UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft

Die/der
Vorsitzende des Prüfungsausschusses

Antrag auf Zulassung zur Abschlussarbeit

Antragsnummer 429991

1. Antragsteller

1.1.1 Daten zur Person

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Thema: Evaluation and Implementation of a motivational bot to support documentation process in mechatronics system design

Ich beantrage die Zulassung im Rahmen des o.g. Studiums. Mir sind die Regelungen der für mich geltenden Prüfungsordnung bekannt. Ein Exemplar der Arbeit ist 5 Jahre aufzubewahren (die Frist beginnt mit Abgabe der Arbeit) und auf Verlangen der Universität Paderborn zur Verfügung zu steller

Paderborn, 11. 01. 2021

Unterschrift Antragsteller/-in

2. Zentrales Prüfungssekretariat

Das ZPS bestätigt mit Ausstellung dieses Antrages, dass der o.g. Antragsteller / die Antragstellerin die Zulassungsvoraussetzungen zur Vergabe der Abschlussarbeit erfüllt hat.

Ausstellungsdatum: 30.11.2020

Bemerkungen:

3. Betreuer/-in bzw. Gutachter/-in (Lehrstuhlinhaber/-in)

Hiermit bestätige ich die Angaben unter 1.2. (Falls zutreffend: Thema unter 1.2 durchstreichen und die Änderung auf der Rückseite vermerken)

Laufzeitbeginn: 1. 1. 2021 (BITTE STETS EINTRAGEN!)

Paderborn, 18. 12. 2020

Unterschrift Betreuer/-in bzw. Gutachter/-in

Bitte den von allen erforderlichen Personen unterschriebenen Antrag umgehend einreichen:
Dezernat 3.2, Manuel Leßmann, C2.332

Studienarbeit: MA-0188
Status: vergeben
Stand: 20. Oktober 2020

Thema: Evaluation and Implementation of a motivational bot to support documentation process in mechatronics system design

Problematik und Zielsetzung

Der Entwurf mechatronischer Systeme ist ein fortwährender Problemlösungsprozess. Ständig stehen Entwickler*innen in den einzelnen Entwicklungsdomänen vor einer Vielzahl von Entscheidungen: Sie bestimmen zum Beispiel über Aussehen, Funktionalität oder Benutzerschnittstellen einzelner Systemelemente, die in vielfältigen Abhängigkeiten zum Gesamtsysteme stehen. Die Ergebnisse der Entscheidungsprozesse sind oft nur in den spezifischen Autorensystemen hinterlegt. Eine nachvollziehbare Dokumentation des zugrundeliegenden Entscheidungsprozesses erfolgt nur sporadisch oder unstrukturiert. Im Arbeitsalltag werden oft andere Themen höher priorisiert.

Vor diesem Hintergrund bieten Kollaborationsplattformen wie MS-Teams neben der eigentlichen Kommunikationsfunktionalität ebenfalls Lösungen zur Prozessautomatisierung. Mit sogenannten Bots können so wiederkehrende Aufgaben erledigt werden. Eine Einsatzmöglichkeit dieser Bots ist die Verwendung als Motivationswerkzeug. Mitarbeiter können durch Bots (z.B. Disco) gezielt motiviert werden, Aufgaben zu erledigen. Ein Einsatz dieser Bots zur Motivation der notwendigen Dokumentation von Entscheidungen im Produktentstehungsprozess ist noch nicht bekannt.

In der vorliegenden Arbeit soll auf Basis einer umfassenden Literaturrecherche ein Konzept für einen Motivationsbot zur Dokumentation von Entscheidungen entwickelt und umgesetzt werden. Durch eine umfangreiche Literaturrecherche zu den Themenfeldern Entscheidungsdokumentation, Anreizsysteme, Collaborationtools und Kommunikationsbots (insb. Motivationsbots) soll zunächst die Grundlage der Arbeit ausgearbeitet werden. Anschließend sollen vorhandene Lösungen für Motivationsbots in Kollaborationsplattformen recherchiert werden. Danach sollen die vorhandenen Bots auf Basis ihrer Eignung für einen Einsatz zur Entscheidungsdokumentation bewertet werden. Aufbauend auf den Ergebnissen soll im Anschluss ein eigener Motivationsbot für den definierten Einsatzzweck entweder neuentwickelt oder ein bestehender Bot entsprechend angepasst werden.

