International Journal of
Applied Mathematics,
Electronics and Computers
ISSN: 2147-8228 http://ijamec.atscience.org

Advanced Technology and Science

Original Research Paper

Improving Quality of Election Process Using Crowdsourcing Techniques

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Accepted 5th May 2016

Abstract: Quality of election process is the main factor for acknowledging the general election results. In this sense a feedback from voters is critical to maintain a desired quality of the process. Crowdsourcing is establishing as a standard platform for capturing feedback and new ideas from the participating stakeholders. This paper presents an efficient solution using crowdsourcing techniques for improving the quality of election processes through a simple feedback web form in polling stations. These polling stations are securely connected to the Central Election Commission monitoring room, where the overall quality in national scale can be monitored. The survey conducted with more than 600 respondents shows that this approach would be acceptable from citizens and would improve the total quality and acceptance of election results.

Keywords: *Crowdsourcing, crowd voting, privacy, security.*

1. Introduction

Crowdsourcing is one of the most widely used platforms to capture ideas from the crowd. A large number of global companies have started to use crowdsourcing advantage to connect with their users and get new ideas from the crowd. However, crowdsourcing it's not limited only with capturing ideas from the crowd but it has found wide application such as in distributed problem solving, marketing, development of information systems, database design, and mass collaboration. The concept of crowdsourcing was first introduced in 2006 by Howe, as:" Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call" [1].

Erickson defines crowdsourcing in the following way: "By 'crowdsourcing' I mean: Tapping the perceptual, cognitive or enactive abilities of many people to achieve a well-defined result such as solving a problem, classifying a data set, or producing a decision" [2].

Based on the work of [3] it shows that the definitions of crowdsourcing vary from each other and in some cases there is possibility when definitions can contradict each other.

Crowdsourcing became an integral part for a considering number of large global companies and even for small companies. Some emerging companies, such as Turkish Airlines in late of 2013 has launched "Invest on Board" crowdsourcing initiative. The reason for the acceptance of crowdsourcing based systems lies in power of crowds. Erickson in his work claims three values in which crowdsourcing provides value beyond individual work which are: speed, quality, and legitimacy [2].

Today's most famous online web platforms which users (crowd) can gain money for their work and where the organizations (crowdsourcer) ask the unknown crowd for their work to be done is based on the principle work of crowdsourcing. From the viewpoint of organizations crowdsourcing can be considered as a kind of outsourcing. The main difference between outsourcing and the crowdsourcing stands that the crowdsourcing is based on giving job to the unknown crowd while outsourcing is based on giving job to the known organization. However, giving job to the unknown crowd might be cheaper compare to the outsourcing work to the known organization, but it's good to consider that sometimes giving a specific task to the unknown crowd may not bring the expected results in respect to quality and time constrains.

Results gained by using crowdsourcing platforms depend highly on the complexity of task and to which crowd is dedicated. As much as the task is complex, the gained results could be non-satisfactory. This is because people are bound to solve easier tasks than the complex ones. There are a lot of easy tasks that the computers still can't solve (e.g. choosing some best nature images among other images) and in these cases human intelligence is inevitably. According to the work of [4], crowdworkers aren't merely computational units; they are real people with complex emotions, capable of incredibly creative, higher-order thinking.

Collective participation or collective intelligence can best describe the idea of crowdsourcing that the knowledge gained by the participation of population is more accurate than any of us which will decide individually – "all of us together are smarter than any one of us individually" [5].

There have been developed several commercial platforms for crowdsourcing and the most comprehensive are Amazon Mechanical Turk [6], [7], and Threadless [8] and [9]. Some other examples of crowdsourcing systems are CrowdGrader [10], CrowdFill [11], and CityFEED [12].

