Computerized support for ad-hoc social networks

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Abstract: This paper describes three social network applications, based on labeled transition systems. These concepts are presented to explore their potential for forming virtual organizations in a serendipitous fashion. The main contribution of the paper is a framework of concepts that describe technology, which we believe will support these spontaneous entities.

Keywords: Social networks, formal models and frameworks for describing serendipitous formation of organizations

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1 Introduction

Various types of social networking is getting much attention. Unlike many other examples of technological innovation [21], they seem quickly to attract mainstream users, who see them as instrumental to furthering commercial or political interests [14]. This means that they can be seen as important realizations of social capital. The importance of such networks in getting work done, and the effort needed to develop productive alliances, integrate the networks and promote innovation, warrants extensive research and development work to facilitate it.

The exact factors contributing and the means and resources necessary to sustain social networks, are multifaceted. Henk D. Flap points out that the investment in social capital my be a side-effect of pre-requisite interaction, which as such may be oriented towards other objective or even be a goal in itself [11]. There is always an active effort that need to be taken, in order to forge the linkages between individual intentions and actions[a], and hence contribute to the formation of virtual organizations and social networks. Failing to take this need to make a "mosaic" of individually oriented work (albeit sometimes routine or institutionalized) into account, and thus rely entirely on *serendipity*, must be seen as part of the explanation of the failure of a certain class of groupware systems[25]. This is not to be taken as an argument against the force of co-location as a driver for social closeness. Serendipity of encounters is arguably a powerful dimension of social network integration [7]. It is one of the strongest determinants for friendship and collaboration [1]. The problem is that it tends to occur too infrequently for computer-supported co-operative work (CSCW) to gain critical critical mass. Even in an online setting, the frequency of chance encounters tends to be too low [15]. This hampers adoption.

Current social networks are supported with a relatively narrow selection of technologies, such as Short Message Service (SMS), Internet newsgroups, Wikis and more proprietary systems such as Twitter[b] and Facebook[c]. The functions thus supported, are not tremendously diverse, however. It comprises individual, group and public messaging and status updates. Moreover, the more advanced ones are *explicitly* social network applications, which make the work of making and contributing to the social network into a task in itself.

This paper proposes three applications of a formal modeling approach, which relies on Labeled Transition System, to *implicitly* create three diverse forms of social networks. They are:

1. Setting up, monitoring and controlling integration projects.
2. Creating user manuals and expert systems, including direct communication with peers.
3. Mixing and matching digital audio effects and music.

The number of possible applications that may contribute to form networks implicitly is limitless, of course, so these are just examples. However, we want to contrast this with other approaches to modeling networks of this kind.

2 Related work

Taxonomies have become an important part of the social networks research area [19].This is not a concern limited to novel technologies, of course [3]. There is a clear rationale for wanting activities to be manifest as structures, so that in the next instance they can be utilized as resources for further action [22].

Sichman et al. have described the formation of a social reasoning mechanism for intelligent agents [23]. They use a local repository for each agent to keep a global view of information that they have about other's *goals, actions, resources* and *plans*. This information is used in a set algebra to calculate the dependencies

[a]Blumer, Herbert. 1969. Symbolic Interactionism: Perspective and Method. Englewood Cliffs, NJ: Prentice-Hall., cited in [6]
[b]http://www.twitter.com/
[c]http://www.facebook.com/

one agent has to others. The challenge of this approach, like most taxonomies, is that they depend on the explicit encoding of the properties of each agent.

Building taxonomies "by hand" has been the prevalent approach. A systematic approach involving literature reviews, exploratory surveys, in-depth case studies and surveys is solid [12], but resource-demanding. Moreover, there is always a danger that the actual practices as they unfold may be based on a different ontological mapping than the one that has been normatively discerned by researchers or consultants.

Our aim is to see how far we can get by collecting this information "on-the-fly". This is not entirely the same as collaborative tagging, although once the terms (representing tags, or action, or content, etc.) have been gathered, the algorithm presented e.g., by Heyman et al. in their paper [13], will be one candidate to explore further for the actual organization of these data.

Our data will be generated by usage, inconspicuously and implicitly by the tasks that the users carry out. In the next instance, these data needs to be compiled and presented in a pedagogical manner. There is an organizational *purpose*, however, attached to this, and it is this purpose that we intend to explore systematically in this paper.

