

Design and implementation of e-voting system based on Descriptive statistics

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Abstract:

In this paper, we implemented a new form of a secure voting method, namely NFC voting, which facilitates data transmission within a short distance between NFC-enabled devices and smart tags, we present the design and implementation of secure e-voting to ensure an open, fair and reliable election where electorate preference counts. The information that can be obtained by using modern means and applying the statistical method is considered one of the important tools in developing state institutions, and in this research the special program was designed and created as a tool to collect information and to know the extent of using modern methods in the governmental institution. It helps in developing performance and conducting fair and fast elections, the prime target of voting (in a situation involving the inhabitants of a given country) is to find candidates of the preference of the people. Also collecting the data and counting the results showing with basic and simple tools of descriptive statistics with graphs in the end of process, when it comes to elections in Kurdistan/Iraq, Riding votes during voting, insecure or unavailable polling stations, insufficient polling materials, and even inexperienced workers are some of the issues involved. This method of online voting/polling aims to solve the aforementioned problems. It should be remembered because in this situation, with this system in place, consumers and residents are granted adequate time during the voting cycle, also until election time, they will be educated on how to vote online.

Keyword: Statistical Tools, Descriptive Statistics, Election, Near Field Communication (NFC), E-Voting (electronic voting).



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Introduction

Civilians are bombarded with statistics, graphs, tables and results from opinion polls alluded to in indexes prior to democratic processes, estimates such as the anticipated strength of parties involved in elections, publicity of individuals, evaluative assessment of issues and lawmakers. The findings are explained and evaluated after the polls, using sophisticated methodological methods aimed at promoting political parties' pre-electoral declarations and attitudes. Statistics do not represent a compilation of guidelines and recipes for data processing. By using complex computerized systems and good diagrams, it is not drained. It requires a good knowledge of the observed phenomenon, the organization of observation, good knowledge of gathered data, and description phenomenon. (Chadjipadelis,2002,1).

The organization for Security and Cooperation in Europe has indicated, as a system of states, committed to respect and disseminate human rightsDemocracy and the rule of law, to the role of democratic elections as the basic pillar of security and stabilitythe long-term.Allcountries participating in the organizationpledge to host the incoming international observersofotherparticipating countries in the organization, the Bureau for Democratic Institutions and Human Rights, and the AssociationParliamentary Organization for Security and Cooperation in Europewith the aim of their participation in monitoring the elections. On thisas such, states believe that election monitoring can play an important role in promoting transparency and accountability, as well as strengthening public confidence in the electoral process. The deployment of monitors clearly supports democratic processes and may helpcountries to participatein the Organization for Security and Cooperation in Europe (OSCE) in achieving their stated goal of holding electionso fair democracy in line with the commitments of this organization. However, the presence of international observers should not be considered alone tantamount to lend legitimacy or credibility to the electoral process itself. But in general, most operations are capable of electoral benefits from the existence of an independent and impartial evaluation prepared by international observers. (www.osce.org).

Literature Review:

In 2017 SayaliMokashi, Priyanka Wadkar, P.V.Mahadik, points the program that recovers the information contained in the tag, and alongside its ward, the client is then checked. The program is composed of two authentication-OTP code in the personal contact number of the voter so that the voter can truly check with that as the password is delivered on their devices instantly. When the authentication is complete, the application reveals all the candidates from that ward who are running in the election. We also added another kind of secure voting scheme, unique NFC voting, and tested the ease of use of the mechanism in a race with an executable model. In comparison to alternative approaches, we see that NFC voting follows the electronic voting prerequisites and further expands the proposed system's subjective ease.

In 2016 Using this mobile-based voting system by using the NFC module by Pratiksha Bhosale¹, Sayali Mokashi², Priyanka Wadkar³, in this paper polls can be held quickly and efficiently in a proper way so the individual can vote

from the location where he/she works using this framework. It can be altered for public and legislative elections as well. The proposed system for e-voting is very efficient and will be helpful in many aspects for electors and will minimize costs and time. Internet-based polling has many advantages, including reduced cost and improved voter turnout. Voting frameworks must closely understand protection and human factors and, in particular to ensure that they provide accurate and intuitive indicators of the legitimacy of the voting process to the electorate.

