

UNIVERSITY OF THE PHILIPPINES MANILA
College of Arts and Sciences
Department of Physical Sciences and Mathematics

VOTER'S INFORMATION SYSTEM: PRECINCT MAPPING

A Special Problem in Partial Fulfillment
of the Requirements for the Degree of
Bachelor of Science in Computer Science

Submitted by:

ALFREDO REYES DIMAUNAHAN

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ACCEPTANCE SHEET

The Special Problem entitled "Voters Information System: Precinct Mapping" prepared and submitted by Alfredo R. Dimaunahan in partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science has been examined and is recommended for acceptance.

Prof. Gregorio Baes
Adviser

EXAMINERS

APPROVED

DISAPPROVED

1. Prof. Ma. Sheila A. Magboo

2. Dr. Vincent Peter C. Magboo

3. Ms. Celina D.G. Umagtang

4. Mr. Philip D. Zamora

DATE

Accepted and approved as partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science.

Vincent Peter C. Magboo, M.D., M.S.
Unit Head
Mathematical and Computing Sciences Unit
Sciences
Department of Physical Sciences and Mathematics

Harry Engle, M.S.
Chair
Department of Physical
and Mathematics

Marilou G. Nicolas, Ph.D.
Dean
College of Arts and Sciences

ABSTRACT

The internet is quickly changing the face of citizen relations with the government. New technology offers instant information at little or no cost. The on-line environment creates new levels of efficiency and speed in communication and dissemination of information.

As information is ported to the web, people can quickly locate anything they want. One source of information (web-sites) can serve many users who can select the level of detail they need. People expect to find answers to all of their questions on the web.

The on-line mapping system of precincts in Manila shows the location of precincts and polling places in the Map of Manila. It aims to help the voters in Manila to easily locate the precinct assigned to them by the election personnel.

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I. INTRODUCTION

A. BACKGROUND OF THE STUDY

The Philippine Political System is described in summary by a principle in the Philippine Constitution - "*The Philippines is a republican and a democratic State. Sovereignty resides in the people and all government authority emanates from them.*" [1]

One way of exercising the "*sovereignty*" of the Filipino people is through elections that held almost every two year where the people directly choose their national and local leaders. From the President down to the last member of *barangay sanggunians* (village councils), all elective officials are directly elected by the people. Regular elections are held every three years but in between these schedules are barangay elections, Sangguniang Kabataan (Youth council) elections, and the regional elections.[1]

Manual distribution of voter's information sheet is made during an election period. The Commission on Election (COMELEC) is the authority maintaining the conduct of elections in the Philippines. COMELEC personnel visits every barangay and houses to give the voter's information sheet.

Instead of disseminating the information through visiting every houses, or by advertisement in televisions, another good option for delivering information regarding an election can be through the internet.

B. STATEMENT OF THE PROBLEM

The eligibility of citizen as a voter is determined by his credentials or records handled by the governing body on election. Although, individual citizen has no means of personally updating his own personal record, having a way of viewing his credentials would help the COMELEC maintain an accurate collection of citizen's records.

Before an election, a voter must be informed of the location, specifically the precinct, where he is assigned in order for him to vote. Providing a good geographical representation or map of his assigned precinct will help him easily locate the voting place on the election day.

In addition, the COMELEC also needed the status of polling places and precincts, including the barangays assigned to it as well as the total number of voters in a polling place, for the analysis of readjusting the assignment of voters.

C. OBJECTIVES OF THE STUDY

The main objective of this special project is to create a system, the "Voter's Information System: Precinct Mapping" for the city of Manila, with the following functionalities:

1. Allows the user (or voter)
 - a. To view his personal information
 - b. To view the map of the polling places as well as precincts with levels of magnification
2. Allows the COMELEC personnel (or system administrator)
 - a. To perform addition, modification, and deletion of voter's record

- b. To perform addition, modification, and deletion of precinct's as well as polling place's information and location in the map
- c. To search for record of voter, polling places and precincts

D. SIGNIFICANCE OF THE STUDY

The system is aimed for the benefit of the voters as well as the COMELEC.

For the voters, they would have a way for easy access to the precinct as to their locations. It will alleviate the voter from stress of finding the exact room of a school or building where he is assigned on the day of voting. Moreover, it would be easy for them to determine and have access to the information regarding their eligibility as voters and the correctness of their personal information. One may wish to notify the COMELEC regarding incorrect information not only about himself but also to those whom they personally know or on which they have personal knowledge of.

For the COMELEC, on the other hand, this project will serve as another option of effectively preparing for the conduct of election in Manila specifically by informing the voters on their assigned voting location. They can easily manage and adjust assignment of voters if necessary through the information provided by the system regarding the number of voters and barangays in a precinct.

Another importance is that the system can help identify "flying" voters, if there are any, in the system database through the help of the users, viewers or other voters. A barangay captain may be able to view the list of voters of the room where he is assigned as well as the other rooms of their polling place. If he find something suspicious in the list of voters, for example, the use of single house address in their barangay by several voters, like around 20 or more, he can inform the COMELEC regarding that anomaly. Although the system is not designed to prevent "flying" voters, it offers a way or a mean of determining them by presenting the complete list of registered voters.

E. SCOPE AND LIMITATION

The mapping of the precinct will be limited to the area of the city of Manila only. All citizens of voting age residing in Manila are the only persons in the voter's database. The system can show the location of an establishment/polling place in the map of Manila through house-shaped objects. Few information including establishment's name, address, number of voters and precincts are displayed in the map. The specific rooms or precincts where each voter was assigned can be located by clicking on the polling place. Each precinct indicates the precinct number, room number, and barangays associated to it. The list of voters can be viewed by clicking it. However, the layout of the establishment is selected from only 3 predefined images.

In addition of new voters and modification of voter's record, actual verification of the submitted documents to effect the changes is outside the system.

Another limitation for the voters is that not all of them have a personal computer with an internet connection. This is necessary in order to view or access the system.

II. REVIEW OF RELATED LITERATURE

The Internet is quickly changing the way by which citizens relates with the government. New technology offers instant information at little or no cost. The on-line environment creates new levels of efficiency and speed in communication and dissemination of information.

As information is ported to the web, people can quickly locate anything they want. One source of information (web-sites) can serve many users who can select the level of detail they need. People expect to find answers to all of their questions on the web. Web enabled citizens also desire government services. Agencies are actively developing sites to renew licenses, and file documents over the web. [10]

One government process that is becoming web enabled is elections. Voter Registration cards, Candidate and Voter pamphlet information and election results are all being posted on web sites. Using web technology to facilitate the voting process is an idea with many supporters. Groups have proposed on-line voter registration, Initiative petition signing, and on-line voting. Proponents argue that this technology would deliver increased voter participation, better voter convenience, and improved voter interest at reduced costs.[3]

In Washington state, voting by mail and permanent on-going absentee voting has become very popular.[4] The portion of the population that is permanently receiving their ballot in the mail for every election will soon be the majority. Additionally, entire elections are conducted through the mail and voters may request absentee ballots by telephone. These provisions are all driven by the desire to provide convenient balloting options for the public at a time and place that serve the voter. The result of these efforts is increased voter participation. Voters can find information about the logistics of Voting and Voter

Registration in addition to contact numbers and e-mail addresses for other questions on-line. Additionally, Online Voter Pamphlets and election results are becoming ubiquitous.[4]

In the Philippines, in recognition of changing needs brought about by the technological revolution, the Commission on Election (COMELEC) have been empowered by Congress to modernize their operations and the conduct of elections, plebiscites, and referenda.[2] There exist a Republic Act 8189, the Continuing Registration Law, and Republic Act 8436, an Act Authorizing the Commission on Elections to Use an Automated Election System in the May 11, 1998 Elections and Subsequent Electoral Exercises. Collectively, these two statutes have since become known alternatively as the Modernization Laws of the COMELEC.[2] Under these statutes, the Commission on Elections was supposed to have modernized its operations in time for the National and Local Elections of 2001. Unfortunately however, the goals set by these laws were not completely met.

The objectives of the COMELEC as set in its new policy directions for a modernized election system is through this three projects designed to address, if not eliminate electoral problems: 1) the National Precinct Mapping and CVL Verification Project (Precinct Mapping); 2) the Voters Registration and Identification System (VRIS) Project; and 3) the Automated Counting and Consolidation of Results System (ACCORS) Project. Unfortunately, given the budget of PhP12,847.50M (2001-2004 budget), it is still not properly finalized and implemented. [2]

III. THEORETICAL FRAMEWORK

Information System

An information system is a system, whether automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information.[6] It is in the form of any telecommunications and/or computer related equipment or interconnected system or subsystems of equipment that is used in the acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of voice and/or data, and includes software, firmware, and hardware. [5]

Geographic Information System

An information system can use graphics to visually represents information. A Geographic Information System (GIS) enables you to envision the geographic aspects of a body of data.[6] Basically, it lets you query or analyze and receive the results in the form of some kind of map. Since many kinds of data have important geographic aspects, a GIS can have many uses: weather forecasting, sales analysis, population forecasting, and land use planning, to name a few.

In a GIS, geographic information is described explicitly in terms of geographic coordinates (latitude and longitude or some national grid coordinates) or implicitly in terms of a street address, postal code, or forest stand identifier.[6] A geographic information system contains the ability to translate implicit geographic data (such as a street address) into an explicit map location. GIS developers sometimes obtain the map data from public sources or companies that specialize in collecting and organizing geographic

information. The process of converting implicit geographic data into explicit or map-form images is called *geocoding*. [7]

GIS do these kinds of things: [6]

- They accept geographic input in the form of scanned-in and digitized map images. Often this data is supplied by a source that may own maps and has already digitized them.
- They rescale or otherwise manipulate geographic data for different purposes
- They include a database manager, usually a relational database management system (RDBMS).
- They include query and analysis programs so that you can retrieve answers to simple questions such as the distance between two points on a map or more complicated questions that require analysis, such as determining the traffic pattern at a given intersection.
- They provide answers visually, usually as maps or graphs.

Simply put, a GIS combines layers of information about a place to give you a better understanding of that place. What layers of information you combine depends on your purpose—finding the best location for a new store, analyzing environmental damage, viewing similar crimes in a city to detect a pattern, and so on.

To create maps using GIS, one needs good data. If one is trying to see the locations of your customers, he will use the database of customer addresses to make that map. One thing need to ensure is that those addresses are correct for the map to be useful.

Data Types and Models

Data for a GIS comes in three basic forms:

- Spatial data – what maps are made of. Spatial data, made up of points, lines, and areas, is at the heart of every GIS. Spatial data forms the locations and shapes of map features such as buildings, streets, or cities.
- Tabular data - adding information to maps. Tabular data is information describing a map feature. For example, a map of customer locations may be linked to demographic information about those customers.
- Image data—using images to build maps. Image data includes such diverse elements as satellite images, aerial photographs, and scanned data—data that's been converted from paper to digital format.

