HIGHLIGHTING ETHICAL DILEMMAS IN SOFTWARE DEVELOPMENT: A TOOL TO SUPPORT ETHICAL TRAINING AND DELIBERATION

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EXTENDED ABSTRACT

INTRODUCTION

Ethics is an increasingly important facet of software development and a key concern for all stakeholders of software systems (Gogoll et al., 2021). The now pervasive use of software in our daily lives means that a lack of ethical deliberation by software professionals can have serious consequences for stakeholders including end users. This recognition has led to the definition of codes of ethics for software engineering (SWECOE) (Gotterbarn et al., 1997) and sets of ethical principles applicable to specific areas such as Artificial Intelligence (AI) (Floridi & Cowls, 2019; Lo Piano, 2020). These codes and principles are intended to serve as a foundation for ethical decision-making by software engineers. However, software professionals are not typically offered training in ethical deliberation or given pragmatic tools to support it. Therefore, they may find it challenging to apply the principles in practice (Hagendorff, 2020). Our work aims to create a project management tool that helps to highlight ethical dilemmas during software development and integrates an extensible training resource for ethical deliberation. This paper describes the context, design, implementation, and evaluation of a proof of concept tool developed for this purpose and outlines avenues for further work.

RELATED WORK

The ACM / IEEE Software Engineering Code of Ethics, published in 1997, provides ethical guidance for software engineering professionals in the form of eight principles relating to: Public, Client and Employer, Product, Judgement, Management, Profession, Colleagues and Self (Gotterbarn et al., 1997). Several ethical principles and frameworks for AI have also been defined (Floridi & Cowls, 2019; Lo Piano, 2020; Prem, 2023). However, there has been limited research on how ethical deliberation can be supported during the creation of software artefacts (Gogoll et al., 2021) and whether effective ethics frameworks exist for software engineering processes in the industry (Mitchell et al., 2022).

Several solutions for facilitating ethical practices in software engineering have been proposed. A robust ethical framework helps in creating educational resources and training modules for students so that they develop into ethically aware professionals. Taherdoost et al. (2011) suggested including topics like "computer crime, privacy, intellectual property, accuracy, accessibility, morality, and awareness" in computer ethics courses. Additionally, the Ethical-Driven Software Development Framework (Lurie & Mark, 2016) encourages consideration of ethics throughout the Software Development Life Cycle (SDLC), particularly in agile software development. Despite the significant work already done on defining codes and principles of ethics and ethical frameworks, applying these principles and frameworks in the workplace can be challenging (Mitchell et al., 2022).

Despite these contributions, there is still a lack of practical support for ethical deliberation in software engineering.

METHODOLOGY

A survey of related work was conducted to ascertain the state of the art in the area. Based on the findings, a prototype agile project management tool, incorporating support for ethics training and highlighting ethical dilemmas, was developed. The development itself followed an agile methodology. The prototype tool was evaluated to assess its usability and effectiveness in raising awareness of ethical dilemmas and refined to reflect the results of the evaluation. Ethics approval for the evaluation process was obtained from the higher education institution.

DESIGN, IMPLEMENTATION AND EVALUATION

The design and implementation phase focused on creating a proof-of-concept web-based ethics-centred project management tool aimed at software professionals. The features supported by the tool include an interactive ethics training resource, a Kanban project management board as an exemplar of agile project management, ethical framework infographics, ethics regulation checklists, a text adventure game, chatbot recommendations, ethics keyword flagging, and ethics self-assessment.

The resource illustrates the principles of the ACM Code of Ethics interactively via text adventure games and includes a recommendations component to extend users' knowledge of ethics. The project management tool highlights ethical concerns and resolutions to ethical dilemmas in decision-making. The highlighted dilemmas are related to the features or tasks in the product backlog. The Kanban board support the management of agile software development. Tasks are visualised on the board, allowing developers and project managers to see the state of each task at any time to promote ethical awareness and foster a culture of ethical responsibility and accountability throughout the software development process.

A client-server architecture was used for the web application system. The client handles the user interface for all the features listed above. The server manages backend processes, data processing, and business logic, and provides APIs for the client. The MERN stack (MongoDB, Express.js, React.js, Node.js) was used for the development of the tool.

A software artefact evaluation questionnaire was used to assess the software's effectiveness in supporting ethical practices in software development. Feedback was gathered from 21 participants in a higher education setting through opportunistic sampling. All participants were experienced in software development and used the software prototype before completing the user evaluation questionnaire. The questionnaire evaluated interface clarity, ease of use, progress tracking, and integration of ethical guidelines in software development. It also assessed risk identification, resource support, and integration with existing project management tools.