Arbeitsprogramm

1.	Detaillieren der Problemanalyse	20 h
2.	Literaturrecherche zu den Themenfeldern Entscheidungsdokumentation, Anreizsysteme, Collaborationtools und Kommunikationsbots	60 h
3.	Recherche nach vorhandenen Lösungen für Motivationsbots in Kollaborationsplattformen	60 h
4.	Bewertung vorhandener Lösungen für einen Einsatz zur Entscheidungsdokumentation	60 h
5.	Zwischenpräsentation	20 h
6.	Aufbauend auf den Ergebnissen Anpassung oder Neuentwicklung eines Motivationsbots	60 h
7.	Anfertigen der Arbeit	60 h
8.	Abschlusspräsentation	60 h
		400 h

Bemerkungen

Voraussetzungen

- keine

weitere Bemerkungen

- Bei den angegebenen Zeiten im Arbeitsprogramm handelt es sich um Richtwerte

Betreuung

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HEINZ NIXDORF INSTITUT

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Master Thesis

Proposal

Evaluation and Implementation of a motivational bot to support documentation process in mechatronics system design

presented by

Bhargavi Mohan

Matr.-Nr. 6843331

Supervisor:

Prof. Dr.-Ing. Roman Dumitrescu
Prof. Dr. Eyke Hüllermeier

Paderborn, 14.10.2020

Master Thesis Nr. (MA0188)

Evaluation and Implementation of a motivational bot to support documentation process in mechatronics system design

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1 Introduction

Mechatronics is an engineering field that comprises of mainly mechanical, electrical and computer science domains [Neu12]. Mechatronic product development means the independent development of mechanical, electrical and software parts that are later united to constitute the entire system. The process of development of such a system has numerous challenges [BVK+16] [ACFT+10]. These challenges are mainly due to the presence of a wide range of disciplines and stakeholders. To overcome these challenges and to promote collaborative, simultaneous engineering, Mcharek et al. propose a useful framework called "Knowledge Based Engineering" in [MAH+18]. This helps the engineers in one of the main tasks — decision making [DDW15][Hir07]. The study of mechatronics can be split into a variety of other focus areas like sensors, actuators, system modeling, logic systems etc. It involves complex decision making throughout the life cycle of product development process[HJC+15]. Therefore, mechatronics product development happens to be an extremely interactive domain. Due to this multi-disciplinary nature, the team members involved in mechatronics system design also come from multiple fields of engineering. This demands a high level of collaboration among the team members for a successful system design or product development [Neu12]. Collaboration tools become very significant in such a team for all it's members to be aligned. Tools like slack [LZSS16] and Microsoft teams [HB18] are extremely popular in the developer community. Additionally, such tools also aid the exchange of knowledge, information, updates and decisions about the development during the process. Furthermore, collaboration tools these days are highly sophisticated with numerous useful bots[LZFS19]. Bots are nothing but an interactive interface for users to avail software services. They can also be termed as artificially intelligent, capable of comprehending commands from users or sometimes smart enough to carry out automated tasks. These bots are said to be highly convenient to carry out regular tasks. Conversational bots these days are so engaging and intelligent that it is often difficult to spot differences between a human and a bot[MP19]. There are also software bots [LSZ18] that aid a variety of tasks related to code development, code maintenance and other productivity tasks through simple commands. Further, Carlene et al. highlights that these chatbots help reduce the collaboration friction among the software developers [leb17].

So far, I have discussed some of the prime responsibilities of a mechatronics team such as design, decision making and collaboration through the product development process, now I highlight another salient task — documentation. There are numerous benefits attributed

to the documentation activity. For instance, up-to-date knowledge is recorded and as a result, all the learning and know-hows is conserved. The documentation also serves as a road map for the further developmental activities. Lack of documentation leads to lack of maintenance, lack of complete, updated systems and lack of traceability of the crucial design decisions. Therefore, Heesch et al.in [HAT13] discusses why decision documentation can be valuable for the junior engineers.

In this master thesis, I study the mechatronics systems/mechatronic product development process, assess different types of challenges in the product development process, with that knowledge analyze the relevant problems pertaining to documentation of design decisions, explore how collaboration tools can act as a beneficial medium to gather key design decisions and finally prototype a bot that can help transform that data as a document for future reference. I will also evaluate some of the existing bots in parallel to see if they can be adopted to achieve our goal in the context of documenting design decisions.

