The 2021 Annual Conference of the Asian Association for Public Administration (AAPA)

Towards a Secured i-Election System in the Philippines: The Development of Hybrid QR Code Technology for Sustainable Election System to Increase Voter Turnout

Conference Sub-Themes
Digital State and E-government as Innovative Emergency Instruments

Author

Ms. Analiza V. Muñoz
Chief, Investigation and Enforcement Division
Anti-Red Tape Authority, Office of the President
Quezon City, Philippines
-and-
Doctor in Public Administration Student
National College of Public Administration and Governance
University of the Philippines
anvilmun@yahoo.com
+63 9178078121

INTRODUCTION

The Commission on Elections (COMELEC), as mandated by the 1987 Philippine Constitution, is the primary government agency responsible for enforcing and administering all guidelines and restrictions, rules and regulations, and policies relating to the management and conduct of regular and special elections. It is a government entity tasked with ensuring democratic, transparent, and fair elections while remaining relatively independent of the executive, legislative, and judicial branches of the government (Philippines, 2002).

The author believes that elections are the lifeblood of a political system, and they are the birth and death of political life. Political life begins when the people elect a candidate to represent or lead them. A candidate's political career ends when the public loses faith in their promises and political platform, regardless of whether they intend to run for re-election to any local or national office, which results in political death.

Every Filipino citizen who is eligible to vote has the right to elect the candidate they believe is best qualified to lead the country; this right is guaranteed by the Constitution. However, the country was hit by a novel coronavirus (COVID-19), which disrupted not only human activity and mobility, but also political processes such as elections. This pandemic has ushered in a "new normal" in which all transactions, whether private or public, have been transformed by the adoption of technology. To adapt to this new normal, an organization's present processes and procedures must be revised to reflect the new reality. All government initiatives, including the election process, should undergo rapid digital transformation to ensure voter safety and health while participating in democratic activities.

Concerns about health and safety protocols remain the most significant criteria in deciding whether elections should be held during the pandemic. As a result, any election, whether local or national, held during a pandemic must take protective and preventive measures to prevent disease transmission through the electoral process, which is typically the result of hundreds or thousands of people interacting and gathering in small and enclosed areas.

The study aims to emphasize that people can use COVID-19 to empower themselves and exercise their right to vote without fear of contracting the virus. They can still vote remotely without leaving their homes. As a result, voters do not need to travel to the polling place to vote. The author also emphasizes the importance of innovating the electoral process by developing a hybrid technology-based voting procedure for the new normal. She conducted a literature review, examined how to use technology to reinvent the election process, and assessed the findings of various election-related studies for policy and implementation recommendations.

OBJECTIVES:

1. To realize the role of technology in ensuring a long-term election process.
2. In addition to web-based technology, it introduces a new avenue for innovation and improvement in electoral systems by using hybrid Quick Response (QR) Code Technology.
3. To improve democratic governance while also ensuring timely and transparent voter turnout.
4. To introduce a new approach based on the results of the study.

Elections in the Philippines are really coming. Online registration for the election is still open at irehistro.comelec.gov.ph, and aspirants have begun to campaign informally by appearing on television shows or accepting interviews from social media bloggers. Political debates and social media criticisms against politicians are becoming more interesting to observe and watch.

The election is already in the air. President Duterte's potential vice-presidential run and its constitutionality dominated the news every day. As a result, the media neglected to stress how important it is for the COMELEC to first explore viable ways to avoid physical voting at the polling places to prevent the growing number of COVID-19 cases, especially because traditional voting is done personally, and appearing in-person will put individual voters at risk.

When exercising one's right to vote, the utmost caution is required, and nothing should be taken for granted. Clearly, the futures of the citizens and their children are at stake. Leaders and those who represent the people's interests should be elected through responsible voting. People should not dishonor the nation by voting for someone who comes to them with boldness and deception. They should not sell their votes to candidates who offer money or promises in exchange for their votes, and who, if elected, will take advantage of their position to acquire even more prestige, riches, and authority (Dooc, 2021).

Elections are, without a doubt, a vital element of democratic government and national development. Leaders who fail to meet the demands of the people during crises or properly manage emergencies should be replaced, and a new leader should be tested. However, the country's situation is very urgent and potentially life-threatening, given the rising number of COVID-19 cases and the severity of the new variants. Should individuals risk of contracting the virus by voting in person at a polling place? Should the government use technology such as web-based, mobile apps, or hybrid QR codes to reinvent the election process?

The phrase "new normal" has become more widely used to characterize new practices, new methods of doing things, and new modes of education and work, as well as a person's changing surroundings. Technology has emerged as the primary means of communication and job completion. If the election really pushes through in May 2022, mobility limitations are necessary at this time, and people's health should not be compromised. Therefore, the government should prioritize the transition from traditional voting to remotely conducted elections and develop policies, programs, and projects to assist people in adopting and learning how to use technology, as well as providing them with appropriate resources and technology such as smartphones and the internet. To secure a more sustainable future, the government should offer its people more opportunities to benefit from innovation and technology (Munoz, 2020). Hence, the author believes that this research might help the Philippine government bridge the digital gap in the country.

Governments must embrace this chance to shape and lead the country by showing confidence in developing a comprehensive Digital Transformation Strategy for the digital economy or e-governance. As the author points out, developments in data and technology can give the Philippine government a unique chance to better serve and connect with its citizens, particularly by allowing them to exercise their right to vote while simultaneously protecting their health and safety from COVID-19.

However, as with any social transformation and innovation opportunity, such as the election process, there is a risk that the desire to automate and reshape the electoral process as much and as quickly as possible will lead to the assumption that this system is a one-size-fits-all approach that will eventually benefit a selected few, further isolating many people from the government. If the digital divide is not thoroughly evaluated and assessed by the government, it will further isolate many people from the government in remote locations, both physically and emotionally.

The author offered alternate approaches to support COMELEC in reviewing the existing election procedure because face-to-face voting exposes more people to new COVID-19 variants, which appear to be more life-threatening and transmissible than before. The i-Election System, which connects voters via mobile devices, is presented in this study as a possible solution to the pandemic's disruption of the political process, and it has been demonstrated to be a viable hybrid technology approach, following the author's extensive assessment and analysis of numerous studies. The i-Election System's innovative features, which combine the use of QR codes, facial recognition, and fingerprint security, will benefit the public by allowing them to vote remotely from the comfort of their own homes while also ensuring the accuracy of data transmitted directly to the COMELEC's database.

The author's "Whole of Techmocratic" approach to governance represents a significant innovation in the e-government process, a game changer for e-governance in the exercise of democratic rights through hybrid technology, and a revolutionary transition that allows citizens to actively participate in governance by voting remotely and securely, such as an e-voting system. This approach involves use of technology to allow people to exercise their democratic right to vote. Election-related issues like as vote buying, violence, and fraud, as well as the country's current conditions, which hinder people's mobility for health and safety reasons, will be addressed by shifting from traditional election methods to hybrid QR Code technology. It is a modern automated voting system for the new normal that also addresses the country's long-standing issues of digital divide and communication gap, hence improving election turnout and ensuring transparent and credible election results.

CONCEPTUAL FRAMEWORK

Filipinos were among the most frequent users of mobile applications and internet access prior to the pandemic. The Philippines has seen a significant increase in mobile experience; they don't just go online for work or school; they live online as well. They rely on technology for everything, including searching for simple words, cooking recipes, watching movies, and browsing social media accounts, among other things. Technology has been their constant companion.

The pandemic has caused Filipinos to form stronger ties with their smartphones, with some even sleeping with it. They are already the most prolific mobile internet users in the world. They spend their entire day and night online for work, education, communication, shopping, social networking, instant messaging, and watching movies, all of which consume a large amount of data, causing internet traffic.

