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Service design for artificial intelligence

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Abstract

In this paper, we present the first findings of a project testing Artificial Intelligence (AI) in an academic library with the aim to support and redefine library services. The context of the research project is an academic library. Libraries represent an ideal environment for containing potential bias and test prototypes. Several AI supported services are prototyped and tested during a research project. The paper features approaches such as user journey and blueprint to address issues service providers and service users might encounter. The paper identifies a series of factors that need to be taken into account when designing prototypes in which AI features centrally. The paper also charts the implications of AI-enhanced library services in relation to users's behaviour and expectations and organizations' workflow.

KEYWORDS: service design, artificial intelligence, service blueprint

Introduction

The discourse on artificial Intelligence (AI) is constantly expanding in scope and depth. For the intents and purposes of this paper, we will operatively subscribe to Nils J. Nilsson's definition: "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment" (Nilsson, 2010: 13). The objective of most of the research in progress that aims at mimicking human intelligence is to adapt and improve machine learning using formal logic and mathematics. Advances in machine learning and Natural Language Processing (NLP) are among the main drivers behind AI, and have represented well-frequented research fields for many decades. Eventually, the technology that informed AI crucially gained momentum toward innovative solutions thanks to access to big data and cloud based processing capability. In addition, the willingness by some of the major stakeholders in the field, like Google, to share technologies needed to support AI, has been central to achieve the level of activity we now observe both in research and service provision. Google has a strong milieu in AI and machine learning, supporting especially end-to-end learned systems (Google, 2017). Other major companies also built large AI platforms, and offered usable solutions to the market even though the costs to access them may often seem dissuasive. IBM developed Bluemix (IBM-Bluemix, 2017), a platform for AI services, including Watson (IBM Watson, 2017), which has gained a reputation for being able to help doctors find the correct procedure and treatment for cancer patients. Watson, when asked,

can analyze enormous amounts of research papers, documentation, and other relevant medical research data. In this context, several concerns need be mentioned. On the one hand, there are several issues concerning how AI is developed without any form of regulation, which may have unforeseen effects on social, ethical and political arenas (Sampel, 2017). On the other hand, the majority of currently available AI services are quite simple, like chatbots—chat-based customer service tools for large companies that answer common or recurrent questions posed by users. Other small services are entering the marked as well, like Watty (Watty, 2017), which monitors the power line at users' homes to analyze patterns of power consumption, and break down consumption by device and time of the day.

There is also a lack of research on the impact AI-based services may have both upon users and the organizations providing the service, as very few fully implemented services have been developed so far. Another factor reinforcing the effect of AI in a service context is the ability AI technology has to learn from the work done when performing a service. Taking into account societal and individual needs and behaviors, an AI-based service may have a major impact in how the service is perceived by the users and on several levels in the organization or company providing the service. For instance, trustworthiness and reliability may be emotions emerging when users interact with an AI-based service. For a company or organization, the self-learning capabilities that characterize AI may force strategical changes, cooperation issues, and so on. All the above are still assumptions as this type of services are still in their initial stages.

Atomization of technology in the form of ubiquitous computing creates sub-spaces for interaction between organizations and users in which exchange of can take place intuitively and in a progressive fashion. This fragmentation of action and interaction does not only concern the trading of goods and services, but also the domains of knowledge production and knowledge mediation. Alexandra Schneider argued that the smartphone can be considered as an "object of knowledge" for it physically represents a probe into archival materials (Schneider, 2012). The methods and capabilities in-scribed into devices and their code involve sets of constraints and affordances that redesign actions that would otherwise be required of the user to access and process the raw material of the library resources. At present, the outcomes of this process is typically determined through impersonation. Users of technology and their forays into the services are imagined as a priori projections. A more daring implementation of AI could amount to a fostering a mode of dialogue between the user and the technology in which digital assistance is designed to adapt and work back end to anticipate and fill the gaps in the users' skills and knowledge. In other words, AI would also stand for "archival intelligence," i.e. it would inhabit the complex, pre-existing "knowledge of archival theory, practices, and procedures." Most importantly, this implementation of AI would seamlessly aim at providing "strategies for reducing uncertainty and ambiguity when unstructured problems" result in ill-defined solutions (Yakel & Torres, 2003: 51).