2 Problem Description

Mechatronics being a diverse team raises certain concerns in the course of product development lifecycle [BVK+16][Neu12]. I assess some of them in this masters thesis. Based on my literature review, there are two most important issues that needs to be addressed in a typical mechatronics team. These two are separate issues and are yet inter-dependent. The first problem causes the second problem below. So, problem number 2 is the major issue of concern.

1. Among the multiple domains within a team, there is room for improvement to exchange knowledge with respect to terminologies, functional requirements, design parameters and developmental processes. Weak knowledge management can lead to confusions within team members and hamper the design and development. There needs to be an organized method for the required knowledge sharing task. Furthermore, as mentioned above, mechatronics product development implies intricate details about design, architecture, implementation decisions and once again documenting(knowledge management) such important decisions become significant [Neu12].
2. The major issue is lack of care for explicit documentation, particularly decision documentation. From the problem description number 1, the inference is that poor documentation is a consequence of poor knowledge management. Therefore, the focus here is to study the decision making challenges[HJC+15] and going further, the need to document all the decisions. Decision documentation is a process of capturing vital information in a readable format, often required for future references. The authors in [MTA+16] highlight the fact that documentation for architectural decisions in the industry are usually neglected. The cost of poor or no documentation in the field of systems engineering can be well comprehended from [Kas95]. Therefore, there is a clear purpose for documentation in systems engineering or mechatronics. Since collaboration tools are a critical medium for co-ordination among mechatronics team members, most of such decisions lie inside the collaboration tools. They are often present in the chat logs or sometimes even lost during the online meetings. How to differentiate between productive and unproductive material in chats/group chats [ZC18]? How do we extract any design decision that was made on a collaboration tool? For instance, on call whiteboards are increasingly getting popular lately, how does the team manage to capture any architectural/design decision that could be useful at a later stage [GW19]? Also, going through long threads

of chats for any vital data or decision will be a tedious task. How do we make this process hassle-free? Henceforth, there is need for motivation to manage knowledge and documention in such a team and also have a more structured mechanism to tackle the above issues.

There have been several tools as part of modeling platforms in order to record the design decisions[MTA+16] where as there are no means yet to secure the design decisions that are present in collaboration tools.

3 Objectives

The primary objective of this master thesis is to aid employee motivation specifically with a focus to document design decisions. The ultimate objective is to prototype a software bot that promotes employee motivation in the same focus area. Lately, software bots are useful in numerous fields like engineering[SSR+19], development [ABS20] and HR [Moh19]. This type of employee dependence on such software bots bespeaks that the bots are generally helpful in motivating employees in one way or the other in order to reach their milestones. Research carried out by Suri et al. [SEH17] say that there is usually a business case developed for the usage software bots in organizations. The research summarizes the factors that are critically important for development of such a business case in which employee motivation constitutes 71%. Therefore, in this thesis, employee motivation is achieved through design and development of a software bot but, considering the scope of the thesis, motivation to document design decisions is the main focus. The objectives of the bot are intended to drive the design of a software bot and help decide on the features to be implemented.

The software bot will have one major objective and 2 optional objectives as follows. These in turn reflect the features of the bot that is discussed in the next section.

1. This is the major objective and holds a higher value in priority of execution. The goal is to find an optimal solution to trace the design decisions present in collaboration tools. The employees use these tools for regular communication and coordination [LZSS16]. Many prominent decisions would be made over these tools in group chats. There could be design decisions, organizational decisions, management related decisions. They can all be present jointly in a single chat. Later on, it is not a simple task to go through them to access any desired message that indicated a design related decision[ZC18]. Hence, the aim is to save relevant notes using a bot in a chat and make them handy when required[GW19].

Next up, the two optional objectives that hold a lesser value in priority are discussed. The execution of these depend on the successful execution of the major objective.

1. This optional objective is to improve knowledge exchange spanning across multiple teams. Lack of knowledge exchange hampers the collaboration thus leading to poor motivation among the employees [Neu12]. There are knowledge about design models from different disciplines and it is challenging to evaluate all of them in parallel [ACFT+10]. Huge amounts of complex information or knowledge sharing

would help the team to align better during product development process. This approach will also help the employees to obtain a holistic perspective on a product development which in turn adds up to employee motivation. Nevertheless, a lot of collaboration tools [HB18] are available for this purpose but the idea here is to use these tools to further exchange information in an effective and an efficient manner with the help of a bot.