In this paper is presented an efficient and novel solution using crowdsourcing techniques for improving the quality of election processes. A simple web form customized on polling station properties was developed to obtain citizen (crowd) feedback. These polling stations are connected via Secure Socket Layer (SSL) protocol to Central Election Commission (CEC) monitoring room. The CEC based on site information gathered from crowd will not only monitor the overall quality in national scale but also can take decisions to improve quality of election process in particular polling station. To evaluate the acceptance of this approach the survey was conducted with 606 respondents, from different ages, gender and areas in Kosovo. Their feedback

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Note: This paper has been presented at the International Conference on Advanced Technology&Sciences (ICAT'15) held in Antalya (Turkey),

is very encouraging and in favour of using the proposed crowdsourcing techniques to improve the total quality and acceptance of election results.

The remainder of the paper is organized as follows: In section two are presented the privacy in crowdsourcing systems. In section three are given the results of conducted survey for difficulties during in election process. In section four are presented the crowdsourcing techniques that are used to improve quality of election process and its implementation. In last section are given final conclusions and future work.

2. Privacy in Crowdsourcing Systems

Nowadays, information technology is becoming closer to our lives. In our everyday life we use a numerous social networks and digital devices connected to the Internet such as smartphones, smart TV's or smart watches. In order to use benefits of these technologies users need to accept some information to be shared with the services. Most of these devices pretend that they are accessing to our personal information just to improve the quality of services. However, during the year 2014 often we have witnessed the leakage of large scale of personal information as presented in [13].

The issue of privacy remains the biggest concern of new era in which we live. In crowdsourcing platforms, users need to know what exactly they share and how the collected data will be used. Platform such as Google Consumer Surveys [14] is an opportunity for researchers or market analysers to collect data from online crowd for a specific topic. By participating in online surveys there is possibility that users can be profiled by survey initiator or from platform itself [15]. In these cases, participants might not be aware that they can be profiled by either platform or survey initiator. The gradual leak of small information can be accumulated over the time and can be used to profile individuals. The more data that is collected, the higher are chances that the user can be profiled. There have been proposed a certain number of platforms that take into account the aspects of privacy [16], [17].

In [15] is proposed new crowdsourcing platform called "Loki", which is privacy aware. In this platform users are allowed to perturb their multi-choice or rating based responses based on their selected privacy level, and give surveyors aggregated population averages with known statistical confidence. Furthermore, it claims that the perturbing of responses does not prevent leakage of information, only slows it downs and makes it harder to collect data in short period of time. Similar approach, to protect user privacy is presented in [18], where by users are authenticated using anonymous X.509 digital certificate stored in national biometric card, and send their feedback through Internet. Our approach proposed in this paper does not require authentication in polling station as this step is done, in manual form, before citizen has casted a vote, i.e. the web form is accessible only from eligible voters during voting process.

3. Survey about difficulties during in elections

A questionnaire "Difficulties presented during participation in elections was developed to identify and evaluate main concerns during an election process. The survey contains 15 questions, divided in two category of participants (i) voters, and (ii) non-voters as depicted in Table 1.:

Table 1. Survey details

Category	Percentage
Voters	90.8%
Non-voters	9.2%

Voters category are the highest participants in the conducted survey. The survey results showed that 48% of voter participants think that the level of abuses in the election process in Republic of Kosovo is high, as presented in Fig. 1.

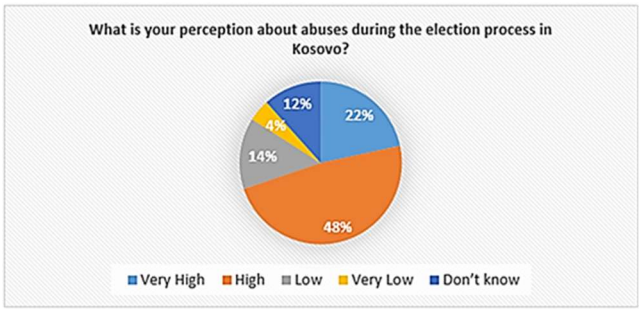

Figure 1. Perception about abuses during the election process.

Over 55% of voter respondents think that the creation of a system in which citizens will assess the election process would significantly improve the current situation. While 19% of respondents are neutral and 6% disagree, as presented in Fig.2.

