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Enabling Crowd Participation in Governmental Decision-making

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Abstract: Democratic governments constantly need to make sense of their citizens' needs to make appropriate decisions that reflect the overall wishes and needs of the population. However, except for mandatory voting scenarios, a low rate of citizen participation in government decisions through democratic processes is an aspect that defies democracy itself. Brazil's participatory budget policy emphasizes people's direct guidance regarding certain budget allocations though group meetings. This paper presents mParticipation, an agent-based model for eliciting and answering citizen demands in a participatory government structure using mobile technology. A prototype system applied to the domain of public budget allocation domain demonstrates that it is feasible to provide effective computational support to participatory collective decision-making.

Keywords: m-Government, Mobile interaction, Crowdsourcing, Collective Intelligence, Participatory decision-making, m-Democracy
Categories: H.1.2, H.5.2, H.5.3, K.4.1, K.5.2, M.0

1 Introduction

Many countries, including Brazil, actively seek new methods to engage their population as a partner in the government's decision-making processes. This type of partnership not only fosters the creation of new solutions to open-ended problems, but also promotes trust in the decision-making process by increasing the transparency and accountability of government decisions, making the populations' needs, concerns and interests possible, and providing an opportunity to conceive novel solutions [Rowe 2000].

Participatory activities require the creation of new communication channels between the organizers of the participatory process and participants, to enable different forms of synchronous and asynchronous interaction between these two groups, such as referendums, opinion polls, negotiation of regulations, popular

hearings and focus groups, which in turn increase transparency and social participation [Hirst 2000; Rowe 2000].

Voting and referenda are popular and widespread democratic means of letting people take part in a country's governance [Hirst 2000; Rowe 2000]. In these participation scenarios, the government draws up a number of possible policies from which people should select a subset. Social participation occurs on specific dates with a great deal of prior announcements, so people have time to reflect on the available options. Brazil has a robust and effective voting system that was first used in 1989, during a mayoral election in a small southern city, and that nowadays supports 100% of our elections. It consists of electronic voting hardware, as illustrated in Figure 1, that is distributed to specific voting locations. People must go to the specified location to use the electronic voting hardware. However, it is the government and political parties who are responsible for preparing the options. In this context, popular participation is restricted to selection from a pre-defined group of options.

Figure 1: Brazilian voting hardware used for the disarmament referendum.

However, each citizen may have a creative gaze on a country's problem or may have a detailed understanding of his district's needs. This type of democratic participation in which the crowd voice their needs is the focus of this research. The participatory budget is a good example of a government's intention to listen to people's needs. Following the federal government budget calendar, municipal group meetings, open to the public and with the presence of a govern representative, are held for a period of time to let the crowd communicate suggestions, problems and priorities. Crowd's contributions are annotated, filtered, synthesized and then used as an input for creating a voting pool from which the population will select a subset.

As the population grows, it becomes harder to provide an efficient means for popular participation in government decision-making without computer support. This need has been noted in several countries, leading to new methods and technologies designed to enable this massive collaboration [Verna 2007]. Difficulties related with engaging the crowd in decision-making activities, such as brainstorming ideas, identifying novel proposals, collecting and synthesizing contributions, as well as choosing what to do, make extensive participation difficult. However, advances in information and communication technologies (ICTs), especially greater internet accessibility and the diffusion of mobile systems, have created opportunities to

improve popular participation in the public sector [Layne 2001], as well as increase the population's expectations regarding e-government services' reach [Stragier 2010]. It is now possible to create tools to assist mass interaction and exchanges, leading to both 'just in time' and 'just in place' organization of ideas and coordination of tasks [Smith 2000].

Although the Internet provides a rich environment for large-scale participation, access is still restricted to a small slice of the population. In order to enable governments to be more inclusive, there is a need to engage the support of a more pervasive communication technology.

Mobile technology has evolved to become the mass interaction medium [Keshav 2005]. Even considering social class, age, gender and the degree of education diversity, mobile communication is widespread throughout the population. The technology's speedy acceptance was probably due to device cost affordability and the population's urge to communicate wirelessly "anytime, anywhere, with anyone" through a network expected to be available [Helal 1999]. According to ANATEL [Anatel 2009], the Brazilian National Telecommunication Agency, in July 2010, Brazil had over 180 million subscribers, almost 98% of the population. A high cell phone adoption rate is found in many countries according to the 2009 CTIA Semi-Annual Wireless Industry Survey, 91% of Americans use cell phones. High usage rates are seen across the globe [Wiki 2010]. People participation using mobile technology can dramatically expand the reach of e-democracy by involving citizens in democratic decision-making processes, giving rise to what can be defined as m-Democracy [Hermanns 2008].