In addition, this data can be further classified into two types of data models:

- Vector data model

Discrete features, such as customer locations and data summarized by area, are usually represented using the vector model. Information about points, lines, and polygons is encoded and stored as a collection of x,y coordinates. The location of a point feature, such as a bore hole, can be described by a single x,y coordinate. Linear features, such as roads and rivers, can be stored as a collection of point coordinates. Polygonal features, such as sales territories and river catchments, can be stored as a closed loop of coordinates. The vector model is extremely useful for describing discrete features, but less useful for describing continuously varying features such as soil type or surface elevation data.

- Raster data model

Continuous numeric values, such as elevation, and continuous categories, such as vegetation types, are represented using the raster model. A raster image comprises a collection of grid cells rather like a scanned map or picture. Every cell can have a unique value.

Scalar Vector Graphics

SVG stands for Scalable Vector Graphics. It is a new language that describes two dimensional graphics in Extensible Markup Language (XML). Graphical objects such as vector graphic shapes, images and text can be used. It can be transformed, grouped, or styled into previously depicted objects. One of its features is its being dynamic. This means, SVG is also suited for animations and simulations. This can be done either by embedding SVG objects or for more complex ones, be assisted by scripting languages. This is done by accessing SVG DOM (Document Object Model) which contains access to its elements, properties and attributes. SVG is compatible to the W3C standard which makes it more appealing and powerful for web applications. [9]

Scalable Vector Graphics (SVG) is the description of an image as an application of the XML. Any program such as a Web browser that recognizes XML can display the image using the information provided in the SVG format. Vector graphics is the expression of an image using mathematical statements rather than bit-pattern description. Scalable emphasizes that vector graphic images can easily be made scalable (whereas an image specified in raster graphics is a fixed-size bitmap). Thus, the SVG format enables the viewing of an image on a computer display of any size and resolution, whether a tiny LCD screen in a cell phone or a large CRT display in a workstation. In addition to ease of size reduction and enlargement, SVG allows text within images to be recognized as such, so that the text can be located by a search engine and easily translated into other languages.

Vector graphics images also have the potential advantage over the standard Web image formats, the GIF and the JPEG, of size. Compared with a bitmap image, an SVG image may be much smaller and arrive more quickly. By being written in XML, SVG builds on this strong foundation and gains many advantages such as a sound basis for internationalization, powerful structuring capability, an object model, and so on. By building on existing, cleanly-implemented specifications, XML-based grammars are open to implementation without a huge reverse engineering effort. SVG can be a stand-alone or xwork with an XML namespace. [9]

Precincts and Barangays

According to the Omnibus Election Code of the Philippines, Article 13 entitled *Precincts and Polling Places*, precincts are numbered and indicated by Arabic numerals and a letter of the English alphabet. Original or mother precincts shall be indicated by the Arabic numeral and letter “A” of the English alphabet. Spin-off or daughter precincts shall be indicated by the Arabic numeral and letter of the English alphabet starting with letter “B” and so on.[2]

Polling place refers to the place where the Board of Election Inspectors conducts its proceeding and where the voters cast their votes. Each polling place shall be, as far as practicable, a ground floor and shall be of sufficient size to accommodate voters. A public building can be designated as a polling place. Every barangay shall have at least one (1) precinct. Each precinct, shall have no more than two hundred (200) voter and shall comprise continuous and compact territories.

There are 6 districts and 905 barangays in Manila. In Article III of the Election Code, the distribution of the barangays per district are as follows:

- First District – Barangay Nos. 1 – 146
- Second District – Barangay Nos. 147 – 267
- Third District – Barangay Nos. 268 – 394
- Fourth District – Barangay Nos. 395 – 586
- Fifth District – Barangay Nos. 649 – 828
- Sixth District – Barangay Nos. 587 – 648 and 829 - 905

DEFINITION OF TERMS

Voter's Identification Number (VIN) refers to the number assigned by the Commission on Elections to a registered voter that shall consist of three (3) parts: (1) The current address (city/municipality and province); (2) the current precinct assignment of the voter and (3) the permanent birth and name code unique to every voter.

Precinct refers to the basic unit of territory established by the Commission for the purpose of voting.

Polling place refers to the building containing precincts.

SVG stands for Scalable Vector Graphics. It allows the use of text, vectors and images for graphics.

GIS stands for Geographic Information System. It combines graphical features combined with tabular data for solving real-world problems

IV. DESIGN AND IMPLEMENTATION

In the existing setup of the COMELEC, every registered voter is assign to a voter's identification number (VIN) consisting of three parts, each separated by a dash. For example: 7501-0019A-C1251BCD.

1. Part 1: Current Address of the Voter

- a. The first two digits, 75, stand for the province; and
- b. The last two digits, 01, stand for the city, municipality, or a district, particularly in Manila.

The code assignment for provinces, cities and municipalities follows the Urban Code devised by the National Census and Statistics Office (NCSO).

2. Part 2: Current Assignment of the Voter

- a. The first four digits, 0019, stand for the permanent number of the precinct where the voter is currently assigned; and
- b. The letter indicates whether it is a mother or a daughter precinct.

The number assigned to the precinct in every city or municipality shall be permanent but the voter may transfer his precinct number. The VIN reflects the current precinct assignment of the voter.

3. Part 3: Permanent Birth and Name Code Unique to the Voter

- a. The letter, C, stands for the month, i.e., A for January, B for February, and so forth;
- b. The next two digits, 14, stand for the date of birth;
- c. The next two digits, 51, stand for the year of birth; and
- d. The last three letters, BCD, stand for the name code, i.e., Bayani Cruz Davide.

The last three letters stand for the first letter of the first name, the middle name, and the last name in that order.

The COMELEC ensures that Part 3 of the voter's identification number (VIN) shall be permanent and unique to each voter. If necessary, the Commission may expand and modify if the same. The combined birth and name code is assigned during the lifetime of every voter. Upon transfer of the voter to another precinct, the first two parts of the VIN shall change.

The assignment of the polling places is designated by the chairman of the board of election. The chairman designates the public school or any other public building within the barangay to be used as a polling place. The rooms of the polling place are designated as precincts and is assign to specific barangays. Every barangay shall have at least one (1) precinct. Each precinct, shall have no more than two hundred (200) voter and shall comprise continuous and compact territories. As soon as the 200-list for every precinct has been reached, a spin-off or daughter precinct shall be created by the Commission to accommodate voters residing within the territorial jurisdiction of the original precinct. A barangay or group of barangays with less than two hundred voters may comprise one (1) original precinct.

After the designation of barangays to precincts, the Commission will prepare and post the list of voters to every precinct.

The "Voter's Information System: Precinct Mapping" contains a database consisting of Polling Place, Precinct, and Voter's table. The structure of the database is shown in the Entity-Relationship Diagram in Figure 1.

A voter is uniquely identified by *VIN*. Other attributes like *Lname*, *Fname*, *Mname*, etc. refers to the information regarding the voter. The citizenship, *Cznship*, of the voter must be Filipino. As a result, the value of this attribute is always set to “Filipino”. The value of the distric number, *DNo*, is dependent on the barangay number, *Bno*. It is indicated in the Theoretical Framework that a district in Manila has a range number of barangays. The associated precinct to a voter is identified by his polling number, *PNo*, and SVG object ID. The precinct number and room number can be determined by the *ID*, and the polling place name

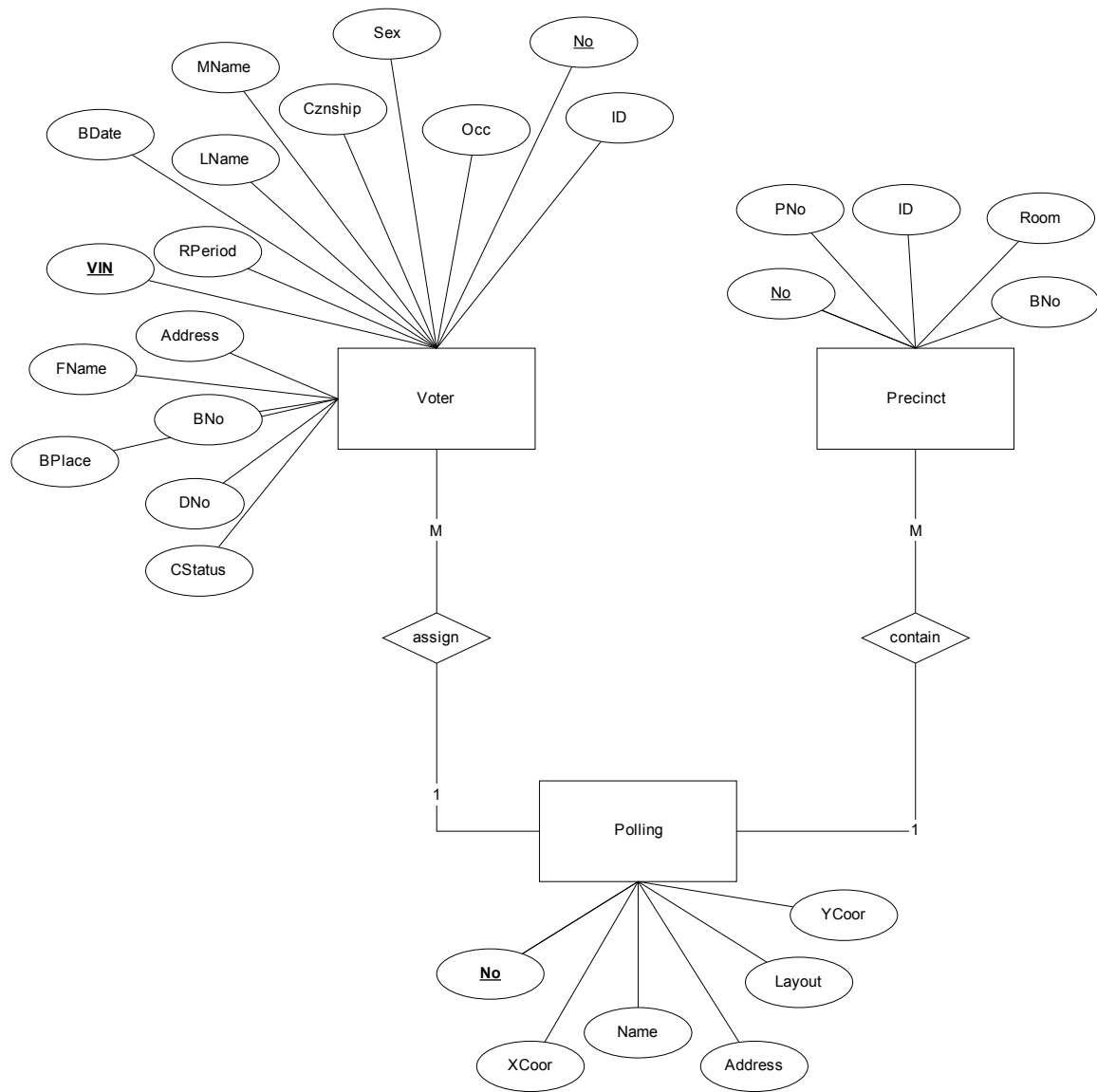


Figure 1. Entity Relationship Diagram of the “Voter’s Information System: Precinct Mapping”

and address can be get through the polling number, *PNo*.

