Requirements Elicitation Applied to Electronic Voting System

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Abstract

Nowadays, technology has become the key element to carry out the management, organization and fulfillment of the electoral process. The electoral process should be understood as the actions that entail the making of the electoral roll, citizen identification, the act of voting, the counting of votes and the reporting of the results.

The act of voting is considered as the software system to be specified, using as the source of information the National Electoral Code of Argentina Republic. The scenario technique is applied in order to obtain the system requirements, with the purpose of reducing the semantic gap between the legal written documentation and the implementation of an electronic voting system.

Constraints regarding the compliance with the current legislation, the specific vocabulary, and the need to have, at least, one stakeholder that interprets the Law are analyzed. An elicitation technique, which emphasized the role of Language of the Universe of Discourse, is proposed.

Finally, it is stressed the importance of having a requirements specification with the necessary steps for the casting of the vote, including all the alternative situations, from which a software design can be done.

Keywords: Electronic Voting System, Vote Casting, Lexical Extended Language, Scenarios and Requirements Specification.

1. Introduction

The advent of Information Systems has enabled people to perform most of their activities through the use of computers in a direct and efficient manner. Contemporary countries are striving to transfer an increasing number of their activities to this new medium so as to provide citizens with the ability to participate and to reduce the costs and bureaucracy of public administration [1].

Argentina Republic is not alien to this evolution and is gradually implementing, in different pilot tests, the "electronic vote" or vote casting using an Information Systems. In academic publications [2], magazines and newspapers [6] this evolution is being emphasized, stating the advantages and disadvantages of the technology use, as well as providing details as regards the characteristics or requirements that an Information System should meet to cover the whole electoral process. However, none of these publications analyze the process of requirements collection, or, in other words, how these requirements surface, and how they were defined.

This work aims to show the importance of Requirements Elicitation for an Information System in connection with the Electoral Process, especially the casting of the vote Subsystem.

As any Elicitation task, this process needs information sources with which the analyst can interact. In this case, the legal frame currently in force is the source of information needed, and at

the same time is the source of constraints due to the use of a specific vocabulary. With all these things in mind, the choice of an elicitation requirement technique is neither fortuitous nor by chance. According to its characteristics, the use of LEL (Language Extended Lexicon) and Scenarios, is a good option, since it allows a clear specification of the specific vocabulary as regards information domain, and the most important actions carried out during the casting of the vote.

This paper is organized in 5 sections: section 2 describes the adopted elicitation technique. Section 3 provides details of a subset of LEL elements and elicited Scenarios necessary to cast a vote. Section 4 shows elicited requirements. Finally, section 5 draws some conclusions.

2. LEL and Scenarios

Scenarios are partial descriptions about the system operation, which are focused on a specific moment during its application. Scenarios are not formal and can be represented in different ways: textual narration, storyboards, mock-ups videos, written prototypes or physical situations [3] [4] [5].

The level of detail with which they can be described depends of two factors:

- The degree of importance the user gives to the specific facts of the problem
- The stage in which the development process is.

Although each Scenario is a partial description of the application behavior, neither Scenario is totally independent from the rest of the Scenarios. Each Scenario bears a semantic relation with the others.

Scenarios must evolve during the life time of the software and this evolution must be documented. This allows us to track requirements up to their origins (traceability).

The use of a more natural language is suggested to elicit to model Scenarios. This entails using an easy way to understand but, at the same time, entails risk of including ambiguities or inconsistencies, which are pruned down by the use of a well-defined vocabulary in the discourse universe. In order to do this, Scenario construction is exclusively based on LEL (Language Extended Lexicon), facilitating the understanding of specific problem domain vocabulary. New interviews are conducted later on [3] [4].

Scenarios objectives are:

- **Capture requirements**
  - Avoid abstractions aimed to a solution
  - Provide a more comprehensive vision of the macrosystem behavior
- **Provide means of communication**
  - Secure communication between the user and the software engineer
  - Guarantee communication among the development team members
  - Facilitate the requirements validation with the user
  - Make the user feel committed to the system development
  - Validate the LEL
- **Have a traceability instrument**
  - Document the requirements
  - Train the new members of the team in order to understand the application
  - Stimulate Scenario evolution as the development process goes on
  - Generate trial cases

In the construction process the application point of view is used. In Table 1 the representation outline is reproduced.

As it has been mentioned, the construction process is based on LEL (Extended Language Vocabulary). The LEL comprises a set of symbols that identifies the application language. Symbols are, in general, words or phrases used ad frequently repeated by the user. It also comprises words or phrases relevant to the problem domain, beyond repetition frequency. The semantics of each symbol is represented by one or more than one notion, or one or more than one impact. The **notion** indicates what the **symbol** is and the **impact** indicates how it affects the system. The set of symbols make a net that enables to represent the LEL in a hypertext as well as to explore in the web in order to know all the domain vocabulary.

The initial process of construction could be summarized as follows:

a. Identify in the LEL the symbols representing the Universe of Discourse actors. Main and secondary actors are identified.
b. From each LEL symbol corresponding to each main actor, their impacts are obtained (candidate scenarios)
c. Description of candidate scenarios.
d. Enlargement of the candidate scenarios lists.
e. Scenarios revision.
f. Scenarios validation.