1.2: Election&E-VotingSystem

1.2.1: Voting Systems

Democracy has been carried out in numerous ways internationally. The system in place in the United States is by no means the world standard. In fact, from state to state even within the United States, voting systems vary dramatically. However, with the 2000 presidential election, more concern was given on the federal level to the consistent carrying out of election law. Below is some types voting (Gelman, Katz, Tuerlinckx, 2002, 18)

1.2.1.1: Parliamentary System:

The American electoral system elects' representatives by a majority or plurality based on one geographical area (whoever gets the most votes in that district wins). For Representatives, the districts are entire states and portions of states for house members. This is known as the method of First-past-the-post", All representatives are chosen at large in the legislative system, meaning from the population of the whole country, which voters choose one party.

1.2.1.2: Instant Run-off Voting:

I.R.V. is a system developed to aid the involvement of third parties in a two-party system. Voters pick their first, second and third options. When their first preference fails, their vote will be passed to their candidate of the second choice. In 2000, for instance, electors should have voted first for Nader and second for Gore allowing more political views to be articulated while avoiding the "spoiler effect." In many nations overseas, and even in various local elections in the United States, programs are in operation.

1.2.1.3: Fusion Voting:

Fusion voting allows candidates to run under several party labels in one election. New York State is the largest example. Candidates also run as nominees for both the Democrats and the Democratic Party; or as nominees for the Right-To-Life Party and Republicans. Third-party participation is welcomed so electors may select an individual and a party, because in either party the name of the person appears once. Most bargaining takes place to secure major party candidates' third-party endorsements, which are absent in states without fusion elections. (www.duvalelection.com).

1.2.1.4: Voting Equipment:

Congress passed the Help America Vote Act (HAVA) to address issues echoed nationally. Now voters have the right, if their identity is challenged, to cast a

provisional ballot; and citizens with the same names as felons are not routinely excluded from the voting rolls.

When applied to door protection and payment processing systems, secure NFC data has been developed. This paper focuses on the evaluation of passive "smart" chip card, NFC protection approaches and will include pros/cons for each, as well as a recommendation of best practices. Due to its ease of use for individuals, NFC will most likely follow its journey of being heavily used in all fields. Compared to identifying devices of the past, it is also very versatile, facilitating many forms of identification. The outcome is that NFC is used mostly for detection and several protocols. [Gripentog, kim,2015,

1.3: The Role of Statistical in election

The field of statistics is the science of learning from data. Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions. Statistics allows you to understand a subject much more deeply (forst, 2020, MS). The goal of the elections issue of Statistical Science is to advance overall knowledge and understanding of this interesting social phenomenon, as well as to call attention to a challenging set of problems for statisticians and political scientists. The contributing authors here have done an excellent job of providing fundamental concepts as well as new methods and new theories, and the hard work of a number of reviewers helped to make the presentations even better. (Statistical Science 2002). Elections are random events. From individuals deciding whether to vote, to people deciding for whom to vote, to election authorities deciding what to count, the outcomes of competitive democratic elections are rarely known until Election Day...or beyond. explores this random phenomenon from two points of view: predicting the election outcome using opinion polls and testing the election outcome using government-reported data (OleJ. Forsberg,2020).

1-4: Statistical tools

Statistics is a mathematical science or we can say is a branch of mathematics that is concerned with the collection, analysis, interpretation or explanation, and presentation of data. Properly used statistical principles phase of data exploration, is routinely a fundamental source for discovery and innovation. Insights from data may come from a well-conceived visualization of the data, from modern methods of statistical learning and model selection as well as from time-honored formal statistical procedures. There are two goals when presenting data. The first encounters have to data through graphical displays and numerical summaries, and the second goal is to find an elegant method for this presentation that is at the same time both objective and informative - making clear with a few lines or a few numbers the salient features of the data. In this sense, data presentation is at the same time an art, a science, and an obligation to impartiality. (Hill, 2006,15).