An interesting fact about cell phone usage concerns the use of text messaging. It has been observed that many people rely heavily on text messaging for short one-way communication. These messages are usually short and precise due to ergonomic difficulties posed by the cell phone input interface size. This communication drawback, in fact, was used in our research as a key factor for supporting automatic text mining over a large number of contributions. While this may change with the introduction of new technologies, it presents a valuable opportunity at this moment.

In addition to selecting the population participation medium, we had to decide on the participation procedure. We started with a very simple procedure inspired by the Delphi method [Delbeq 1975]. People submit suggestions that would later be summarized and returned for public discussion, which, in turn, would led to new suggestions or refinements. After a pre-defined number of cycles, the final set of suggestions should be used for formulating a voting pool.

The Delphi method [Delbeq 1975] represents an iterative way of refining experts' individual contributions to the resolution of a problem. First, experts are probed to reflect on issues and send suggestions that include solutions, demands or new interpretations of the issues. A facilitator gathers, interprets and synthesizes the experts' contributions into more abstract propositions, which are then returned to the experts. The experts receive and reflect on the facilitator's material and send back improvements, ratifications or rectifications. This interaction can stop whenever the facilitator or the experts are satisfied with the resulting material.

Inspired by the Delphi method, our research defines the expert's and the facilitator's roles as follows. Each citizen plays the role of expert on his or her own needs (that generate demands related to the government's posted subject). In order to

deal with a humanly unmanageable set of experts' contributions, the facilitator's role is divided into two:

(a) the role of gathering, filtering and synthesising contributions, played by a computational agent, and

(b) the role of developing abstract propositions to be posted for further discussion or for composing the voting pool, played by the government's legal representative.

The interactions run for a small number of iterations (usually two rounds).

The application domain is the Brazilian participatory budgeting process in which the government seeks to understand citizens' demands in order to improve governmental decisions regarding resource allocation. The people's participation of the people in the decision-making may occur in three ways [Davies 1995].

- direct, where citizens interact directly to reach decisions;
- representative, where citizens delegate their interests to a small group of representatives; and
- participative, which combines both direct and representative mechanisms.

This paper presents an approach to promote crowd sourcing and mass participation in decision-making scenarios called mParticipation. This approach utilizes mobile technology as the communication medium between citizens and government, and the Delphi method as the population coordination technique, mediated by a central government representative. The following artificial intelligence techniques were used as the building blocks of our proposed crowdsourcing solution: a stemming algorithm to reduce lexical processing; semantic parsing to extract the central meaning of each suggestion; clustering algorithms built in a multi-agent platform.

This paper is organized as follows: first, we will briefly outline participatory budgeting, our chosen application domain for this research. Then, we will describe mParticipation, an agent to support decision-makers in participatory decision-making. We follow with a presentation of our empirical study in the domain of participatory budgeting applied to federal universities. Finally, we conclude with a discussion of the results.

2 Participatory Budgeting in Brazil

Participatory Budgeting (PB) was introduced in 1989, in Porto Alegre. In a nutshell, the city was divided into regions, and each one hosted a round of discussions between citizens and state representatives, where problems, demands and proposals were made for the following year's budget distribution. After some time, other cities developed their own variations of PB based on this original concept, which maintained as the core activity, the discussion of the population's needs and demands as the core activity [Avritzer 2006; Davies 1995].

A PB process is an open forum, where anyone may participate. It has rules and may include local or regional Popular Assemblies or Plenary Meetings. PB is always related to a specific theme. Almost all variations allow any participant to express him

or herself and include a hierarchical organization of priorities, where the community elects, within a theme, its priorities within the theme.

In 2006, Belo Horizonte, one of the largest Brazilian cities, implemented its PB process in a web-based environment, hoping to increase quality and participation, and named it Digital Participatory Budgeting (DPB.) The same criteria applied to regular PB and to DPB. This was the first successful transition of PB to a digital medium in the country. To succeed, however, the city had to invest heavily in advertising and in technological infrastructure to ensure that citizens from all social classes had access to computers and the Internet and thus increase popular participation.

In terms of participation, Porto Alegre saw a participation peak at 17.241 in 2002 and in 2006 a participation of 11.536 citizens [Fedozzi 2007]. Given that the number of registered voters is 1.040.572 [TRE-RS 2008], we can see that only about 1% of the population participated. In Belo Horizonte however, following investments of 20 million reais, 124.320 people took part, out of a total of 1.772.227 voters [TRE-MG 2008]. The government is committed to making participatory budgeting a reality, but popular participation is still timid. We hypothesize technology for participation may be the key component that is still missing. Given these observations, we felt that PB would be an appropriate domain for the application of our support system.