In [3] [4] strategy, Scenarios are obtained from LEL, via the mentioned process.

Name	It identifies the Scenario
Goal	It establishes the aim of the scenario
Context	It describes the previous actions needed to start the Scenario, preconditions, physical and temporal location
Resources	They identify the passive objects with which the actors work.
Actors	It details the entities actively involved in the Scenario
Episode set	Each episode represents n action performed by an actor, where other actors participate and where resources are used. Episodes are executed in a sequential manner. An episode can also refer to a scenario. Scenario *constraints* are included.
Alternative cases	It mentions exceptional cases, which can belong to other scenarios.
Constraints	They describe the existing limitations.

Table 1: Scenario Outline [3] [4] [5]

3. LEL and Vote Casting Scenarios

To start with this work, analyzing the bibliography related to electoral processes, especially for Argentina Republic was the first thing to do. In this context, the National Electoral Code of Argentina Republic was the necessary and sufficient documentation for the application of the requirement technique above mentioned. Taken this legal frame into account, chapters directly related to the casting of the vote were selected.

The process of LEL construction begins by selecting the symbols. To do this, a computing tool was used [8] that identifies and automatically nominates LEL symbols from a document, in our particular case from the relevant chapters of the National Electoral Code. This fact has contributed to the rapid identification of words or phrases that would make up the LEL.

This section is organized as follows: two of these symbols are described -perhaps the most important ones which are closely related to the vote casting-, candidate scenarios are suggested from the impacts of each symbol and finally, definitive scenarios are presented.

Elector / Citizen

Notion:

- person of any sex, native or by option and naturalized, 18 years old or above, without any disqualification provided by the National Electoral Code.
- person included in the electoral register.

Impact:

- the person appears to vote in the corresponding election center, with the legally authorized identification means.
- he/she recedes to a polling booth, chooses one or more than one ballot and puts it/them in a ballot envelop signed by the polling officers.
- he/she puts the ballot envelop closed in the ballot box

Chairman / Deputy

Notion:

- elector/citizen acting as a polling officer
- elector/citizen that lives in the election district where she acts as a polling officer
- he/she can read and write

Impact:

- the chairman is present during the opening and the closing of the voting event.
- the chairman is the responsible for voting event proceedings to be carried out smoothly and correctly.
- leave a written evidence about the time in which she takes and leaves the charge.
- the chairman appears in the voting event day in the election center at 7:45.
- the chairman is provided with a ballot box, electoral registers and other elements delivered by the post officer and signs a receipt, upon verification.
- close the ballot box with a paper belt, which is signed.
- fit out a site -easy to access and in full view of everyone- to set up the table and over it a ballot box
- set up a site as a polling booth.
- seal the polling booth so as to guarantee the secrecy of the vote
- seal with a belt the polling booth door and windows
- sign the belt sealing the polling booth
- check the official ballots from the political parties sent by the Electoral College.
- put the official ballots in the polling booth
- put at the entrance of each table a copy of the electoral register to be easily consulted by the electors , and two more copies to control the voting process
- place in the table a sign containing all the voting regulations
- check the identity and powers of each party representatives present in the voting event.
- pronounce the voting event open at 8:00 and draw up the minutes filling the blanks of the forms in the registers that correspond to the table.
- cast a vote
- add her/his name or the deputy name in the register in case it is not included in the list.

- verify that the citizen , to whom the identity card belongs, who visits the election center to vote, is included in the electoral register, comparing the data of the identity card with the data of the electoral register in order to authorize the casting of the vote.
- question the elector about the notes in her/his identity card
- object to a vote when she considers that the elector has falsified her identity.
- order the elector detention when the vote has been objected.
- give the elector an open and empty envelop, signed immediately after in her own hand and invites her to go to the polling booth
- go with handicapped electors to the polling booth and remain inside if it is necessary.
- verify whether the envelop that the elector is about to put is the same envelop that was given before.
- write in the electoral register "voted" in the respective elector ´s column .
- stamp, write the date and sign the elector's identity card
- verify the state of the polling booth, and verify whether there are ballots of all political parties.
- cross out from the electoral register the elector's names that did not cast a vote
- and write the amount of voters and the possible requests made by other polling officers.
- make the vote counting with the aid of the deputies
- draw up the minutes corresponding to the votes counting
- close the ballot box with a special belt, which must be signed
- deliver the closed ballot box to the mail employee
- write the telegram containing the results of the election that will be delivered to the mail employee

From the Language Extended Lexicon the following candidate scenarios were obtained:
a) Verify whether the citizen, to whom the identity card belongs, is included in the electoral register.
b) Object the vote.
c) Choose the ballot/s and put into envelop.
d) Write "voted" in the electoral register in the corresponding elector's column.
e) Put the closed envelop in the ballot box.
f) Write "voted" in the column the electoral register.
g) Stamp, write the date and sign the elector´ s identity card.

The process ended up with the following defined scenarios:
a) Verify citizen's identity.
b) Object the vote.
c) Cast a vote.
d) Leave a written proof of the casting of the vote.