A polling place has a unique *No*, which is the polling number that automatically increments when adding a new polling place record, and decrements *No* of succeeding polling places when deleting a certain polling place record. This leaves the administrator from manually assigning a unique identifier for a polling place. The *Xcoor* and *Ycoor* refers to the location point of the polling place in the SVG file map. The name, address, and layout of the polling place is specified by the administrator.

The precinct table does not have a primary key. A precinct number is not unique and can be used in several polling places. A record in the precinct table is consist of:

- the polling number, *No*, of the polling place it belongs to;
- the *ID* of the object that is considered as a room in the SVG file associated to a polling place. This serves as the location of the room in the establishment;
- the precinct number, *PNo*, specified by the COMELEC personnel;
- the name of the room, *Room*, which is predefined in the establishment's layout or in the SVG file of the polling place; and
- the barangay number, *BNo*, assigned to it by the COMELEC personnel.

For the complete description of the attributes, see the Data Dictionary.

There are two main users in the system: an ordinary vistor or voter, and the system administrator. The system administrator can be a personnel from the COMELEC. The overview of what the users can do to the system is represented by the diagram in Figure 2.

The administrator can submit records of voters, polling places, and precincts. The system processes the information submitted and generates the query in accessing the database either to add, edit, or delete. In return, he can view all the records of voters, polling places, precincts in the database.

The voter can view his own record by typing his voter’s identification number (VIN). The system will then generate his record and precinct assignment by searching the VIN in the database.

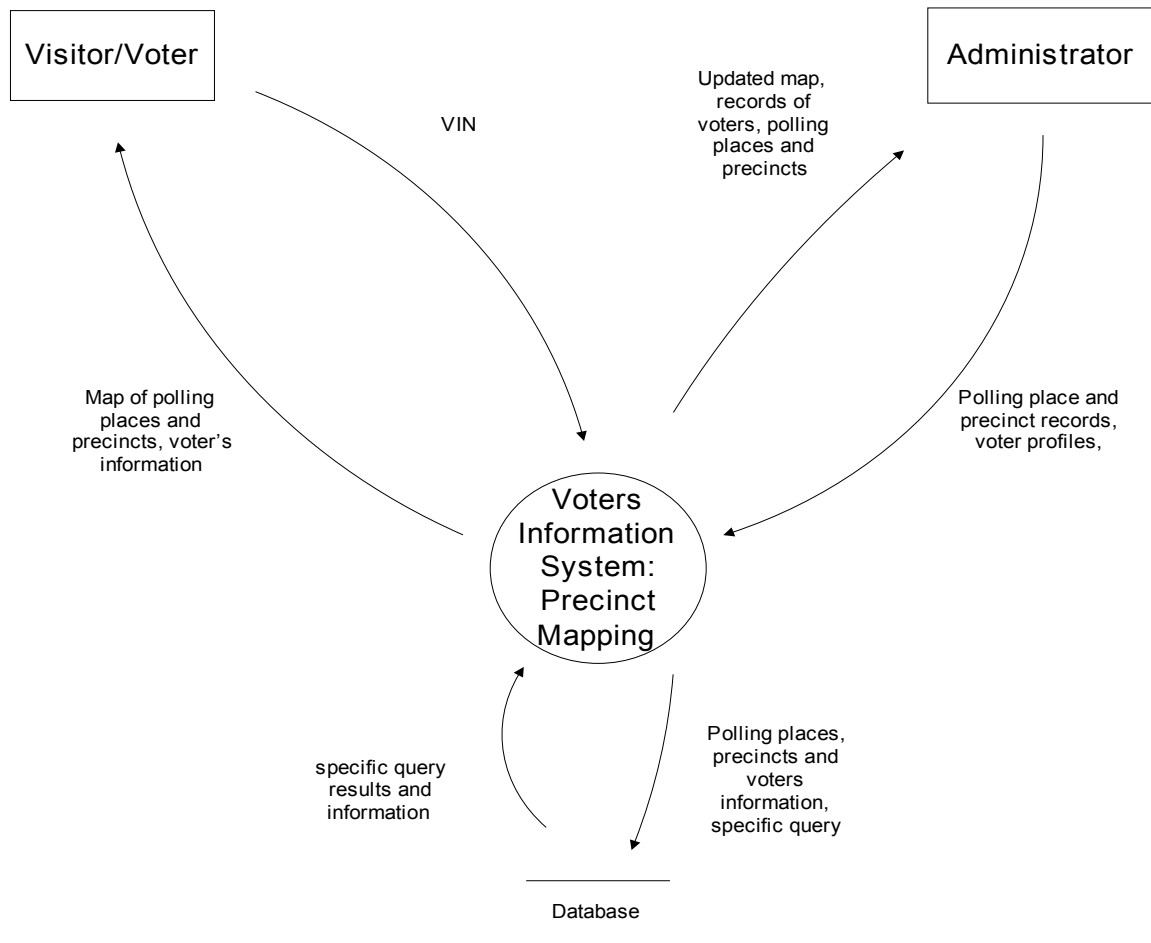


Figure 2. Context Diagram of the “Voter’s Information System: Precinct Mapping”

The Top Level Data Flow Diagram is seen on Figure 3. It shows the main processes involved in the system namely:

1. Update Voters by the Administrator
2. Update Polling Places by the Administrator
3. Update Precincts by the Administrator
4. View Own Record by the Voter

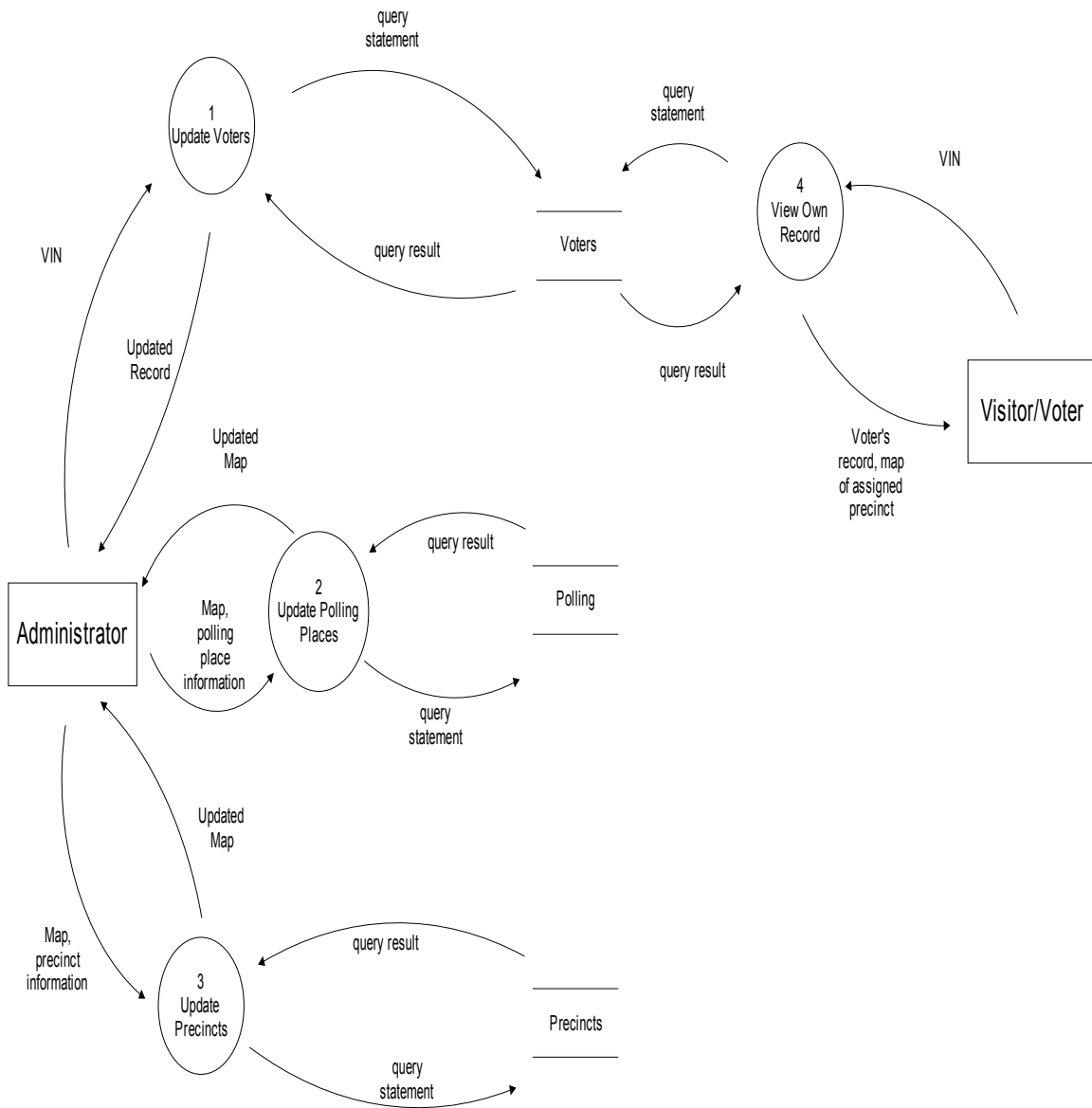


Figure 3. Top Level Data Flow Diagram of the “Voter’s Information System: Precinct Mapping”

UPDATE VOTERS

The subexplosion of the Process Update Voters is illustrated in Figure 4. The process of updating the record of voters is by adding, modifying, and deleting records. The administrator selects the operation he wishes to do. The process Add Voter submits a form containing information of a voter and generates the SQL add query statement. The process Edit Voter first displays the information of an existing voter in the database. The administrator can modify the information then submit the form containing the voter's information. An SQL update query will be generated. The process Delete Voter submit the VIN of the voter to be deleted and generates the SQL delete query statement. The process View Record generates an SQL query displaying the contents of the Voter's Database. The results are displayed in a web page.

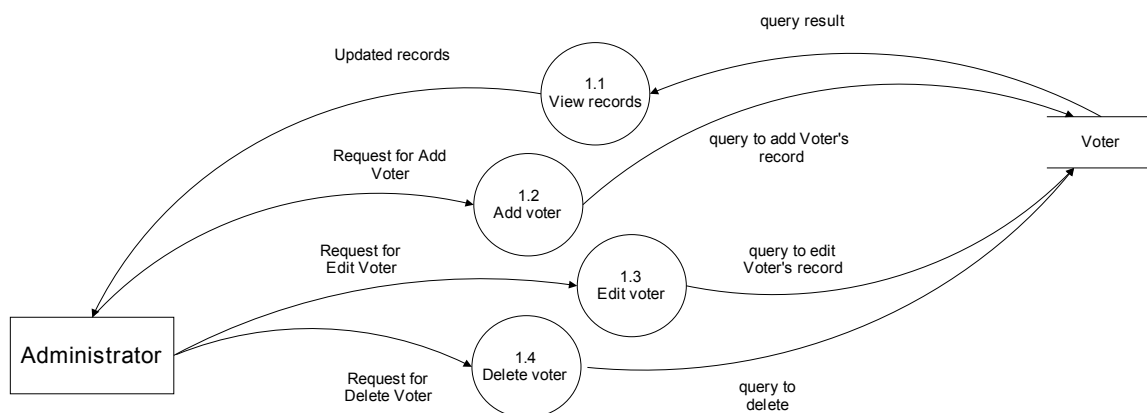


Figure 4. Sub Explosion of the Process Update Voters in the “Voter’s Information System: Precinct Mapping”

UPDATE POLLING PLACES

The subexplosion of Update Polling Places is shown in Figure 5. The process of updating polling places is by adding, modifying, and deleting polling places through the map.

