Crafting the Requirements Record with the Informed Use of Media

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Abstract

This paper highlights some of the issues that need to be considered when communicating and modelling requirements expressed in media other than text. It proposes to marry practical work in the area of requirements traceability with theoretical work on the differentiation of media types to provide a framework to help engineers make informed decisions about media choices, combinations and transformations when crafting a representative requirements record.

1. Introduction

Requirements exploration is an activity that involves both spoken and written communication. It frequently involves the observation of a working context or process, where activities may be recorded for future analysis and complex tasks may be sketched out graphically to reach understanding. Reducing such a rich initial data set into an agreed textual description of requirements obviously involves either some form of information loss or information gain. While it may appear an attractive proposition to maintain descriptions of requirements-related information in multiple forms of media, such as audiovisual representations of requirements workshops or audio recordings of interview sessions, there are a number of associated issues that need to be considered if the integrity of the record is to be maintained.

This paper highlights some of these issues and proposes to marry practical work in the area of requirements traceability with theoretical work on the differentiation of media types to provide a framework to help engineers make informed decisions about media choices, media combinations and media transformations when crafting a representative and continuous requirements record.

2. Barriers to crafting a representative requirements record

Comprehensive descriptions maintained during the engineering of software-intensive systems have become one of the primary ways to address a class of important problems related to requirements traceability. Such problems are described exhaustively in the literature and include managing changing user needs, accounting for the lack of sufficient contextual or attributional information to make decisions about requirements, the uncertain recording of rationale and absence of full information about alternatives which were or might have been pursued [2].

Today's requirements management tools support the storage of multi-various project-related data. Such data can be retrieved to complement other formal documents deriving from the development process. However, in the absence of an underlying model guiding the type of data to record and the type of interrelations to make between these data, a promiscuous and undisciplined gathering of data can result. Not only is the recording of everything costly, but an unmanageable proliferation of data has limited use and longevity. Compounding this problem is the fact that these tools are increasingly beginning to handle data in a full range of media. Requirements engineering documents have thus become a genre in transition, both because of an increasing appreciation of their important role, and because of improved opportunities for the recording and documentation of all requirements-related activities in a 'raw' form. This can range from the inclusion of video recordings of users performing daily tasks through to early hand-drawn storyboards that sketch out a workflow.

Media representations such as these can therefore be recorded and used as a starting point for subsequent requirements analysis activities, leading to

intermediate representations in the same or other media, and ultimately result in code (when dealing with software-intensive systems). However, without an appreciation of the potential information loss or gain that can take place when moving between different types and combinations of media, due to the difference in expressive power, the representativeness and continuity of an evolving record can be jeopardised.

Those responsible for creating the requirements record need to make choices about the media they use at all stages in the engineering process and understand the impact of any media transformations. We suggest that support for making informed decisions about the choice and combination of media to use is presently lacking, and the consequences of media transformations are poorly recognised. We argue that the ability to use multiple and multimedia in the documentation of requirements demands that we consider this process and its products from a media perspective. This will not only improve through-life traceability, but will also aid in the development of a new genre for such documentation, one which exploits the full potential of the digital recording medium.

3. A framework for dealing with media

We propose a theoretical framework through which any decision about the use of different media for recording requirements-related information can take place in an informed manner. It distinguishes between *abstract* media and *physical* media and uses this distinction to clarify the nature of multimedia. The reader is referred to [5] for full details on this work.

In summary, abstract media are concerned with the world of sign systems, in the semiotic sense [1, 7], and are used for the communication of content. Physical media are concerned with encoding the representations of abstract media on some physical substrate. The two media types are obviously inextricably linked as certain abstract media are typically associated with particular physical media, but there are frequently options for choosing the physical media upon which to carry an abstract sign. Examples of abstract media include *text* (written 'natural' language in any form) and *speech* (spoken 'natural' language). These may be carried on *paper* or on *sound waves* respectively. Multimedia can thereby be defined as any combination of abstract media carried by a single virtual (i.e. digital) physical media. We suggest that we can use these distinctions to define a number of canonical media transformations which, in turn, reveal how information can be lost or gained as it is translated between media and hence between evolving requirements descriptions.

