Towards Implementation of Ethical Issues into the Recommender Systems Design

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***Abstract*—In the last two decades, an increasing number of companies have adopted a business model based on digital services attained from user data. Accompanying these developments are not only the changes in the processes but also the attention that is brought by the society towards the effects and the constitution of these services. Moral and ethical demands are steadily rising and requests for regulation are getting louder in public discussions. In this paper, a scenario of a Machine Learning- based System (MLS), a fictional recommender system for food delivery, is used to identify potential ethical issues that occur during the composition and usage of the artifact. Based on the scenario and its real-life counterparts, suggestions of what ethical aspects can be implemented into the design of the information system are derived. This approach is used to argue that MLSs are socio-technical systems that have an impact on the system user, but also on the receiver of the MLS-based result. Hence, the focus on the social aspect of the system design needs to be put early in the development phase of such a socially aware information system.**

Keywords- socio-technical systems; information systems design; machine learning based systems; ethical analysis.

I. INTRODUCTION

The pervasiveness of algorithmic systems in our daily lives is stimulating public and research debate about their potential effects on the individual behavior and also on the society as a whole. Several companies and governmental initiatives react to this development by publishing ethical principles on how their Information Technology (IT) artifacts that involve Machine Learning (ML) components are created, leading to the so called "principle proliferation" [1]. Evidently, Information Systems Research (ISR) should manifest its leading role in pursuing practices for the creation of IT artifacts that are not only technically innovative but also socially acceptable. This paper provides a contribution by presenting and discussing the outcomes of the ethical analysis of a paradigmatic case of a Machine Learning-based System (MLS) application. Here, an MLS is an Information and Communication Technology (ICT) that is composed of one or more algorithms working together and capsuled into one or more executable software components [2].

The results of the applied analysis approach lay the ground for theoretical development of a mixed method approach that is focused on ethical reasoning in ISR.

The presumption here is that ethical compliance of an IT-system is an integral part of the design process, as well as the product use. The linkage to ethical questions and the design of an IT artifact can be historically established in several ways. First of all, the core of the engineering activities, such as software engineering and IT systems design, is the solution to the design problem [3]. Since there are multiple possibilities to solve a problem, (software) engineers weight one alternative against another. The decision criteria for the design alternatives can be financial restrains, user requirements and functional fit of the alternatives. Once the chosen alternative is realized as an artifact, it will have good and bad effects. Hence, one obvious moral obligation of a (software) engineer in the role of the solution creator is to pick a design alternative that does not induce harm [3].

Thus, to create an IT system that takes into account the effects of its application on the business processes, users, as well as the affected parties, theses potential effects need to be taken into account in its design [4][5]. It is e.g., the case, when digital systems such as a recommender or a digital assistant system provide a service for its user. A service, in the physical world, as well as digital, comes with costs that are not only monetary. It entails partial loss of autonomy in the realm it is being offered as a service. A user accepts the service if the assessed amount of the autonomy loss is acceptable and thus the user provides a consent to this loss by agreeing to use the service instead of performing the offered function him- or herself. The engagement with the service can furthermore be associated by the user with loss of autonomy due to opaque processes of result generation. Social reluctance of these practices is evident. Only 19% of surveyed users of digital services believe that tech companies design their services with people's best interests in mind and 47% feel they have no choice but to sign up to services despite having concerns [6]. Identifying and complying to ethical issues in the MLS design can thus enable autonomous decisions for the user within the interaction with the service. In addition, this quality can provide a distinctive feature on the market of IT products.

Following this reasoning, the goal of this research is to identify the potential ethical issues of MLS in the example presented in Section III using the data process centered ethical analysis [7] in Section IV. Suggestions about how the identified ethical issues can be integrated into the IT

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system are provided in Section V. Using the offered scenario, the process and supplementary effort to include these aspects into the artifact design can be assessed by the system designer or business engineer, providing an actionable radius to create socially acceptable IT products, as well as to lay the ground for future research questions. Conclusion and outlook on the future work finish the paper.