The process Add Polling has a sub explosion illustrated in Figure 6. The administrator selects the location on the map by clicking on it. The x and y coordinates are calculated as the function performing this is shown in Figure 7. The result is then submitted to a next page where the administrator must enter the name and address of the polling place. The layout to which the establishment would be associated must be also selected. Before adding to the database, the polling number will be generated. This is done by adding 1 to the polling number of the last record in the polling database. After generating the polling number, the complete information consisting of x and y coordinates, name, address, layout and the polling number will be added to the Polling database.

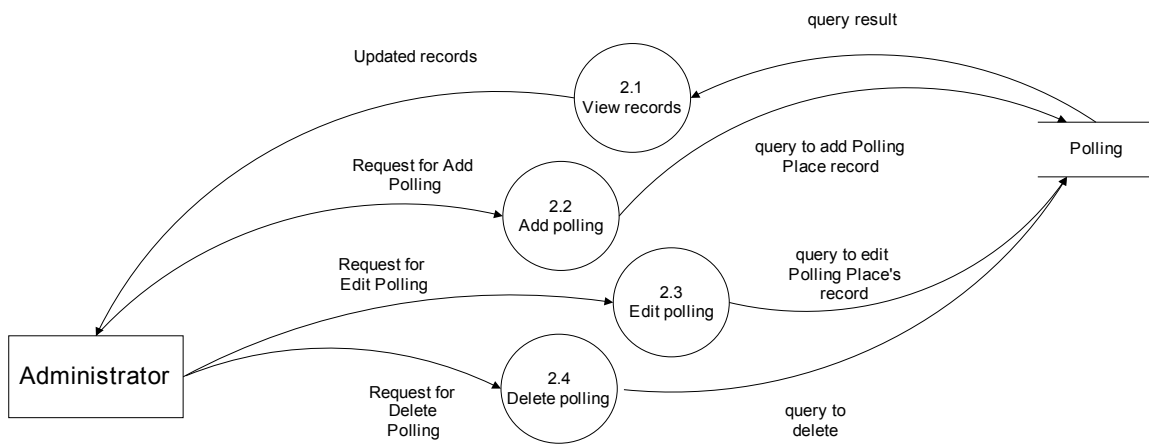


Figure 5. Sub Explosion of the Process Update Polling Places in the “Voter’s Information System: Precinct Mapping”

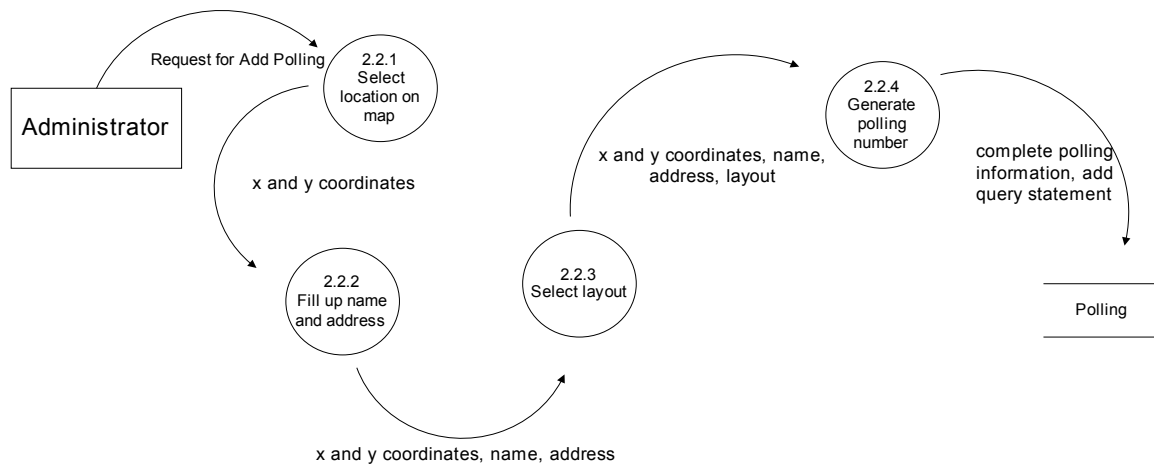


Figure 6. Sub Explosion of the Process Add Polling in the “Voter’s Information System: Precinct Mapping”

```

function getTransformToElement(node)
{
    // Initialize our CTM the node's Current Transformation Matrix
    var CTM = node.getCTM();

    // Work our way through the ancestor nodes stopping at the
    // SVG Document
    while ( ( node = node.parentNode ) != svgDocument ) {
        // Multiply the new CTM to the one with what we've
        // accumulated so far
        CTM = node.getCTM().multiply(CTM);
    }
    return CTM;
}

function findUserCoord(evt)
{
    // Get the target
    var target = evt.getTarget();

    // Get the outermost SVG element
    var SVGRoot = window.svgDocument.rootElement;

    // Get a CTM that accumulates all transforms leading up
    // to the node that fired this event
    var CTM = getTransformToElement(target);

    // Find the inverse of that transform so that we can map
    // mouse coordinates back to the node's coordinate space
    var iCTM = CTM.inverse();

    // The SVG pan and zoom values are not included in the
    // accumulated CTM that we calculated earlier. These
    // value must be handled separately
    var trans = SVGRoot.getCurrentTranslate();
    var scale = SVGRoot.getCurrentScale();

    // Create a couple of points to work with
    var p1 = SVGRoot.createSVGPoint();
  
```

```

var p2;

// Remove the current pan and zoom from the mouse coordinate
p1.x = ( evt.clientX - trans.x ) / scale;
p1.y = ( evt.clientY - trans.y ) / scale;

p2 = p1.matrixTransform(iCTM);
return p2;
}

```

Figure 7. Function for Getting the X and Y coordinates in the map

The process Edit Polling has a sub explosion illustrated in Figure 8. First the administrator selects an existing polling place in the map by clicking on it. The polling place’s object in the map has an attribute containing its unique polling number. This number will be passed to the next page. The administrator also has an option of changing the location of the polling place. A new x and y coordinates will be generated (See Fig. 7) and submitted to the next page if the administrator changes the location. Otherwise, it will retain the original coordinates. On the next page, the name and address of the polling number will be extracted from the Polling database using the polling number from the previous page. The administrator can then edit the information and submit it. The information in the database will then be updated through an update SQL statement.

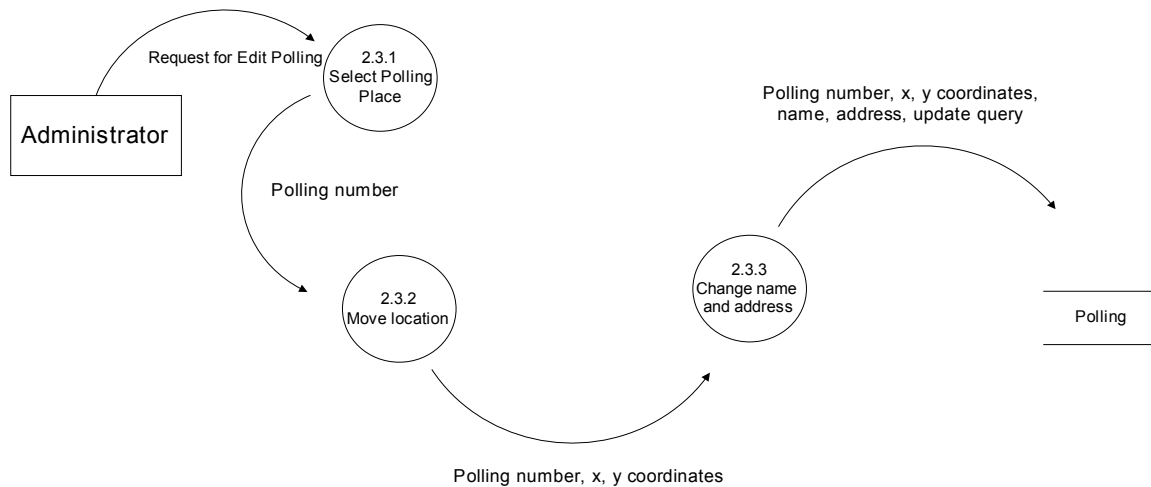


Figure 8. Sub Explosion of the Process Edit Polling in the “Voter’s Information System: Precinct Mapping”

The process of Delete Polling is done almost the same as the process Edit Polling. However, the polling place's information are no longer displayed. From the polling number submitted, an SQL delete statement is already generated. The information will now be deleted from the database. In addition, the precincts it contain and voters assigned to it will be removed. The process of deleting precincts will be discussed later. The process of assigning voters is discussed in the addition of precincts and also will be discuss later. The process of clearing the assignment of voters is done by setting the *No* and *ID* attribute of voters to NULL. The following PHP statement will clear the assignment of voters:

```
...  
$sql = " UPDATE voter SET no = '', id = '' WHERE no = '$no' ";  
...
```

where \$no is a variable containing the polling number of the polling place.

The important process in updating the polling places is the View Records of polling place. Every add, edit, and delete polling place first need to view the map representing the polling places' record. This process is done by a single PHP page, *writefile.php*, that creates an SVG file or updates it if already exists. It creates the map of Manila using the *fopen*, and *fwrite* functions of the PHP language. It includes the query that displays all the records in the Polling database. The necessary fields used in the map are the *Xcoor*, *Ycoor*, *No*, *Name*, and *Address*. A polling place is represented by a red house-shaped object in the map. The location of this object in the map is determine by the *Xcoor* and *Ycoor*. The SVG statement

```
... transform = "translate(xcoor, ycoor)" ...
```

is an SVGObject property that adjusts the location of an object to the specified coordinates (x, y). The object id is set to *No* and the *Name* and *Address* are added as object's attributes. Using the SQL query,

```
....
```

\$q = "SELECT * FROM polling ORDER BY no";

....

the created SVG file contains information of all the information of polling places in the Polling database.

When the SVG file is displayed, the location of each polling places is the shown in the map.

UPDATE PRECINCTS

The subexplosion of Update Precincts is shown in Figure 9. The process of updating precincts is by adding, modifying, and deleting precincts through the layout of the establishment.

