THE WEB BASED SYSTEM FOR RECORDING AND ANALYSING DIFFERENT KINDS OF NEGOTIATIONS

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Abstract: Negotiations are a base of various human and electronic activities. The paper describes a web based system for recording, analysing and supporting some steps of negotiations. It also discusses several, fundamental problems of implementation of the system. To show its usability, some experiments and outcomes of negotiation processes are demonstrated. Two kinds of negotiations (*f2f* and *cmn*) where analysed and the essential drivers are pointed out and discussed.

1 INTRODUCTION

Nowadays most of professional human enterprises are performed by teams, where important activities and decisions are taken by negotiations (Krawczyk-Brylka and Piotrowski, 2004; Unsworth and West, 1999). Negotiation is a process that occurs between at least two competing parties who discuss a certain topic. The topic is an object of the real world that parties have interest in. For the negotiation process to take place, demands, connected with the topic, should be formulated by both sides (negotiators). If the demands are satisfying for both sides, an agreement of negotiation has been reached.

We can distinguish two kinds of human negotiations: natural (face to face) and executed in the Internet environment (e.g. supported by chat). Moreover, software agent technologies can be used to automate some steps of the negotiation process. Understanding of the face to face negotiations (*f2f*) and computer mediated negotiations (*cmn*) is very important to make various human enterprises more efficient and effective (Phelps et al., 2004).

Let us consider a simple case of business negotiations. The objects of negotiations are goods which one partner (buyer) wants to buy and another partner (seller) wants to sell. The demands are the suitable properties of the analysed goods such as prices of goods, delivery terms, payment forms, etc. The final step of the negotiation is the contract for the goods describing conditions for completion of buying/selling transactions. The outcome of the negotiations represents the accepted values of contract demands.

There are many different possibilities to formulate demand sets as well as to organize negotiation strategies. Apart from the above mentioned aspects, the compromise outcomes depend on many other factors: negotiators' personalities, their motivations and experiences, available communication channels and methods, alternative possibilities of other contracts, quality of the negotiated goods, criteria of negotiation demands and so on (Bazerman et al., 2000).

The paper presents a web based system for recording and analysing negotiation enterprises called GAJA. The system provides tools for examining many different aspects of negotiation processes. In Section 2 we describe functionality of the proposed system. In Section 3 we present the GAJA architecture and Section 4 shows the main implementation problems. Section 5 gives some experiments and outcomes which demonstrate system usability.

2 IDEA OF GAJA

GAJA is a web based system that enables studying negotiations in a natural environment (*f2f*) and in artificial environment (*cmn*). The main features of the GAJA system are as follows:

- possibility to monitor several types of negotiations. Currently it is possible to consider:

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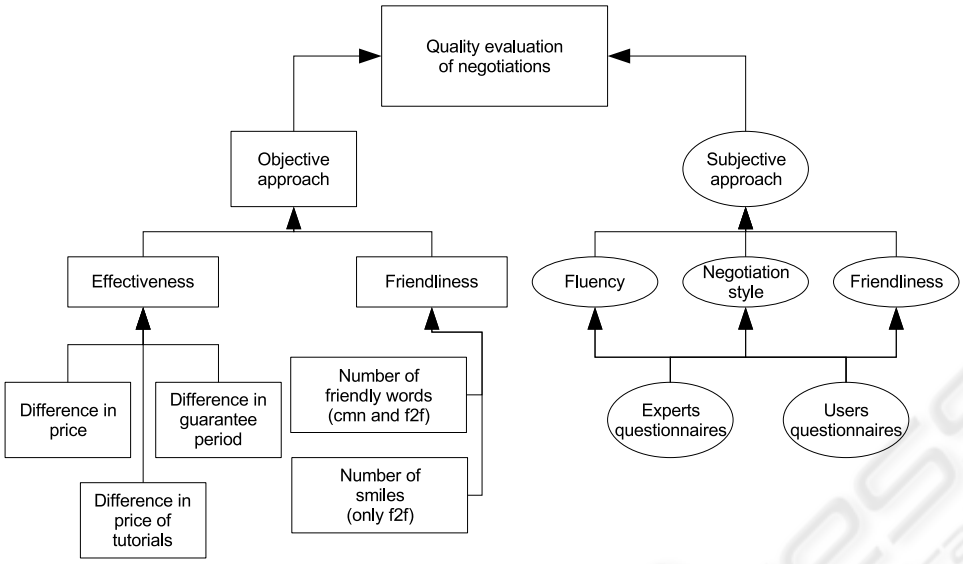


Figure 1: A fragment of the evaluation tree for sell/buy negotiations.