II. THE SOCIO-TECHNICAL ASPECTS OF RECOMMENDER SYSTEMS

Socio-technical systems are described by Baxter and Sommerville [7] as systems that involve a complex interaction between humans, machines and the environmental aspects of the work system. Machine learning-based systems incorporate this interaction already in their input, i.e., the data from which patterns are derived and test data sets for the mathematical models are the result of an interaction between a human in an organizational context and a business information system. Thus, their implementation into the organizational processes has an intermediate effect on the actors on the outside and inside of the organization. Specifically, in this context, socio-technical considerations are not just a factor within the systems development process, but they have to be considered at all stages of the development life-cycle.

For MLS, the development life-cycle includes the development life-cycle includes data processing. Data processing is furthermore divided into phases of data collection, data processing, model definition, model training and calculation of the results. The socio-technical factors are triggered when the MLS results are implemented into a business process, requiring a human decision or a decision that concerns human actors. To address these challenges, the ALTAI principles were established by the European Commission [8] to help evaluate a socially aware MLS design. These are: Participation, Transparency, Human Autonomy and Auditability. These principles are considered here as facilitators for the software design approach that focuses on the person affected by the software result rather than the direct user of the software.

Identifying any ethical issues that might occur during the system design is considered here the first step of the incorporation of these values into the systems design. Hence, a scenario for an MLS, a recommendation application, is described here and used to demonstrate an approach to identifying ethical issues.

III. AN EXAMPLE APPLICATION: FOODAPP- THE APPLICATION FOR MEAL DELIVERY

The FoodApp is a fictional application based on a three-sided digital platform that is implemented as a mobile app. It is a branch of a fictional large company Acima that offers on-demand individual transportation provided by freelancing drivers. To further explore the transportation market, Acima started FoodApp, a fast growing food delivery platform connecting the customer, restaurant owner and the delivery partner. It allows the customer to choose from a large database of participating restaurants and order a menu to be delivered to the customer's address via delivery partners. The eater can choose a specific delivery partner based on the ratings of the currently available partners. The payment process is integrated into the platform as is the real-time tracing of the order delivery.

The platform business goal is the "fast and easy food delivery whenever, wherever". To achieve this goal, an MLS, namely a recommender system, is used to provide the best food suggestions for the user in accordance to the indicated preferences and the order history. The business performance indicators for the FoodApp include the return and re-order customer rates, as well as customer number growth rates. The implemented ML-model is thus optimized to drive user's re-ordering on the platform.

To use the FoodApp, the customer downloads it on the mobile device granting permissions for it to access the location of the device. Further, a profile including information on delivery address, name, e-mail and phone number is required. Payment methods and login to the payment provider is further required. No manual modifications concerning the data collection by the app is possible. Then, the meal preferences such as preferred cuisine or menu item need to be indicated or a meal can be chosen from the provided suggestions. The first suggestions are based on the historical frequency of the orders made within the community in the area of eater's location. A rating system for restaurant and delivery partner performance is implemented.

The platform gains revenues from the customer via convenience charge, fixed commissions and marketing feeds from the restaurants, while providing the assignments and the payment to the delivery partners, as well as the technical infrastructure for the platform participants. The application is a key driver of Acima's revenue and is a fast-growing meal delivery service with over 15 million users worldwide (this estimation is made based on the data from other food delivery companies such as e.g., Uber Eats).

Additionally, the platform includes an app for delivery partners that provides the possibility to accept or decline a specific delivery job, monitor the revenues, rate the restaurant's delivery process, as well as provide directions to the restaurant and to the eater. This app is out of scope for this research.

IV. IDENTIFYING ETHICAL ISSUES

To identify ethical issues, data process-oriented analysis [9] has been conducted. Since the core component of the FoodApp MLS converts (user) data into a food recommendation, the data process as described by [10] is

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referenced to structure the identification of ethical aspects. These aspects are derived using a hermeneutic approach from basic values such as human rights and are rooted in the basic principles and moral considerations of ethics and data ethics, see [1][11]. The ethical analysis looks at the data process within the system's design and identifies some of the relevant aspects, where ethical questions arise and give direction to the system's design.