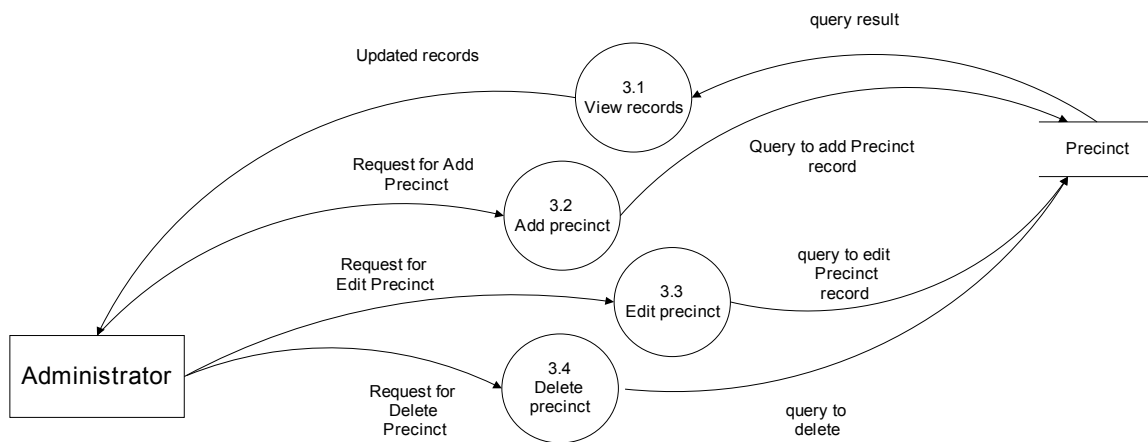


Figure 9. Sub Explosion of the Process Update Precincts in the “Voter’s Information System: Precinct Mapping”

The process Add Precinct has a sub explosion illustrated in Figure 10. The administrator must select an existing polling place on the map by clicking on it. The polling number will be submitted to the next page. The layout of the establishment associated to the polling number will be displayed. The layout is an SVG file containing objects representing rooms. Each object has an ID and Room Name attributes.

When the administrator clicks on the room, the ID and Room Name will be passed to a form in the next page. The administrator must enter the Precinct Number of that room and the Barangay Numbers that will be assigned to it. The barangay numbers are automatically there if there are unassigned voters. The administrator can modify the barangay numbers and then submit the form. From the barangay numbers submitted, a new page will display the list of voters by barangay sorted by their surname. From the literature, only 200 voters shall be designated per precinct. The *VIN* of first 200 voters will be updated as well as the *No* and *ID* fields of the voters' record. The complete information of the precinct will be stored in the database.

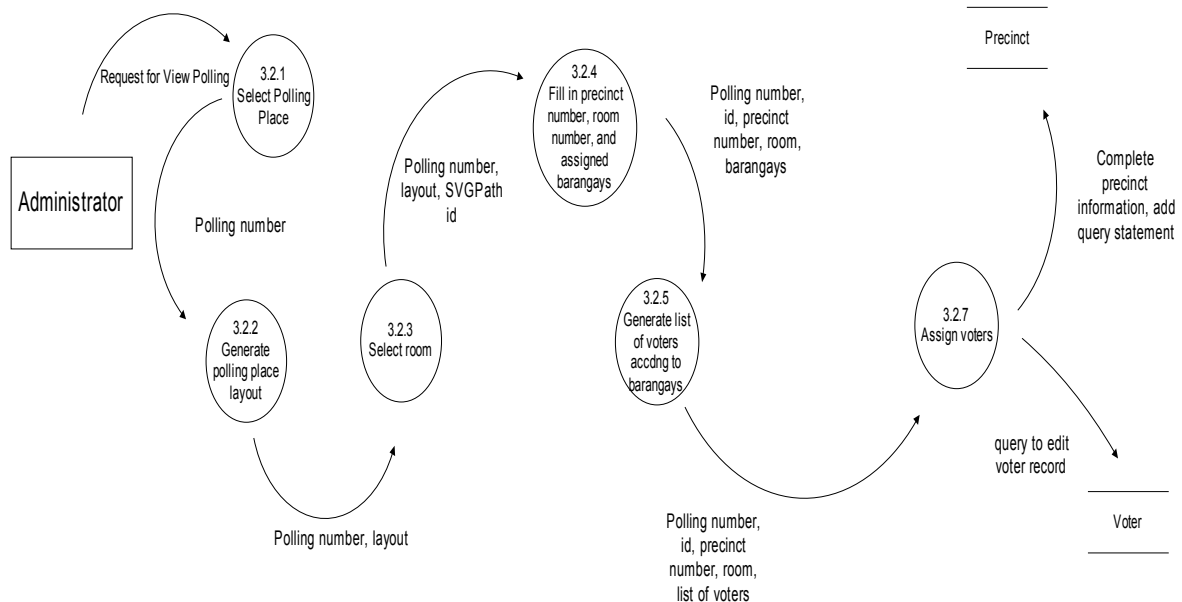


Figure 10. Sub Explosion of the Process Add Precinct in the “Voter’s Information System: Precinct Mapping”

The process Edit Precinct has a sub explosion illustrated in Figure 11. The process is almost the same with adding a precinct. However, it includes moving the location of the precinct in the layout. When moving to a new location, the new *ID* and *Room* will be submitted. The administrator can also modify the precinct number and the barangays associated to it. New list of voters will also be generated. Finally, all the precinct information will submitted and updated by an SQL update statement.

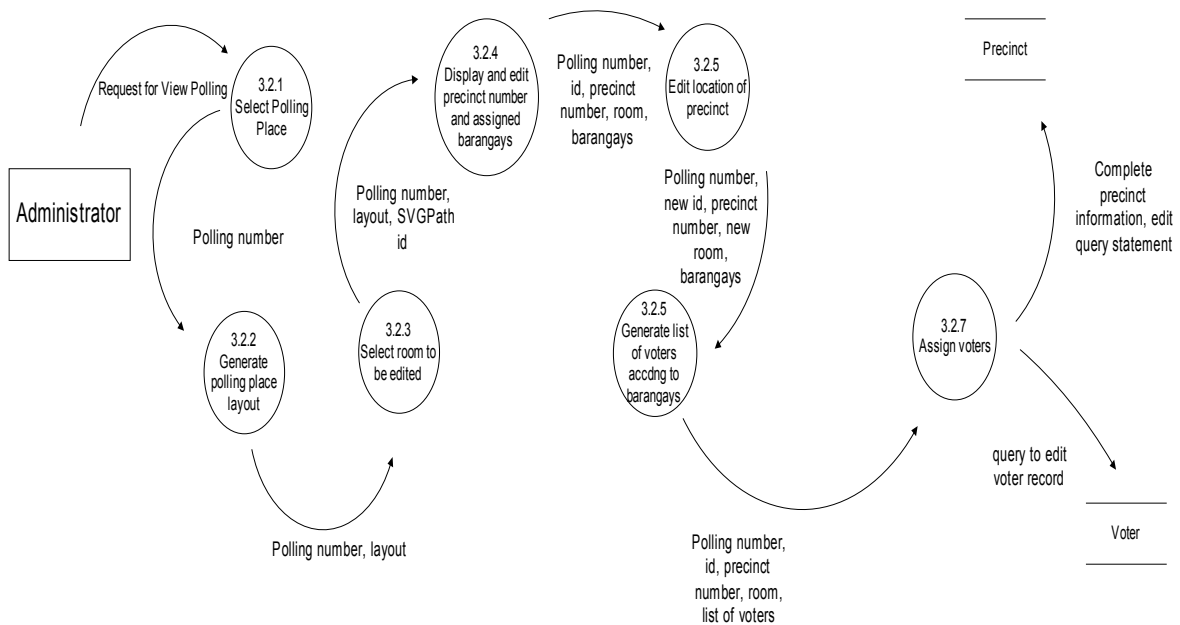


Figure 11. Sub Explosion of the Process Edit Precinct in the “Voter’s Information System: Precinct Mapping”

The process of Delete Precinct is done by clicking the precinct in the layout. The *No* and *ID* will be submitted and an SQL delete statement will remove the precinct in the database. Voters assigned to it will also be removed.

The process of View Records of precincts is done almost the same as viewing polling places (see UPDATE POLLING). There is also a PHP file creates an SVG file of the layout. Instead of using coordinates, it makes use of the attribute *ID*. The SVG file includes the result of the queries;

```

...
$q = "SELECT * FROM precinct WHERE no='$no' "
...

```

This displays all the precincts in the polling place *No*.

VIEW OWN RECORD

The process View Own Record is for the voters. The voter will enter his voter's identification number (VIN) from a text box. If the VIN exists in the voter's database, a page will be displayed showing his own personal information. It includes the map of Manila zoomed to the location of the polling place. The process of zooming is done by a Javascript function. It makes use of the SVG property, *transform = "translate(xcoor, ycoor) scale(0.5)"* , by changing the scale to a larger magnification. Clicking on the polling place will show the layout of the establishment. The assigned room would be colored red in order to easily identify the precinct. The list of voters will be displayed when the voter clicks on the red precinct. This is done by getting the *No* and *ID* of the precinct and then a query will search the Voter's database that will display all the voter's assigned to that precinct.

DATA DICTIONARY

TABLE Admin

Username	-	Sign in name of the Administrator
Password	-	Code to prevent unauthorized access

TABLE Polling

Xcoor	-	The abscissa of the polling place in the map
YCoor	-	The ordinate of the polling place in the map
<u>No</u>	-	Unique identifier of the polling place. Automatically assign to polling places.
Name	-	Name of the polling place
Address	-	Current address of the polling place
Layout	-	Type of layout of the polling place. Has 3 types.

TABLE Precinct

<u>No</u>	-	Unique identifier of the polling place where the precinct is a part of
ID	-	ID of the object in the map (for SVG coding purpose)
PNo	-	Precinct Number in a polling place.
Room	-	Room Number in a polling place
BNo	-	Number of barangay assigned/serviced by the precinct

TABLE Voter

VIN	-	Voter's Identification Number
LName	-	Last name of the voter
FName	-	First name of the voter
MName	-	Middle name of the voter
Sex	-	Gender of the voter
BDate	-	Date of birth
BPlace	-	Place of birth
Cznship	-	Citizenship of the voter
CStatus	-	Civil status
Occ	-	Profession, occupation or work
RPeriod	-	Periods of residence in the Philippines and in the place of registration
Address	-	Exact address with the name of the street and house number
BNo	-	Barangay number of the voter
DNo	-	District number of the voter
<u>No</u>	-	Polling number where the voter is assigned
ID	-	Object ID in the map. Associated to a precinct.

TECHNICAL ARCHITECTURE

The minimum specification/requirements on which the system will run are the ff:

SERVER

- PIII 1.6 GHz or higher processor.
- Windows 98 or higher operating systems.
- PHP Triad Installed.
- 128 MB computer memory
- 32 MB Video card
- 17" SVGA monitor
- An Internet Explorer 6 browser with installed SVG viewer.