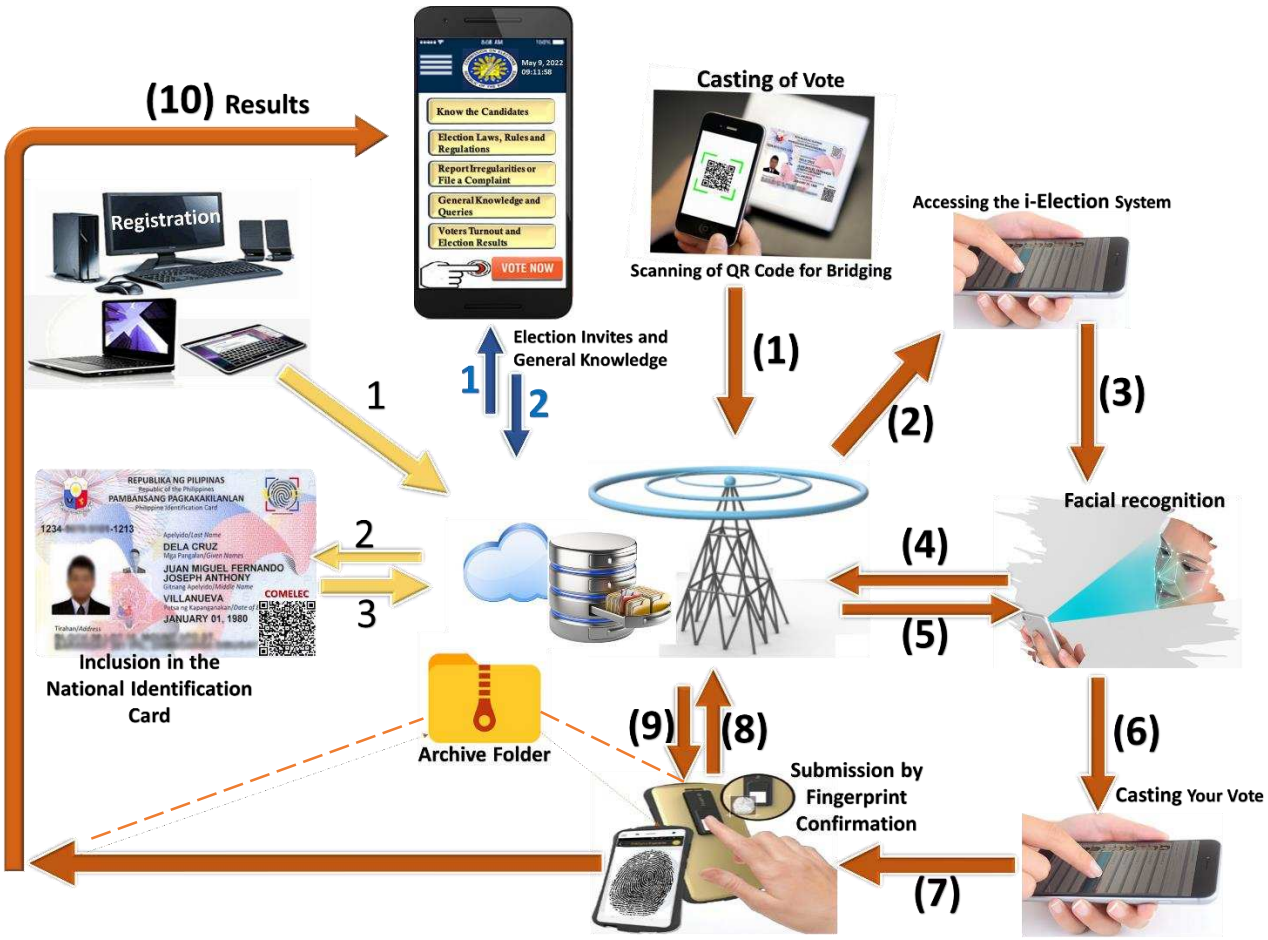
Increased internet traffic will add to the country's already overburdened network connectivity and communications infrastructure. Filipinos have already embraced technology, as evidenced by their use of smartphones and internet. As more Filipinos connect to the internet through smartphones and computers, the country requires a dependable, strong, and secure internet connection to manage connectivity traffic. In today's world, owning a mobile phone, particularly a smartphone, is more practical than owning a laptop or desktop computer, and this trend is rapidly spreading across the country. It has become a must-have device because education and work have already moved online. A smartphone is a mobile phone that can also be used like a computer. It usually has a touchscreen and can connect to the internet as well as run multiple programs, making it a valuable and useful digital communication tool.

People are becoming more cautious, choosing long-term solutions over interim remedies or short-term solutions. One of the most noticeable implications of the pandemic was an increased reliance on commonplace technology, from online shopping to virtual meetings and public/private service delivery. People need this motivation to continue the digital revolution, and they already see technology as a strong instrument that can help them improve their lives in a variety of ways.

As technology becomes an integral part of everyday life, the author suggests that the government should prioritize long-term or sustainable digital transformation of public services over short-term actions like glamorous new apps that do not integrate with and have limited value in the organization's systems. There are numerous technologies that can meet our needs, but majority of them are costly. The use of QR codes on smart phones is a low-cost, yet reliable technology because it connects directly to an agency's core system and database. The best feature of QR code technology is that it is secure and cannot be hacked (Kaspersky, undated). The security concerns associated with QR codes, hacking, phishing, or malware, are caused by the end destination of each code or the core database of the agency, not by QR code technology. Hackers can create malicious QR codes that redirect users to fake websites that collect personal information like usernames and passwords, or even track the location of a mobile device. This is not the case with the author's i-Election System, where the individual QR Codes are imprinted on the government-issued national ID and are accessible only for a limited time—before, during, and after the election. As a result, hackers cannot get hold of the individual ID to install a fake QR Code.

Innovative policy design, faster digitization, better data usage, and active public participation are critical components of all responses of the government to the growing expectations on public service and people's reliance on privacy protection and consent (Friday et al, 2021). These issues must be addressed if the government decides to use a hybrid QR Code technology to connect with and fuel the i-Election System for the transformation of the electoral process.

Figure 1: Process Flow of i-Election System Using Hybrid QR Code Technology



The use of digital interventions to reduce COVID-19 transmission has aroused interest and debate. The author of this paper explored the connection between technology and the voting process to offer new options for the COMELEC to continue the election while prioritizing voter's safety and health by preventing personal appearances in polling stations. To reduce virus exposure, the author designed a hybrid QR Code technology that allows the government to provide citizens with a secure means to vote remotely and elect their leaders from the comfort of their own homes.

Registration

Figure 1 illustrates voter registration in the COMELEC main database to create a verification system. The COMELEC-generated QR Code for each individual voter will be printed on the government-issued National ID as part of the government's thrust for a unified ID system. This identification system does not require the voter to claim an identity; rather, it compares the features captured during COMELEC registration to the captured images during system use. When the QR code on the National ID is scanned, it connects directly to the i-Election System or the COMELEC's central database. This was initially available during the pre-election period for campaign updates, announcements, and the publication of election rules and regulations.

Authentication

Authentication is necessary for accessing sensitive information and preventing hackers and account intruders. When adopting a robust authentication technique, such as the one employed by the i-Election System, access to sensitive data is more secure.

The COMELEC will provide voters with access during the election, but only until the results are revealed. They have the authority to determine when to allow or close access to the i-Election System to the public. The facial recognition and fingerprint identification systems will be activated once voters begin using the i-Election System. All citizens must have a smartphone capable of reading and scanning QR Codes, or a QR Code app installed on their mobile devices, as well as a mobile phone camera capable of capturing the actual face for facial recognition and a fingerprint scanner to verify and confirm the voter's identity.

When the COMELEC QR Code is scanned, the mobile phone is redirected to individual record/information. Before proceeding, the user must authenticate the account by using the camera on their mobile phone for face recognition. The matching algorithms are programmed to compare the image stored in the system to the user's actual face. If it does not match, the user/voter will be given three attempts before the transaction is automatically canceled to protect the account from a possible spyware or malware attack or an attempt to commit election fraud. However, if the facial features match, the user/voter can now begin voting on the system's online ballot, also known as the e-ballot. They may either browse through the qualifications of the candidates first or go straight to the list of candidates with pictures for each position. They can vote and select a candidate by clicking on the candidate's name.

Vote Casting

After the selection phase is completed, users/voters can cast their ballots or check the list of candidates they have selected. After accomplishing the e-ballot, the system will prompt the user/voter to scan his/her fingerprint for confirmation. If the validation is successful, the voter/user will receive notification that their submission was accepted. If the user/voter's fingerprints do not match, he/she has given five attempts to scan his/her fingerprint. If the validation failed or it did not match the voter's fingerprint in the COMELEC database record, the e-ballot was saved and transferred to the system's archive folder for manual counting and verification.

Once the votes have been cast, the voter/user cannot edit the e-ballot; otherwise, the system will automatically lock the e-ballots, preventing the individual from casting another vote. If the system detects an attempt by the voter/user to cast another vote, it will automatically notify the COMELEC of this attempt. This is a system-specific feature for any attempt to commit vote manipulation and adulteration, as well as election irregularities.

Confirmation of Identity

The voter's identity is identified and validated using facial recognition and fingerprint identification. This cross verification of voters during the election process is more accurate than the traditional single parameter of manual checking of election records per district.