FoodApp's business goal is to engage the user in the re-ordering of the food via FoodApps's digital platform. The user interacts with the app aiming for a comfortable provision of the favorite food in an efficient way. Therefore, as described above, the user is inclined to give up some autonomy within this process. Nevertheless, in the digital realm, the user is often not aware of what elements of his/her *autonomy* are jeopardized when the digital service, here food selection and ordering via a digital platform, is created [12][13].

FoodApp's user profile provides the information that is, among others, needed for the algorithms in the MLS to derive food recommendations. The user does not have any information about the exact *purpose* of the provided datasets, the *data lifecycle*, nor about who has *access* to the (possibly) un-anonymized profile or historical data and about the data state timeline, i.e., when the data are transferred or deleted. These aspects can be categorized as "*transparency* issues", since the user does not have the information about FoodApp's processes s/he might need or would like to have.

On the home screen of the FoodApp, the most frequent orders for eater's automatically identified location are presented. The user can filter the suggestions using the provided filter categories. These categories, defined by the MLS-engineers and designers, include cuisine and menu item names, as well as the ratings of the accordant restaurants. In future interactions with the FoodApp its home screen offers the meals and food items that are most frequently ordered by the eater or users that were identified to have a similar ordering behavior, thus nudging the eater to order the same or similar kind of food [14].

The ordering process is organized in a way that no extended explanations or additional information are given so that the user does not have to choose, decide or react during the interaction process. This design allows a *fast phase-out* between opening the FoodApp and ordering the food. This effect can be expected to contribute to user satisfaction and thus re-visiting the platform for the next order. Nevertheless, consequences of the provided recommendations based on historic behavior could lead to *decisional de-skilling* [5] or, in this case, potentially *homogeneous* food preferences for the eater.

The process efficiency offered by the FoodApp is also built on to the lack of decision possibilities and a limited items selection that is based on the historic and profile preferences for the user. Such an automated decision support can also potentially result in the *de-skilling of the evaluation* abilities [15] for the eater in the given context.

Additionally, the gained comfort for the user in terms of food selection and delivery has implications on the *ecosystem* of the FoodApp. The restaurant partners will be faced with the increased amount of reviews from the delivery customers, potentially forcing them to concentrate on robust packaging to ensure the sound condition of the meal for delivery. More or more robust packaging means more damage to the *environment* but potentially better ratings from the FoodApp users [16].

Furthermore, the food recommendations based on historic and similar orders might lead to the *homogenization* of the food offered and prepared in the participating restaurants, as menu items that are ordered less often might not be prepared by the restaurants anymore, potentially leading to the decreasing of the skills of the cooking staff. The individual delivery of the food orders requires reliable and efficient delivery partners. Acima relies here on its network of drivers for personal transportation that are also incentivized to transport food orders via reward programs.

Additionally, efficient and effortless process of ordering food for individual consumption can and does cause significant *environmental damage* in terms of air pollution through traffic and waste [16]. The eater rates the restaurant on the food quality and the delivery partner on the quality of the delivery. The rating is based on eaters' satisfaction with the end result, whereat the traffic situation and other eventualities are not considered. This relationship pattern also causes societal effects.

The rating of the delivery partners results in an increasing number of orders for high ranked drivers and in a reduction of delivery orders for the worse ranked drivers. This transforms the reviews into the main factor for job acquisition, and thus income, for the drivers. This type of job market is known as the *gig economy* [17]. It provides income potential for the workers while creating an interdependency between the platform customer and the gig worker. This relation seems to remain unclear for the platform customer and is often debated by the platform owners [18][19]. Consequently, the Organisation for economic Co-operation and Development (OECD) stated that digital platforms need social values to be reflected in the platform governance [19].