  - sell/buy negotiations — a simple case of selling/buying a good by the participants;
  - ranking negotiations — a group of people have to collectively create a ranking of goods being under consideration;
  - enterprise negotiations oriented towards a design of applications where small groups of students are involved in designing of a simple web based applications (using interactive incremental approach);
- possibility to define many versions (instances) of experiments for each of the defined types of negotiations, for instance:
  - different communication channels used during negotiations;
  - different roles and positions (power) of negotiators;
  - different negotiators tasks and demands;
- possibility to support activities of different types of users, which are as follows:
  - experts — they can define negotiation experiments, observe their executions and evaluate negotiation processes and obtained outcomes;
  - negotiations' participants — they participate actively in experiments and give their own opinions about the expected results, negotiations outcomes and moods;
  - administrators — they have access to all the available data and they configure the system for concrete requirements;
- possibility of quality analysis of negotiators' behaviour and negotiation processes:
  - evaluation of personal characteristics of all negotiators using psychological tests;
  - reviews of available chat logs and recorded video media by experts to improve evaluation process;
  - discovery of knowledge hidden in the collected data and available questionnaires using professional analytical application suites.

For each type of negotiations we would define the suitable model of evaluation. We use groupwork model: contribution – processes – outcome (CPO) described in (Unsworth and West, 1999; Bazerman et al., 2000) and generalized by (Krawczyk-Brylka and Piotrowski, 2004). Figure 1 shows a fragment of the model (quality tree) used to evaluate wide aspects of negotiation outcomes. The tree contains several different factors divided into two main categories: objective (calculated from monitored data) and subjective (calculated from questionnaires). Each of these categories have subcategories such as:

- effectiveness — describes how negotiation outcome is close to BATNA (Best Alternative to a Negotiated Agreement) alternatives for each participant. Here, effectiveness means the difference between accepted and expected demands of goods;
- fluency — describes how fluent the negotiation process was like. It takes into account sequences of negotiation phases, interruptions, etc.;
- friendliness — shows if negotiations were handled in a friendly way (negotiators used kind words, they were smiling, etc.);
- negotiation style — could be aggressive or cooperative.

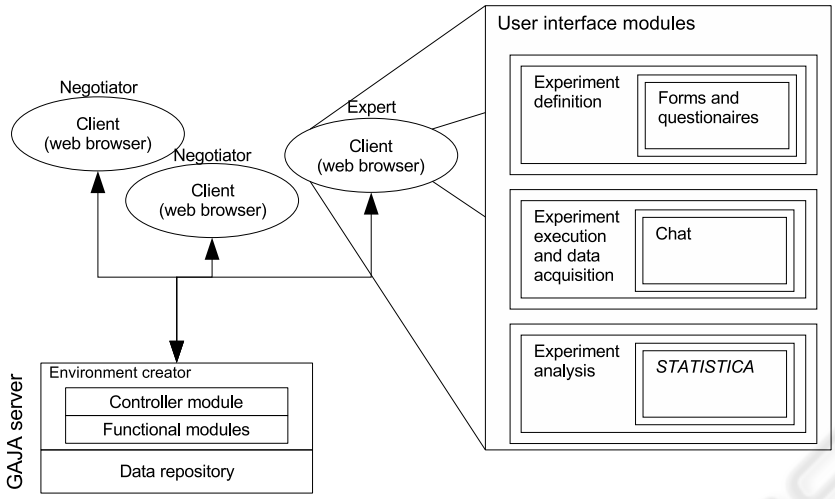


Figure 2: GAJA system architecture.

Some of the above factors can be evaluated in both objective and subjective ways and some of them either objectively or subjectively (see Figure 1). Some quality metrics can be evaluated either by negotiators or experts, or by both of them. Besides, we can register the whole process of negotiations in the logs (chat, video) and then analyse them many times for in depth studies.

3 GAJA ARCHITECTURE AND FUNCTIONALITY

In Figure 2 the GAJA system architecture is presented. It works in Internet infrastructure and its users can connect to the system server using a web browser. The available network environment is created by controller module. The controller module has access to repository where description of the system configuration is stored. Also, all recorded data gathered from experiments are registered in the data base. The controller is responsible for creating user interface views using appropriate functional modules. There are three types of functional modules: experiment definition modules, experiment execution modules and analysis modules.