Biometric features of voters, such as fingerprints and face features, are captured, matched, and compared to all previously captured facial and fingerprint traits in the COMELEC database to confirm the voter's identity. The purpose of this one-to-many comparison is to determine who the individual is (Wolf, 2017)

Monitoring of Voter Turnout

A voter can view how many registered voters have already voted by clicking on the Voters' Turnout and Election Result button. When a vote is submitted, it is automatically counted, and the total number of votes cast can be monitored in the system until the voting period ends, the counting of votes is completely automated and requires no human intervention. Except for votes transferred to the archive folder. If there are votes found in the archive folder, the COMELEC may declare the results unofficial before the end of the day. Voters can also access some data in the archive folder, such as the number of votes cast and the region in which they voted. These ballots should be counted as soon as possible by COMELEC officials, who should be accompanied by representatives from various parties. The e-ballots in the archive folder are validated before they are manually counted and tallied. The results of the counting will be encoded in the i-Election System and witnessed by the candidates' representatives. If no data is found in the archive folder, the COMELEC may announce the official results on the same day.

Records Update

If a voter/user wants to update his/her record due to a medical procedure or accident that slightly changed their facial appearance, or a change in personal information such as civil status, they can do so only during the registration period prior to each election by personally appearing at the respective COMELEC office.

An Attempt to Compromise the System

The system includes a program that detects registration duplication and can automatically delete one of the duplicated records. This is accomplished by matching all the fingerprints saved in the system with those of the voters. It is used to find and compare similarities in personal data such as full names, birth dates, birthplaces, and facial recognition. This will prevent identity theft and multiple voting. When a user attempts to access the system with a forged National ID, the system detects it and prevents the user from proceeding with the initial phase of identity validation. The COMELEC will be notified of the attempt through a system warning on their dashboard. The ID includes a secret distinctive feature that cannot be seen with the naked eye and can't be transferred even if it's reproduced, scanned, or photographed. The QR Code image in the ID is visible, but not the system's distinctive feature.

"Whole of Techmocratic" Approach

The author of this study developed a hybrid technology voting system that allows people to exercise their democratic rights without delay, even in the face of unprecedented crises like COVID-19, which she referred to as the "Whole of Techmocratic" approach to governance. This is an innovative use of various technologies to increase voter turnout and encourage responsible

voting. This is a game-changing approach because it uses hybrid technology to convert traditional face-to-face voting to remote voting without risking voters' health and safety. It is made up of various technologies that are combined to form a single system, such as web-based, interactive mobile phone technology, QR Code technology, facial recognition, fingerprint scanning, and special programming for system-specific features to create an effective technological mechanism for voting remotely at the convenience of the people and allowing them to participate actively in the election, to achieve 100% voter turnout.

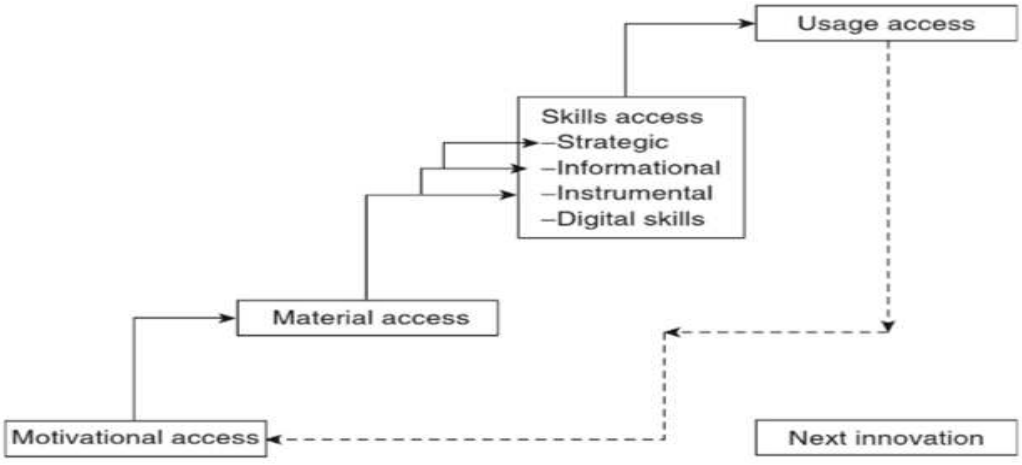
THEORETICAL FRAMEWORK

It remains a challenge for the Philippine government to ensure that Filipinos in remote areas, vulnerable and marginalized communities, and illiterate people have internet access and the financial means to purchase a smartphone, which may impede the success of the development of the i-Election System.

The COVID-19 showed how Filipinos are being pressured to use technology regardless of their financial status or social standing. This change is unavoidable, but the government can't expect people to buy a smartphone or subscribe to an internet service if they can't afford to support their daily needs. If a technological transition is inescapable, the government and public administration should devise projects, programs, and policies to assist them in meeting the demands of this digital transformation. A collaboration and partnership between and among the government, public administration, civil society, the private sector, and citizens should jointly address this problem because the severity of COVID-19 cases in the country, social isolation, and mobility restrictions force people to go online for everything they do.

Another challenge is that older people and marginalized groups have a much harder time adjusting to new technologies, including online banking, QR code-based registration, online shopping, and virtual meetings, compared to younger technology users who can easily switch between offline and online activities with ease (Veale, 2021). This challenge results in disparities and inequalities in access to and utilization of information and communication technologies (ICTs) among individuals, families, institutions, and geographical areas (Venkatesh, 2013).

Figure 2. A Cumulative and Recursive Model of Successive Kinds of Access to Digital Technologies



Source: Van Dijk JAGM. 2005.

Figure 2 illustrates Van Dijk's (2005) cumulative and recursive approach to successive types of access to digital technologies. Nowadays, technology continues to provide new innovations, there are four successive stages or types of access to digital technology that are intended to be systematic and cumulative. First, 'motivation access' is based on people's motivation to use the i-Election System. People can be persuaded to use technology if you give them a reason to, such as the right to vote, which allows them to choose who will lead the country to help its people in the current situation. If they are motivated, they will almost certainly try to obtain the necessary "access to materials," such as smartphones with QR code scanners, facial recognition, and fingerprint identification. With this, there is already an impetus to try the system and obtain the materials needed to test it or explore its features, which will result in having "skills access" to operate it.

People are now driven to learn and expand their technical abilities by exploring the System's functions, until they gain the necessary knowledge, familiarity, and digital skills with the System, which determines the individual's "usage access." When this occurs, the use of new or updated technology results in the development of a wide range of digital abilities.

Physical access, as well as adequate digital skills, are required for satisfactory and acceptable use of the i-Election System or potential applications of a more sophisticated i-Election System. As a result, the stages are cyclical, as they repeat themselves in whole or in part with each new technology or innovation. The issues with material and usage access have been revisited to determine whether such access is still appropriate considering the system's potential improvement. The main challenge now obtaining the required material and mental resources to complete the transformation. Is the government, the COMELEC, and the people ready for this change? The properties and evolution of technology play an important role in upgrading and introducing new features to the system at any stage. The author's goal is for the COMELEC to be open to the possibility of implementing this technological reform using the Whole of Techmocratic Approach, utilizing hybrid technology for the people to exercise their right to vote and providing them with more opportunities to participate in governance.

