles with high standards for any medical research that participants are involved. It is common to see that human participants are involved in the human robot interaction field, so robotics ethical codes can be informed by some of ethical principles in [9].

The paper [3, 5] propose that WoZ is a typical ethical issue that robot can be operated remotely which cause participants cannot determine whether they are interacting with human or robot. For example, manufacturers exaggerate the functionality of their robots, which leads to users being deceived or even cause the privacy data leakage.

For those principles that can be referenced in [9], they emphasize rights and protections that participants can gain during studies. They state that all participants have the informed consent right and privacy protection right which deal with the ethical issues like WoZ.

2.3. ACM Code of Ethics and Professional Conduct

The ACM Code of Ethics [10] is designed for professionals working with software and on computers. As it states, their code is not for solving the particular ethical issues, but servers as a basis for ethical decision-making, so multiple principles should be considered when facing the ethical issue. There is a guideline behind each principle that helps professionals to better understand the principle to decide whether it can be applied on the specified ethical issue. It expects that professionals take the public good always as the primary consideration when making decisions.

2.4. Ethics issues in the field of HRI

The analysis of Rosén et al. [2] shows that ethical conduct is rarely reported in the HRI field. It is undoubtedly too late to be aware of ethical issues until they occur. For stimulating the ethical thought and raise the consensus, a few representative and typical ethical issues are summarised from [3, 4, 5].

- What form should robots present?
  - Through the research, people's attitude towards robots can be manipulated easily by appearance, emotions, and voices of robots. This leads to the possibility of deliberate manipulation of human emotions for profit, so ethical oversight is required on the presentation form of robot.
- Privacy data leakage issue when interact with social robot.

- As long as the robot is running, there is a possibility that sensitive data may be revealed unintentionally. For instance, the simple log data record the active and inactive time of the robot, which reveal the privacy sensitive information unintentionally since the house occupied time can be easily deduced. It is tricky since nothing is really secure to attackers, the mitigation strategy should focus on the reasonable design consideration.

- Turing deceptions caused by the Wizard of Oz (WoZ) technology.
  - WoZ is a technology used by human to operate the robot remotely, so, participants cannot determine the thing with which they are really interacting. To mitigate and prevent Turing deception issues like this, robot capabilities should be transparent to the public.

2.4.1. Code of ethics for HRI Profession

Riek and Howard [5] propose a code of ethics that aiming for addressing ethical issues such as above. Particular principles are designed and constructed in four considerations, which are social, legal, design and human dignity considerations. The main idea behind all the principles is that HRI practitioners should consider the need for robots to be always respectful of people in human-robot interactions and to avoid offending any human rights and protections just because they are robots. They specif the prime directive that all HRI activities such as development, marketing, and research, should follow the overall principle which respect for human persons that involves autonomy, bodily and mental integrity.

Rosén et al. [2] analysed the reporting trend of ethical conduct, and point out five ethical principles, which are *ethical board approval, informed consent, data protection and privacy, deception and debriefing.* Through their theoretical justifications, these five ethical principles are identified from three widely used ethical guidelines which represent the psychological, medical, and social area. It strongly illustrates that they are more valuable principles then others. Additionally, Li and Meng [6] propose several strategies to deal with the ethical issues arise from the robotics application area. There is a strategy that can be fit into our framework that is: the constructed ethical code should meet an objective that all robotic activities must satisfy the human moral values and act in a way that is acceptable by human. And turn it into the normative position such that pervade and apply it through all aspects.

3. Code of ethics

A code of ethics is a guide of principles which document the set of standards which the professional need to adhere to approach problems [7]. It is manifested outwardly by guiding professionals to work with honesty and integrity so that they can serve each other and society, as well as become the support when facing the less ethical practises and unfair treatment while working.

The literature review section explored a set of ethical best practice documents created by professional institutions, and the ethical codes proposed by individuals. To cream off the best and filter out the impurities from them, my code of ethics for robotics can be drawn to portray the expected behaviour of professionals to work with honesty and integrity from the following principles:

1. Safeguard health and safety which including both physical and mental health.
2. The product capability is transparent to participants and the public.
3. The human right to data protection and privacy should always take as the primary respect with reasonable design objectives.
4. The robot behaviour should be predictable and re-constructible for the purpose of accountability.
5. Do the study and research with the ethical board approval.