The experiment definition modules are available only for experts and administrators. An expert selects a type of negotiations and enters descriptions of an experiment required by that type. Each negotiation experiment consists of a task and contains background information and precise instructions for each of the negotiators. For example, an expert specifies what the subject of the negotiations is, what the criteria which can be negotiated are (good price, guarantee period, tutorial course price etc.) and defines specific roles for each participant. Moreover, a role of negotiator follows from real quality goods and their minimum and maximum price. Knowing the contracts, the system estimates the effectiveness of negotiation process as a difference between the expected and achieved negotiation outcomes. Besides, an expert define the evaluation trees, suitable questionnaires, negotiation period (lengths) and scales of ranking of possible outcomes (see Figure 1).

All the data referring to the experiment definition are prepared in advance. When negotiators log into the system, the system presents the tasks suitable for them and then they make experiments. This process is controlled by the experiment execution modules. The main steps executed by negotiators can be as follows:

- understand negotiation instructions (situation background, aim of negotiations, their roles),
- start, perform and finish the negotiation process,
- fulfill questionnaires: personal information, forms about negotiation outcomes and about their opinions and their feelings.

The negotiation processes are recorded as chat logs or video logs. The analysis module allows to examine outcomes by experts. All the recorded data are used in post mortem analysis of given set of negotiations. Some factors are calculated automatically on the basis of stored information and they are available immediately after experiments. Some extra information needed for further analysis is entered by experts, following observations of available logs. Experts, similar as negotiators, fulfill the questionnaires that evaluate both the whole negotiation processes and performance of each participant (subjective evaluations). To

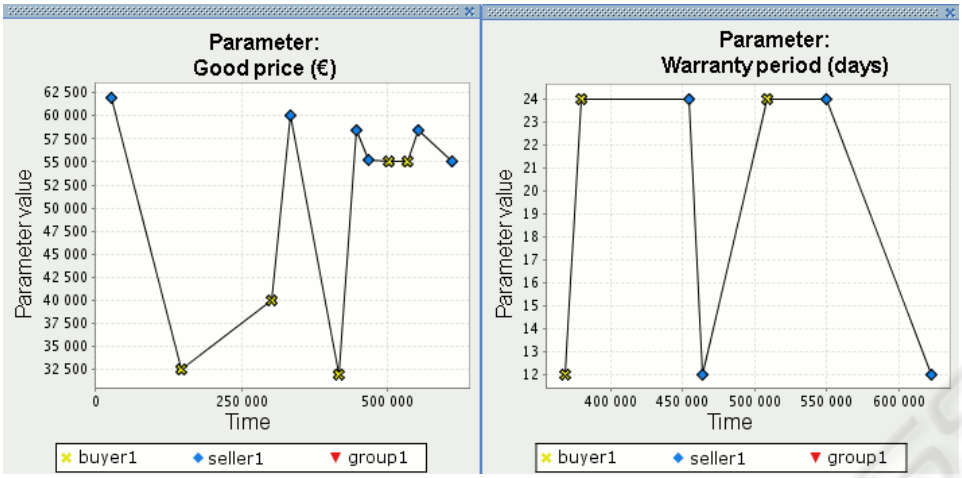


Figure 3: Negotiation dance graphs for two criteria of negotiations (good price and its guarantee period).

facilitate the log evaluation GAJA, offers new possibilities. During observation of the logs experts can push different buttons of the keyboard to automatically point out some events and to provide some essential values connected with the events. The GAJA system counts such events and calculates as objective factors.

One of the possibilities of GAJA analysis is to display so called "negotiation dance" which shows changes in time of the negotiated demands. Figure 3 presents the graphs for the price and warranty period.

The analysis modules allow us to display all gathered data as tabular reports (see Figure 4). The tabular reports show some parameters such as participant expectations for negotiation outcome, weight for each of the negotiated demands and final values for negotiation demands. The system enables exporting the table to a CSV (comma separated values) file which can be imported to any professional package e.g. *STATISTICA* for more advanced statistical analysis.

4 IMPLEMENTATION PROBLEMS

To achieve high system flexibility we decided to use a web technology. We decided to use PHP technology to implement the main modules of GAJA. We also used Java Applets or Java applications when it was necessary or more convenient. The choice of PHP was motivated by facts that it is widely known, popular and open source technology and it is easy adaptable for typical hardware and software.