Figure 3. Factors Contributing to the Growing Impact of the Digital Divide – **ARMS of Technology**

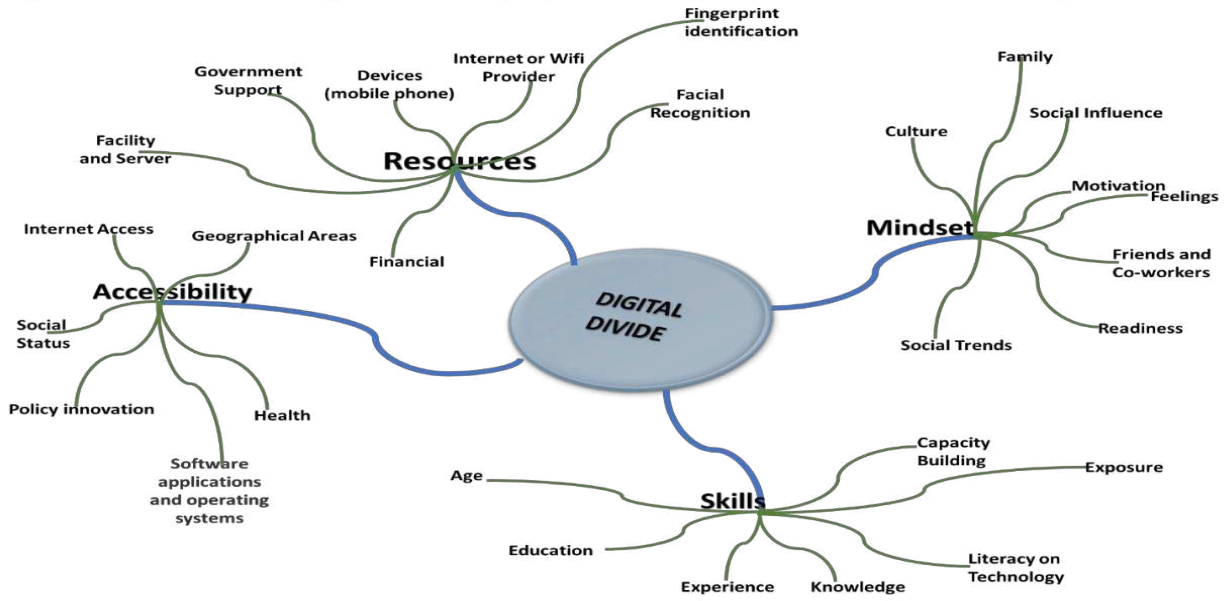


Figure 3 shows the factors that contribute to the Digital Divide, which this study intends to bridge for the i-Election System to be successfully adopted and deployed. The author termed it as the "ARMS of Technology." Its function, like an arm, is to reach out or connect to something and grab something or to offer support for the purpose of providing solution. To effectively bridge the digital divide for the adoption of the i-Election System, the government, public administration, and individuals must address these factors jointly.

There is a digital divide in Accessibility when there is a barrier to accessing the system in terms of geographical areas, internet access, health, social status, policy innovation, and software application and operating systems. All these factors have an impact on i-Election accessibility. For example, if the user lives in a remote area or belongs to a marginalized community with limited to no internet access, or if the user has a mobile phone that is incompatible with the operating system of the software application, access to the i-Election System will be difficult. The same can be said about healthcare and policy change. COVID-19 affects both people's mobility and their mental readiness to accept technology. When people are forced to use technology without choice, they are more likely to be dissatisfied, which contributes to the digital divide. People will use technology because “they have to”, not because “they want to”. If this is the case, the digital divide will pose a significant threat and impediment to technological progress. Access to the system is also hampered if the person is unhealthy, which limits their mobility for technology use. In terms of policy innovation, the policy may be applicable to all Filipinos, but its implementation may be selective, preventing full access to technology from being used. When there are barriers to successfully accessing the system, these factors contribute to the technological gap.

There are several factors that may affect the System's implementation that comprise the digital divide in "Resources," such as a lack of funds to develop and maintain the System, a lack of facility or server to host the System, a lack of government support, and the individual's lack of a smartphone with a camera capable of reading the QR Code and determining the user's facial features as well as scanning their fingerprints for validation. It is difficult for both the government agency and the individual to create and access the technology that supports the system if neither has the necessary resources.

The mindset of both government officials and people contributes significantly to the digital divide when people are not ready to embrace change, embrace technology instead of fearing it, and overcome the feeling of discomfort associated with using technology due to influences from culture, family, friends, and coworkers. Some people are also influenced by social trends. If most of the people around you are unwilling to experiment with technology, others will. People who are not motivated to use technology due to social pressure have a tendency not to use technology, which contributes to the worsening of the technology gap by demonstrating that they are not ready to adopt innovation.

The widening of the digital divide is also influenced by skills. Senior citizens may be unfamiliar with technology due to their age. Less access to technology results from a lack of education in the field. People's ability to access technology is similarly determined by their level of experience and exposure to technology. The system's ability to function will be limited by a lack of information, illiteracy, and a lack of capacity building in the application of technology. As a result, the government and public administration must give opportunities for people to diversify

their skill sets by training them on how to use technology. If these concerns are not handled properly, they will worsen the country's growing digital divide. The ARMS are barriers to the country's technology growth and, if not addressed effectively, will have an impact on the country's developing technological disparity. If these reasons contribute to the ARMS's excruciating distress, the failure to take proper action on these factors will undoubtedly continue to have a negative impact on the people, the government, and the public administration. This should be addressed correctly by addressing each factor separately.

STATEMENT OF THE PROBLEM

The 2022 National Election will be a very challenging period in the Philippines because of the never-ending issues faced by both the government and the citizens, such as election-related violence, identity theft, election fraud, vote buying, never-ending disputes on election turnout and results, and now the threat of the COVID-19 virus to the health and safety of the citizens who will vote. This is a problem that the author intends to address in this research.

Sub-problem

1. Do Filipinos have smartphones with QR Code readers as well as built-in cameras for facial recognition and fingerprint scanning?
2. Do Filipinos agree to vote remotely from their mobile phones?
3. Is hybrid technology, such as the i-Election System, capable of bridging the country's digital divide?

SIGNIFICANCE OF THE STUDY

The transition from manual and face-to-face voting in polling places to the hybrid i-Election System or remote voting will certainly assist:

1. The Public Administration. To provide a provision for the long-term development of the electoral process through a fast, highly reliable, and transparent election process.
2. The Citizens. They can vote remotely, keeping themselves safe from election-related violence and the COVID-19 virus and its variants.
3. The Government. It will give them the option of a long-term electoral process that will produce a sustainable solution to electoral fraud, vote buying, multiple registration, and other election-related issues.
4. Other neighboring countries. To provide them with research and a process for developing a hybrid technology that could be used to replicate the i-Election System.
5. Other Researchers. They can use this study as a reference and make suggestions for improvement.

LIMITATION OF THE STUDY

The number of respondents should not be interpreted as an equal representation of citizens in the various regions of the country because the survey questionnaire was distributed on-line using Google forms and was disseminated to people known by the present author due to the threat of

COVID-19 in the country and through the endorsement of these people to their friends, family, and co-workers to take the survey. The author also failed to conduct an interview or request an official document from COMELEC regarding their innovation in the electoral process. Thus, the author relies solely on documents posted on COMELEC's official website, news, articles, blogs, and other related studies to triangulate her findings.

The study does not include explanations of deep technological intricacies, such as technical IT procedures and programs, but rather employs a common language that everyone understands to describe the process, importance, and purposes of the system. Notably, the author is not an IT specialist or a technical person who studied technology; rather, she describes and discusses this study in such a way that everyone can comprehend how the i-Election System works and why it was developed. The primary goal of this research is the adoption of hybrid technology to improve election turnout and the importance of remote voting for a timely, reliable, and sustainable electoral system.

REVIEW OF RELATED LITERATURE

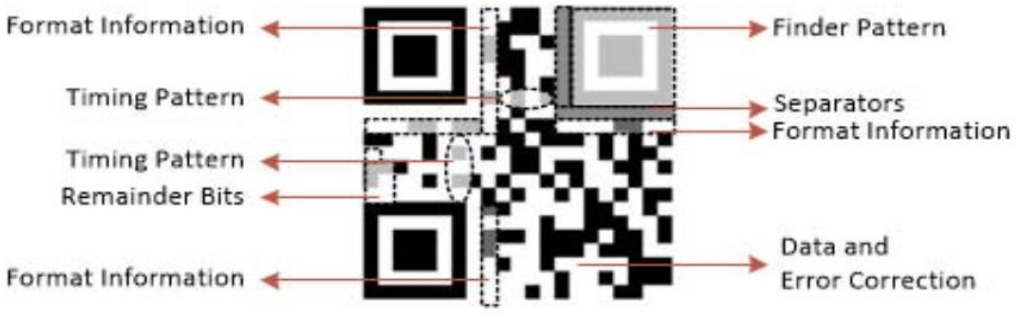
This literature review will give the author a better knowledge of how diverse technologies can be used to create a system that streamlines processes such as the voting system, allowing individuals to be more involved in democratic governance.

The i-Election System was initially developed by the author using a smartphone and a web-based monitoring system, with the purpose of reducing election-related issues. This system provides three options for tire authentication: first, the person's national ID, where the QR Code is placed for scanning; second, facial recognition to confirm that the registered voter and the real-time user are the same person; and finally, fingerprint identification to validate the identity of the user/voter.

A. Quick Response (QR) Code Technology

The QR-code is a two-dimensional barcode that was invented in 1994 by one of the Japanese Toyota group companies. The codes perform the same function as traditional barcodes, but QR Code can store significantly more data (Falkner, 2014).