Over time, as people feel their suggestions and demands were heard by the government, their actual desire to participate will increase. In this scenario, technology will be required to make the crowd participation feasible. The mParticipation model addresses this technological issue by assisting the government in the recognition and identification of demands, and in the subsequent deliberation of projects and actions needed to address them.

Nogueira [Nogueira 2008] identifies several problems inherent to e-Government in the internet medium. Most importantly, searching for information from government sources is difficult. Information and services are dispersed throughout several sites without a clear navigation map. In addition to being difficult to understand government information, means for citizens to express their opinions are insufficient, which leads to "digital exclusion" since a large part of the population finds it difficult to access ICTs and, therefore, cannot participate (the latter is especially true in third world countries.)

To reinforce the previous statement, recent Brazilian survey data [IBOPE 2008], indicates that approximately 41 million Brazilians have access to the Internet (about 21.5% of the population). In addition, the Brazilian census and statistics institute [IBGE 2008] documented the presence of the Internet in only 23% of Brazilian homes. In contrast, in data from the Brazilian telecommunications agency, put the total number of cell phones in Brazil in January 2009 at 151 million, in a population of 190 million people according to the latest census [IBGE 2009]. Studies from the mobile citizenship forum show that a large part of resources available on mobile phones are easy to use, and that the average number of Short Message System (SMS) text messages sent is around 900 million per year [m-Gov 2006]. For instance, the reality show "Big Brother Brazil" received between 10 and 12 million votes via SMS messages, which indicated that the average Brazilian citizen is familiar with this system.

In this scenario, the goal of our research is to investigate and evaluate the effectiveness of cell phones as a means of increasing participation in decision-

making, given that other media may be harder to access. This also means that appropriate systems must be designed to support interaction in this new medium.

3 mParticipation: An Agent-Based Model for Crowdsourcing and Mass Decision-Making

mParticipation is an agent-based model for crowd participation in problem solving or decision-making scenarios. Crowd participation can be split into three phases that may cycle many times, as suggested by the Delphi method:

- Emergence of suggestions: At this idea elicitation stage, the mParticipation agent's task consists of receiving, interpreting, clustering and categorizing demands and suggestions sent by the population;
- Develop of alternative solutions: Decision-makers (the facilitator, according with the Delphi method) interpret the summarized demands and rephrase them into a more concise group of alternative proposals that should be re-submitted to the group. It is important to note that the facilitator's role is executed twice, first by the mParticipation agent that does the rough consolidation of the population's contributions, and then a human agent who refines the consolidation to feed the process;
- Selection of an alternative solution: Solutions are sent back to the population, who by majority vote select the best option or decide to reopen the issue for further discussion.

This process involves the population, decision-makers and an automated agent, which helps by pre-processing demands so that they become manageable for decision-makers. By sending alternatives back to the population, the cycle is completed, as choices are made in a participatory fashion. In this way, participants not only generate demands, they also prioritize and choose the best solutions.

The mParticipation model, presented in Figure 2, is composed of five major processes, described in the following paragraphs.

Content Capture: Establishes the interaction with citizens for the purpose of gathering suggestions. The Interface and the Identifier modules are responsible for, respectively, capturing the user data and suggestions/demands, and classifying them as an already known or new contribution. The figure illustrated a cell phone interface device, but the architecture contemplates both website and mobile device interfaces.

Content Interpretation/Summarization: Extracts the meaning of the individual contribution. It contains two main modules: the Lexical Processor and the Interpreter. The Lexical Processor is a module responsible for treating the text of the new suggestions. Mobile text needs a special treatment. "Mobile shorthand" expressions (the shortening of words commonly used in the mobile environment) must be substituted by their equivalent in natural language. After that, stop-words are removed, as they contain no additional information, and serve only a functional purpose [Grobelnik 2005]. This leaves the keywords, to which a stemming algorithm is applied [Alvares 2005], removing prefixes and suffixes, to obtain the stem of each keyword, after which the process moves on to the next phase. By dealing with stems, instead of words, the lexicon is able to be more concise. Mobile sentences are small

and simple, allowing language processing based only on lexicon treatment and semantic interpretation. The semantic processing done in the Interpreter module is domain dependent because it is heavily supported by the existence of a domain ontology. With the ontology, ambiguity problems are reduced, and the ontology works as a concept dictionary for the numerous demands, which have been sent in [Wang 2004]. When this module receives the stems that refer to the demands, it generates a set of characteristics or words obtained through the ontology vocabulary.