Each of the defined scenarios are described below:
Name: verify citizen's identity
Objective: verify whether the citizen is included in the electoral register
Context: the citizen appears to vote in the election center before the polling officers with identity card.
Resources: identity card, electoral register
Actors: chairman, polling officers, citizen
Episodes:

- The citizen gives the identity card to the chairman
- The chairman reads the data of the identity card and looks for the citizen's name in the electoral register
- If the citizen is in the electoral register , the chairman compares the data of the identity card with the data of the electoral register
- If the data correspond with those of the electoral register, if they are legible, if the photograph is not missing, and if the elector has not voted yet, the casting of the vote is authorized.
- If there are additional notes in the identity card or if the photograph is missing, then the chairman or other polling officers question the citizen.
- If the chairman or polling officers consider the answers as satisfactory, then the casting of the vote is authorized.

Alternative cases
If the chairman considers that the citizen has falsified his identity, then the chairman objects the vote.

Name: Object the vote
Objective: leave a written proof that the vote to be cast is objected.
Context: The chairman considers that the citizen has falsified his identity.
Resources: identity card, electoral register
Actors: chairman, polling officers, citizen
Episodes:

- The president writes down the name, surname, number and type of identity card, year of birth, takes the objected elector's fingerprint in the corresponding form.
- The chairman and polling officers sign the corresponding form.
- If a polling officer refuses to sign the form, the chairman leaves a written proof under any elector's signature
- The form is placed above the envelope, which is delivered open to the citizen to cast a vote.
- If the chairman considers it necessary, the citizen is arrested.

Name: Cast a vote
Objective: The citizen must cast a vote
Context: The citizen has been identified as a valid or objected elector
Resources: envelope
Actors: citizen
Episodes:

- The elector enters into the polling booth and closes the door.
- If the elector does not cut the ballot, then chooses the whole ballot belonging to the political party he wants and puts it into the envelop.
- If the elector does not choose any of the political parties, then he does not choose any ballot.
- The elector closes the envelop.
- The elector gets out from the polling booth.
- The elector puts the envelop into the ballot box.

Alternative cases:
There are not ballots belonging to the political party that the elector wants to vote.

Name: Leave a written proof of the casting of the vote
Objective: leave a written proof in the citizen's identity card and in the election register, that a vote has been cast.
Context: the citizen has put the ballot in the ballot box
Resources: identity card, election register
Actors: chairman
Episodes:

- The chairman writes "voted" in the election register, in the corresponding elector's column.
- The chairman stamps, writes the date and signs the elector's identity card.
- The chairman gives the elector the identity card.

Alternative cases:
The elector ´s identity card does not have room for a written proof of the vote

4. Elicited Requirements

Each scenario shows the sequence of actions carried out to meet the goal stated in the scenario. From the analysis of the depicted scenarios it is possible to identify a set of functional requirements.

The *Verify citizen's identity* scenario could be reduced to verifying the existence of the citizen in the election register. This action could be carried out via a digital register. Thus, the "search citizen in register" requirement arises. If there is a positive answer, this fact would enable the citizen to cast her vote, thus generating the "set up a ballot box to vote" requirement.

The *Cast a vote* scenario entails choosing a ballot, which in a digital medium entails having virtual ballots to be chosen. Therefore, it is obvious the need to previously "draw up the digital ballot". The elector may want to "cut the ballot", being this action a requirement that the system must take into account. Besides, there must be the possibility to choose a ballot without any reference to any political party, or blank ballot, suggesting that this requirement is also necessary.

Finally, the proper action of casting a vote is the crucial event for the information system. This action may also entail the production of a paper receipt to put in a traditional ballot box for future audits.

Finally, although it is impossible to automatize the stamping of the elector's identity card, which would lead to the *Leave a written proof of the casting of the vote,* it is feasible to update the digital register automatically to leave a proof of who cast a vote, preventing, in this way, someone to vote more than once.

5. Conclusions

The scenario approach developed by Leite and other authors [4] is an elicitation requirement approach that has proved to be useful in a number of domains. That is the reason why we consider it a suitable tool to elicit requirements.

The described scenarios depict the process related to the casting of the vote, without considering the use of an Information System to automate it. Basically, this enables us to understand the problem, since each of the key instances of the process includes the sequence of actions carried out. The understanding of the problem constitutes the first step in the software construction [7].

It is obvious that scenarios do not generate a complete requirement idea, but they do give an approach to a real requirement subset according to the "stories" they tell.

The proposed approach stresses the available content in the application of language domain, thus setting a process of requirement elicitation via the construction of the system scenarios.

This construction is based on the scenario derivation from Language Extended Lexicon. As the electoral system is governed by regulations (according Argentine legislation), it is particularly interesting to obtain requirements from the use of this approach. As a conceptual test, some initial LEL versions and some scenarios from the regulations in force have been produced. The requirement approach was stressed.

The future steps consist of validating the resulting scenarios thoroughly with the domain experts, making the corresponding adjustments and selecting the definitive process to obtain requirements.

6. References

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7. Acknowledgments

We are very grateful to translator Monica Ruiz for her collaboration.