Figure 1 depicts a typical requirements engineering activity, that of conducting, recording and analysing a questionnaire-based interview with a stakeholder. We use this example to illustrate the above mentioned terms. The figure shows that the interview session is guided by a pre-written questionnaire, so the abstract media is text and the physical media is paper. The questions are delivered by the interviewer using speech (abstract media) carried on sound waves (physical media). The interviewee's response is communicated using spoken natural language (speech as abstract media), recorded together with any background noise (sound as abstract media), and jointly carried on some substrate for sound recording (physical media). If the interview session is also videotaped, the abstract media of moving pictures would be carried on video tape. The activity *elicit* in Figure 1 can be regarded predominantly as one of information transfer.

Once the interview session has been recorded on physical carriers, the subsequent activities of extracting data, transcribing the audio or video data, encoding and analysing the data to determine requirements, and eventually structuring this understanding (the activity *analyse* in Figure 1) is essentially a process of transformation. The result is a communicative artifact; a designed object with a purpose. Note that this figure is intentionally illustrative, so the analysis activities are liberally compressed. The objective of the example is to emphasise the transformations that inevitably need to take place between disparate intermediate physical media as one set of abstract media gets transformed into another. In this case, the end products are textual and diagrammatic – a use case diagram accompanied with use case descriptions and supplementary unstructured interview text. Despite the richness of the multimedia used in requirements engineering, natural language (i.e. text) remains the primary modelling system that we build our eventual requirements descriptions around. A hierarchy of modelling systems that build upon text is thus posited.

4. A hierarchy of modelling systems

In the semiotic discipline, all sign systems serve as a means of modelling, cognizing and explaining the world. Whether an explanation of all such systems should be based on the framework of natural language remains a contentious issue. For the purposes of this work it is necessary to employ a framework that at least