3 Method

The projects described in this paper are simple feasibility studies. They capture an initial idea, and represent it in a prototype, which, in most instance, is still premature for a full evaluations. Nevertheless, there are certain lessons easily within reach. The exercise of formulating the ideas as such bring out weaknesses and expose them the critical examination of the target community. More importantly, however, the first prototypes can be analyzed with regards to the technical feasibility, and this is the prime objective of this paper.

4 A simple theory of processes

In this paper, we rely a simple model of processes. It sees them as a Labeled Transition System(abbreviated LTS). A LTS can be defined as a general automaton, accepting a language of strings, each of which comprises a sequence of terms. In our modeling approach, such terms can abstractly represent anything that causes a change of state in the processes within our scope, such as a method call, a received message or an action performed by the operating system or the user.

5 Results

There is much common ground between the following applications, since they are all conceptualized as compiling an input of terms into meaningful structures, which will serve as vehicles for the pertaining social networks.

The applications will be described only briefly on the technical level. We are also going to describe the mapping from technical functionality to the social formation of user groups and their future needs.

```
{in_port="dealer",out_port="player",timestamp="1234",message="msg
JOINGAME from A to DEAL">
{in_port="player",out_port="dealer",timestamp="1235",message="msg
GETCARD A wildcard(DECK) from DEAL to A">
{in_port="player",out_port="dealer",timestamp="1245",
message="msg dealer GETCARD DEAL wildcard(CARD) from DEAL to A">
{in_port="dealer",out_port="player",timestamp="1249",
message="msg GETCARDmsg STANDTHISROUND A from  A  to  DEAL">
```

Figure 1 Some messages flowing in an integration architecture

5.1 Setting up, monitoring and controlling integration projects

We have elsewhere applied the mathematical reasoning described in this paper, in the "opposite" direction, i.e., to start from an application graph describing the Labeled Transition Systemof a simple blackjack-playing agent. The results show that, indeed, coming from two sufficiently precise application graphs, an automatic translation between terms that are syntactically different, is possible.

In this paper, we suggest forming virtual organizations by going in the other direction. From the traffic of terms that we know are translated correctly (figure 5.1) to the application graph, which we see as a Labeled Transition System, we want to use the messages that flow through an integration hub to form its own documentation. This application takes messages flowing between applications, which are connected to each other via an *integration bus*[d].

The intercepted terms are seen as actions in the language of a Labeled Transition System(LTS), which at the most trivial level can be formed by linearly stringing together the terms. The LTS then needs to be compacted and re-represented with cycles and branching, before it can be presented to the users in a pedagogical fashion. The mathematical challenges of this is beyond the scope of this paper. The corresponding LTS might end up looking something like in figure 5.1, below.

The foremost question is which information is useful for the purpose, and how may it contribute to forming a social network, or a "community of practice", which is affiliated with the integration project. In the blackjack-example, one possibility would be to form guilds of players or markets of casinos, in which collaboration or competition might be encouraged. Blackjack and other forms of gambling, still, are probably not the most tempting scenarios for which to furnish social networks, however.

Another, more pertaining, example is taken from the financial services, in which transactions are analyzed with regards to forgery and theft from bank accounts. The service provider of the switch card terminals and other access points, need to be able to act when a bank card has been stolen, e.g., in order to minimize the customers losses. Some errors occur in the order of normal production processes, whilst others represent failed attempts of forgery. In both instances, the badly formed transactions have to be picked up. This process is largely automatized, but a manual follow-up is implemented for all failed transaction. The illustration below (figure 5.1) shows the workflow for this scenario.

[d]This could typically be a hub architecture, like Microsoft BizTalk™or Oracle Weblogic™. The payload and meta-data about each message will vary between architectures, of course.