Figure 4. Structure of version of QR-code



Source: Falkner et al., 2014

The QR Code structure is depicted in Figure 4, which is divided into modules, each of which is a collection of pixels. This structure contains a finder pattern that is used for QR Code position detection and identification. The scanning process necessitates the presence of a quiet zone, denoted by a white border, around the QR-code. The timing pattern for determining module coordinates, separators for separating finder patterns from the rest of the code, the data area, the error correction region, and areas that contain format information, as well as the remaining bits, are all part of a QR-components code (Falkner, 2014). The QR code is distinguished from other technologies by its structural system and framework. It also includes error correction, which is used to recover the QR-code if parts of the symbol are rendered undetectable or destructed. QR Codes help to bridge the gap between online and offline activities.

With the increasing popularity of smartphones with built-in QR Code scanners in their native camera apps, the author examines how this technology could be utilized to modernize the electoral process, as voting in person is required when other options are not available. If the suggestion in this study is accepted, each voter will be assigned a unique QR Code that will be inscribed on their government-issued National ID for easy identification. When a voter scans a QR Code during an election, they are instantly identifiable and can vote after their identity has been verified. Scanning a QR Code is a simple method for making elections more convenient, accessible, efficient, and secure (Hegde, 2020). E-voting systems, such as the one used in this study, are intended to provide high levels of security by allowing users to vote remotely and privately.

B. Facial Recognition System Technology

Face recognition is a biometric technology that identifies people based on individual face characteristics. To determine identity, the software's machine learning and artificial intelligence algorithms navigate identifiable facial features, search for patterns in actual and current visual data, and match with photographs taken during registration or on the most recent updates of personal information to other data stored in face recognition databases (Marr, 2019).

The face recognition paradigm, as illustrated in Figure 5, scrutinizes the spatial geometry of the distinct patterns of faces. It is a type of computer vision software that is commonly used for individual recognition, identity verification, and validation. The face is often used in biometrics due to its physiological features and because it is less intrusive than other biometrics. One of the key advantages of face biometrics over other biometrics is that it does not require the use of a sophisticated device to acquire data (Alim, et al., undated)

Figure 5. Authentication of Identity based on Facial Recognition

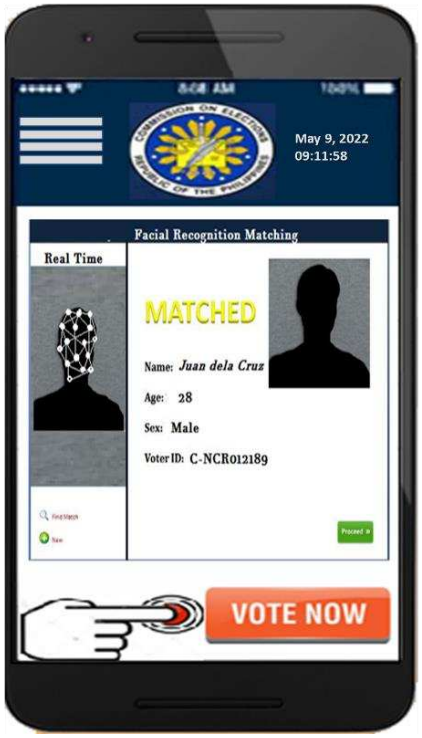


Figure 6. Fingerprint Identification

C. Fingerprint Identification Technology

Fingerprint identification is one of the most reliable biometric technologies. This is due to a variety of factors, including well-known fingerprint qualities such as consistency, permanence, ease of acquisition, and high matching precision levels (Hazzaa and Kadry, 2012).

Following fingerprint recognition identification, Figure 6 illustrates what would show on the voter's/mobile user's phone. There are four stages: First, the sensor, for example, is used for biometric data registration, enrolment, and recognition. The second stage is pre-processing, which entails using improved algorithms to remove superfluous data and improve the clarity of the ridge's patterns and structure. The third stage is the feature extraction stage, which extracts fingerprint features using the input from the output of the pre-processing stage. The fourth stage is the matching stage, in which the acquired feature is compared to a database template (Charan, et.al., 2020).

Table 1. Voting System Adopted by Other Southeast Asian Countries During Pandemic Period

COUNTRY	MODE OF ELECTION	KIND OF ELECTION/DATE OF ELECTION	Election Turnout COVID Cases and Death	CAMPAIGN RALLIES
INDONESIA	Personal appearance at the polling stations	Regional (local) Election December 9, 2020	COVID cases increased from 586,842 to 678,125: death 18,000 to 20,257, 14 days after December 9, 2020	In-person events limited to 50 participants
LAOS	•Early Voting for Soldiers and police •Mobile Voting for patients in the hospitals •Personal appearance to polling stations	Parliamentary Election February 21, 2021	Voter Turnout 98% COVID cases increased from 45 to 47 cases with no death from February 21 to March 7, 2021	Campaign meetings are allowed
MALAYSIA	Personal appearance at the polling stations	Pahang State Assembly By Election July 4, 2020 Perak State Assembly By Election August 29, 2020 Sabah State Assembly General Election September 26, 2020	Voter Turnout 73% COVID cases increased from 8,648 to 8,764; death from 121 to 122 between July 4 to 19, 2020 Voter Turnout 68.4% COVID cases increased from 9,306 to 9,810; death from 125 to 128 between August 29 to September 10, 2020 Voter Turnout 66.61% COVID cases increased from 10,687 to 14,368: death from 133 to 146 between September 26 to October 9, 2020	Large gathering and house-to-house campaigns were banned Public campaign allowed not exceeding 250 people, house-to-house visits is allowed without handshake, social media campaign Political Campaigns failed to follow the Standard Operation Procedure
VIETNAM	Early voting People isolated at home-ballot box was brought to the home of the voter	Parliamentary elections May 23, 2021	Voter Turnout 95.7% COVID cases from 5,119 and 41 deaths	10 people in public gatherings Online Meetings and Social Media
MYANMAR	Advance Voting to selected voters (in-constituency and out-of-constituency) Personal appearance at the polling station	General Election November 8, 2020	Voter Turnout 72% COVID cases from 60,348 to 77,848; death from 1,396 to 1,722 November 8-22, 2020	Campaign was prohibited
PHILIPPINES	Personal appearance at the polling station	Palawan Division Plebiscite March 13, 2021	Voter Turnout 60% COVID cases from 616,611 to 702,847: death 12,766 to 13,149 March 13-27, 2021	Campaign via television, social media and radio
SINGAPORE	Personal appearance at the polling station	Parliamentary Elections July 10, 2020	Voter Turnout 95.63% COVID cases from 43,423 to 49,098: death from 26 to 27 July 10 -24, 2020	E-rallies (virtual space) In-person campaign observe social distancing Door-to-door campaign with maximum 5 person, no shake hands Broadcast recorded message

Table 1 summarizes the voting processes of some Southeast Asian countries that held elections despite the pandemic, including Indonesia, Laos, Malaysia, Vietnam, Myanmar, the Philippines, and Singapore. Despite the increasing number of COVID-19 pandemics, personal appearance of voters at the polling centers is common in these countries. Aside from personally voting, Laos has implemented early voting for soldiers and police officers for their Parliamentary election on February 21, 2021, as well as mobile voting for patients in the hospital or healthcare employees who are unable to attend personally at the polling places. While in Vietnam's Parliamentary election, early voting was used, and a ballot box was delivered to the voter's home. Similarly, Myanmar employed advance voting (in-constituency and out-of-constituency) in addition to personal appearance in the polling center to cast their vote during the General Election on November 8, 2020. However, the author observed an increase in COVID-19 cases during these elections, even though these countries denied that their physical appearance during the election might be one of the reasons for such an increase. Unfortunately, the pandemic condition in these nations affected the percentage of election turnout.

RESEARCH METHODOLOGY

The author employed a mixed research methodology, collecting both qualitative and quantitative data. To acquire quantitative data from structured survey questionnaire replies, the Four Point Likert Scale was employed. The mean and median would be derived using a simple percentage to obtain the verbal interpretation based on the Four-Point Likert scale. Based on the findings of various studies, the Scoping Review qualitative approach was used to identify gaps and/or priorities in the election process during the pandemic, as well as the methods used by several Southeast Asian countries to continue their election processes.