In the context of a library, AI implementations may support, but also and perhaps most interestingly re-articulate several of the current services this kind of institutions offer to their users. The 2015 Horizon report predicted that the use of AI will be relevant within few years ("NMC Horizon Report Library Edition," 2015). Libraries have already amassed data that can be exploited in new ways using AI. This includes examples such as metadata (Linked-Data) from collections, large silos containing research data or publications. AI can also help the library anticipate future user needs. For example, AI can be able to help in a faster and more targeted manner the creation of services tailored to those who have special needs (universal design). Users with dyslexia or other disabilities could have a library service designed on the fly, but based on their particular needs. Introducing AI-based services in a library creates new issues as well as perspectives. It also involves a reframing of goals such as security and credibility through delivery of quality assured information. On the personal level, changes in the emotional landscape of the interaction between service provider and service consumer also need to be taken into account (Beck & Libert, 2017). Those are values the library as an institution rests upon, and how AI will affect those is still unclear.

This paper and the research on which it is based represent a foray into this uncharted space. It examines of different service design methods, conceived in a site-specific fashion to look into services that can be delivered when AI is prototyped and tested in the context of a Norwegian academic library. In the first part of the paper we present our project and its goals at large. In the second part, we describe the results of two workshops through which the project was implemented. The outcome of the workshops consisted in a variety of different prototypes. Finally, one of these prototypes is analyzed using the service blueprint method. This eventually informs a discussion in which the overall aims of the project are reassessed and scope for further work is envisaged.

The research project

Encouraged by the increasingly subtleness and stability of latest-generation applications using AI, the Library of the University of Oslo (UiO) resolved to apply for funding from the National Library of Norway to develop its own AI-based services. In comparison with other similar institutions, the overall size and character of the user base of the UiO Library allows this institution an agile stance in relation to technological change. In addition, the general context of the academic library also provides a favourable environment for testing new services. Libraries have access to large amount of data in databases that have traditionally grown in an organic manner thanks to the implementation of consistent metadata. Access to large amounts of data is a crucial precondition to educate AI systems within relevant problem areas.

The acknowledgement of a gradual decrease of usage that libraries have experienced over the last decade further provided momentum to embark on a similar research project for this specific academic library. Decreased demand in borrowed books and slow reaction times in adapting to new formats and consumption modes caused some libraries to be outdistanced from more readily accessible service providers. Moreover, as access to digitally based knowledge increases, the need to re-design the interaction between libraries and users also became a relevant objective. Today's library patrons are demanding more user-friendly services and services that are related to their research fields. The relevant amount of digital data upon which the library can rely provided an opportunity to design a project and reach useful conclusions within a foreseeable time span. The digitalization of many collections and the creation of consistent metadata for these collections were pre-existing resources that could readily be tapped upon. Making use of those large amounts of data is a golden opportunity for AI-based services in the library.

The project framework is explorative, in the sense that the goal is to test, study and gain experience in the field of AI in the context of a library setting. In addition, the emerging trend of using AI in various domains needed a prompt reaction by the library, as new concurring services will probably be developed in the near future. The objectives of the project include building up the knowledge of the different technologies needed to create an AI platform; suggesting AI-based services in a library; and finally designing and testing prototypes of these AI-services. We opted for using a service design approach in order to understand the manifold implications of AI being used in an organization involving several groups of heterogeneous human and nonhuman actors.

A series of service design workshops have been planned involving library staff and researchers acting as both facilitators and observers. In addition, small seminars were organized during the first part of the project to gather feedback and mediate the results of the work in progress to the rest of the organization. The second phase of the research project started after the development of the user journey. The library is now developing AI-based services with the help of a data scientist, who was coopted into the core research group. Three new services are currently underway. The first is a service helping researchers in papyrology that is already functioning as beta version and yielding fruitful results. Using

large amount of data from databases to educate the algorithm, the output of this new AI-based service will give to researchers predictions about values concerning papyrus items. The second service has the goal of read, analyze, and understand English literature corpuses, e.g. texts by the modernist author Virginia Woolf. This is also currently working as early beta version. Finally, the third service features a differently focus, for its goal is to solve automation problems in the context of self-archiving services that the library aims to provide to researchers.