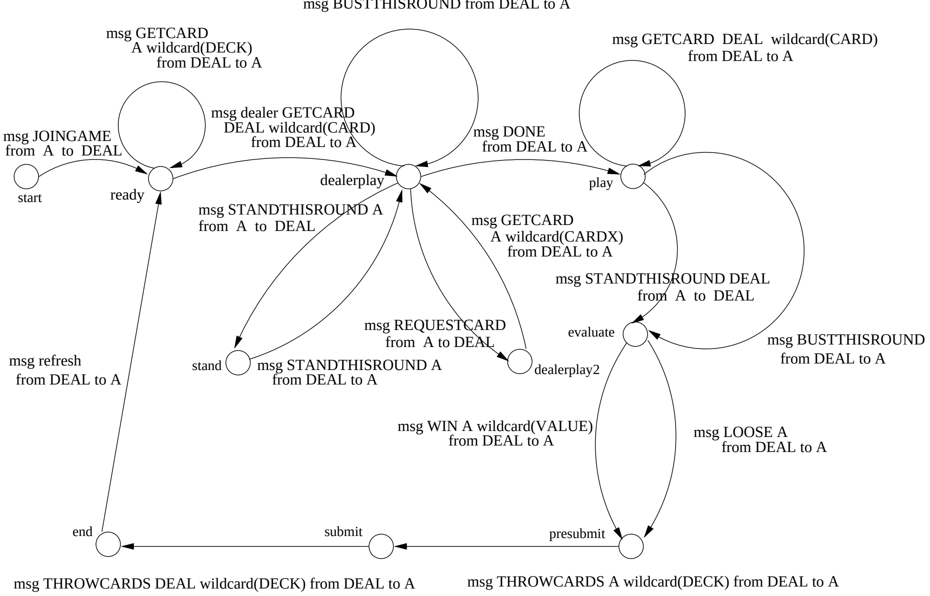

Figure 2 A possible Labeled Transition Systemcomprising the application graph for a game of blackjack

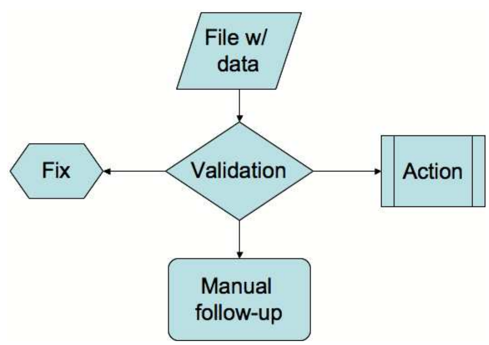

Figure 3 Workflow for bank transaction validation application

The objective of an automatic application would be to visualize and accommodate the virtual enterprise of collaboration between the points of access and the control functions. The effect, as compared to the way in which this is managed manually today, would be to make sure that without exception an *intervention* is initiated, whenever a data record is detected, which does not comply with syntactical and semantic rules. Manual repairs need to be carried out, but the formation of virtual teams to do it might be alleviated with our application.

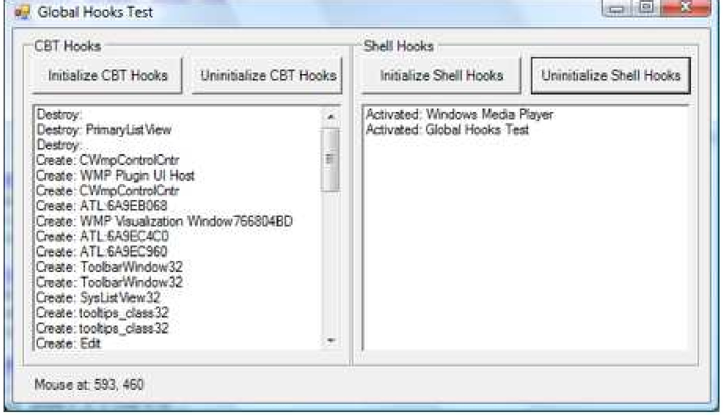

Figure 4 A printout of the global system events "hooked" by the Wilson application

5.2 Creating user manuals and expert systems, including direct communication with peers

The next proposal that we are making, comprises a general infrastructure for "on-the-fly" usability engineering. It takes user (inter)action in its basic form, as system events, to be the input stream. Each event in figure 5.2 corresponds to a term, in the definition above. The pattern matching approach is used analogously, to be able to present previous "best-practice" sequences of interaction with the relevant application, if and as the current sequence of events matches with the consolidated previous experiences of a host of users.

The matching (part of) an aggregated LTS can be presented graphically for the user, and help figure out a way to proceed with the application based on the experiences of a whole community. It is also possible to replay scenarios from previous user sessions. This raises important questions concerning privacy, but it also offers the potential to form communities of users in a network of similar application domains.

It may be objected that most of the "shared lessons" thus learned, are straightforward, and that they depend mainly on the motivation of users to work more efficiently. Our experience from this type of case, is that users, indeed, seem to find it more efficient to "trial and error their way through" the problems. They do this well ahead of asking a colleague or consulting the manual, in spite of the time it takes and the redundancy of operations that we observed. They have good reasons for doing so, we must assume, but the availability of social network support, which grows in size and impact over time, might nonetheless play a role.

