From Eye-to-Eye to Hand-in-Hand: Collaborative Solution Building in Interdisciplinary Manuscript Research

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Abstract

Among the various interdisciplinary domains, Digital Humanities is one of the most interesting as it attempts to bring two competing cultures together. But this interestingness eventually comes with its own problems when trying to produce practical solutions. How does one ideally approach to build an Informatics-based solution for a research question in the Humanities? We particularly focus on the field of Interdisciplinary Manuscript Research and propose a methodology inspired by design thinking to collaboratively build solutions through interactive exploration. To this end, we present the *iXMan_Lab*, where this methodology is to be actively put into practice.

1   Introduction

The humanities are usually considered to be an *inexact science*, assuming that subjective opinions abound, unique solutions usually do not exist, and it is often difficult to perform quantification. This is in contrast with Informatics, considered to be an *exact science* that typically aims towards finding objective solutions. Digital Humanities (DH) thus is placed in a situation where conflicting (Snow, 1957) perspectives and objectives not only have to meet but also produce working solutions. Due to such a context, DH solutions that have had wide-spread acceptance are rare and often face problems with usability and usefulness.

From the vast domain of Humanities, we here focus on the field of Interdisciplinary Manuscript Research (IMR). Currently, one is more and more likely to find scholars dealing with digitized manuscripts, therefore, providing opportunities for researchers working in the field of Digital Image Processing (DIP) to apply their methods in this domain. This typically involves individual components such as image preprocessing, layout analysis, OCR and writer identification. However, one has to avoid the fallacy that solutions can be constructed through a simple daisy chain of such computational methods. The reality on ground is far from that.

Since, we frequently have to deal with intricate issues such as degraded data, limitations of computational methods, parameter regimes, user-adequate presentation of the final results and experimental setups. Additionally, due to the specificity of research questions, there is a distinct need to provide customized solutions and a one-size-fits-all approach is not possible. All this requires at first is an eye-to-eye joint interdisciplinary work in all stages of the solution building process, which would eventually involve everyone in the process to work hand-in-hand in order to create a workable, usable and useful solutions. However, a proper methodology facilitating such needed interdisciplinary work is a prerequisite.

2   Related Methodologies

Traditional Software Development Methodologies (SDM) such as the waterfall model are nowadays seldom useful and can even be counter-productive. Casting the roles of client and developer on the sides of the Humanities (consumers) and Informatics (producers) will only result in solutions that are skewed towards the side of informatics leading to imperfect solutions. Both the sides are equal stakeholders, who must work together and be appreciative of each other's theories, methodologies and cultures at all times. The development process by its very nature is also quasi-research and quasi-software development and, hence, has to strive for the right balance between the two. SDMs do not provide appropriate support for the research and design part of the process. Although there have been attempts to adapt Agile Methodology to research (Hicks et al., 2010), the lack of concrete deliverables and fixed deadlines makes it difficult for research projects. There also have been attempts such as the Evidence-Based Software Engineering (EBSE) and Domain-Driven Design (DDD) paradigms that try to integrate research-based methods and take a domain-based approach in implementation respectively. But they are not particularly tailored to include co-creating stakeholders that complement and learn from each other in the course of the development. Even within the DH community, there have been criticisms regarding the current development of DH solutions (Thaler, 2012) but at the same time also suggestions on how they should evolve to help the target domain (Stokes, 2018). Currently, there appears to be no particular methodology that encourages a collaborative approach with respect to developing DH solutions, particularly in the context of Interdisciplinary Manuscript Research.

3   Building Collaborative Solutions

We therefore propose a Design Science (Bichler, 2006) inspired methodology that allows co-creation of solutions for IMR in an interactive and exploratory manner. A Design Science-like focus on iteration and evaluation fits our needs better. To circumvent the black-box problem often found in Digital Humanities, we focus on developing theoretically grounded solutions.

The initial stage of building solutions would be a *Joint Requirement Analysis (JRA)* in order to analyze specific needs and problems. Humanists initially pose their research questions from their perspective with informaticians then presenting options for prospective solutions.