V. INTEGRATING THE ETHICAL ISSUES INTO THE SYSTEM DESIGN

Based on the ethical analysis of the previous section, Table 1 provides a synthesis of the identified ethical issues. Also, an example how the identified issue can be integrated into the IT system is provided.

The recommendations are structured along the following levels: business level, User Interface (UI) and system level. While business level addresses the definition of the business model and business goals, the system level considers the

systems design, including the design of the algorithms. The UI aspects can be used to balance the business goal, i.e., eater's re-ordering behaviour, and the eater's interaction expectations with the digital platform. This paradigmatic nature allows an insight into the application of the ethical analysis during the MLS design. A more detailed analysis would be needed to provide specific insights into the algorithm level.

TABLE I. ETHICAL ISSUES OF THE FOODAPP AND SUGGESTIONS FOR THEIR IMPLEMENTATION

Ethical issues	Suggestion for implementation
No explanation on the data storage	*System/UI*: Include clear and transparent information for the user about the data storage, in e.g., in individual contracts or in general terms and conditions. *System*: Develop a concept for deletion routines if the purpose of the data processing is no longer applicable. Accordant selection of the storage location.
No explanation on the purpose of data collection	*UI*: Provide information, e.g., via mouse hover, about the purpose of the data collected in the field, as concrete as possible *System*: To collect data that are not essential for the provision of the service, provide opt-in options by asking the user directly, e.g., "Would you like to help us to improve our service by providing your automated location data?"
Lack of an opt-out for specific data type collection	*System/UI*: Privacy friendly default settings, e.g., opt-in function for every data item collected instead of the implementation of the "required" fields.
Lack of the possibility to manually adjust the collected data	*System*: Possibility to add or correct data manually, e.g., to type the address for delivery. Establish a reporting system for customers if they wish to have data corrected.
The fact that stakeholders have access to the collected data by FoodApp	*Business*: No data exchange between other stakeholders without agreements; user can be asked if s/he wants specific data to be shared for a specific purpose with the specific partner (a reimbursement could be offered) Implement an accordant opt-in or rewarding mechanisms for the user in the settings.
Data life cycle is unclear for the user	*System*: Describe the data life-cycle to the user, e.g., on the FAQ page. Integrate an automated deletion routines after the needed data are collected; inform the user about the routine in the FAQs, provide opt-ins for further data collection if needed; implement a reward system for additional data collection.
Data state: Is the data anonymized before the analysis?	*System*: Make clear in FAQ that data is processed anonymously. If this is fulfilled, the GDPR does not apply for the processing. Implement anonymization process via e.g., distributed data bases. If anonymization is not possible, secure data by pseudonymisation and encryption.
Lack of feedback from stakeholders.	*System/business*: Provide a transparent feedback system from and to every actor in the ecosystem; provide an explanation of the ratings and their effects for the actors on the FAQ. Eliminate one-sided rating mechanisms.
Lack of tracing of (e.g., societal) changes induced by the app.	Business: Schedule surveys regularly with eaters, restaurants and delivery partners to assess the changes induced in those ecosystems; perform simulations to define potential changes to the traffic in the delivery area; establish contact to the traffic agency; include actionable changes suggestions, e.g., provide contact to a sustainable packaging producer for the restaurant partners; make these actions transparent on the FAQ.
Optimizing the algorithm for user re-ordering	System/Business: Include other stakeholders such as restaurants, delivery partners and the environmental effects with similar weights into the recommendation algorithm; evaluate the systems on a regular basis. UI: Provide different recommendations foci for the user, e.g., focus on preferences, focus on restaurant convenience, etc.
Lack of a test phase about the effects of app usage on the society	*Business*: Include a laboratory phase, where the app is tested by the users and stakeholders with evaluation of the UI, UX, legal and ethical aspects plus relevant simulations on the ecosystem e.g., food and restaurant landscapes before release.
Definition of the parameters for food selection by the engineers	Business/system: Include a customer survey on which categories they would like to have; change categories or filters for sorting and extend these cate-gories regularly.
Live roll-out of changes to the MLS, i.e., online experimentation	Business: Perform changes roll-out during the laboratory phase and simu-lation; when approved, roll-out for the whole community.
Usage of power resources to train the (modifications to) ML- model recommendations are based on a selection of pre-set parameters	*Business*: Change and train the model as rarely as possible, e.g., once a year. UI: Provide information why the recommendation was generated and what impact the change of the parameters (e.g., delivery time) would have on the results; Provide possibilities to have parameters adjusted or included into the list.
Lack of understanding of the rating mechanism	UI: Provide an explanation of the rating mechanism containing a relative comparison to other ratings, as well as potential consequences (e.g., in a dialog: "Your rating will decrease the number of suggested orders to this delivery partner by 0.2% per cent").
Tendency of the user to accept the MLS suggestions	*UI*: Include a "surprise me" function, where a product is suggested to the eater that does not adhere to his/her top preferences; add a reminder function: "you have already ordered this meal *n* times this month. Would you like to try Y (second choice) today instead?". System: Perform an assessment on how ML might impact user behaviour and present the results on the website.
Effects on the eco-system of the app are not clear for the user	*Business*: Make the results of the conducted surveys and traffic analysis accessible to the users on the website. *System*: Carry out an impact assessment on the rights of users and also on those of the stakeholders.