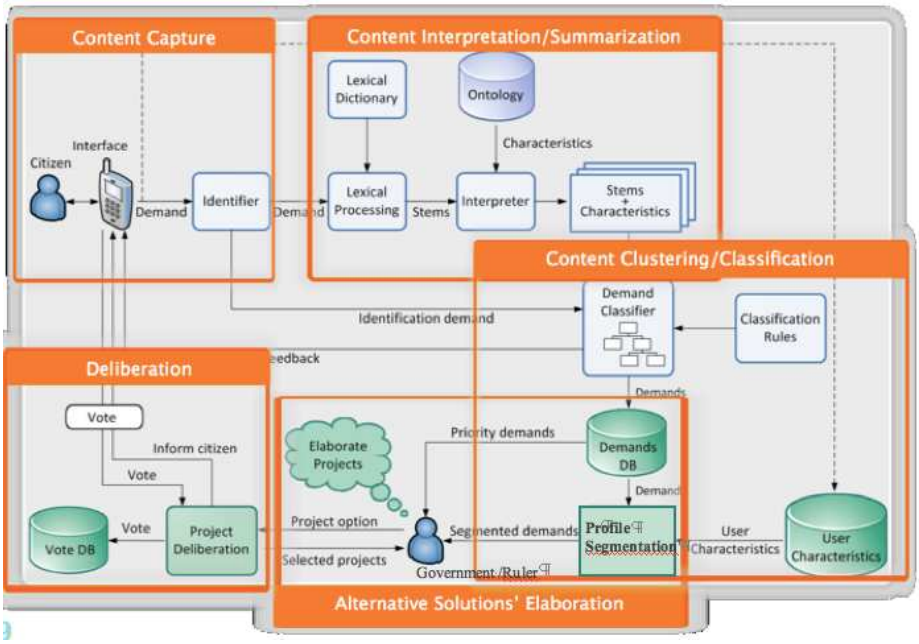

Figure 2: mParticipation Architecture

Content Clustering/Classification: The demand classifier is a module responsible for recognizing whether a given demand (or a part of it) belongs to one or more previously defined classes. It categorizes and adds up demands according to characteristics obtained in the Interpreter to one of the existing classes. If there is no correlated category, a new one is created, associated to the closest abstract class and added to the classifier. The demand is then stored in the database and a feedback message is sent to the citizen thanking him or her for participating and stating that, as soon as project voting is available, a new message will be sent. After this step, classified demands and user profile information are sent to the profile segmentation module and the prioritized demands (i.e., those most frequently mentioned in this aggregation stage) are sent to the government. The suggestion classification module make use of the profile segmentation that is responsible for processing all the information gathered from crossing the data from the demand classifier with the citizen profile data. The information is analyzed with data mining algorithms that may lead to the discovery of patterns and relations that would not be found through simple

reading of a large number of demands. Results of this process are sent to the government.

Alternative Solutions' Elaboration: Provides summarized suggestions to the ruler and allow him/her to elaborate and post a voting pool of options. The ruler is the external agent included in our model. The ruler is the agent that receives the data regarding prioritized demands, as well as the information obtained through segmentation, and which formulates more generalized demands to be re-sent to the population. The government analyzes the data and identifies projects or actions that address the main suggestions/demands raised by the population. It then directs them to Project Deliberation.

Deliberation: Receives all of the options elaborated by the government and sends them to the citizens so that they can vote on them. It informs the citizens when the voting will start. Once the voting process has started, this module receives the votes and adds them up, and at the end of the process, it sends the results to the government, which is responsible for the execution of the selected projects or actions. The Vote module is responsible for conducting the deliberation process, frequently through a vote for one or more of the previously elaborated alternatives.

4 The mParticipation experiment

A few government departments have created websites that implement voting systems, designed to reach a larger portion of the population. In these voting arrangements, the government defines the questions and alternatives to be presented. This reducing the range of contributions participants may provide, as they are limited to the existing choices. In addition, in Brazil (the focus country for this study) a large part of the population does not have internet access. With the mParticipation initiative, we sought to allow the population at large to send in demands, providing them with a direct channel to decision-makers, through the adoption of mobile technology.

Making the crowd participate in a country's governance is not a technical issue, but rather it is related to the population's level of citizenship awareness. However, even if people overcome their participation inertia, crowd participation – depending on the size of any given country's population – is only feasible with technological support. It is feasible to think on a meeting with dozens of people, but not one involving thousands.

Our study was based on the premise that the population's direct participation in government's decision-making process is desirable. The Brazilian participatory budgeting policy is evidence of this wish and will be the basis of our experiment. With this context in mind, the leading questions of our study consisted of:

- Can an mParticipation-based system work as a crowdsourcing and mass decision-making tool [Brabham 2008]?"
- What is the best communication channel for *crowdsourcing*: direct (face-to-face) contact (unfeasible for groups composed of more than a few dozen people), indirect contact though internet web sites or indirect contact though cell phones?