CLIENT

- 333 MHz or higher processor.
- Windows 98 or higher operating systems.
- 32 MB Video card
- 17" SVGA monitor
- An Internet Explorer 6 browser with installed SVG viewer.
- Internet connection with 56.6 kbps speed

The recommended specification are as follows:

SERVER

- PIV 2.2 GHz or higher processor.
- Windows XP
- PHP Triad Installed

- 256 MB computer memory
- 64 MB Video card
- 17" SVGA monitor
- An Internet Explorer 6 browser with installed SVG viewer.

CLIENT

- 700 MHz or higher processor.
- Windows 98 or higher operating systems.
- 64 MB Video card
- 17" SVGA monitor
- An Internet Explorer 6 browser with installed SVG viewer.
- Fast Internet connection (56.6 kbps speed or higher)

V. RESULTS

The system is implemented as an on-line system. Users can visit the site by providing the URL address of the main page. The address will be provided by the COMELEC personnel if ever implemented. The layout of main page is in Figure 13.



Fig. 13 Main Page Design of the “Voter’s Information System: Precinct Mapping”

The main page consists of links to the Welcome Page, Map of Manila, Log in page, and FAQ site of the Official COMELEC website. It also provides a textbox for voters who wishes to view their precinct by entering their Voter’s Identification Number (VIN). In case they forgot their VIN, they can ask for it by e-mailing the administrator. A link that automatically opens the default email application of the user and targeting the email address of the administrator is also provided. For questions and other information

regarding the election, the FAQ site of the COMELEC can be visited through the link also provided by the system's main page.

In order to update the records of voters, polling places, and precincts, the administrator must first log in. Ordinary users cannot continue to the next page since they do not have an administrator account. The Log in page is connected to a table of administrator's username and password. (see Figure 14)



Fig. 14 Log In for Administrator in “Voter’s Information System: Precinct Mapping”

The link to the Map of Manila is a page showing the distribution of polling places in the area of Manila as shown in Figure 15 . Each polling place is indicated by a red house-shaped object. When the mouse is placed over the object it displays the information of that polling place. Below the map is a statistics showing the total number of voters, polling places, and precincts in the database. When a user clicks on the polling place, it displays the establishment's layout.

The user or voter can view his personal record as well as his assigned precinct. The user must input his Voter's Identification Number and then click the "Show" button (see Figure 16). A page will be displayed containing information regarding the voter. It also includes the map of Manila zoomed to the location of the polling place where the voter is assigned as shown in Figure 17.

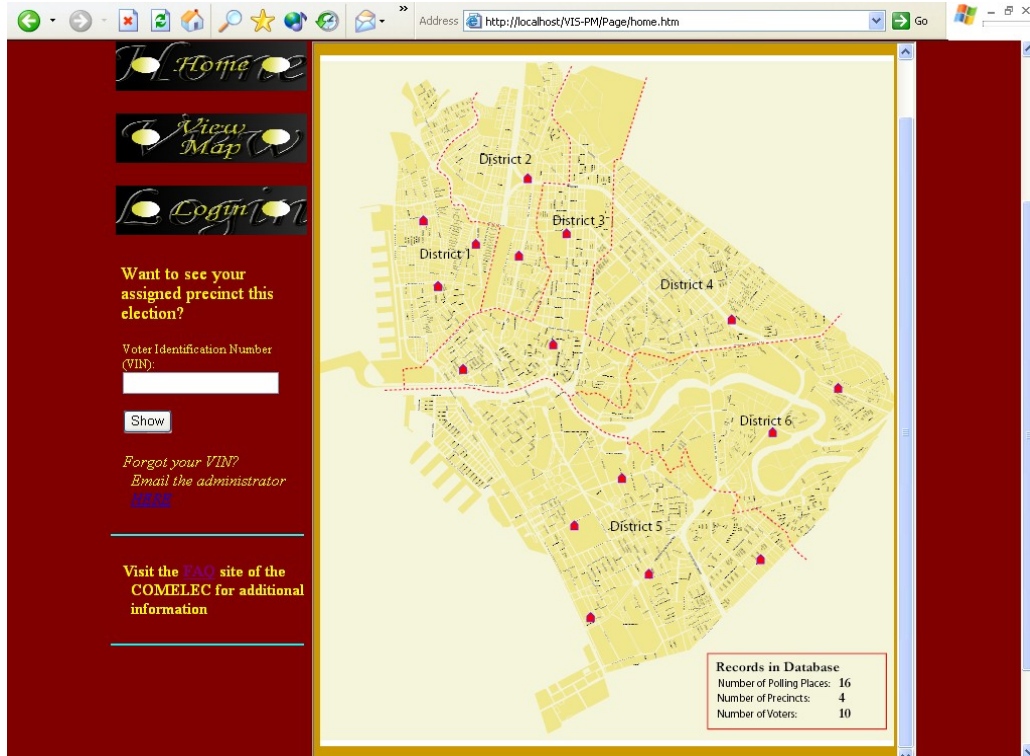


Fig. 15 Map of Manila in "Voter's Information System: Precinct Mapping"

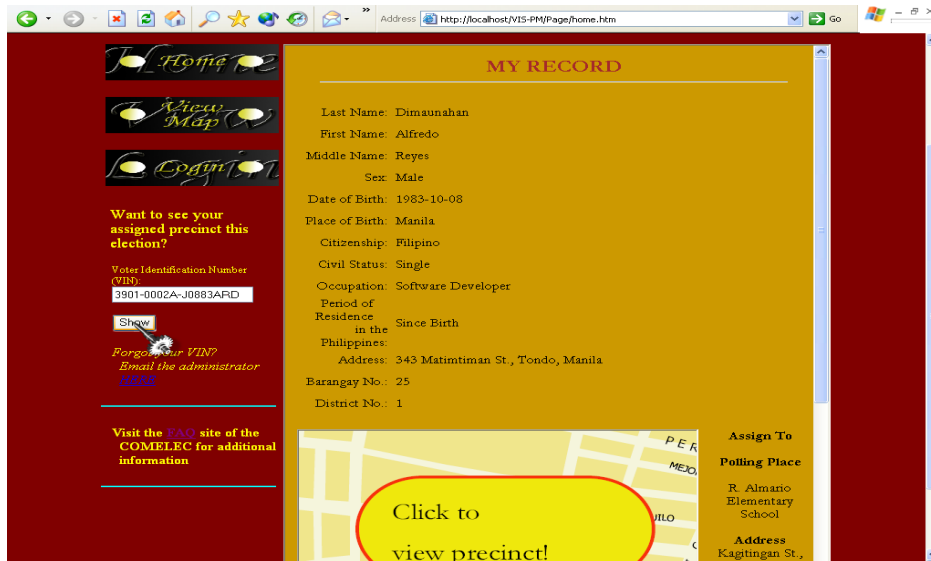


Fig. 16 Viewing Own Record in “Voter’s Information System: Precinct Mapping”

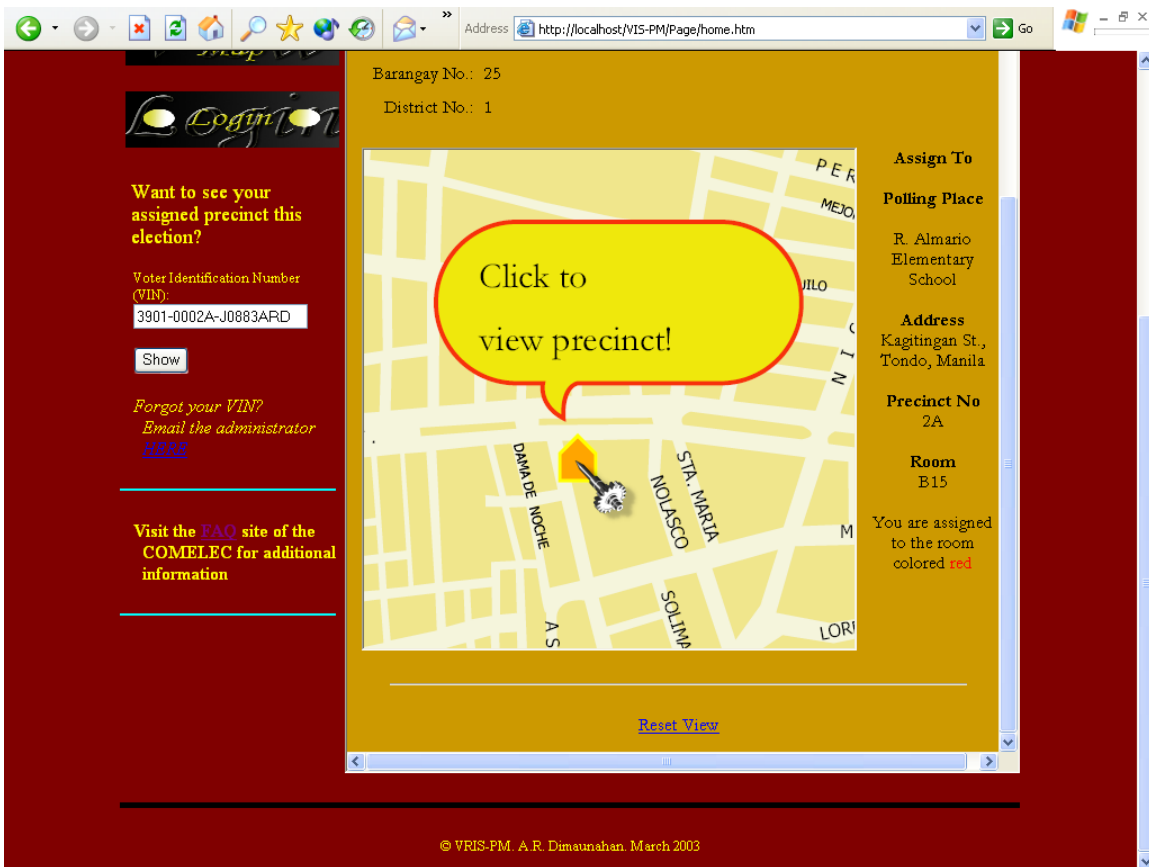


Fig. 17 Location of Assigned Precinct in “Voter’s Information System: Precinct Mapping”

By clicking on the polling place, the layout of the establishment will be displayed. The blocks represent rooms of the polling place. Blue rooms are rooms assigned as precincts by the administrator. Red rooms are the precinct assigned to the voter having the entered VIN. Voter can click on each precinct to view the list of voters of that precinct. This is illustrated in Figure 18 and 19.

Voter can view the list of voters of all precincts of a polling place where he is assigned. Other polling places are not authorized for viewing to unassigned voter of the polling places as shown in Figure 20.