2. The next optional objective is concerning employee recognition. It is said that employee motivation enhances both an individual's performance as well as an organization's performance [MBP20]. These recognition could be managerial-based recognition or coworker recognition. This helps employees to develop a sense of positive competition among themselves which directly influences the company's growth. In this case, employee recognition takes place in collaboration tools and there are already a couple of software like HeyTaco[1] and Achievers[2] that help to boost employees to complete their assignments. Once again, the purpose of this objective is to encourage positivity and motivation among employees using a bot.

[1]https://www.heytaco.chat/
[2]https://www.achievers.com/gb/

4 Solution Idea

The proposed solution in this work is to device an intelligent bot that supports employee motivation in the process of documentation in a team like mechatronics. Documentation is even further narrowed down to decision documentation. The initial workaround for this is to firstly evaluate the existing bots, i.e., to carry out a research to see if there are bots already capable of fulfilling the major objective stated in chapter 3. If there are bots that are found to suit our requirements, I work towards adapting it's functionalities to prototype a bot that is exclusive to mechatronics domain. If there are no such existing bots, design and prototype of an appropriate bot that solves the major issue pointed out in chapter 2 will follow.

This bot will be implemented to be added to MS Teams. It can be added to individual chat or can be added to a group chat depending upon the need and the features of the bot varies accordingly.

The features of the motivational bot are listed below but like mentioned above, there is a ***key*** feature that is prioritized and is implemented first.

- The ***key*** feature of this bot is to track all the important design decisions that are present in an unorganized fashion. The bot should be able to summarize chats and present a text file in a readable format. The summary will based on a particular date which means the bot will create one file per day. The user is either allowed to save or discard the file. The default file name will be the date or can be chosen from the inbuilt options and these options are such that, it reflects the name of popular design decision terminologies used in the mechatronics domain. This way, it is easier for a user to refer to it at a later stage.

The below features may or may not be implemented in this work. If the ***key*** feature is successful well before the deadline, the following optional features will be implemented. However, I would like to put across my ideas here.

- The feature is to tackle the issue of lack of knowledge exchange in a mechatronics team. This bot can act as a translator for terminologies, knowledge base in terms of data, information, requirement parameters and development processes thus helping the knowledge flow across the inter-disciplinary teams. This may also be termed as a center for any FAQs. For instance — A user from a certain domain should be able to interact with the bot by querying, through simple commands and receive the desired information pertaining to a different team.

- The next feature is to motivate employees by acknowledging their work and efforts in any project. The bot is designed to appreciate the team members who have worked to successfully make git commits and have closed high priority jira stories/issues/tasks. The bot grants reward points for every task completed. Furthermore, the reward points depend on tasks completed versus bugs returned before a sprint is over. After a certain number of points have been achieved, make the employee eligible for a more substantial reward. Certain gamification ideas can be used in this case, the messages can appear like in a video game. For instance, after every 5 tasks successfully closed(without any bugs returned), bot posts a message like — **Hurray! Level 1 completed! It is now time for you to accomplish next challenging level** and so on.

Note: *The above features form the proposed solution and I would like to mention here that there may be modifications during implementation in the near future. Appropriate reasons and arguments to any changes shall be formulated in my final thesis document.*

5 Preliminary Structuring

1. Introduction
2. Fundamentals
    a) Mechatronics
    b) Collaboration tools
    c) Design decisions
    d) Software bots
    e) Literature review
3. Related work
4. Solution concept
5. Evaluation of existing bots
6. Design of a motivational bot
7. Prototype of the bot
8. Testing
9. Future work
10. Conclusion

6 Time Plan

Tasks	Start date	End date
Evaluation of existing bots - Research and planning	01/01/2021	10/01/2021
Evaluation of existing bots - Documentation	11/01/2021	15/01/2021
Design of a motivational bot - Research and planning	16/01/2021	31/01/2021
Design of a motivational bot - Documentation	01/02/2021	06/02/2021
Implementation and Prototype of the bot - Research and planning	07/02/2021	10/03/2021
Implementation and Prototype of the bot - Documentation	11/03/2021	20/03/2021
Testing of the bot - Testing	21/03/2021	26/03/2021
Testing of the bot - Documentation	27/03/2021	31/03/2021
Introduction and Fundamentals - Documentation	01/04/2021	10/04/2021
Related work and solution concept - Documentation	11/04/2021	20/04/2021
Future work and conclusion - Documentation	21/04/2021	31/04/2021
Documentation review, Presentation and defense preparation	01/05/2021	31/05/2021

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