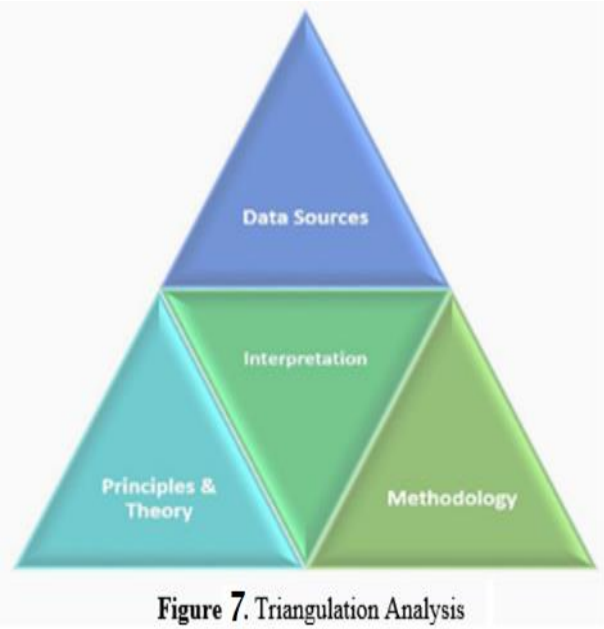


Figure 7. Triangulation Analysis

Source: Munoz, 2019

Both the survey findings and the scoping review will be synthesized and analyzed using Triangulation Analysis, as shown in Figure 7, which is used to strengthen the findings and establish trust in the study's outcomes (Bryman, 2004).

From July to August 2021, data was collected online using Google forms. Respondents were sent links to the survey through email and Facebook Messenger. The survey received 305 responses from people living in different regions of the Philippines. However, the survey is not a comprehensive representation of respondents' perceptions because there is no equal representation of voters per region in the Philippines due to mobility restrictions based on community quarantine.

A scoping review of the literature was further conducted to acquire a better understanding of the feasibility of developing a hybrid technology for remote voting to improve people's involvement in the election, resulting in increased election turnout. It is also used to identify research gaps. The author also sought the advice of an IT expert on how to develop a QR Code and the feasibility of merging multiple technologies into one single system.

RESULTS AND DISCUSSION

Demographic data of respondents are summarized as follows:

Figure 8. Number of Respondents in Terms of Gender

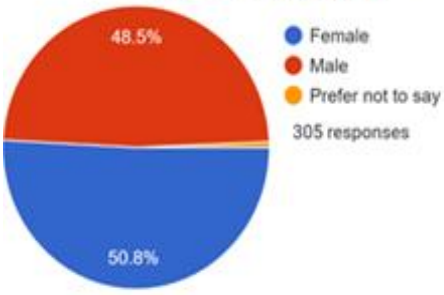


Figure 9. Number of Respondents in Terms of Age

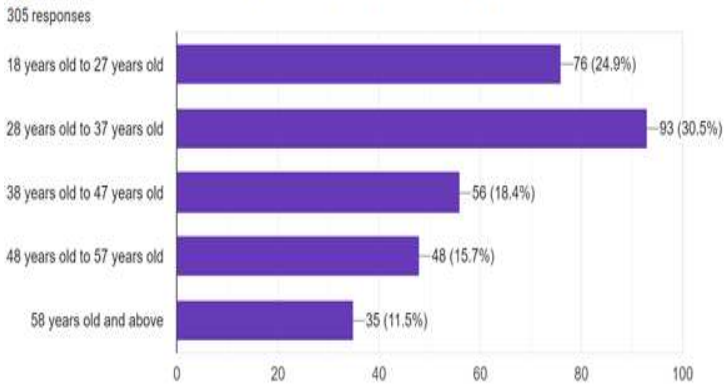
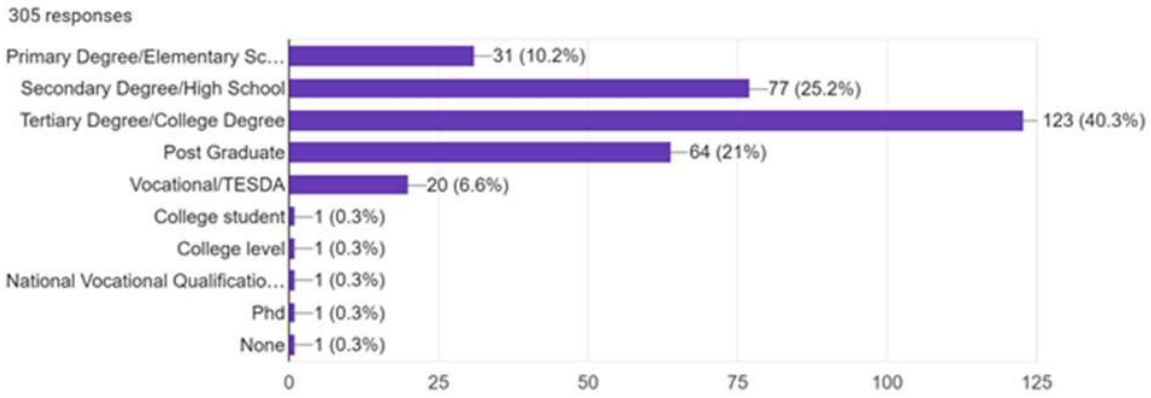


Figure 10. The Educational Attainment of the Respondents



Figures 8, 9, and 10 show how respondents' gender, age, and educational attainment are evaluated as demographic characteristics. About 50.8% of respondents, or 155, are female, 48.5%, or 147, are male, and 1%, or 3 respondents, did not disclose their gender. Gender was used in the study to determine which gender preferred to use technology to replace face-to-face voting in polling places. The results show that there is a nearly equal representation of respondents in terms of gender. Age, on the other hand, was utilized to determine which age group is willing to adopt and use the hybrid QR Code System in the election. The age group of 28 to 37 years old accounts for 93 responses or 30.5 %. The age group of 18 to 27 years old received 24.9% of responses in this study, or 76 respondents. The age brackets of 38 to 47 years old account for 56 respondents or 18.4%, while the age brackets of 48 to 57 years old account for 48 respondents or 15.7% and 35 respondents or 11.5% of the population is aged 58 and above. The survey included age to see if it had any effect on how people use and understand technology, because most respondents are between the ages of 18 and 37, and they are the most exposed to technology, whereas the age group 30 to older, or 45.6% is in the middle and older generation, which has less exposure or knowledge to the rapidly changing technology. Is their age a factor on how they respond to the survey questionnaire? The author also included the respondents' educational attainment in the study to

assess how they respond in terms of their capacities and ability to comprehend the technicalities of the development and function of the i-Election System as an alternative to face-to-face voting in polling places.

Figure 11. The Region where the Respondents Cast Their Votes

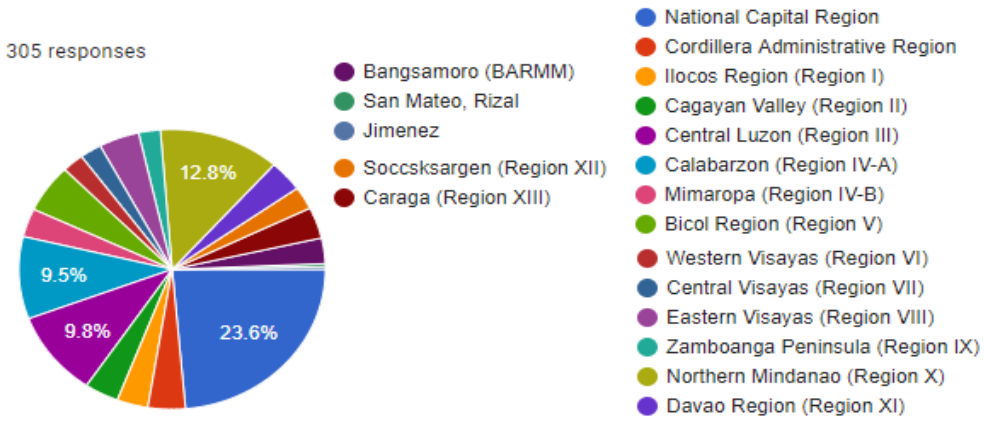
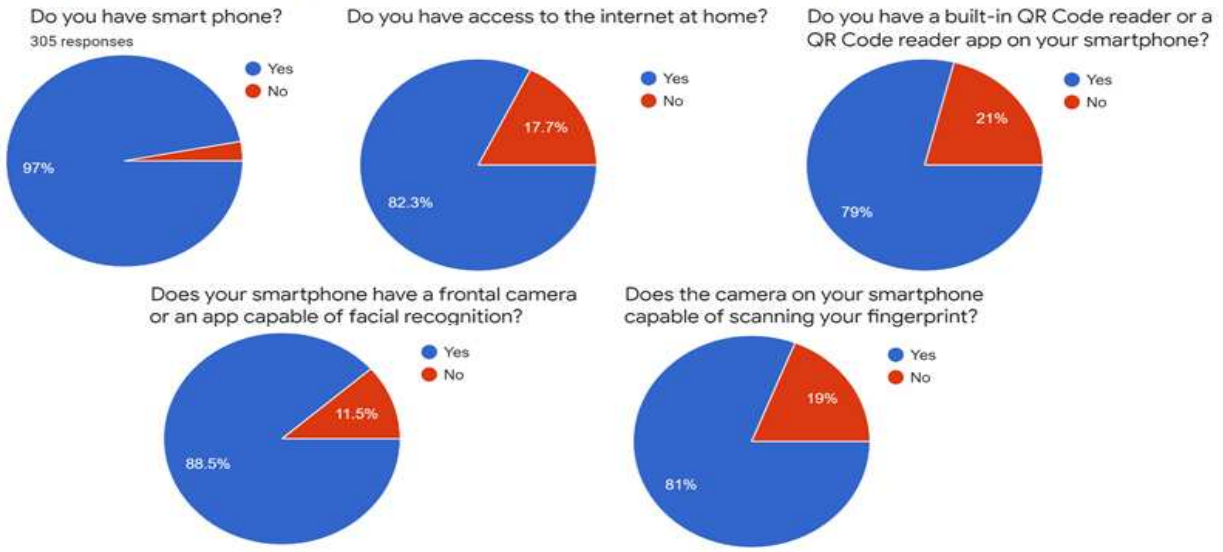