These questions guided our quest for answers. We examined three problems: (a) designing an easy interaction for widespread participation, (b) creating an automatic

means for interpreting, summarizing and classifying huge amounts of people's demands to become humanly manageable and (c) sending feedback to the participants in order to build trust in the participation process.

Our research hypothesis was that: *"The use of artificial intelligence techniques including text summarization and multiagent systems allied to an already accepted and widespread interaction device made crowd participation possible and effective."*

In order to confirm it, we developed an e-participation application to be used either though a cell phone or a website interaction media. Our purpose was to evaluate the application's feasibility and usability and whether preferred interaction media was a website or mobile device.

4.1 PBMobile: The Participatory Budget Prototype System

The prototype system was developed to verify the feasibility of using mParticipation for supporting a Brazilian participatory budgeting task. In participatory budgeting dynamics, meetings are held periodically at the city, state and federal levels. Any citizen may participate in these decisions, but the participation level is low, as people have to be physically present at meetings and, once there, try to get their ideas across.

Client-server architecture was chosen for the mobile device's communication with the Web environment. There is a web application on the server responsible for routing each demand, sent by the citizens, to the m-Participation agent. Thus, each claim is classified in a more abstract one and stored in the database. The database server was MySQL 6.0. It provided a fast and stable platform for the experiments.

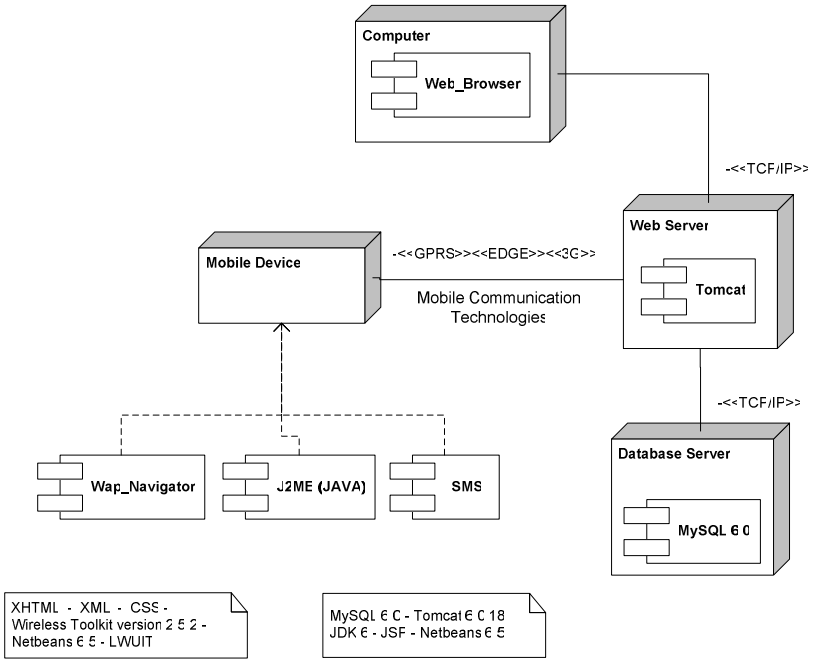

Figure 3: Implementation details on the PBMobile prototype system.

J2ME and WAP technologies were utilized to implement the application for the mobile device. They were selected due to their portability and documentation. The J2ME technology made use of a set of libraries from the Wireless Toolkit version 2.5.2 [SUN MICROSYSTEMS, 2008] and the LWUIT framework [LWUIT, 2009], which simplified the development of interfaces in the mobile environment.

With regard to hardware, there were no special requirements. The tests were run on an Athlon X2 1.8 GHz server, with 1GB of RAM. Software requirements for running the application on the server were: the installation of JDK 6 (Java Development Kit), MySQL 6.0 and Apache Tomcat 6.0.18. There was no special configuration needed for them. Figure 3 shows the deployment diagram for the prototype system. This diagram represents the distribution system through its components.

To enable each citizen to participate using a cell phone, it was necessary to deal with some problems and limitations intrinsic to the mobile device technology such as: the lack of interface standardization to permit interoperability among cell phones, since there are different implementation kits for each brand or model. Consequently, it was necessary to development various interfaces for mobile communication, WAP, J2ME and SMS, in order to facilitate the coverage of the devices with respect to different technologies.

Figure 4 illustrates the possible forms of participation via mobile devices. The user sends information through a Java app on the cell phone, which is sent either by SMS or WAP, to the PBMobile back-end application. This is where demand processing happens, and the process described above is enacted.

Figure 4: PBmobile's interaction media.

Since the prototype was for mobile devices, textual contributions, which in general represent a bottleneck for any automatic text interpreter, were not expected to be an issue because they tend to be short, direct messages. In addition to sending free text, citizens could choose from pre-registered claims/demands to facilitate their interaction. The latter type of contribution was available only in WAP and J2ME technologies.