The workshops

The two workshops to which this section is dedicated were arranged in one of the branches of the University of Oslo library. Their goals were to develop prototypes of services using AI and chart the practical ramifications of using AI for such new services. The format of the first workshop was based on a well-established methodology one of the authors has developed to support innovation when designing services for academic libraries (Culén & Gasparini, 2014). The set-up in this occasion involved three groups of participants with different competences in a half day long effort using service design methods like customer journey. The workshop provided an opportunity for several prototypes of services implementing AI to emerge. Among them, two were developed upon.

The first concept, using the aforementioned Watson, was planned as a standalone AI service in the library. It was named "James," and imagined to be a humanoid or something simpler, such as an iPad. James was projected to welcome the user at the entrance of the library and offer a variety of services (Fig. 1 shows a picture of James made by a participant with drawing skills). James will have the capability to use face-recognition to find out information about users and help them accordingly. For instance, James would pull up information about courses, preferences or special needs and re-configure the type and level of assistance it provides on user by user basis. One of the authors also entrusted James with the ability to analyze a curriculum text and allow students to ask questions across the content.

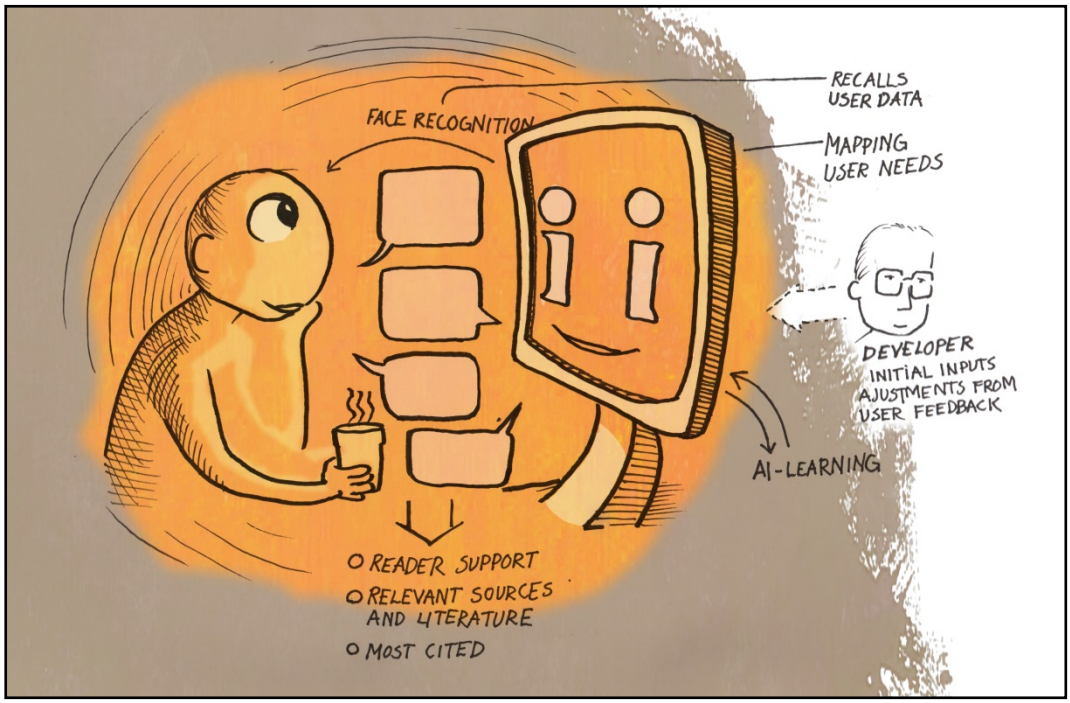

Fig. 1. Part of the user journey developed during the workshop. James has the ability to use face-recognition to retrieve information about the user and help them accordingly (Drawing by Ane Hem).