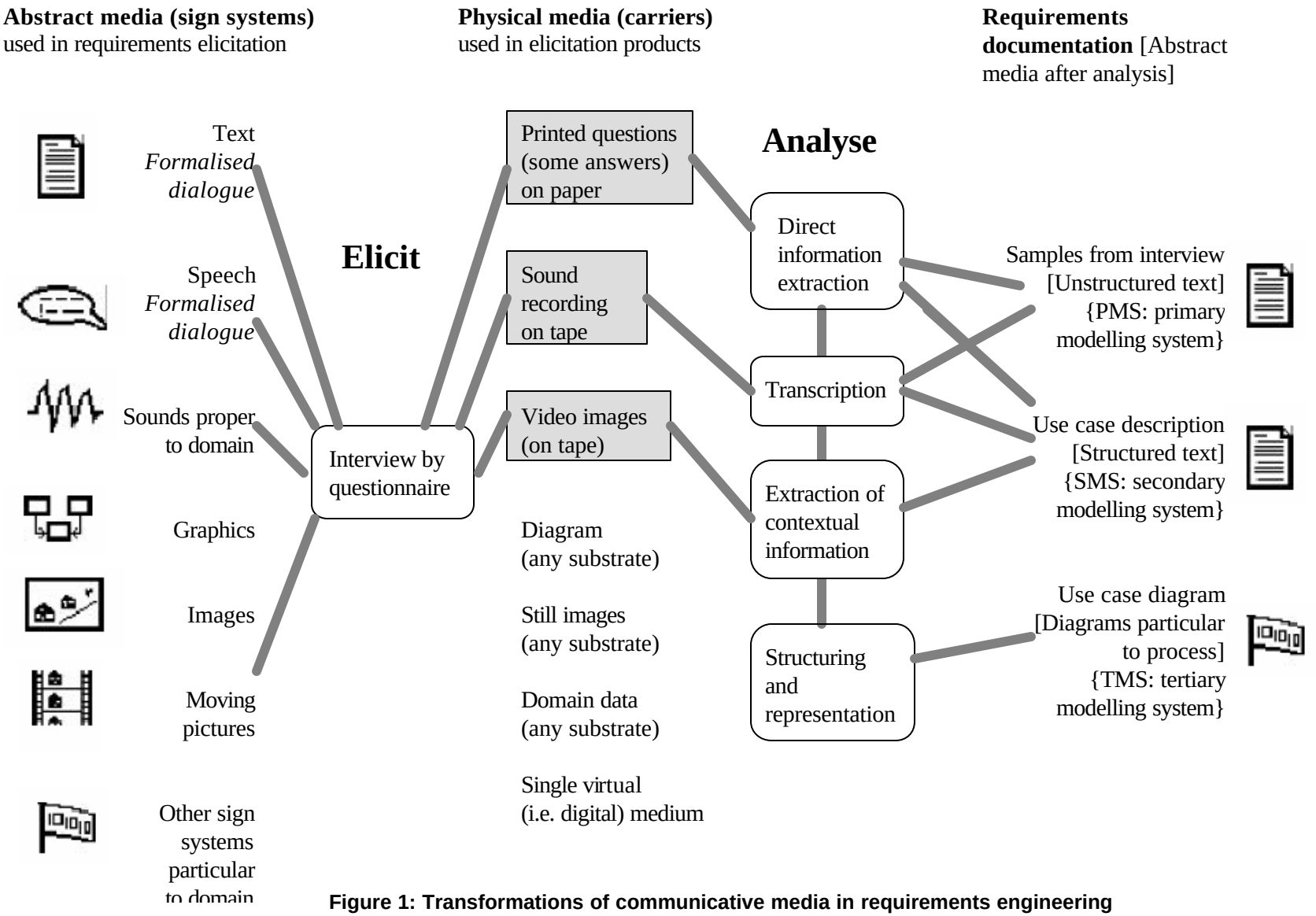

Figure 1: Transformations of communicative media in requirements engineering

encompasses both textual and non-textual signs. For the Moscow-Tartu School of semiotics [3] the 'primary modelling system' (PMS) is natural language and the proper object of linguistics. In the example, raw textual data from the interview questionnaire may very well feature in the eventual requirements documentation (far right of Figure 1) and would be classified as primary.

Natural language serves as the universal metalanguage for the interpretation of 'secondary modelling systems' (SMS) which are realised by correlation with the system of natural language and which use it as their material, whilst at the same time adding to it further structures. The classic early application of such structuring revealed a standard framework within Russian folk tales [6]. In software engineering, structured use case descriptions and scenarios are an important example [4], and obvious products of the example given in Figure 1. In general, any structured text serving a descriptive rhetorical function is definable as a SMS.

It does not violate the overall principle to posit a class of 'tertiary modelling systems' (TMS) that also depend on natural language as a metalanguage of interpretation but employ exclusively non-textual components as the foundation for representation. State charts or UML use case diagrams are classic examples in software engineering and potential products in the example of Figure 1.

Text is not just another medium. Natural language as text is the primary modelling system upon which we build descriptions. Any move to supplant text with multimedia representations in the requirements record needs to be carried out from an informed position.

5. Practical use

We propose to use this framework to illustrate how the records produced during the systems and software development process can be viewed from a media perspective. In particular, the use of a combination of abstract and physical media to make a record should be distinguished from the creation of representations for specific communicative purposes that have been derived from that record by some combination of transformations. The development and validation of this framework is the subject of on-going research.

We posit that, by extending traceability models with details of the media in which data are recorded, we will be in a position to track the media transformations that take place and so pinpoint those places in the record where consistency of communicative purpose is more likely to be affected by information loss or gain. In this way, we can reveal where placing anchors to supplementary rich contextual information (in the form of multimedia representations) would provide the most leverage. In the absence of such descriptions, indicating where links to the underlying social contribution networks may be most helpful.

6. Conclusions

With the use of non digital physical media for requirements representations, the problems associated with traceability have been predominantly ones of transfer. With the use of digital physical media, it becomes straightforward to replicate a digital record (in whole or in part), irrespective of the abstract media that it carries. With the emerging use of multimedia representations in requirements engineering, the problems associated with traceability become more ones of transformation. Ultimately, most of the abstract media we use will be transformed into text, if the primacy of text as a natural language is accepted. This is a phenomenon that needs to be understood and explicitly addressed if we are to design processes that capture and preserve the integrity of the record.

7. References

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