4.2 Application Domain: a Federal University's Restaurant Budget Allocation

PBMobile was implemented in the context of a federal university scenario. In Brazil, federal universities receive an annual budget from the government. A small portion of this budget is used to meet the demands of the "university citizens". University citizens are students, professors and staff. They vote on some of the university's proposals including the use of this special budget. The Fluminense Federal University (UFF) agreed to participate. The dean helped our researchers select an issue that had received numerous complaints over the years.

At first, the dean proposed the university's hospital budget as the theme for the university debate. Since the hospital population included patients from outside the University's population, we decided to move on to a more restricted domain, such as the restaurant's budget allocation, which is historically a critical theme, but which only concerns the University's population. Students, professors and staff would be probed to send suggestions, via cell phone, concerning the use of the restaurant budget. They would be allowed to suggest other topics for future discussion as well. After receiving the suggestions, the system would interpret, summarize, cluster and synthesize the information, providing the dean with a small set of citizens' proposals. The dean would then draw up a set of options for the voting phase.

A public WAP portal, http://www.opmobile.com.br/wap, illustrated in Figure 5, was created to enable citizens to send in their demands.

Figure 5: The PBMobile experiment web site.

Through the portal, it was also possible to obtain information about the project, choose new topics to be discussed in the future and download the Java BPMobile application to be installed in cell phones. The application was developed for Brazilians. A web site portal, as illustrated in Figure 5 (the original Portuguese

version), was developed to provide extensive information of the empirical study offering a tutorial and a step-by-step installation kit.

Cell phone interfaces were translated into English to facilitate understanding of this paper. However, the application was all developed in Portuguese. To encourage the user's initial interaction, the interface elicited a suggestion for the next month's theme, as illustrated in Figure 6.

Figure 6:BPMobile for proposing discussion themes.

Within the current theme, in our case the restaurant budget, users could choose an already filed suggestion or write a new one. Users could also send an SMS to a specific phone number. There were two available options: (a) contract a SMS service that provided a special phone number which would cost from R$0.5 to R$0.8 per message (2009 assessment) or (b) use a software for re-directing the message though a modem GSM and a cell phone with GSM technology built-in. The later option was selected for cost reasons. Figure 7 illustrates the main interface for submitting a suggestion using the WAP application.

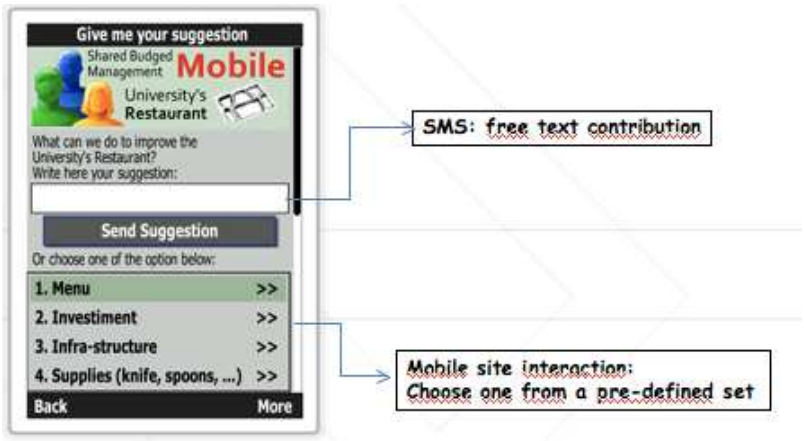

Figure 7: BPMobile main interface.

There was also a web site application, available at www.opmobile.com.br during 2009, from which users could participate in the experiment, as illustrated in Figure 8. In the pilot study phase, we randomly asked people to participate either though cell phones or the web site application.

Figure 8: Web site application for the e-participation experiment.

4.3 Experiment set up

The experiment was developed in four phases: experiment calibration, e-participation (mobile or website application usage), voting and pos-test evaluation. During the experiment's calibration phase, twenty graduate students from the computer science department used the mobile application and the website application. In this phase, we figured out important restrictions when running the mobile application in certain cell phone brands. Website application was very simple and presented no need for changes. Participants also suggested adjustments in the tutorial material of both applications to allow speedy understanding. During e-participation, people sent suggestions related to the discussion posted theme by either using the mobile or website application. The voting phase consisted of obtaining the summarized suggestions in order to draw up a pool of options that would be sent to all participants so as to decide exactly how to spend the restaurant budget. Finally, during the post-test evaluation phase, participants answered an evaluation questionnaire available on the web.