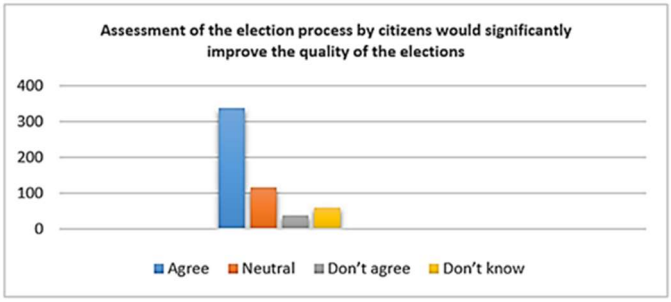

Figure 2. Difficulties presented during participation in elections.

In order to achieve better and more sustainable results from the conducted survey, we took in consider also the group of non-voters which never votes in any election processes in Kosovo. The questions for the category of non-voters was designed to identify reasons for not participation in election processes and their viewpoint in involvement of information technology in the election processes. The survey results showed that 37.5% of non-voters do not vote due to the abuses in election processes, while 24% do not like candidates. Over 66% claim that in case of involving information technology they will participate in election processes.

Due to the high rate of abuses, significant percentage of responders from both categories believe that the assessment by citizens would significantly improve the quality of election process. We believe that developing such a system would have positive results in terms of improvement of the Election Process in Kosovo.

4. Improving Quality of Election Process

Elections and voting are the basic democratic rights of every citizen in democratic based countries. The importance of free and fair elections is an inseparable part of democracy. Elections take place in all democratic countries, but unfortunately, not all

elections can be considered as democratic. In most developed countries of the world, governments still sought different ways to protect the citizen's vote by investing and creating sophisticated computer systems. However, Kosovo and in generally countries in transition, so far have shown bitter history and numerous abuses of the citizen's vote.

The academic literature examining digital election monitoring is limited [19]. Until, today a significant number of Non-Governmental Organisations for Election Monitoring in Kosovo have tried different approaches to collect data through reporting's by citizens. SMS-based election monitoring was used by "Democracy in Action" for the first time in national elections of 2014 [20]. In order to improve the quality of the election process, increasing the confidence of citizens for free elections and identification of problems at poll stations we propose a crowdsource system in which citizens will assess the election process. We call the developed system as CrowdVote.

The CrowdVote System is divided it into five stages: (1) System architecture, (2) Dynamic question management, (3) Process of voting, (4) Real-time data representation, and (5) Implementation.

A. Stage 1: System architecture

CrowdVote consists of seven entities which take part in the system architecture. As it is presented in the Fig. 3, these entities are: Crowdsourcer, Dynamic Questions Management, Poll Stations, Crowd Voters, Evaluation Process, Notification Centre, and Reports.

The crowdsourcer is someone who makes an open call for the participation in particular task. The crowdsourcer [3] might be an individual, a non-profit organization or a company that tries to accomplish a particular task through the power of the crowd. In our case the crowdsourcer is Central Election Commission (CEC) which will hold all gained results of voting in CrowdVote System.

Dynamic Question Management is entity where all questions are predefined, as described in next sub-section.

Poll Station is an entity where each of them consist of unique ID and other information which will be used to connect to the system. In each voting centre there will be devices which will be used to capture data from the crowd.

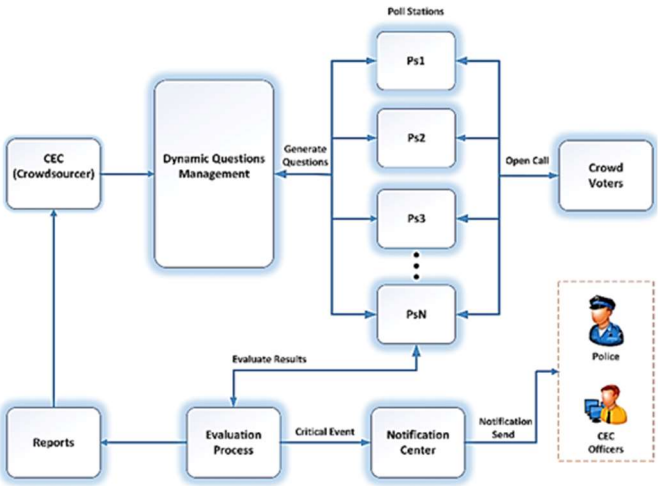

Figure 3. CrowdVote System architecture.