Individual food delivery	*System*: Include environmental concerns into the algorithm evaluation; *Business*: Provide rewards for environmentally friendly behaviour of the partners (using e-vehicles, e.g., or using environmentally friendly packaging).
Recommendations presentation to optimize the business goal	*UI*: Change the UI to be more intuitive for the user with the goal of finding favourite food selection.

The suggestions provided in Table 1 are centred around mainly two aspects: providing information about every data element collected by the FoodApp, i.e., the facet of transparency, and establishing a reward system for the user in return to providing data to the company, i.e., a reward. The implementation of a reward system would implicitly make the data life-cycle more transparent for the user, as well as provide the user with more autonomy within the engagement with the service. It would also help the user to understand that the data is a resource that is traded and thus has a value.

Identified issues that go beyond the business processes might be subject to the interpretation of the regulation or the business ethics. Furthermore, due to the context of the example, some identified ethical aspects are due to the example being positioned in the platform economy and therefore are not specific for every MLS. Nevertheless, bigger negative effects such as the effects on the environment or the society are part of the social awareness and responsibility that are not (and maybe should not be) regulated, but can be supported by socially acceptable IT artefacts.

The term of socially acceptable IT has been introduced to describe a system that considers and integrates ethical requirements into its design. The added effort but also the value of the implementation of the suggestions of the ethical considerations in Table 1 could lead to socially acceptable IT products and thus a realization of a socio-technical IT systems. To ensure the remaining and homogeneous quality adherence, inter-company assessment mechanisms, i.e., ethical quality audits, could be put in place.

VI. CONCLUSION

Here, a scenario of a fictional food ordering platform that uses an MLS for item recommendations was used to perform an ethical analysis of an MLS. This scenario was chosen as a realisation of a socio-technical system that incorporates the system designers, users and stakeholders affected by the system design and process implementation.

The results showed that users of digital services need to be integrated into the design of a socio-technical system as they may have expectations that rely on the ethical awareness of the company and thus need to be implemented into the workflow. The examples of how to address these issues demonstrated that changes in the UI, system design but also in the business model can be realistically made to accommodate these challenges. Hence, designing socially acceptable socio-technical IT systems can be a chance to find a niche on the growing and competitive market of consumer-oriented digital services.

Although the provided approach needs validation and verification in a rea-life environment, it can already be used by the designers and architects of information systems, business developers considering a data-based business model, as well as ISR scientists as it shows how ethical aspect can be incorporated into the context of IT design. Future work will aim at establishing the criteria for the definition of the quality requirements for the social acceptable IT, evaluation of the suggested measures, as well as developing methods for the assessment of the effort of their implementation.

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