Fig. 18 Layout of Polling Place in “Voter’s Information System: Precinct Mapping”



Fig. 19 List of Voters in a Precinct in “Voter’s Information System: Precinct Mapping”

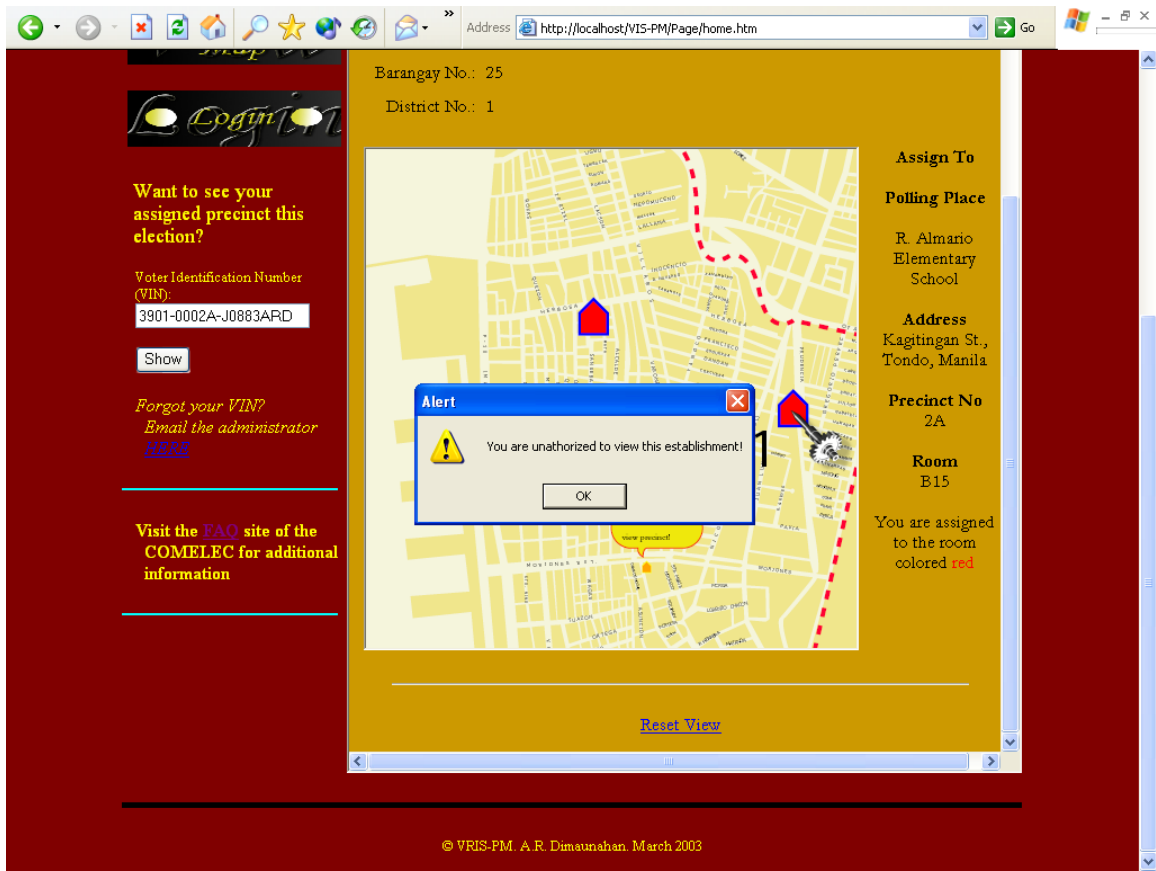


Fig. 20 Unauthorized access to other polling places in “Voter’s Information System: Precinct Mapping”

Ordinary users can only access the main page. For administrators, a new set of web pages is available. Once an administrator is verified and permitted, the page on Figure 21 will be displayed. In the administrator’s main page, it has a Navigation Bar consisting of links to Map of Manila, Precinct Records, Voters Records, and Log out. The View Map displays the page almost the same in the View Map of the System’s Main Page where ordinary viewers can also access. The only difference is, the View Map page of the admin can further view the list of voters of the precincts. This is not accessible to the View Map of the Main Page, only the layout is displayed.

The link to precinct shows a page (see Figure 22) with a menu: either to update polling place and precinct records or search a polling place or precinct.



Fig. 21 Administrators Main Page in “Voter’s Information System: Precinct Mapping”



Fig. 22 Precinct Menu in “Voter’s Information System: Precinct Mapping”

When the administrator clicks on the “Update” button, he can perform addition, modification, and deletion of precincts on the map. These are shown in Figures 23 and 24. A precinct is a part of a polling place, and in this case the administrator can also update polling place records.

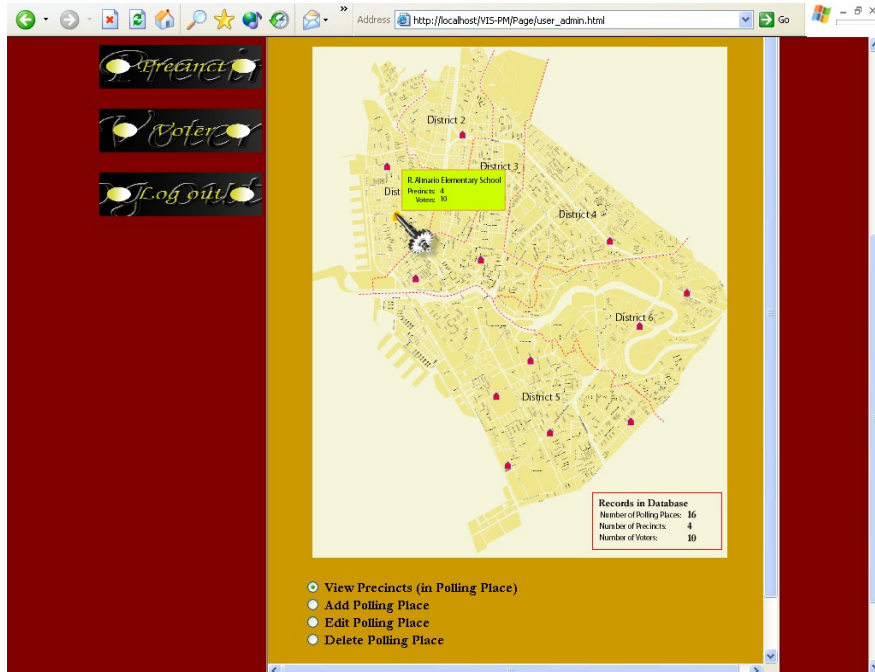


Fig. 23 Update Polling Place in “Voter’s Information System: Precinct Mapping”

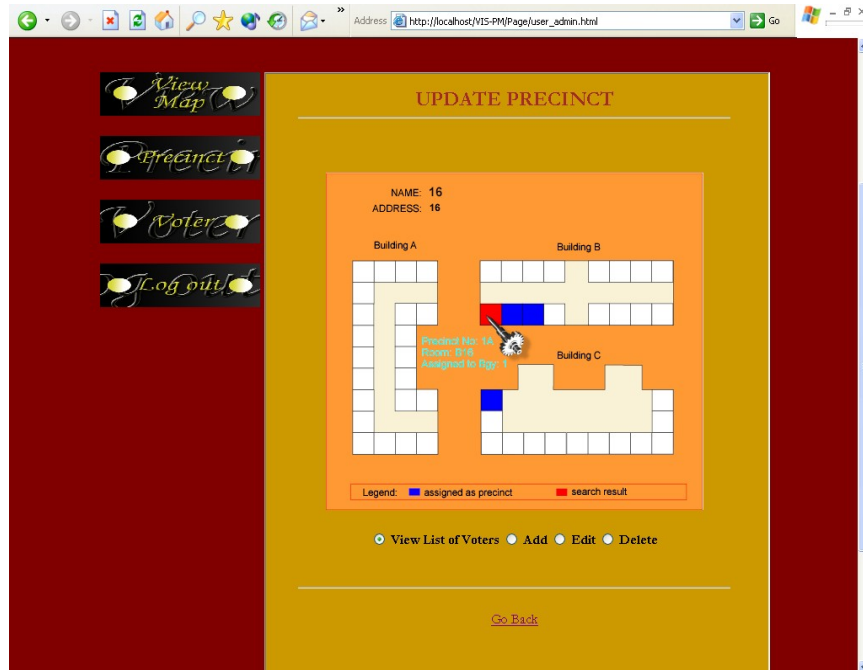


Fig. 24 Update Precinct in “Voter’s Information System: Precinct Mapping”

The “Search” button allows the administrator to view specific polling place or precinct in the map. It also displays a summary of statistics regarding a polling place. This is illustrated in Figures 25 and 26. This includes the polling place name, address, location in the map, precinct numbers, serviced barangays of the precincts, total number of precincts and voters, and the list of voters.

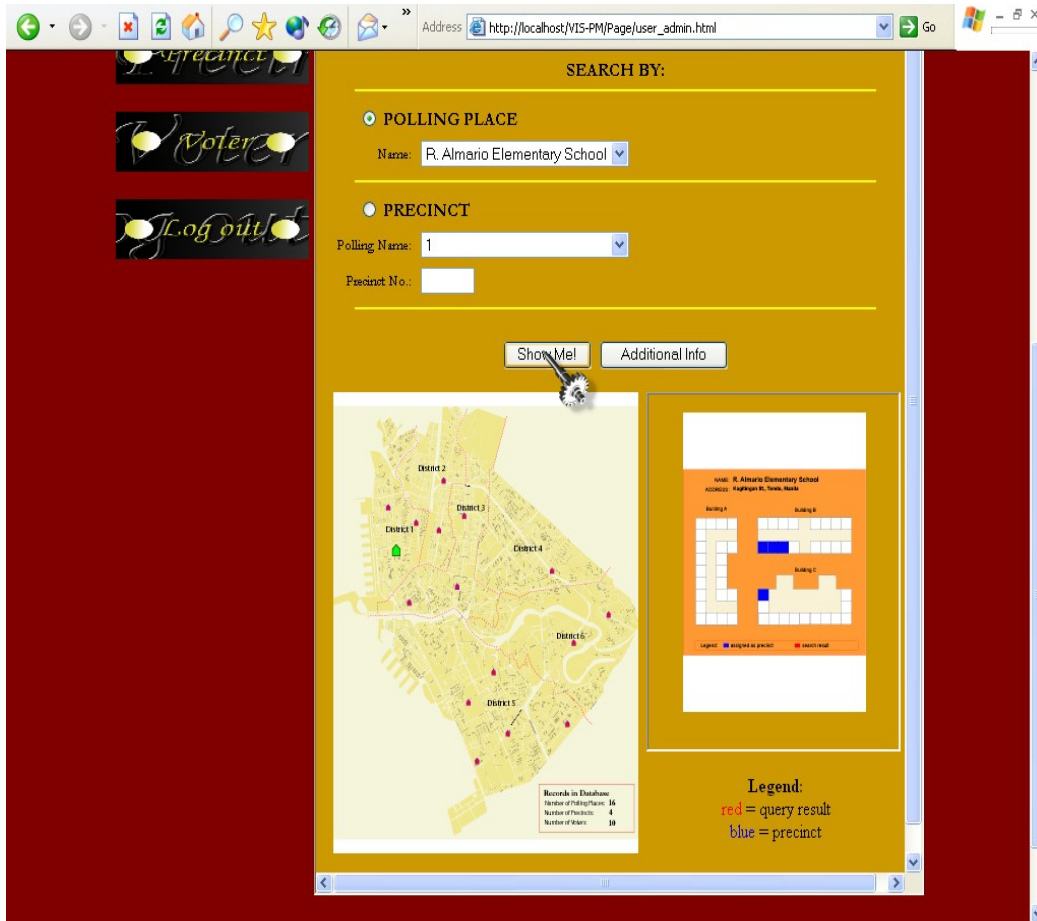


Fig. 25 Searching the Map in “Voter’s Information System: Precinct Mapping”