The crowd is the group of people which contributes in some way in crowdsourcing platforms. Their contributions differ from the platform in which they contribute. In CrowdVote they will answer questions with two choices. The crowds are mainly characterized by diversity in profession that take part in crowd systems. An advantage of the crowds in crowd systems are numerous. It allows a large number of people from different locations to take part in the crowd group and participate in crowd platform.

Evaluation process is an entity where data generated from the poll stations are collected and used for identifying different category of problems. Through the evaluation process critical answers will be processed to notification centre.

Notification Centre will be triggered in case of critical event if it happens in a poll station. Critical events are triggered through the answers of crowd voters. Let assume the case where the voter claims for abusing of votes. After submitting the results, the notification centre will be triggered and send an SMS or an email notification to the Police and CEC Commissioners.

Report is an entity where all collected data will be represented for each poll station, municipal and in national level. Additional part of report entity, will be the calculation of the correlation poll for each station result.

B. Stage 2: Dynamic question management

The crowdsourced task is a typical outsourced task by the crowdsourcer that's need to be completed by the crowd through the participation. Since the crowdsourcing found wide application it's obvious that the most crowdsourced tasks are represented in different forms. CrowdVote task take part into the group of tasks with low complexity. Voting is one of the popular crowdsourcing tasks [21]. Task are organized into questions with two possible options.

Questions which will be presented in the polls are defined based upon the survey and in cooperation with the Kosovo Election Monitor Organizations [20], [22]. The questions are categorized into two groups:

- Non-critical questions
- Critical questions

Non-critical questions are those questions which there is no need to send notification messages to the CEC Commissioners and to the Police. These type of questions can be considered as technical problems which doesn't cause any degradation of election process. For an example questions like delays to vote or purity are categorized as non-critical questions.

Critical questions are those question which the CEC Commissioners and the Police must be informed through the notification messages. For an example questions like multiple voting or voting in group are considered as critical questions.

In each polling station questions order will be different. The concept behind the dynamic questions is based on the concept of the majority voting. Answers of questions which appear to be a major problem in a specific polling station will be considered to be more actual than the others that are chosen as not happening at the specific time. These questions will be presented first. In order to improve the quality of question suggestions two approaches are used: (i) to reset order of appearance of suggested questions by CEC commissioner, and (ii) reset appearance of suggested questions every three hours during the Election Day. With resetting questions order we avoid the problem of stuck questions for a long time.

C. Stage 3: Process of voting

While designing the voting process flow we took in consider as much as possible simplicity of interface design. Rahmanian and Davis claims in their work that user interface design have also a significant effect on crowdworkers performance. Furthermore, researchers claim that achieving high quality results by putting

humans in the loop is one of the main goals of these crowdsourcing systems [23]. The process of voting is separated into three parts which are:

- Rate election process,
- Suggested questions and
- Other questions.

Rate election process is the image based question on which the voter estimates the quality of election process in that particular polling station, where voter automatically assigns value between "Excellent", "Average" and "Poor" after clicking (touching) one of the images, as presented in the Fig. 4.

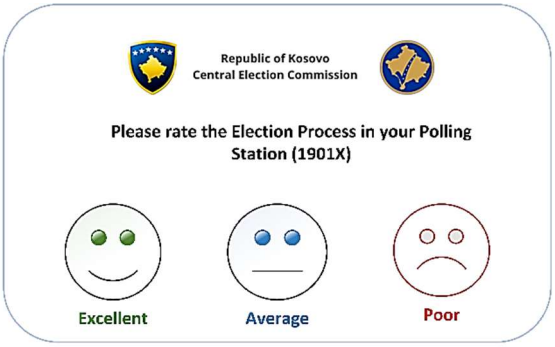

Figure 4. Rate election process interface.

Suggested questions appears whenever the voter rate the quality of process as average or as poor, as presented in. Fig. 5. These suggested questions are proposed by the system itself and voters have only two choices 'Yes' and 'No'.