Figure 11 is an important component of the study because it determines the respondents' willingness to accept different options in the conduct of the election and their experience with the digital divide, as indicated in Figure 3. Most respondents (23.6% or 72 of the 305 total respondents) are voters in the National Capital Region (NCR). The voters/respondents in Northern Mindanao (Region X) accounted for 12.8% or 39 respondents. Central Luzon (Region III) received 9.8% or 30 respondents. While Central Luzon (Region III) had 9.8% or 30 respondents. And in Calabarzon (Region IV-A), they got 9.5% or 29 respondents. This information will aid the author in understanding how respondents answered to the survey, particularly in terms of the digital divide and access to resources in their respective regions.

Figure 12. Summary of The Materials and Internet Access of the Respondents



The author explains in Figure 2 that it is critical to know whether respondents in their respective regions have access to the internet and material resources to use this voting system. On the other hand, when asked if they have a smartphone, 97% or 296 of the respondents said "Yes," while 3% or 9 respondents answered "No." When asked if they have access to the internet at home, 17.7% or 54 of the respondents said "No," while 82.3% or 251 said "Yes." In response to the question "Do you have a built-in QR Code reader or apps on your smartphone?" 79% or 241 respondents said "Yes," whereas 21% or 64 respondents said "No." When asked if their smartphone has frontal camera capable of facial recognition, 88.5% or 270 respondents said "Yes," while 11.5% or 35 respondents said "No." As to the question, whether their smartphone is capable of fingerprint identification, 81% or 247 respondents said “Yes,” while 19% or 58 respondents said "No". These survey questions revealed that many of the respondents do not have access to the internet or other resources. Despite its small percentage, it does not address the issue of the digital divide, which could stymie the i-Election System's adoption and implementation.

The respondents' access to materials and the internet in their respective locations is clearly shown in Figure 12. Even though the number of respondents did not fairly represent their respective regions due to COVID-19, the author explains this in the limitations of the study. In some ways, the findings of this survey will reveal if respondents in their communities have access to technology as well as the viability of the i-Election System as a pandemic response to the challenge of modernizing the election process. While the answer to this question is moderate, it offers a challenge for many regions in terms of closing the digital divide, because the factors that contribute to the worsening of the digital divide, such as the "ARMS of Technology," have been clearly described.

The Survey Questionnaire using the Four-point Likert Scale

Rating Scale	Range	Verbal Descriptions	Verbal Interpretations
4	3.51-4.0	Strongly Agree	The respondents are very much in favor of the statement in question.
3	2.51-3.5	Agree	The respondents are in favor of the statement in question.
2	1.51 – 2.5	Disagree	The respondents are not in favor the statement in question.
1	1.00-1.5	Strongly Disagree	The respondents were extremely disapproved of the statement in question.

Table 2. Verbal Interpretation using Four Point Likert Scale

The verbal interpretation of the Four Point Likert Scale employed in this study is shown in Table 2. This will help the author analyze the statistical results of the data collected in the survey questionnaire, as shown in Figure 17 and Table 3.

Figure 17. Quantitative Findings on the Answers of the Respondents on their Willingness to Adopt the Hybrid QR Code Technology in the Election

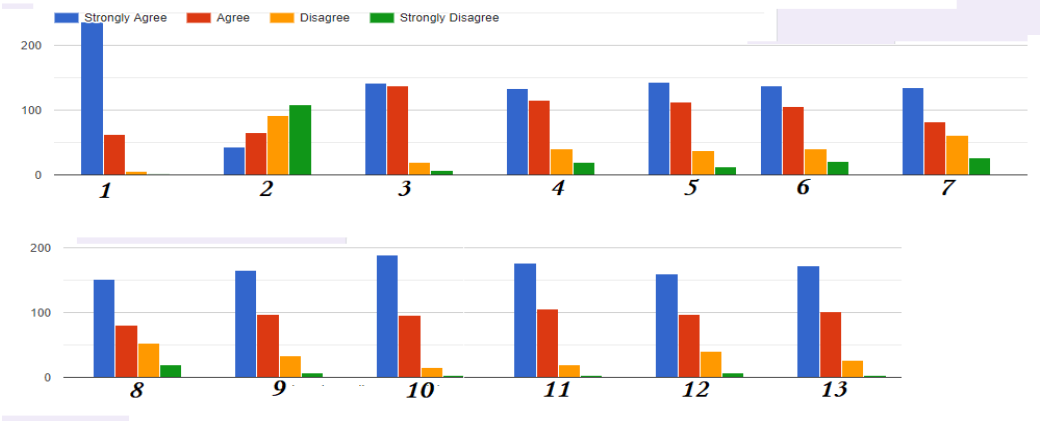


Table 3. Verbal Interpretation on the Results of the Survey Questionnaire on the Willingness of the Respondents to Adopt Hybrid QR Code Technology in the Election Process

	Questions	Mean	Median	Verbal Interpretation	Rank
1	You registered to vote in the upcoming 2022 National Election to exercise your right to suffrage?	3.75	4	Strongly Agree	1
2	If the pandemic situation remains at status quo or worsens in 2022, do you still intend to appear in person at the voting station?	2.11	2	Disagree	12
3	How strongly do you feel about the option of casting your vote using another method of voting, e.g. through your smartphone?	3.37	3	Agree	7
4	How strongly do you feel about the security and confidentiality of election information stored in an online database?	3.13	3	Agree	10
5	Do you believe that using hybrid QR code technology to record voter turnout will generate reliable results?	3.27	3	Agree	8
6	Do you believe that using hybrid QR Code technology in the election process will eliminate election fraud?	3.18	3	Agree	9
7	Do you believe that when elections are conducted using mobile devices, vote selling or buying will be eliminated?	3.07	3	Agree	11
8	Do you believe that casting a vote with a hybrid QR Code will prevent voters from election crime, violence, and coercion?	3.18	3	Agree	9
9	Do you believe that using hybrid QR Code technology will result in an immediate election turnout or the declaration of newly elected officials on the same day?	3.38	4	Agree	5
10	Remote voting, which may be done from the comfort of one's own home, is completely safe, especially from possible exposure to the COVID-19 virus.	3.54	4	Strongly Agree	2
11	The i-Election System is an innovative approach to achieve sustainable e-governance by shifting from traditional to technology-based elections.	3.48	4	Agree	3
12	The i-Election System can authenticate voters' identities and prevent double voting or ghost voters.	3.34	4	Agree	6
13	By using the i-Election System, voters can immediately send their votes to the COMELEC's database without delay.	3.45	4	Agree	4
	TOTAL	**3.25**	**3.34**	**AGREE**	

The results of the author's quantitative data collection are shown in Table 3. For 2022 National Election, Filipinos registered to exercise their right to vote, resulting in a verbal interpretation of (VI) Strongly Agree. This proves that, despite the country's pandemic crisis, they are determined to vote in the election. The question on remote voting, which ensures voter protection, likewise obtained a VI of Strongly Agree. All questions addressing respondents' adoption and willingness to embrace hybrid QR Code Technology or the i-Election System, as well as how this would handle election-related problems and challenges, with a projected result of increased voter turnout, received a VI of Agree.