1.4.1. Descriptive Statistics

There are two main branches of statistics: Descriptive and Inferential. The basic features of the data in a sample are represented using descriptive statistics. Easy summaries of the sample and the measurements are given

They form the base of nearly all quantitative data analysis, along with basic graphics analysis. Descriptive figures are only used to indicate more about a set of data that has been obtained.

Inferential statistics are used to use information obtained from a particular portion of the population to make estimates or comparisons about a wider group (a population). Inferential statistics thus require generalizing beyond the results, something that is not achieved by descriptive statistics. (Hone, 2014,6).

1.4.2: Data Collection

Data: Facts, especially numerical facts, collected together for reference or information. Information is Knowledge communicated concerning some particular fact. Information you gather can come from a range of sources. Likewise, there are a variety of techniques to use when gathering primary data. (Sathianadan, P., Rahiman,2017,3).

1.4.3: Types of data and choice of graph

There are numerous conflict types of graph; the use of selecting type of graph based on the kind of data being represented.

1.4.3.1: Categorical data

Categorical data are those data which enter upon one of two or more distinct categorization, but with no underlying succession to the classes. For example, gender is a categorical variable of two categories (male, female). The variables do not have a simple structure for strictly classification knowledge. Graphs useful for categorical data include bar graphs, clustered bar graphs and layered column maps (both horizontal and vertical). (Cooper, Shore,2010,12).

1.4.3.2: Ordinal data

Ordinary data is identical to categorical data, because the variables are explicitly ordered. The degree of variation between groups is not necessarily reliable or measurable, while ordinal data has a definite ordering. (Marshall, Jonker,2010,3).

1.4.3.3: Data on a numeric

Data on a numeric scale are usually thought of, and treated, as continuous data. The exemplification of solid data include height, time, pile, extent and dollar values. Graphs satisfactory for continual data comprising line graphs and scatter plots. (Marshall, Jonker,2010,3).

1.4.3.4: Interval data

Interval data are the facts that have both an order, and an equal spacing between categories. Occasionally, continuous data are converted to interval data for reporting impetus. Graphs appropriate for interval data contain bar graphs, histograms and box-whisker plots (Watkins,2017).

1.5: The Graphical Method

1.5.1: Data Presentation

The visual representation of data may be used not only to present results/findings in the data, but may also be used to learn about the data. (Sathianadan,2017,5).

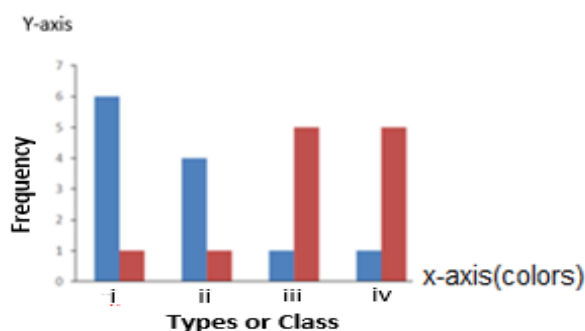
Charts are a way to present data in optical formation. They are a valuable medium for viewing multiple data types, and one of the simplest ways to see variables' relationships and/or compare numbers. To ensure that graphs are easy to interpret, they need to be presented in a way that enables them to

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“stand-alone”. They should be free of clutter and use fitting names, stories, titles of axes and footnotes. There are a number of various graph forms that can be used. Awareness should be taken to guarantee that the type of graph plump for is significant for the genre of data that is being plotted. An appropriate and properly assembled graph can be a powerful way in which to transport statistical information (www.abs.gov.au).