Figure 5. Suggested questions interface.

If a voter is not happy the proposed questions, he can require "More choices", where by the system will offer a complete list of questions to evaluate the quality of election process.

D. Stage 4: Real-time data representation

Real-Time execution is a challenging problem due to highly dynamic crowd, as well as resource constraints and fluctuations in network quality [24]. During the Election Day estimates given by the crowd will be presented in interactive map for each city of the Republic of Kosovo, as presented in Fig. 6. With interactive graphical presentation CEC has a general overview about quality of the election process. In the Fig. 6, each colour represents an estimation of election process with rating scale between "Excellent", "Average" and "Poor". The scale is defined as follows: Poor = Red, Average = Blue, Excellent = Green and White colour represents there is no data yet.

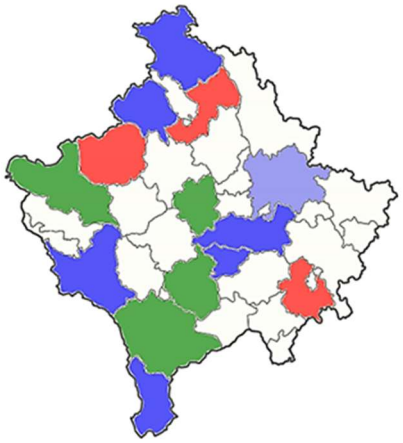

Figure 6. Real-time map of estimations of election process.

Graphical presentation of incidents that occur during the process can be observed in real-time for each polling station and general results for each municipality. We use Google Charts [25] to represent data gained from the crowd. An example of the column chart is presented in the Fig. 7.

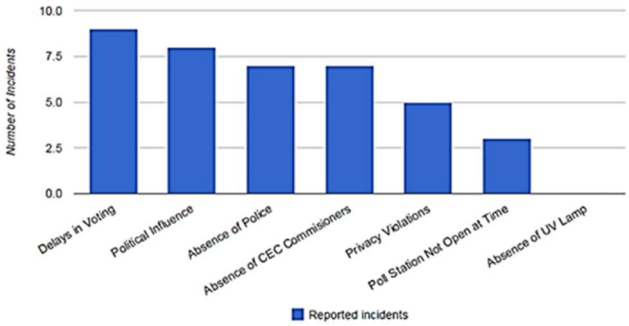

Figure 7. Real-time data with interactive Google Charts.

Data collection from the crowd is an essential part of any crowdsourcing system. Well analysed data is a way of answering the key questions for a different process. In context of the quality, the crowdsourcing platforms still remains plagued by poor quality [7]. Inaccuracies in contributions intentionally or not are very often in every crowd based systems.

However, statistical calculation can help to interpret crowd data into a meaningful results or identifying the relationships between different data. By calculating correlation between each answers in results a meaningful result can be obtained.

Table 2. Collected answers for X poll station

Voters	Delay in Voting	Absence of Police	Privacy Violations	Absence UV Lamp
v1	0	0	1	0
v2	1	0	0	1
v3	1	0	1	1
v4	1	1	0	1
v5	1	0	1	0
v6	1	0	0	1
v7	1	1	0	1
v8	0	0	1	0
v9	0	1	0	0
v10	1	0	0	1

In order to have a more clear view about the correlation between gained results, let us assume that ten voters v1, v2,..., v10, and their four answers in poll station X, as presented in Table 2. Answers with value '1' represents "Yes" which mean the problem appears in polling station, while '0' denotes "No" which mean the problem does not appear in polling station.

The correlation coefficient, is a numerical value between -1 and 1 that expresses the strength of the linear relationship between two variables, as described in [26]. As much as the coefficient is closer to 1 it indicates a strong positive relationship, and closer to -1 it indicates a strong negative relationship. Value of 0 indicates that there is no relationship between variables.