Watson already has the capability to perform this type of analysis, but the the innovation in James's case is to design a potential for this service in the context of education. Allowing students approach knowledge based on their own situation could change the way higher education will work in the future. Another item that emerged through the workshop was the request for a type of service that supports researchers during their work. This also directly relates to the European Commission's aim and policy to keep research data accessible for future use. Accordingly, increasing amounts of data are now available to be fed into AI-services like Watson. The new projected service was imagined in the form of a research-buddy that could help researchers navigate and negotiate available data from previous research projects. Libraries are often in charge of storing and organizing research data and their most specialized expertise is knowledge management. The workshop clearly highlighted the need for a service that mines stored research data and allows researcher to cut the time needed to search, scan, and process previous research outcomes. This would allow researchers to redirect their scarce resources toward research activities where AI cannot (yet) provide assistance. An interesting side discussion involved a reflection on how copyright and intellectual property would be preserved through the use of AI. Such a discussion is outside the immediate scope of the present paper, but we acknowledge further work is required to define the implications of respecting copyright and intellectual property when nonhuman actors are involved. This initial phase of the first workshop was followed by a second one that implement a service blueprint approach to accurately test the service provided by James and map out the potential impact on for the organization providing the service and its users.

The second workshop had a different character. It was shorter, at a half day long, and more intensive. The activities during this workshop aimed to enrich the user journey developed in the first one. The participants were not the same and were chosen according to their competences. One of the effects of this reframing was the addition of new perspectives and issues, allowing for a redefinition of some of the touchpoints. Eventually, the visualized user journey functioned as an elaborative force to provide to the participants an additional opportunity to voice and refine the touchpoints.

Service blueprint for AI-based services

The authors found service blueprint to be a viable way to analyze services developed during the workshop and to map out the impact of using AI in the library. Tax and Stuart (1997) argue for using service blueprint as it supports a holistic view of service provision. The necessity to have a bird's eye view on services is implied by the "evolutionary nature of service design." A continuous monitoring of the effects new changes allows exchange and mutual interaction among the three main "dimension" of design i.e. processes, participants, and context (Tax and Stuart, 1997).

When the AI-supported library service named "James" was mapped out in a service blueprint (Fig. 2), several issues did emerge as valuable points of discussion. Each point, presented below, can be seen as a touchpoint in a user journey (Polaine, Løvlie, & Reason, 2013).

Fig. 2. A first draft of the service blueprint for the AI service James (Photo: Gasparini)

Each touchpoint describes possible effects on the organization, including librarians or management, and effects for users of the library, such as students or researchers. The user journey reproduces the scenario of a student or a patron coming to a physical library to get help with navigating relevant literature. As the user enters the building, James is ready to assist.

1. When the user approaches James for the first time, an agreement of data exchange must be concluded. The use of the service will probably require James to maintain user data from the visit. This data might include: library needs, behavior in the physical space, and search strategies developed together during the visit. Possible also disabilities or other special needs would have to be stored. This is necessary to support James's learning process. There are several implications for the user and they may have unpredicted effects. For instance, repetitive requests of user info, and lack of clarity about how the data will be used later on may prevent future use or bias James's development (for instance if only one group of users interact with James). For a service provider (in this case the library) routines must be

designed to clarify how the data is used by James, and where it is stored.

2. James needs to be updated continually to be aware of the all the major changes in the way the library functions. In addition, it may monitor other minor changes it finds relevant for its own needs.

3. James uploads programme curricula based on the user's identity, after their face is scanned. This includes the courses the student is attending. Concurrently, it primes itself for possible questions. In parallel, it informs the user that it is available to provide a series of services. For the library this requires a check to determine if the access purchased by the library allows this kind of use. Access to e-resources in the context of the academic library is strictly regulated. In addition, if part of curricula and syllabi is not available as electronic resources, James will have to predict and fill the gaps to provide useful answers. The user may otherwise receive a biased result.

4. James may also try to persuade the student to participate in general library literacy courses or other training events on the correct referencing conventions when writing essays and dissertations. This is part of any university library's mission but students are often unaware of this package of services because it requires pre-emptive action on their part, rather than problem-based support.