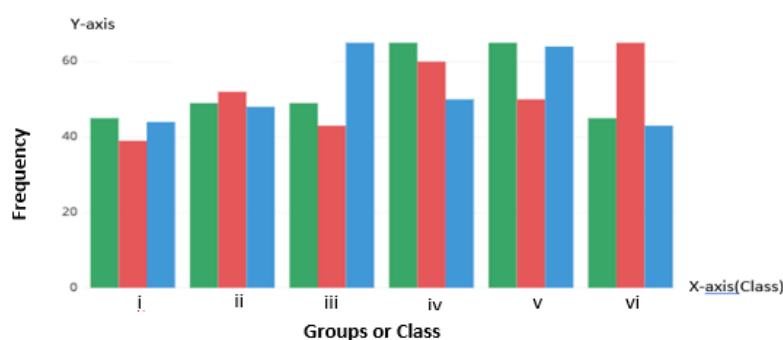
1.5.2: Bar graphs

Bar graphs are supreme for dispensing categorical data. Bar charts use rectangular bars to perceivably exhibit each value and how it balance to other values in the graph the greater the extent of the bar, the greater the value. This supply a simple and easy way to elucidate the data. The bars on a bar graph can be horizontal or vertical. It is easy to comprise error bars on this kind of chart. Bar graphs are therefore favoured and regularly used in survey reporting, vertical bar charts are best for comparing estimates (means or percentages) for between two and several varieties. (Cooper, Shore, 2010, 24) as this graph number(1) below showing the bar-graph used for categorical data:



1.5.3: Clustered bar

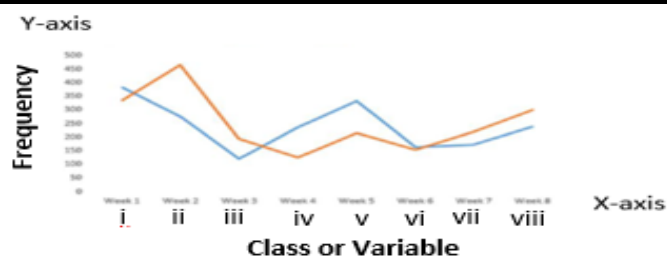
Clustered or grouped bar charts are those that show two or more classes on one graph. Plotting multitudinous categories on one graph expand the amount of information that can be manifest, whilst attentiveness must be taken to avoid over-complicating the graph (2). (Kaur, Fus, Yellapu, 2018, 9).



1.5.4: Line graph

Line charts are utilized to embellish trends over time for continuous facts. They can also be used to compare two various variables over time as this graph (3) below. (Sathianadan, 2017, 7).

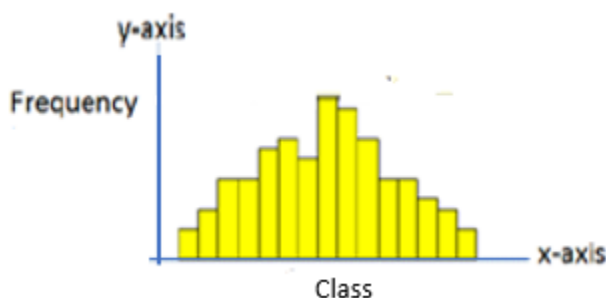
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1.5.5: Histograms

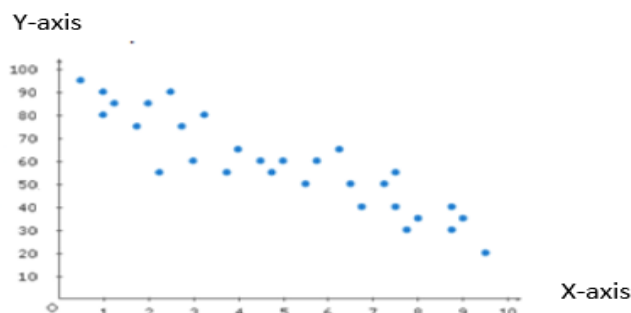
In a histogram, the data are grouped into ranges (e.g. 10–19, 20–29) and then plotted as connected bars. Each bar represents a range of data. The width of each bar is proportional to the width of each category, and the height is proportional to the frequency or percentage of that category. Bars or categories in a histogram are presented in ascending or descending order. Histograms are used for data that are at least at the ordinal level of measurement, and most often for plotting continuous data.

A histogram looks very similar to a bar chart except that the bars are touching and may not be of equal width. In a bar chart the spaces between the bars visually indicate that the categories are separate. (Keeble,2009,20) as this graph (4) below.