Participants were recruited at several locations such as the restaurant, the University campus' main entrance or library entrances. We stood in front of one of the designated locations to invite people to participate in our experiment. Participation was on a voluntary basis, with no payment involved. Participants could choose to participate instantaneously or later. The experiment lasted one month (May/2009).

Prior to participating in the experiment, each participant had to sign a formal participation agreement. After answering the profile questionnaire, a short written tutorial about the application usage was provided. The participant could ask specific questions before actually using the e-participation software.

During the e-participation phase, participants had the option of using our cell phone immediately with the application already installed, sending a text message to a specified number sometime in the near future, downloading the application and installing it in their own cell phones in order to participate later or providing their suggestion using a website application. Although participation was anonymous, they provided their names and e-mail addresses so that we could contact them to obtain an additional evaluation of the experiment.

The voting phase consisted of obtaining the summarized/clustered suggestions provided by the computer application to allow the dean to develop more abstract options that reflected the overall population's suggestions. As soon as the dean had formulated the voting pool, participants received an email message informing that the voting period had started. The voting period lasted one week.

The post-evaluation phase of the experiment consisted of gathering participants' evaluation of the experiment. We were interested to know whether participants felt their suggestions were heard, even when not selected. In addition to the evaluation questionnaire answers, researchers annotated comments while participants filled out the evaluation questionnaire. The evaluation questionnaire had three sets of questions:

- Questions concerning personal data, such as gender and age.
- Questions concerning the participants' perception of whether the application allowed individual contributions to emerge from the group, essentially addressing the question: Did you feel you were heard?
- Questions concerning usability.

4.4 Experiment Task

The main task consisted of sending a suggestion regarding the university's budget allocation. The suggestion could be a text message sent to a specific phone number, a text written in the suggestion input box of the cell phone's input suggestion box or in the website applications or a selection from a pre-defined set of options such as "Change the menu" available in both mobile and website applications.

The task was performed during a one-month period. Participants had to fill out a user profile questionnaire. Although, participation was anonymous, it was important to obtain some personal data, such as an email address, for subsequent follow-up regarding satisfaction rate. In our experiment, a high degree of satisfaction meant that citizens felt the government had heard them, even when their suggestions were not selected for immediate action.

4.5 Experiment Subject

Professors, staff and students of UFF constituted the study universe. The sample was randomly selected, but observed the universe distribution among professors (5%), staff (7%) and students (88%).

We randomly approached people at the front door of the University's restaurant. No one that had participated in the pre-test took part in the experiment. The sample size was calculated according to Yamane (1967), considering a population of approximately 10.000 and an expected conclusion confidence level of over 90% that led to a sample of more than 99 people. We decided to use 200 to take into account possible experiment mortality, i.e. people leaving the experiment before its conclusion. Each participant sent as many contributions as they wanted. A breakdown of the user population can be seen in Table 1. Each participant sent as many contributions as they wanted. Considering that the recall rate in website surveys is generally low, we involved a greater number of participants for the website application. 600 people agree to participate using the website application in the experiment.

We were not interested in the participation outcome, but in the participation process per se. For this reason, we did not assign weights to the participants' suggestions according to their profile, as is usually done in the case of actual University participatory processes in which professors' votes are given a greater weight.

From the profile questionnaire, summarized in Table 1, we identified that most participants were young, familiar with mobile technology (including messaging features), equally distributed as far as gender was concerned, with at least a high school education, with no active participation in democratic processes, except for public opinion polls (responding to official surveys).

Descriptor	Values	%
Gender	Male	47 %
	Female	53 %
Age	Under 20	22 %
	21-30	63 %
	31-40	9 %
	41-50	4 %
	Over 50	2 %
Level of Education	Elementary	4 %
	High School	36 %
	College	52 %
	Post graduated	8 %
Mobile Technology experience	Less than 6 months	1 %
	6-12 months	0 %
	1-3 years	5 %
	More than 3 years	94 %
Mobile messaging feature usage	Often	98 %
	Rarely	2 %
e-Government concept awareness	No	41 %
	Yes	59 %
Voluntary participation in the democratic process	Public Meeting	14 %
	Popular Hearings	2 %
	Public opinion polls(surveys)	28 %
	Brazilian Participatory Budgeting	1 %
	Other kinds of participation	3 %
	No participation recalled	61 %

Table 1: Participants' profiling data.

4.6 Experiment Results

The experiment lasted about one month. Results from the post-evaluation survey of the experiment are presented in Figure 9. About 15% of volunteers who used the web version got to the end of the process, versus 85% of those using the mobile version. The great majority of participants (greater than 80%) were highly satisfied with the final results. In the survey, we asked participants whether they felt heard by the government, and the majority of respondents felt they had been heard even when the options presented for voting were not the exact ones they had submitted in both website and mobile applications. Our data showed an increase in adoption of the technology when using the mobile device, as we expected.