5. The technology behind AI support learns when working with users and might adapt to accommodate the users' recurrent requests. After some discussion between James and the student, James may propose to take a look at the student's essay when they have completed writing the first draft. For the library, this is a borderline ethical case. James's helping the student could be interpreted as cheating, and several services already available today outside the institutional sphere inhabit this grey area. Bringing all the services together to let a self-learning system make this kind of decisions may form a problem. For the student, the service they have access to is open-ended. Possible issues might include damage to their self-esteem; falling short of the learning targets; or even enabling less scrupulous users by providing them with short cuts.

6. In addition, students will probably have questions about the intellectual property of their own academic work. For instance, if James helps a student in different ways and occasions, how much of the communication stored during the interaction between them will be used by James again in another context? Perhaps the research the student has done in a master dissertation might become obsolete before the student manages to publish it. For the library, as an organization, this situation raises questions about responsibility. Who will be in charge for educating James so it will behave correctly? In the case of disputes about re-use of knowledge and academic misconduct, will the library be held accountable? All of those questions require substantial rethinking in the way the library work and the skillset required of its staff in day to day work practice.

7. Finally, the journey in the library can start, either in the physical space of the collections to find literature, or through student and problem-centred coaching and training.

Conclusions

The paper presented a project aiming of introducing AI-based services in the context of a university library. The overarching aims of the project included testing ways to use AI to update the portfolio of services provided and anticipate the wider ramifications of this. Service blueprint was used in the course of the project to recognize several tension points between AI-based services, users and the library. The implications that require further reflection include those informed by AI's self-learning abilities. These are complex and their negotiation is not obvious for it requires continuous problem-based and user-centred

approaches.

AI-based services already form part of everyday life, and advance in both research and service development is fast. The project presented in this paper and the workshop however demonstrated the need to rethink how services can be designed when a self-learning system is part of the process. When AI is put in the position to learn from the complex of activities that take place in the context of a university library, service providers should take a series of preliminary measures during the planning and designing phases of a new, innovative service. Using the framework envisaged by Bitner (1992), the librarian could be understood as taking up a role as enabler of the AI-based service. Further to that, a possible analysis of the service blueprint involves thinking of the AI-supported service as a new type of stakeholder, i.e. a service provider on its own acting to some extent independently from the library's immediate control.

One could assume AI-supported services are comparable to regular tested-and-proven IT-based services, but paper argues this is not the case. To begin with, an important aspect to take into account is that AI self-learns and library has to reflect on the extent to which as an institution it is willing to assume its responsibilities for the behaviour of an AI service. To help understand all the implication for the stakeholders, during the workshops we have used the service blueprint to move from a holistic view of the service ramifications to an in-depth analysis of the touchpoints (Fig. 3). Ensuring that the user can trust the results of an interaction with an AI-based service is an absolute requirement. Undesired effects like misleading or possible disinformation have to be avoided.

The new service on which our research team worked to help researchers in papyrology, which we mentioned above is in beta version, and some of the issues we listed have proved of paramount importance to accommodate the user perspective during the different phases of the project development. The sixth point, which refers to intellectual property, proved particularly central thanks to the reflection it conveys to further shape the service. Should the service be available for all? How can one monitor effects of an AI-based service? What are the long-term effects of an epistemology shaped by the contribution of an AI-based service? How can one respect the unique researcher identity of a scholar going about their work?

Fig. 3. Excerpt from the visual user journey, showing opportunities for interaction between James and a user (Drawing: University of Oslo Library).

What kind of service design tool do we need to develop services when AI is an important stakeholder? Questions of ontology are antecedent to methodological choices and cannot be

flattened by uniform technology. From this point of view, mapping the user journey helped the project to identify a set of crucial questions and decision nodes.

Service blueprint was also an important tool to chart the effect of service provision on the network of interrelations linking the users with the organization. Designing a service in which AI systems are used requires anticipating and defining the different facets of the service provision on the basis of ontological decisions and understanding of the temporal effects of the design effort. The envisaged user journey was used as a mediator between the user perspective described in the visualizations and the logistics of using AI in the chosen institution. There is a specific tension between user perspective and the internal and organizational needs an AI-based service can solve. One of the services under development addresses a back-office automation problem, and the user journey was used to keep the user perspective represented. Future work should focus on further understanding the intersection between service design and AI, especially on the impact of the service has over a number of time scales, and how feedback can be consistently channeled to inform the design process.

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