1.5.6: Scatter plots

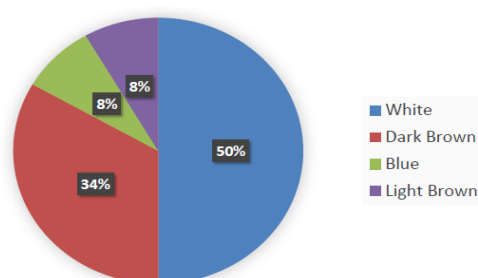
Scatter plots are used to plot data points on a horizontal and a vertical axis to show association between two variables (or how much one variable is affected by another). Scatter plots are utilized for plotting continuous data. They are extremely applicable when comparing two variables in situations where there are many data points. (Watkins,2016,24) these points are shown in Graph (5).



1.5.7: Pie graphs

Pie charts show parts or percentages of a whole. While they are colorful and desired. The human visual apparatus is more efficient at perceiving and discriminating between lines and line lengths (such as are found in bar charts), rather than two-dimensional areas and angles (such as are found in pie charts). While Pie graphs simply don't work while comparing data (shayib,2013,). This type of graph is [Shown](#) in graph (6).

► The area of the circle is proportional to the frequency



2-1: Election & Online apps

2.1.1: Introduction:

Elections are the basic distinguishing features of any society that upholds the very essence of a culture ruled by people sharing their decisions in the form of voting or articulating opinions. The conventional electoral method vacillates around manually tallying, which is time-consuming, difficult, erroneous and vulnerable to fraud. The polling processes have now progressed from leaps and bounds to online voting systems with plain handwritten ballots. The proposed architecture also has the sui generis feature of being autonomous during the operating mode, which helps to minimize and remove the hacking problems that existed in conventional voting systems situations, and also has an eagle eye view of the privacy restriction that clashes directly with the ability to properly verify the data. Before casting their ballots, the NFC tag stores the elector's information such as name, age, gender and position that are manipulated for authentication. The user puts the NFC tag nearby the device scanner, then the tag is scanned and the back-end machine checks the data. One of NFC's notable features, such as data transmission, is its integrated guaranteed protection. Voters would be allowed to vote without territorial limits virtually anywhere in the governorate. [Matharu, Mishra, Chhikara, 2014,]

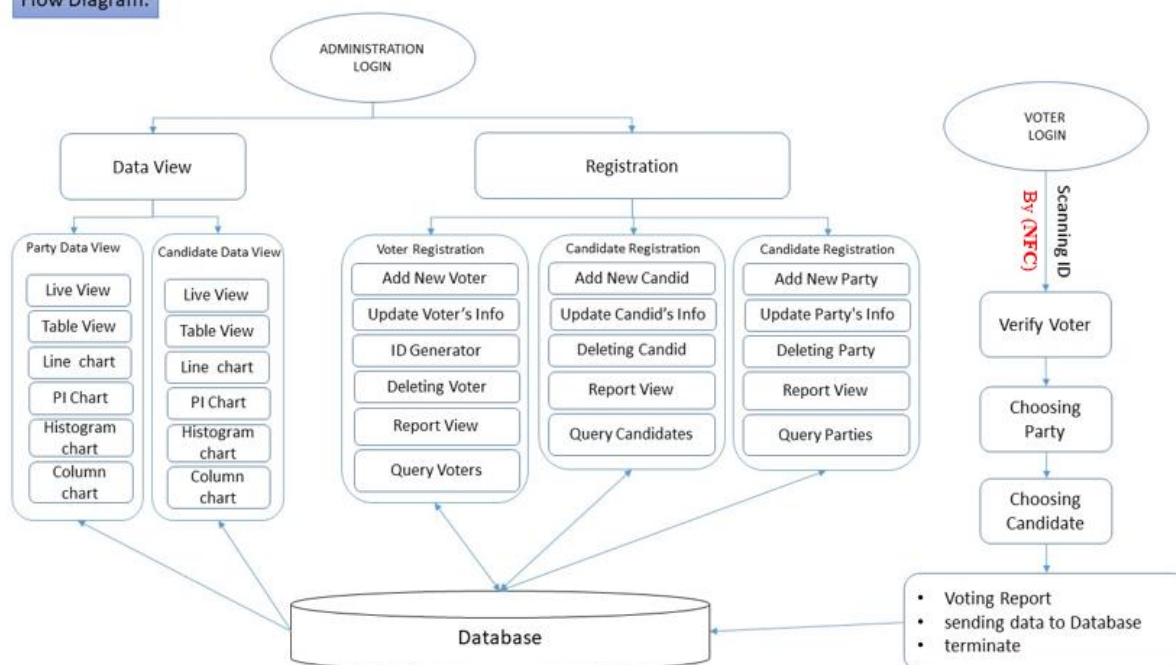
2.1.2: System Model: The major motto for the implementation of the E-Voting System is to maximize the number of votes in our country due to the tight timetable or remote function of just a few people heading to the voting center. So, people in our country will vote and use this device from anywhere in the city. The E-Voting Method is designed to make those algorithms and techniques