The interpretation/summarization automatic process worked properly in both applications, although the mobile application produced better results. This could be due to the fact that suggestions sent though the mobile application were very short compared with the textual contribution provided in the website application. When we asked participants whether they felt the demands they sent influenced the voting pool options, 96% of the mobile users against a 70% of the website application agreed.

Additionally, about 95% of all participants stated they would recommend friends to use our e-participation tool and all agreed they would use it again.

An additional observation was that 81% chose to send in their demands via the pre-set options instead of writing them in, and 68% of participants stated they would not have participated in a process if they had been obliged to go to a physical meeting place. 96% declared they were satisfied with the final result and 86% agreed with the selected demands. Moreover, 71% felt their suggestions helped improve the university restaurant.

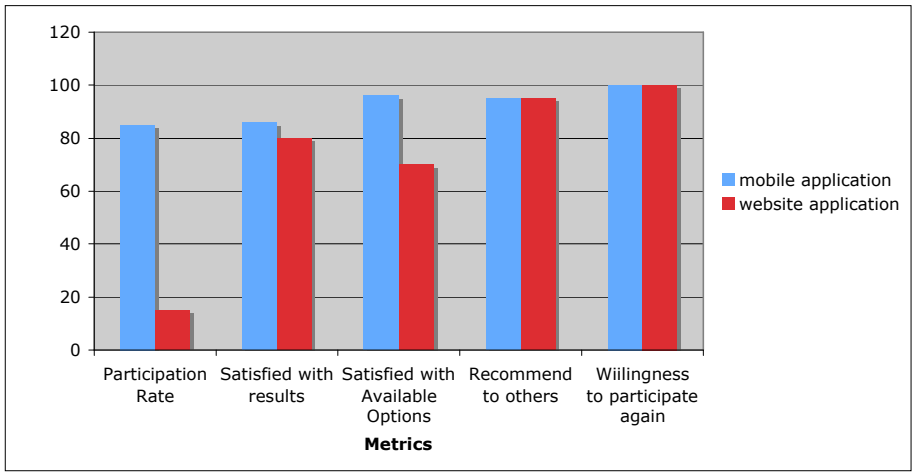

Figure 9: e-participation evaluation results

5 Discussion

In this paper, we presented a model for large-scale participation in decision making and its implementation. A system was built using the architecture described. In this system, demands were sent via SMS, and an experiment was run against a website configuration, where the population could access a page to send in their demands and, later on, vote on alternatives. Through the cell phone interface, users could type in their demands as free text, or select some of the pre-defined demands.

The system was implemented in a university setting with 200 participants for the mobile configuration and 600 participants for the web configuration, including students, professors and staff. The theme under discussion was the application of university resources to the university restaurant, in order to improve its services. This was a real-life issue, under discussion by the dean of the university at the time of the experiment, and provided an example of participatory budgeting.

The widespread adoption of this technology generated an increase in demands sent to decision-makers, which in turn, generated a need for effective methods to cluster and summarize these demands. It is unlikely that decision-makers will be able to cope with the large number and diversity of incoming messages without automated assistance. We consider this experiment to be a great success, providing a solid first step for future work.

However, the observation that 81% of participants chose to contribute through predefined options shows that typing on the cell phone is still something users would rather avoid and raises the issue of the definition of initial (predefined) options. If an inappropriate set of demands is provided, it may bias participant choice, or lead to incorrect selection. This means initial options must be carefully designed to represent all possible options. More research is needed on this front. We will be experimenting with a "no-presets" setting, where there are no predefined options, only free text entry, to see how it affects adoption of the technology and the type of demands generated. Another possibility will be to use the automatically generated clusters as options, so that the user may see what demands have already been sent in, and then only add his or hers if it is effectively a new suggestion.

Our current research has shown the feasible of letting crowds participate in government's decision-making though mobile interfaces. There are many issues that have yet to be addressed, such as trust in participants' contributions and participation non-repudiation. [Chung-Ming 2008] has discussed this last issue related to non-repudiation of commercial transactions through cell phones. We believe that the popular participation market will eventually balance contributions.

We plan on applying this model to other situations, such as actual design, where more options are possible. Criteria and tradeoffs need to be explored and more complex decision-making is necessary. We would also like to investigate ways of involving the population in the development of alternatives and solutions, so that they better represent the real population's needs.

As problems become more complex, the impact of research becomes more important. It enables the population at large (who use the services) to voice their opinions and define how these services should be allocated. This method can also be used to harness collective intelligence, capturing ideas and alternative solutions to the complex problems organizations and societies must face on a regular basis. We expect that, by adopting this technology, new insights will be generated, and solutions may be found to these problems.

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