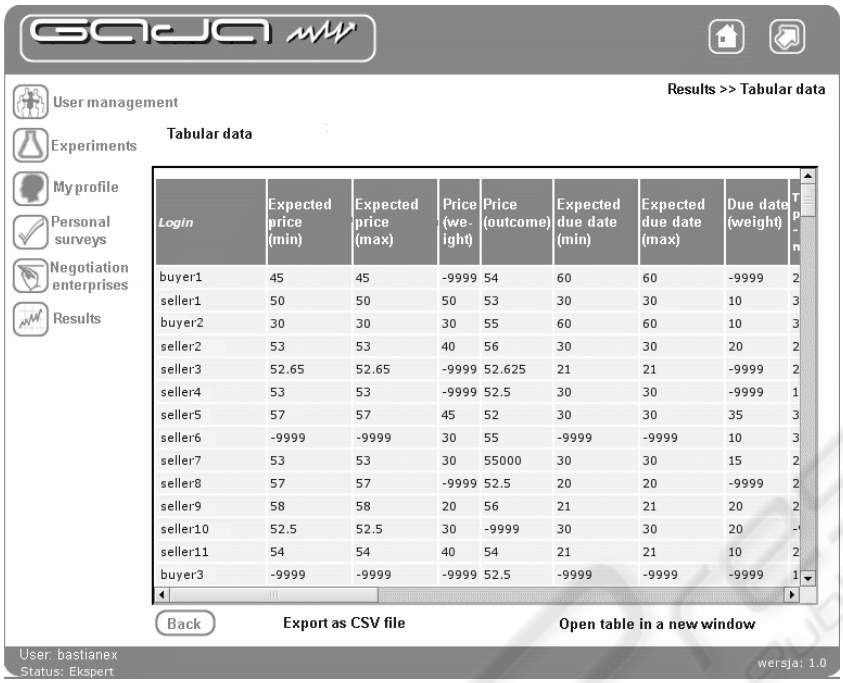
We used modular, component oriented approach to develop the system. We use the Model View Controller pattern (Buschmann et al., 1996). Its main part is the controller module responsible for controlling access to modules and choosing which functional module has to be executed for suitable user actions (Figure 2). In a special configuration file it is set which modules are activated and what types of users can those modules use. Physically new modules are just directories with code responsible for generating appropriate views (Piotrowski and Krawczyk-Brylka, 2003; Krawczyk-Brylka and Piotrowski, 2004).

Each functional module is created with various components (Gellersen et al., 1997). For main functionality basic components were developed and added to the GAJA system's library. For the new functionality, the components were used to build new modules. Thanks to that approach, definition, execution and analysis modules use common components and objects, which simplifies the introduction of changes into the system.

In the development of execution modules we introduced the step based approach. Using the library of components we define steps of activities required in the experiments. Each step is supported by adequate components which display appropriate instructions to a user and require user interactions to enter other information. Moreover, we can rearrange steps according to experiment requirements or reuse them in new types of experiments. In many cases this requires the change of the step's number and the controller module utilizes components in a modified, new configuration.

One of the big challenge in developing analysis modules was to design a special user interface for pointing out negotiation events that would be similar for the video and chat logs. It is obvious that comparison of different media types is a difficult problem so it is not easy to create user interface which will provide a similar way to analyse both video and chat logs.

F2f and *cmn* negotiations are always performed in



Login	Expected price (min)	Expected price (max)	Price (weight)	Price (outcome)	Expected due date (min)	Expected due date (max)	Due date (weight)
buyer1	45	45	-9999	54	60	60	-9999
seller1	50	50	50	53	30	30	10
buyer2	30	30	30	55	60	60	10
seller2	53	53	40	56	30	30	20
seller3	52.65	52.65	-9999	52.625	21	21	-9999
seller4	53	53	-9999	52.5	30	30	-9999
seller5	57	57	45	52	30	30	35
seller6	-9999	-9999	30	55	-9999	-9999	10
seller7	53	53	30	55000	30	30	15
seller8	57	57	-9999	52.5	20	20	-9999
seller9	58	58	20	56	21	21	20
seller10	52.5	52.5	30	-9999	30	30	20
seller11	54	54	40	54	21	21	10
buyer3	-9999	-9999	-9999	52.5	-9999	-9999	-9999

Figure 4: Screenshot of negotiation outcomes presented as tabular data (value of -9999 means lack of data).

a certain time frame. They take a period of time, start in one point and end in another. As it was presented the experts should point out some events (such as nice gestures or friendly words) that occur in a certain moment in time. There arises problem how to synchronize such events. Our proposition is the user interface based on a logical timeline. For each negotiation experiment we can define its own logical timeline. An expert analysing the videos watches the records and presses a key in the concrete moment of time when the corresponding event is observed. Simultaneously the event is marked on the timeline. Similarly an expert analysing the chat logs marks a fragment of the suitable text which corresponds to a certain event. This fact is registered on the logical timeline in the point determined by the moment of sending the message by the negotiator. In such way we obtain "negotiation dances" (see Figure 3).