During the discussions held at eye-level, both sides must eventually agree on using a *common language* by clarifying ambiguous terms to render them understandable and compatible on both the sides. This is then compiled as a *glossary* for future reference as misunderstanding of terminologies may later cause confusion. There may also be too high expectations on what could be achieved by methods in Informatics. Consequently, the joint-work must be grounded to reality. For instance, clarifying the assumptions, conditions and limitations under which existing methods relevant to the problems at hand tend to work. The stakeholders should then further discuss the availability of image data with respect to decisive factors such as image quality, availability of annotation and ground truth, among others. This needs to be documented as *Image Requirements*. Finally, the extent to which the solution can solve the problem within the realms of viability and a realistic time-scale that is needed to achieve the solution must be agreed upon. The discussion should then lead on to (i) striking an optimal balance between qualitative and quantitative approaches (ii) if necessary, agreeing on establishing/using proper quantitative metrics for the same. In a nut-shell, only through a well-designed JRA can we avoid a project that over-promises and under-achieves, which eventually ends up as a disappointment by not establishing pragmatic expectations on both sides. Various *design artefacts* such as mockup UIs and mockup workflows can be generated to materialize the agreement of viewpoints on both sides. And the minutes of the discussion needs to be documented, shared and signed off on both sides to further record all agreements and discussions.

The next step is *Joint Experimentation through Interactive Exploration;* the core of our approach. In the previous stage, we established what can be realistically achieved, whereas, in this stage, we focus on how it can be achieved. Providing an appropriate medium for collaboration between the scholars from diverse disciplines is one of the main factors behind the success of this stage. The medium needs to sufficiently contribute towards a proper understanding of the problems and also facilitate the exploration of the possible solution spaces by both the parties at the same time. In the case of IMR, a Multi-Touch Table (MTT) is an ideal medium for such a collaborative approach, as it lends itself easily to model and reflect the domain. In the last years, MTTs got considerably cheaper thus fostering their utilization as a versatile and invaluable asset for image-based research. The researchers can experiment together via the MTT and explore methods available from standard toolsets such as OpenCV. By working hand-in-hand, goal-oriented experimentation can be performed with respect to methods, parameter regimes, etc. that could be suitable to produce solutions. Both the parties need to be actively present for this to succeed. There also needs to be proper logs that records all the methods, parameters and conditions for the various experimentations being done, which also encourages the scientific rigor of this process. The interactive exploration actually allows the Humanities-side to be put in action and personally understand the intricacies associated with each method. It also lets the Informatics-side to jointly come with a proper workflow in direct collaboration as such workflows are frequently found lacking (or incompatible) from the side of Humanities. Also, by this way different perspectives and apriori knowledge of the scholars can be utilized to get a better understanding and even augment the solution appropriately.

After having conducted several such sessions and agreed on one or even several possible solutions for workflow support, the final step is *prototyping*. The agreed workflows are packaged accordingly as prototypes and delivered to the Humanities-side. The prototypes should focus on end-users as much as possible according to the *user-in-the-loop* paradigm by involving

them in the processing context. After a period of *testing in the wild* with real scenarios and actual data, a formal usability and usefulness study is to be conducted. If the studies yield positive results, the prototypes are now finalized and provided as *tools* to aid researchers who are working on similar problems. If the prototypes are found to be insufficient, the stakeholders must return to the previous stage and iterate until a reliable solution is found. Evidently, this is a time consuming process with high commitments on both sides.

While we specifically focus on building solutions in IMR, it is quite possible to appropriately extrapolate and adapt this methodology to other related domains in DH. Our *iXMan_Lab* at the Department of Informatics, University of Hamburg will implement the above methodology to provide solutions for the subprojects of SFB 950 at the Centre for the Studies of Manuscript Cultures (*https://www.manuscript-cultures.uni-hamburg.de/index_e.html*). We are currently developing the *Advanced Manuscript Analysis Portal* (AMAP) (Rajan & Stiehl, 2018) that can be used for joint experimentation and exploration of possible solution spaces. We plan to conduct case studies to evaluate our approach and refine the methodology further.

4   Conclusion

We have elaborated on the difficulties faced during the development of solutions in the context of Digital Humanities, along with reasons for such difficulties. Subsequently, we presented related methodologies and proposed our methodology aiming at supporting scholars from IMR through joint development and validation of solutions through interactive exploration. Finally, we briefly introduced our iXMan_Lab and sketched future work.

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