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safer. There is no need to go to the provided voting location. Electors can vote from either polling booth center. It also stops phishing attackers, which will reduce fake voting, and provides the system with protection. The proposed framework does not need large-scale hardware interfaces, only so conveniently accessible from any place is required with internet connectivity. This scheme is useful for the electoral commission to administer the elections for numerous offices. With proper protection, elections can be held conveniently and

efficiently in the right way. [Handel,2017,6]

Flow Diagram:



Graph (7) represents the flow Diagram of E-Voting System

NFC (Near Field Communication):

NFC is used to protect the electronic voting system. The NFC stores all the voter records, checks all the information immediately and processes the information and also, cryptography is used for encryption purposes. Each consumer will have an NFC voter id card consisting of a tag; it will store all the baseline information such as name, age, gender, location. Only registered users can continue the process of casting their vote once they have placed their card near the NFC reader. Then when the card is recognized by the scanner it will let you to vote for the chosen candidate. For the verification purposes of each voter, the NFC cards come with a unique number. At the initial stage, once

the card ID is kept in the vicinity of the controller, the contained data or baseline information becomes accurate by the use of the serial display. If the user is legitimate, the id fits the data stored in the database, in which there is a database maintained by the election commission in which it will let you to pass to the next authentication stage, otherwise the message that the "individual is not an authorized user" will be displayed on the monitor. The voter will not be able to vote again and this will be announced on the screen if several votes are attempted by the same person.

2-2: Software Requirements:

MYSQL DBMS (It allows combination, extraction, manipulation and organization of data in the voters' database. It is fast in performance, stable and provides business value at a low cost) , **Visual studio 2019** available for Windows(Mac, Linux, and Solaris, using the c# platform, as well as f#, JavaScript and Python, Visual basic , and C/C++.), C# coding programming language ,Testing via (XAMPP)., Web browsers (Mozilla Firefox and Google chrome), Reporting Tool(i.e. through Data Report) It allows information in the voting database to be merged, extracted, manipulated and structured. It is fast in performance, stable and provides business value at a low cost.

2-3: The system will execute using below procedure with output:

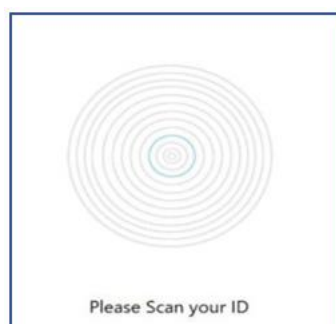
As mentioned earlier, in most countries of the world the election and voting process has been passed by the classic form which is in the form of searching for voter names on a list by observers , and the way of counting and separating the votes that needed a lot of time and cost, despite the tiredness of the group of people who participated in the process, also it gave a lot of ways to interfere and to play with the results, which often the number of votes became suspicious to all the parties, the people who are still in Iraq and Kurdistan region are following the same classic style. After the elections and the formation of a government and sedating the votes and the results takes a lot of time despite the lack of trust in the results even after taking the government. By considering this situation and feeling responsible, in this paper it has been attempted to show a new electronic method in the form of a program to officials and those working in the field of electronics and computers, which is an online method in which each individual in the country can vote anywhere in Iraq and Kurdistan, provided by the availability of Internet in that location and some basic equipment provided at the polling stations.

First, we need to know that this application consists of two main sections, one of which is controlled by the (admin) and conducts the entire process. In today's situation, violence-free polls are one of the critical concerns. There are several issues faced by individuals such as not detecting the voters name, not understanding the precise position of the vote, false votes, not getting enough time etc. The proposed system was used to prevent the limitations of existing processes.