3.1. Safeguard health and safety which including both physical and mental health.

Life safety and health is always the most important factor, so as the professional engineer, we need to do everything we can do to keep the product safe and not hurt anyone. For example, add a feature with the highest privilege that allow the user to terminate the robot in the case that lost control.

For the mental health, the robot should design in a way that respect the human frailty. The appearance and behaviours of the robot should be designed to avoid the human frailty such as ableist morphologies, racist, sexist.

3.2. The product capability is transparent to participants and the public.

As the WMA [9] outlines, participants have the informed consent right which means they have the right to know everything about the robot capability. It can be used to avoid the abuse of the WoZ technology such that the robot product is operated remotely by others which further cause the possibility of the user privacy data leakage and user expect too much from the product.

3.3. The human right to data protection and privacy should always take as the primary respect with reasonable design objectives.

According to NZ Privacy Act [11], all information from people must be collected in a fair and legal way, and should be protected with safeguards that are considered reasonable, to prevent loss, disclosure or misuse.

It illustrates that robots should not collect and store the information from people directly since it is not a fair and legal way. For the legal and fair way, the robot product must tell the user that what kind of information will be collected and stored, each user has the inform consent right. Furthermore, for information collected in a fair and legal way, they must be protected with highest security level.

Also, the data can only be accessed when authorized or when compelled by the public good. Data is a double-edged sword that can be used for the benefit of society or to wreak havoc. As an ethical professional engineer, the data must be used in the right way.
For the reasonable design objectives, it means all physical units should be designed with reasonable purposes. The paper [3] mention that social robots are equipped with different physical units with different purposes, and some units are necessary for the robot to function properly. Therefore, the design that might collect the data illegally is not acceptable.

3.4. The robot behaviour should be predictable and re-constructible for the purpose of accountability.

All robotic activities must satisfy the human moral values and act in a way that is acceptable by human. Only if the issue of how robots make decisions is solved, the public will accept to use the robotic product [6]. Nobody will use uncontrollable robots since unknown is scary that people's safety will be threated.

3.5. Do the study and research with the ethical board approval

It refers to the researcher must ask for approval from the residing country before doing the study. The information about the intended study and how it is intended to be carried out must be provided to the residing country to show the respect [2].

4. Case study

Transoral robotic surgery (TORS) [12] is a type of robotic surgery to enables safe treatment to treat tumours in the hard-to-reach areas, such as the back of the throat. In the TORS procedure, the surgeon will view and access oral structures such as head and

neck subsites, back of the throat from the special camera of the surgical robot. In addition, there is also a computer console that is used by the surgeon to manage every movement of the instruments of the surgical robot and the camera.