Table 3. Relationship between answers in X polling station

Delay in Voting	Absence of Police	Privacy Violations	Absence UV Lamp	
1	-0.04	-0.35	0.80	Delay in Voting
	1	-0.53	0.08	Absence of Police
		1	-0.58	Privacy Violations
			1	Absence UV Lamp

From the Table 3, the relationship between "Delay in Voting" and "Absence of UV Lamp" is high positive correlation, which implies that these two problems are increasing together in polling station. One can easily conclude that "Absence of UV Lamp" leads to more delays in voting, and vice versa. In this case correlation also might be helpful as indicator of the fairness of crowd. However, correlation does not imply the cause of increasing of the other value. CrowdVote system belongs to the group of crowdsourcing systems in which fairness of the crowd is an important attribute to produce legitimate results.

E. Stage 4: Implementation

CrowdVote is a web application developed on .NET technology dedicated to the desktop browser and partially mobile browsers. CrowdVote consists two type of users: System Administrators and Poll Station Users. System administrators are responsible for the registration of new users, editing, deleting, managing, generating reports etc. System administrators in the other words have permissions to read and write actions into the system. The system administrator interface is shown in the Fig. 8.

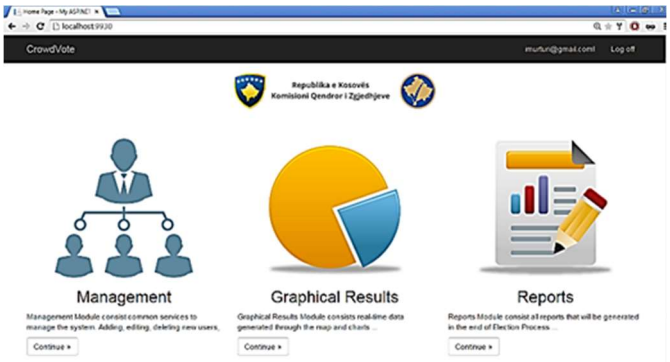

Figure 8. System administrator interface.

Poll station users are device users that will capture data from the crowd. Poll Station interface is developed to support mobile and tablets browsers. Once the poll station user is in the session of gathering data from the crowd, it will remain open until the official end time of elections. At the official end time of elections reports will be accessible by every poll station user. The poll station user interface is presented in the Fig. 9.

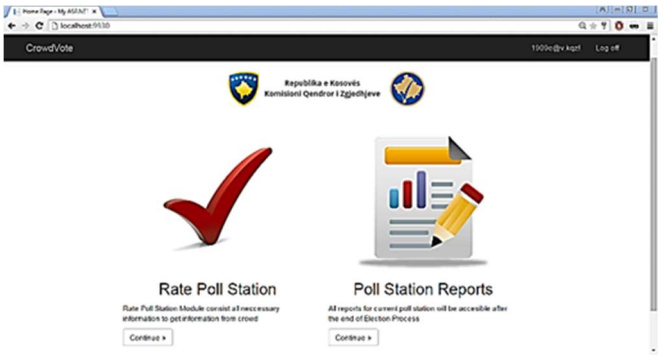

Figure 9. Poll station user interface.

The development of poll station interface is accomplished with the use of jQuery UI plugin and Bootstrap cascade style sheets. Keeping a voter satisfied from having a good experience on participation in CrowdVote is essential to gather more information from the crowd.

5. Conclusion

The right to elect and to be elected is considered one the fundamental rights of our modern society, which is exercised through a voting system. In order to recognize and accept the election results the quality of election process must be assured. The survey conducted has shown that the crowdsourcing approach will be accepted and will increase not only the quality of election process bit also the citizen participation in an election process. The proposed and developed solution aims to increase the quality of election process by using the crowdsourcing techniques.

Crowdsourcing is a modern technique that requires involvement of crowd (citizen) in the process that is achieved using web forms, after casting a manual vote, deployed in devices in every polling station. The data captured, in real time, in these polling stations is stored in central database in CEC. The monitoring centre, CEC in case presented in this paper, can instantly take measures for particular polling station to improve the quality of election process based on crowd feedback.

The approach presented in this paper can be used not only during political elections but also for small scale such students elections and even small entities.

Developing an app for mobile devices remains a future work, which automatically will locate the voter and collect his feedback in a more convenient way.

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