One of NFC's notable features is its incorporated assured protection, as the cryptography algorithm is for transmission of data and encryption and

decryption is used for data privacy and security. NFC will update itself every 5 minutes to secure the votes, so that in that day only one person can vote with a profile name of the voter to avoid cheating problems. The second part of the section is that when each voter enters the polling station and wants to vote, they see a list of information that is necessary, first the assurance of the voters number of voting is required (the voting documents used by the commission) to identify the voter, after recognizing the voter and verifying the ID card due to the NFC, the voter will fingerprint.

Then the section of all the listed parties in the election will appear that are registered as a political entity, the voter chooses a party and after choosing the party, the list of candidates will come forward to select and elect the candidates in the last stage. Voters will be given full assurances of the veracity of their decision and by this way, voters will finish the voting process. Shown in this Graph (8) below:



Graph (8) NFC for scan your ID

To explain the outcome of this programming (apps), suppose that the size of population ($n=200$) person.

In the station that the person chooses to vote after the NFC recognized the voter, the device shows the parties in a listed chain then, the voter chooses one of the following parties that he/she wants to vote. Graph (9).



Graph (9) choose party Logo

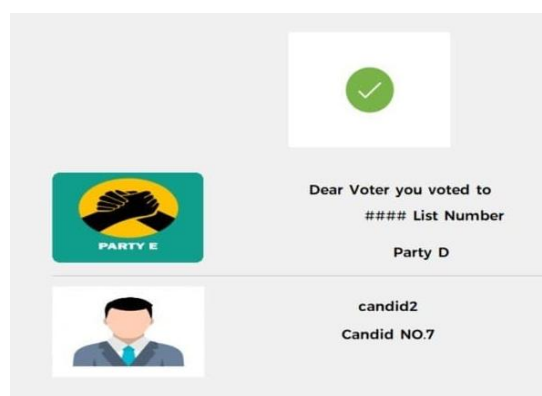
After the voter chose one of the parties, he/she has to vote for one of the candidates of that part. Graph (10)

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Graph (10) chooseCandid name of the party list

Voters should be able to ensure that their vote has been counted then the computer will show (Dear voter you voted to this party and candidate name).
Graph (11)



Graph (11) voter assured to the vote

After Election, the admin will show the election results in a graph and, the accurate numbers that each party and particular candidate got, shown in graph (12). To explain the outcome of this programming (apps), suppose that the size of population ($n=200$) person. With the continuation of the vote and the process of separating the votes, it will start at the same time as it is controlled by the admin, which has already been data based with information and can be controlled by the administrator, which can be known how many people participated and how many people voted, and how many votes were obtained for each party. For example, as testing and experiencing this app, 200 people participated in the voting process at the same time as the vote, and 200 votes can be casted for the parties and candidates. As described in this picture, the pictures and charts used in this paper have been mentioned in the theory

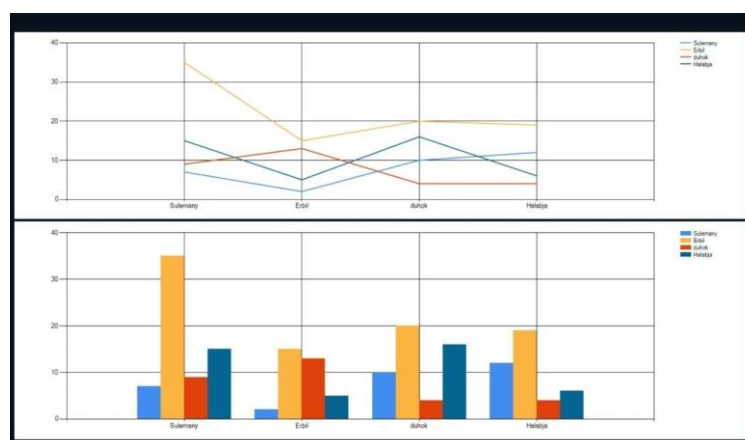
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section. Looking at the right side of this picture, we find that the ratio per each Party (party C=57),(party A=35),(party B=50)and (party D=500) and the percentage of votes is one after the other. And the left side of the picture,we can see the number of the population and people who voted by the admin, at the time the percentages of voters in each Governorate that we can see.