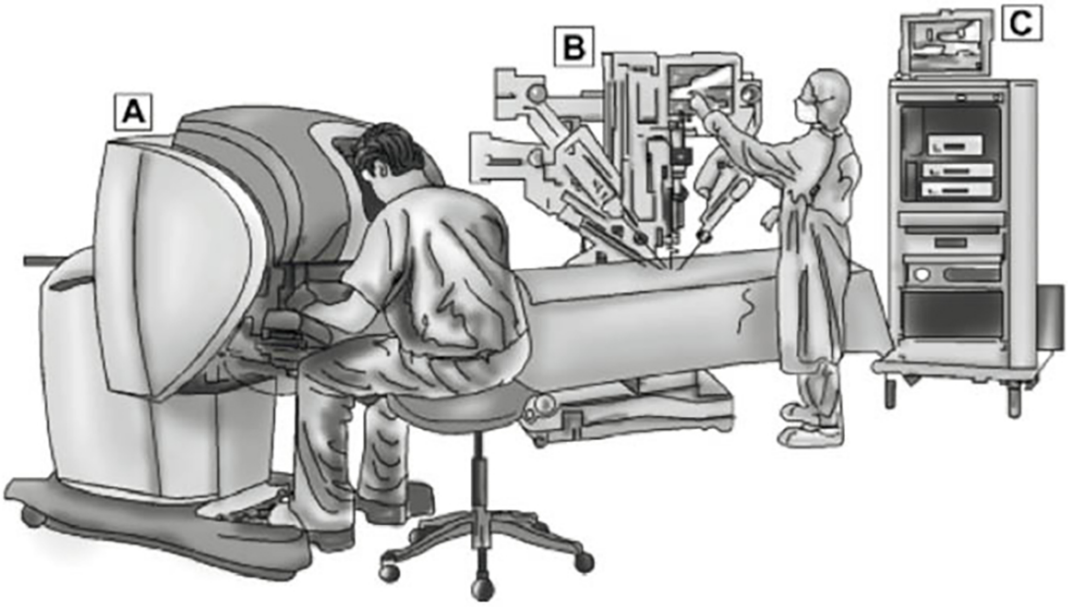

Figure 1. Illustration of surgical system robot
A, surgeon's console; B, patient-side robotic cart; C, high-definition, 3D vision cart
Reproduced from Garg A, Dwivedi RC, Sayed S, et al. Robotic surgery in head and neck cancer: A review. Oral Oncol 2010;46(8):571–76, with permission from Elsevier.

Krishnan et al. [13] illustrate that TORS is increasingly being adopted globally, but not in New Zealand currently due to some reasons. Due to its global trends, it is not surprised that TORS will also increasingly be adopted and diffused in the future. Therefore, for this section, the case of TORS will be introduced and analysed to show how each of my principle of the code can be applied to it.

4.1. Safeguard health and safety which including both physical and mental health.

The appearance of the robot is the combination of the mechanical arm and the computer console. This appearance design respect the human and avoid any cases of ableist morphologies, racist, sexist, so the mental health and safety is protected.
For the physical health, surgeon can terminate the machine in the case that lost control via the button or computer console, which also protect the physical health and safety.

4.2. The product capability is transparent to participants and the public.

Both surgeons and patients know the capability of the surgical robot on what it can do and what it cannot do, so this transparency guarantee the informed consent right. Therefore, they are not under the illusion that this robot can cure patients perfectly 100%, it just increases the chances.

4.3. The human right to data protection and privacy should always take as the primary respect with reasonable design objectives.

Before each surgery, the patient will be informed that what kind of data will be collected and stored to the surgical robot. When the patient accepts, then data will be protected with the highest security.

There will be a part of data about surgery itself such as the image and video data of the tumour position data for each surgery. For the purpose of the public good, these data can

be accessed and reused as the learning experience, they can bring the benefit to the society.

4.4. The robot behaviour should be predictable and re-constructible for the purpose of accountability.

It is common to see surgical accidents from various number of surgeries. If it happens, the cause of the accident will undoubtedly be investigated. If the behaviour of the surgical robot is not predictable and re-constructible, then the patient will never know who should be responsible for the accident thus reject to do the operation since their safety is threated. Therefore, as the profession engineer, with this principle applied, the issue of how the robot operates is solved, so the patient will accept to use it without the fear.

4.5. Do the study and research with the ethical board approval.

For this principle, it is not high related to this TORS topic. It can be understood in a way that if a doctor wishes to explore and investigate a new use of the machine outside of its current application, then information about the new research, and how it will be conducted and carried out, must be reported to the ethical board and ask for the approval.

5. Conclusion and recommendations

This paper finds that the essence of these complex ethical problems is that we are experiencing a crisis of the creative order. That is, the possibility of mankind being turned against itself by the technologies it has created (i.e., AI and robotics). Robots with AI are not as intelligent as humans but are given the responsibility to make decisions for us.

Therefore, in conclusion, the code of ethics for robotics needs to consider the main problem that how we use this increasingly powerful tool without being harmed. It expects engineers to design the product with respects of human rights such as health and safety, privacy data protection and informed consent right. As well as take into the account that the robot system and capability should be open and transparent, the robot behaviour should be predictable and re-constructible.

In addition, it is recommended to apply a concise ethical risk assessment to any robotic product/service. When it is highly risk, then all stakeholders which involves users, engineers, vendors can all intervene in time to calibrate its value, such that the robotic technology can truly be beneficial to human society.

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