RESULTS AND DISCUSSION

The results from the evaluation provided valuable insights into the usability of the tool and its effectiveness in promoting ethical awareness among users. 66.67% of users "strongly agree" and 33.33% of users "somewhat agree" that "the tool supports the training and education of software developers on ethical dilemmas and best practices of software development ethics". Participants provided suggestions for improving functionality and user-friendliness.

According to participants, one key strength of the tool is its customisability, supporting the training of software developers on ethical issues and best practices. The ethical dilemma scenarios and adventure games were deemed insightful and engaging, making the learning process interactive. Additionally, the ethics checklist effectively assesses ethics practices in projects, ensuring ethical considerations in software design.

In summary, the user feedback highlights advantages such as customisability, effectiveness in assessing ethics practices, and interactive features. The suggested improvements include expanding the ethics glossary, enhancing the recommendation system, and implementing version control and peer review for ethical practices. Users would also like to have support for other development methodologies in addition to Kanban. Addressing these areas will enhance the tool's applicability, effectiveness and user-friendliness.

CONCLUSION

This project contributes to the software engineering community by providing an extensible training resource and a custom agile project management tool highlighting ethical dilemmas. The resources fill the gap in ethical training and tools for software professionals. By raising awareness and providing necessary resources, this project improves ethical practices in the software development community.

Figure 1. In the ethical dilemma text adventure game, users engage with immersive scenarios, prompted by a graphical illustration. They select ethical practices from action buttons, indicated by changing button colours.

Figure 2. A sample project board for a student job portal system, with populated sections and tasks. The grey icons allow adding tasks or deleting sections. The red bin icon deletes the entire project board.
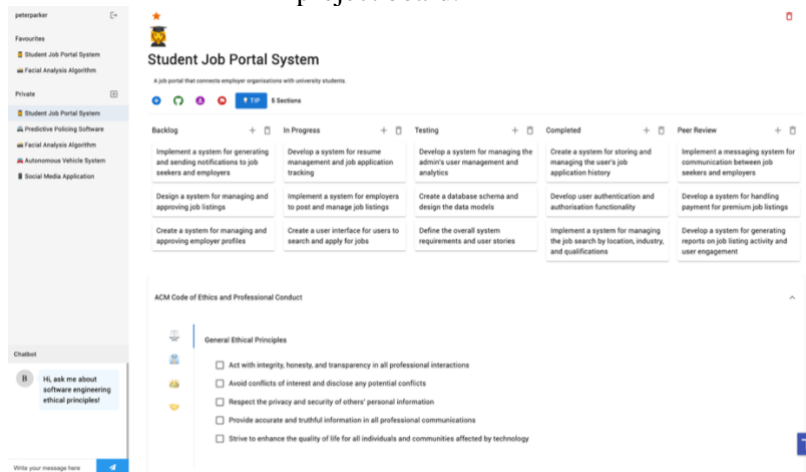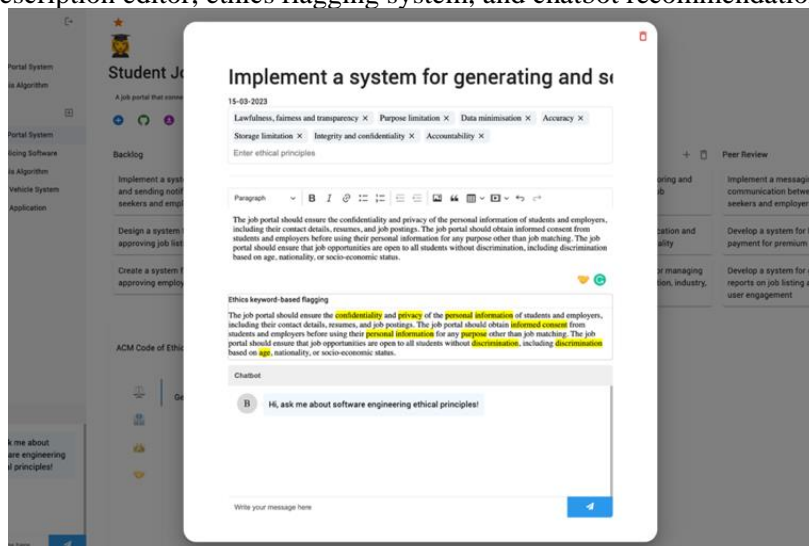

Figure 3. The task modal on the project board displays ethical principle tags, creation date, description editor, ethics flagging system, and chatbot recommendations.

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