The administrator can access the voters’ record by clicking on the “Voter” button. This shows a menu: Add, View, Search. (see Figure 27)

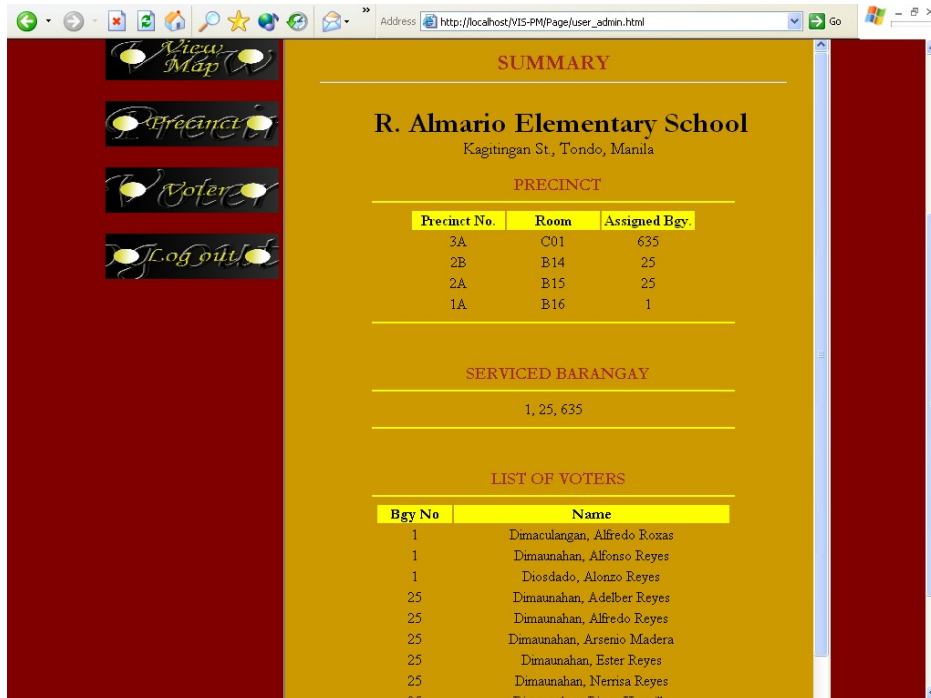


Fig. 26 Information of the Polling Place in “Voter’s Information System: Precinct Mapping”



Fig. 27 Voter Menu in “Voter’s Information System: Precinct Mapping”

The administrator can add a voter in the “Add” option as shown in Figure 28. Only addition of voter can be perform here. The “View” link will display a page showing all the voters in the database. An option to edit or delete is also available as illustrated in Figure 29. The edit function, the administrator is presented with a form consist of text boxes. The text boxes correspond to the information regarding a voter, e.q. last name, first name, address, etc (see Figure 28). The administrator then submits the new or edited form in order to add or update the information in the voter’s database.

The screenshot shows a web browser window with the address bar displaying "http://localhost/VIS-PM/Page/user_admin.html". The main content area has a dark red background on the left with navigation links: "View Map", "Precinct", "Voter", and "Log out". The central area is yellow and titled "ADD VOTER". The form contains the following fields and controls:

- Last Name:
- First Name:
- Middle Name:
- Sex:
- Date of Birth: - -
- Place of Birth:
- Citizenship:
- Civil Status:
- Occupation:
- Period of Residence in the Philippines:
- Address:
- Sub-District:
- Barangay No.:
- District No.:

At the bottom of the form are three buttons: "Back", "Clear", and "Submit".

Fig. 28 Add Voter in “Voter’s Information System: Precinct Mapping”

Finally, the “Search” page is shown in Figure 30. The administrator can search the records of voters by their VIN and Name.



Fig. 29 View Voter in “Voter’s Information System: Precinct Mapping”



Fig. 30 Search Voter in “Voter’s Information System: Precinct Mapping”

VI. DISCUSSION

The implementation of creating the “Voter’s Information System: Precinct Mapping” is by HTML, SVG, Javascript, PHP and MySQL. SVG is used for creating the map of Manila and layouts of polling places. These images are vector. It has a built in features of panning and zooming in and out the image. And through Javascript one can also apply interactions and animations to an image.

The map of Manila in the system shows the distribution of polling places in the district level. Summary of the number of voters, polling places, precincts in the database are also shown. Information about a polling place which includes the name, address, number of precincts it contain and number of voters assigned to it are easily displayed by just placing the mouse on the precinct on any zoom level. A function is created for this. In addition, clicking on the polling place will display its layout. The layouts are of three types: *Single Building with Single Floor*, *Multiple Buildings with Single Floor*, and *Single Building with Multiple Floors*. These maps are predefined and created for the purpose of displaying sample rooms and precincts.

This system can add, edit, and delete records of voters, polling places and precincts. It has a database that handles all these records and maintained by the administrator. Only the administrator can make system-wide changes. Visitor or voters are just allowed to the main page. They can view the map of Manila showing the location of polling places. By clicking on a polling place, it will display its layout. The list of voters in each precinct is not allowed for them to view. Visitors can also look for their own records as well as the precincts where they are assigned by submitting their VIN. Once they forgot their VIN, they can email the admin and ask for it.

VOTER

The administrator adds voter by filling in certain information on voter uniquely identified by they’re VIN, through a form and textboxes. There is an interface where list of all voters is shown. From that page, the administrator can view, edit or delete certain record.

POLLING PLACE

Updating polling places and precincts are done visually. The map of manila can be populated by polling places by selecting its location on the map. After which, the administrator will input the name and address of the establishment through a form. In addition, the admin will associate the polling place to any of the three the given layouts. The admin can then submit the information and then store it to the database. Each layout have a PHP file that creates the SVG file of the layout. Included in this file are specific queries of each precinct.

The process of modifying polling places is done by clicking an existing polling place on the map and the information on that precinct will automatically be displayed. The administrator can then submit the edited information.

Deleting polling places are also done by selecting a polling place in the map. Once the administrator continues to delete the polling place, the information of the polling place in the polling table is deleted. The SVG file associated to the polling place is also deleted. All the precincts it contains are also deleted from the precinct database. Voters assigned to the precincts are left unassigned. A warning message saying that there are unassigned voters appears after the polling place is deleted.

PRECINCT

Precinct records can be updated by first selecting a polling place in the map. This will display the layout associated to the polling place. From the layout, the rooms are color-coded indicating whether it is an ordinary room or a precinct. A Javascript function handles this process. This Javascript function is embedded in the SVG file of the layout. The file is updated every time the admin made updates on precinct records. The layout has the capability of displaying the precinct number, room, and assigned barangays if you place the mouse over an object in the layout. Clicking on the room will display the list of voters assigned to it.

In editing the precincts, the administrator has an option to move the location of the precinct in the layout. He can also change the precinct number, room, and the assigned barangays. The administrator can split, join, or delete barangays associated to it.

Once the administrator delete a precinct, the voters assigned to it will be left unassigned. However, a warning message appears every time there is any unassigned voter.

SEARCH

The system can also perform searches on record of voters, polling places and precincts. The search function of voters is easily done by creating a query from the field selected by the administrator. A page displays the result and orders the voters by last name. The search function for polling places and precincts is not that easy. The search function for polling places and precincts uses query and Javascript functions for displaying the results on the map. The results are displayed visually on the map. The polling place is highlighted and the precinct is colored red. Several variable passing and checking is done in order to display the right result in the map. SVG and Javascript functions are implemented to perform this dynamic search.

ADVANTAGES AND DISADVANTAGES

As stated in the significance of the study, the main advantage offered by the system is for the voters to have a mean for easy access to the precinct as to their locations. This will lessen the stress of the voter from finding the exact room of a school or building where he is assigned on the day of voting.

For the COMELEC, on the other hand, this project will serve as another option of effectively preparing for the conduct of election in Manila specifically by informing the voters on their assigned voting location. Manual distribution of brochure by the COMELEC personnel to voters regarding their precinct assignment can possibly be minimized by just providing few Client PC to some necessary location where

majority of the voters have no access to the internet. As a result, the COMELEC will be alleviated from manually creating thousands of information sheet on precinct assignment for every election.

Another importance is that the system can help identify “flying” voters, if there are any, in the system’s database through the help of the users, viewers or other voters. A barangay captain may be able to view the list of voters of the room where he is assigned as well as the other rooms of their polling place. If he find something suspicious in the list of voters, for example, the use of single house address in their barangay by several voters, like around 20 or more, he can inform the COMELEC regarding that anomaly. Although the system is not designed to prevent “flying” voters, it offers a way or a mean of determining them by presenting the complete list of registered voters.

One disadvantage of the system is that the registration of voters is not handled in the system. In addition of new voters and modification of voter’s record, actual verification of the submitted documents to effect the changes is outside the system. The records of voters are just encoded and stored in the database. The on line environment of the system, although has advantages, can also be considered as another disadvantage and unfavorable to some voters. As mentioned erlier, to possibly solve this, the COMELEC can provide some Client PC’s to necessary location where majority of the voters have no access to the internet.

The existing system of determining the number and location of polling places and precincts for the voters is done manually. From all the voter’s records obtained during the voters registration in Manila, the COMELEC studies and analyzes the distribution of voters in Manila. Then they estimate the number of precincts needed as well as its location. The “Voter’s Information System: Precinct Mapping”, provides the Map of Manila showing boundaries of the six districts. It has a functionality of zooming in and out, allowing different levels of magnification of the image. The COMELEC registrar can conduct the estimation of the number and location of polling places in the map. In addition, as an on line system, the resulting map of precincts and the voter’s assignment can be easily posted in the internet for the use of the voters and other viewers.

VII. CONCLUSION

The Voter's Information System: Precinct Mapping is an online mapping system of polling places and precincts in Manila. The system has the following capabilities:

1. Allows the user (or voter)
 - a. To view his personal information
 - b. To view the map of the polling places as well as precincts with levels of magnification
2. Allows the COMELEC personnel (or system administrator)
 - a. To perform addition, modification, and deletion of voter's record
 - b. To perform addition, modification, and deletion of precinct's as well as polling place's information and location in the map
 - c. To perform search in records of voters, polling places, and precincts.

VIII. RECOMMENDATION

The layouts of establishments are predefined by the system. However, there are only three variety of layouts available. In order for the COMELEC to fully implement the system, the exact establishment's layout would be needed. An additional module that can convert a scanned image of the establishment's layout plan (floor plan) to an SVG file would be necessary. This will help the administrator from manually creating the layout of the establishment using an application like Adobe Illustrator.

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I can't lift that damn heavy weights. The pain in my muscle after a pain in my mind everytime I work in my SP makes my life painful....? ^_^

To all those readers of this SP, thank you! ^_^