Graph (12) show election in one governorate

And in the picture number (13), we can show how many people voted in each province and the voting rate of each party and candidate as it has shown the 200 voters in the provinces of (Erbil, Sulaymaniyah, Duhok, Halabja), Fromhere, we can say that it is easier to separate the votes and send them back to the High Electoral Commission in a short amount of time and the rate of voting and the results of the elections can be shown to the people. In graph (13) It will show the overall of the governorate, the admin knows which party and candidate is first in that governorate.



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Graph (13) will show the list of the entire Election

Conclusion and recommendation

Conclusion:

This online voting system will contain the details of the voter by encouraging the voter to log in and use his voting privileges. Both aspects of the polling system will be integrated into the scheme. It gives each party the tools to preserve the vote of the voters and it counts the cumulative number of votes of each party. There is a database maintained by the election commission of Iraq and Kurdistan in which all the voting names are stored with full details and stored in NFC, He/she who is over the age of 18 years can only register; this reduces the expense and time of the method of voting that we used before on paper, It's very easy to use and less time intensive and electronic voting is used instead of paper during the elections, also it's very simple to debug.

Recommendation:

1-Internet-based voting offers a lot of settlement including a short price tag and increased voter participation. Therefore, we suggest executing this project in next election in Iraq and Kurdistan.

2-This project has its maintainability and extensibility, we ask the government to support this project, like the developed countries, so that our people will vote with integrity.

3-The government should devote a staff with rich information in software to develop this project.

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تصميم وتنفيذ نظام التصويت الإلكتروني بالاعتماد على الإحصاء الوصفي

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ملخص: قمنا في هذا البحث بتنفيذ شكل جديد من طريقة (التصويت الآمن) ، وهو التصويت عبر NFC ، والذي يسهل نقل البيانات على مسافة قصيرة بين الأجهزة التي تدعم تقنية NFC والعلامات الذكية ، ونقدم تصميم وتنفيذ تصويت إلكتروني آمن إلى ضمان انتخابات مفتوحة وعادلة وموثوقة حيث يكون لتفضيل الناخبين أهمية. تعتبر المعلومات التي يمكن الحصول عليها باستخدام الوسائل الحديثة وتطبيق المنهج الإحصائي من الأدوات المهمة في تطوير مؤسسات الدولة ، و تم في هذا البحث تصميم وإنشاء برنامج خاص كأداة لجمع المعلومات ومعرفة مدى استخدام الأساليب الحديثة في المؤسسة الحكومية. فهي تساعد في تطوير الأداء وإجراء انتخابات نزيهة وسريعة ، والهدف الرئيسي للتصويت (في حالة تشمل سكان بلد معين) هو العثور على مرشحين يفضلون الشعب، والاهتمام بجمع البيانات وإحصاء النتائج التي تظهر بأدوات أساسية وبسيطة للإحصاءات الوصفية مع رسوم بيانية في نهاية العملية ، وفيما يتعلق الأمر بالانتخابات في كردستان / العراق ، وادلاء الناخبين بأصواتهم، وعد التصويت ، ومحطات الاقتراع غير آمنة أو غير متوفرة ، وعدم كفاية مواد الاقتراع ، وغير ذلك من الامور المتعلقة بالانتخابات. و تهدف طريقة التصويت عبر الإنترنت إلى حل المشكلات المذكورة أعلاه.

وفي حالة تطبيق هذا النظام ، يتيح الفرصة لحل بعض المشكلات الانتخابية القديمة ويتم منح المستهلكين والمقيمين وقتًا كافيًا خلال دورة التصويت ، واعطاء المعلومات المطلوبة حول كيفية التصويت عبر الإنترنت. الكلمات الافتتاحية: الأدوات الإحصائية، الإحصاءات الوصفية، الانتخابات، الاتصال الميداني القريب (NFC)، التصويت الإلكتروني (التصويت الإلكتروني).