The approach allows us to analyse negotiation processes in similar way regardless of what communication medium was used during the negotiations. Moreover, the system normalises the scale of times and various values of factors for all experiments.

5 EXPERIMENTS

To test GAJA system we arranged two main kinds of experiments:

- sell/buy negotiations (*f2f*, *cmn*);
- enterprise negotiations oriented on a design of applications (development of blog, news site, wiki).

In the first kind of experiments the negotiators focused on selling/buying medical equipments. They have to negotiate prices, delivery terms, payment forms, guarantee period and tutorial course costs.

In the second kind of experiments a small group of students has a list of typical functions that web based system can provide. They have to choose exactly six of them considering their priority and a period of time needed to develop them.

Up to now we have performed more than 150 experiments of that two kinds. Most of them (about 120) where *cmn* negotiations. The rest of them were *f2f* negotiations recorded by a camera. We performed more than ten chat experiments in parallel sessions using two network computer laboratories simultaneously. The participants of our experiments were students from several departments of our university. The experiments allow us to deeply test the system. Presently the system seems to be a mature tool for recording and analysing different kinds of enterprises including various negotiation strategies.

Figure 5 presents an example analysis which was made using *STATISTICA* application. In this case the experiments confirm the BATNA is not the most important factor in subjective assessment of negotiation power. Other experiments show the choice of the

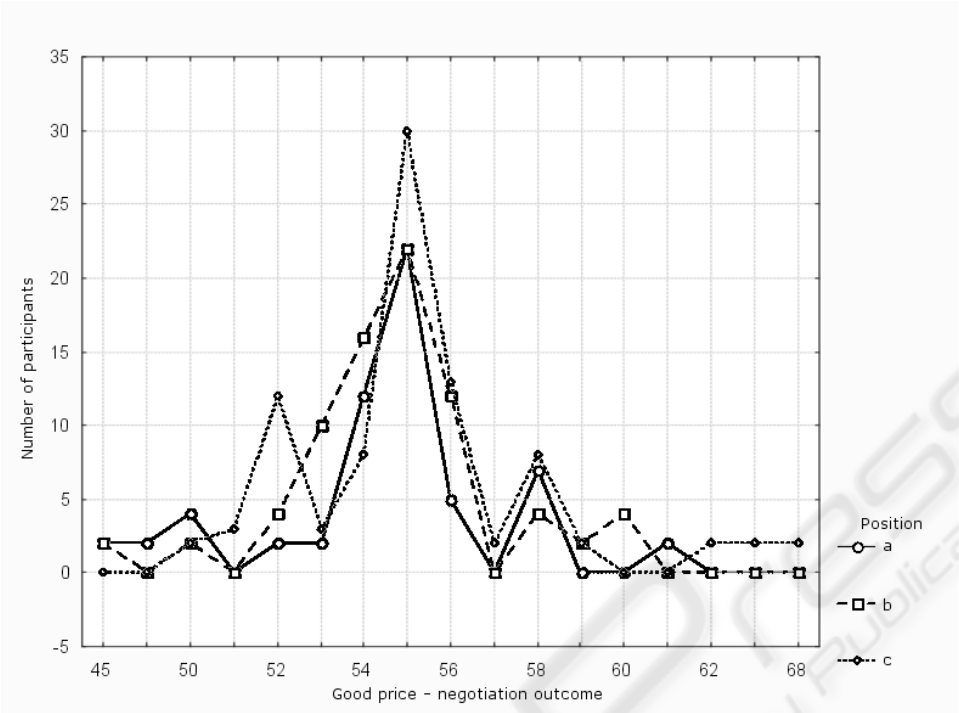


Figure 5: Distribution of negotiation outcomes for different negotiators power: a) equal for seller and buyer; b) buyer dominance; c) seller dominance.

communication channel (chat or *f2f*) does not impact on negotiation efficiency. Moreover, negotiation via Internet leads to decrease of friendliness and fluency what in consequences changes the negotiators satisfaction. The personal features like extroversion and consciousness play much more important role in the chat negotiations that in *f2f* meetings, where for the latter negotiation experiences are essential factors.

6 SUMMARY

GAJA system covers many aspects of analysing human negotiations. It consists of multiple modules which can be reconfigured according to experiment requirements. Distributed GAJA environment enables performing many experiments in parallel. This enables making a large number of experiments in short time. It is very important for multidimensional analysis of negotiation processes and gives new possibilities in discovering new rules hidden in various human activities.

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