In this application, we must allow ourself to assume that all users who subscribe to this "installed base" are going to be interested in the same application. They may be using different versions, however, and over time these may vary slightly and in an evolutionary fashion move into *technical* as well as *interactive and cognitive incompatibility*. These three dimensions of *protocol slide* are going to be important to manage well.

Finally, in this paper, we suggest using the technique that was described above, to implement a more intuitive interface for the type of effects pedals typically used by guitarists. This is a very different type of case. Such pedals have intricate and non-standard user interfaces, using variable terminology, such as “dry”, “mix”, “velocity” and deliberately obscure terms such “Sotra” and “Stril” (local colloquialisms of geographical origin) as in addition to the more intuitive “bypass”, “tone” and “volume”, which may still be in unreadable small font sizes to be read whilst playing the guitar, anyway.

Figure 5 A pedal control panel, which is probably not intuitive

Figure 6 Another effects pedal. What does it do, and how?

There are number of challenges for a user of such devices, of course, in addition to have to learn the exact vocabulary for each pedal type and internalize how it, literally, effects the sound that an instrument makes.

We want to suggest an interface for these effects that produce the desired modifications of the sound, based on the musical actions that are taken. This can, e.g., be associated with the music itself, in terms of the chord progressions or single note runs that are being played, eventually in a combination with the pitch, accentuation or force that is applied (to analog instruments). This is not an argument towards this being more “musical”, as such. The point is that is furnishes a possibility of documenting the practices as they unfold, and drawing, simultaneously, on the resources comprised by the accumulated practices of other musicians.

This is also a step towards the social aspects of using the proposed technology. It is likely, first, to lead to different effects, or old effects applied differently, but additionally we believe that it would lead to *convergence*, meaning that effects could be interacted with similarly across groups of players who are interested in the same style of music.

The situation today, as the pictures (Figure 5.3 and figure 5.3) of the pedals show, is that they all have different user interfaces (5.3). This creates confusion and “lock-in”, inasmuch as musicians cannot easily swap boards, and, indeed, they cannot not easily create radically different soundscapes from their signature sound.

Figure 7 A complete board

Figure 8 Musician working out

An implementation of effects where the *tactile* or musical aspects of the sounds *in context* govern the effects, has in addition a socially-oriented *micro-* as well as a *macro* consequence, potentially. One can imagine (in macro), that the cumulative adaptations of the sounds created by musicians previously starts to become an installed base of various alternatives that the guitarist can tap into as he or she plays. On the session level (micro), one can see this as a structuring of the production of sound that can be communicated in real-time to the other members of the band. Thus, they can draw upon a richer communication channel. In both instances, there is a virtual organization of the production of music that is being formed.

This application represents a complicated idea, of trying to combine the musical structure of pitch and duration of notes, and combine it with the analog musically of the performer. The notes from the "sheet", for instance, representing an *indicative* perspective on music, may be combined with the tactile "attack" on the instrument (figure 5.3) to create this novel paradigm. It may be controversial, inasmuch as "signature sounds" are crucial and relay on individual fine-tuning of analog as well as digital effects controllers. On the other hand, if *playing* instead of twisting knobs and dials create the same effects, it may still be individual, but perhaps more intuitive, and social.

In summary, then, we have presented three scenarios with applications that we believe may implicitly and ad-hoc stimulate the formation of social networks. Through this presentation, the following terms have been highlighted: Term compilation (commands, formats and content), protocol slide management (technical, cognitive and interactive), convergence of interactivity (on a macro- as well as micro-level) and control and action (tactile and indicative); all of which are combined into a context of interpretation for one another. E.g.,for the music application four 1/8-note pairs may be interpreted as two "swing" triplets or eight "even" beats depending on the potentially dynamic "wham" (bend) of a blue note just before the sequence inside a tune.

6 Discussion

One big advantage of our proposal is that it represents "ad-hoc" formation of social networks, in the sense that atomic events are interpreted as terms dynamically forming the picture of a process. The size and structure of these events may be much more fine-grained in an automatic analysis than in a more traditional, interactive perspective. For instance, Tang et al. show how membership information can be deducted from existing sources [24], but this is based on pre-definitions of names that is expected to appear, e.g., in people's web pages. Joly et al. have proposed to make some of the registration of meta-tags automatically dependent on the context, in order to introduce a more flexible architecture and less cumbersome application [16]. We believe that this is a good idea, and something that we would like to try to take one step further in future work. Whilst Joly et al. still look at the "work to make the network work" as a task in itself, albeit one that can be partly automatized, we wish the integrate the formation of the network with the activities that it more broadly was introduced to support, initially.

In order to find a body of work more closely resembling ours, one needs to look at research into serendipitous communication and the formation of ephemeral networks based on chance encounters. However, research has showed that merely being in the same place is not enough [18]. It does not help that the "walks" are computer-generated and -populated [15], either, which is definitely something that we need to be aware of. In future work, we intend to carefully study the effects of initiation-by-computer vs. human, and its correlation between the presentation metaphors, such as "spaces" or "walks".

We would like to propose looking more closely at the domain of so-called "media-spaces". There are good indication that this body of work can be revisited with an objective of supporting virtual organizations [20]. In terms of ad-hoc and chance encounters, it has already been argued that "random walks" are often perceived as intrusive [4], and the "auto-cruise" functions are usually poorly evaluated [10]. Although the default response for users rarely is to block incoming calls that they are not happy with [5], since this may in itself be viewed as impolite, the consensus is that the number of session originating from "glancing" tends to be low [25]. This prevents the important social work that takes place during brief, unplanned meetings [2], as well as the formation of new social networks. We believe that the link that our approach proposes to make with *action as it unfolds*, might alleviate these problems. The added task-orientation is proven to be beneficial [8]. At the same time, our approach ought to be able to reproduce at least the effects of time- and space-based co-ordination, in which case we may have to include synchronization as well as what we loosely may denote as *congruence* of the LTSs.

There are other advantages as well, such as the automatic extraction of the network membership, but in contrast to Tang et al. [24], we think that semantic challenges may be alleviated in our approach. The reason is that extraction is imagined as simply based on process expressions, which are pattern-matched against each other regardless of what the terms actually "means". It is the 'power of the terms to drive a LTS through state changes, which counts.

In terms of the implications on the organizational level, we need to look into some previous contributions from sociology, e.g., which we feel match ours even more closely, since it points towards the requirements of the socially organized network [17, p. 136]:

1. Materials and resources, which are the monetary and physical substances used in the process.
2. Organization of work, e.g., by the sharing of tasks through physical labor;
3. Intimate interaction: social behaviors such as listening; and expressing emotion, empathy and sympathy;
4. Teaching and mentoring: offering advice, information, or instruction;
5. Feedback, which is described as providing individuals with feedback about their behavior, etc;
6. Supportive social engagement and interacting for fun and relaxation.

The question seems to be, then, if these categories can be mapped conveniently against the framework that we presented above. Our first two dimensions, *term* *compilation* and *protocol slide*, addresses the materials and resources needed to facilitate the social network. The convergence of interactive strategies on every level within a use context, provides a background for the social activities hence described in Barrera and Ainlay's framework [17], but stops short of supporting such activities specifically. Hence, our ideas might be seen as a suggestion of how to start designing a technology, which may enable socially organized networks according to Barrera and Ainlay's framework. Still, it remains an open infrastructure for it, rather than a concrete application.

One example of a related system is Walopp, a system that uses explicit tool support to encourage, manage and communication within social groups [9]. A preliminary study of use provided promising results, in terms of deploying technological means for building these kinds of social structures. However, people found the insufficiency of contextual information disconcerting. It was perceived on the one hand as messy, and on the other hand as dissociate from the situation from which the data were sourced. We believe that the strength of the approach that we propose in this paper, is that the originating action itself it the structuring device for this type of information, rather than presenting it in a freer, more cloud-like fashion. Also, the application of it towards bolstering the social network may be entirely implicit, as the state-transition type of structure thus created, is used to re-initiate similar states again. We do not know yet, if this "re-play" of a consolidated *best-practice* is something that will appear as totally opaque to the user, or transparently become an integral part of the current, by definition similar, situation. An empirical investigation of this and many more questions, is a natural next step for the research presented in this paper.

7 Conclusion

We have presented three ideas for applications that exploit the same basic, mathematical notion of a Labeled Transition System, to extract and present information, which may support the formation of goal-oriented social networks. These application ideas have been used to elicit a design framework, comprising concepts that we think are going to be useful for the design of such network technologies in the future.

Acknowledgments

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