Table 4. List of contributions of researchers on Voting systems from 2010-2020

SN	Author(s)	Year	Technology used	Findings
1	Weldemariam, *et al.* [6]	2010	ASTRAL language	To conduct an election on its day using the ES & S system.
2	Gentles, *et al.* [7]	2011	Android 3.0 (Honeycomb)	Biometric secured voting using mobile is developed.
3	Lavanya [8]	2011	Windows CE application	New technologies to maintain safe and secure voting are implemented.
4	Kumar, *et al.* [55]	2012	Biometric devices	Various types of EVM, issues, biometric used are studied.
5	Ankita *et al.* [9]	2013	RFID Biometrics	The limitation of maintaining a centralized voter database according to their constituency is resolved, and multilevel security is implemented through RFID biometric security during the election process.
6	Hussien, & Aboelnaga [10]	2013	Homomorphic System and Blind signature scheme with RFID	For security tools, a new voting system is implemented with Pallier cryptosystem and a blind signature scheme created on RSA.
7	Agarwal, & Pandey [11]	2013	Web-based and Fingerprint recognizer software	A person can vote from anywhere from their allotted constituency or their preferred location.
8	Matharu, *et al.* [12]	2014	Cloud-based ICT	It leverages ICT to combine the current Electronic Voting Machine system with the I-Voting system to increase voting percentages in India.
9	Ujir, *et al.* [13]	2014	3-D face recognition technology	For voting, modular approach human 3D faces recognition through neutral and 6 simple facial image expressions tests were conducted.
10	Mythili, *et al.* [14]	2014	Biometric devices	Voting is conducted using the SMS voting method.
11	Malladi, *et al.* [15]	2014	RESTful web services	Robust e-voting system developed using Micro ATM terminals avoids redundant votes by using OTP and Random Security Question (RSQ) dual-tiered authentication.
12	Adeshina, & Ojo [16]	2014	Online Web portal	E-voting systems focus solely on requirements, technical configurations, and implementation technologies to help choices from various aspects of registration and verification, by balloting and counting outcome.
13	Nikam, *et al.* [17]	2014	NFC with RFID	NFC tags attached mobile phones help users to get candidate information with security and allows people to cast vote anywhere.
14	Pomares, *et al.* [18]	2014	Online voting	A voting machine without the assistance of the user in the election process.
15	Shital & Pravin [19]	2015	Daughman algorithm to scan Iris detection.	The iris detection mechanism is used to scan every voter's iris and match against the same that is stored in the database to prevent dummy votes.
16	Dixit, *et al.* [20]	2015	GSM devises with cryptography techniques and Iris recognition	GSM devise with cryptography technique is used to maintain the number of voters and cast voting information are stored from time to time in the database. Offline

			techniques.	e-voting uses iris recognition to authenticate electors to cast votes.
17	Sudhakar & Sai [21]	2015	Fingerprint-based electronic voting machine using ARM9 microcontroller.	Fingerprint-based authentication to improve security by preventing fake voting and voting repetition
18	Grewal, *et al*. [22]	2015	Du-Vote is a new remote electronic voting protocol	In Du-Vote, trust is distributed between a simple hardware token that is given to the candidate, the voting machine, and a server executed by election authority persons.
19	Data, *et al*. [23]	2015	Paillier cryptosystem and blind signature method.	RSA-based Pailier cryptosystem and blind signature scheme for EVS is designed.
20	Nithya, *et al*. [24]	2015	Smart card and Iris recognition	The smart card reader is used to read a person's information and the iris recognition is used to further verify the user.
21	Madan Mohan & Srihari [25]	2015	RFID	A biometric voting method based on Aadhar card to prevent misconceptions.
22	Anandaraj, *et al*. [26]	2015	GSM module with fingerprint device	Fingerprint devise for authentication and GSM module for updating voting details in the database.
23	Naik [27]	2015	Atmega328 and Zigbee Module	A small-sized - smart wireless voting machine with authentication using Atmega328p is implemented.
24	Epstein [28]	2015	WiFi connectivity	WiFi connectivity helps polling officers to get polling summaries of all such WinVote machines placed at all booths.
25	Nithya, *et al*. [29]	2016	PIC 16F877A, Gsm Module, Cloud Storage.	It uses cloud-based IoT devices to get maximum benefits with minimal costs during the election.
26	Chakraborty, *et al*. [31]	2016	Fingerprint and Iris recognition	BVS is linked to a biometric fingerprint system that uses data stored in the database to recognize authenticated voters.
27	Hasan, *et al*. [32]	2016	Raspberry Pi 2, Arduino Uno, R3 microcontroller	Additional votes are prevented by using the photograph of the candidate with the details he casts.
28	Barnes, *et al*. [33]	2016	Blockchain	Digital voting with blockchain technology
29	Arooj & Riaz [34]	2016	Hash-based finger matching algorithm	A hybrid machine to verify the voter using hash base finger matching algorithm.
30	Dhinesh, *et al*. [35]	2016	ZigBee wireless technology	Zigbee, a wireless mesh network technology with low power and cost implements required communication during voting.
31	Bindia, & Aggarwal [36]	2016	An electronic signature, encryption	E-voting techniques like one-time password techniques, face recognition, and fingerprint recognition techniques.

			techniques, and hash functions	
32	Ayed [37]	2017	Blockchain technology	The new EVM could be used in local or national elections with a low cost.
33	Sarankumar, *et al*. [38]	2017	RS232 serial data transmission cable is used to connect the fingerprint module with Arduino.	Voter details are communicated using IoT to the database automatically.
34	Priya, *et al*. [56]	2017	Arduino and Finger Print Scanner	Arduino controls complete processes such as read button, increase vote value, generate results, and send vote and result to LCD.
35	Rezwan, *et al*. [57]	2017	Arduino and Finger Print Scanner	Arduino and Finger Print Scanner, capable of identifying every voter, counting votes, and preventing fake votes in Bangladesh.
36	Anik, *et al*. [39]	2017	Solar power based	Solar-powered EVM prototype that will perform all the tasks involved in voting.
37	Saravanan, *et al*. [58]	2017	Iris recognition	EVM is used with the IRIS recognition system, and AADHAR card database access is used for IRIS.
38	Selvarani, *et al*. [59]	2017	SMS using smartphone	Online voter registration, voting, and display of results using the SMS concept.
39	Baig, *et al*. [40]	2017	Smartphone App	The smartphone app allows users to cast the vote using mobile with complete security provided using OTP.
40	Deepika, *et al*. [41]	2017	IoT based	IoT will be used to communicate the votes cast to the database needed for ease of complete counting.
41	Bhuvanapriya, *et al*. [42]	2017	Smart device	Finger print-based application also offers the ability to vote online and 100% voting.
42	Kavitha, et al [60]	2018	Fingerprint, face and iris recognition	the voting system based on the Fingerprints and Iris verification is used.
43	Hjálmarsson, *et al*. [43]	2018	Blockchain-based	Blockchain-based technology that improves security and reduces the expense of holding a national election.
44	Khoury, *et al*. [44]	2018	Blockchain-based	Ethereum Blockchain-based decentralized voting platform.
45	Shaw, *et al*. [61]	2018	Arduino UNO	Arduino based Aadhar facilitated an EVM execution with Two-Tier fingerprint security.
46	Prabhakaran, *et al*. [62]	2018	Iris acknowledgment and thumb impression	voting framework with protection and security.
47	Kadam, *et al*. [63]	2018	ATMEGA 32 microcontroller.	Voting machine built with ATMEGA 32 microcontroller provides three-layered extra security.
48	Patil, *et al*. [45]	2018	Smartphone with cryptography	Next-generation online highly secure voting system.

Source: Vinayachandra, et al., 2020

Table 4 was adopted by the author based on the findings of Vinayachandra et al., (2020), which summarized several studies undertaken by various authors on the voting system using technology between 2010 and 2020. The current author went over the contents of these studies and were able to obtain information's and technical assistance for the development of the i-Election System. Since 2010, several researchers have explored the possibility of transforming the election process from physical presence at polling locations towards the use of various technologies and digital applications. Most of the technologies listed above are blockchain-based, smartphone devices and apps, and fingerprint and iris recognition. Several technologies for voting systems were integrated in the research of Agarwal and Pandey, Dixit et al., Sudhakar and Sai, Anandaraj

et al., Chakraborty et al., Hasan et al., Kavitha et al., and Patil et al. While all the studies in Table 4 demonstrate the numerous advantages of various technologies, they are all vulnerable to technological issues and costly because they are all part of the forefront or main system that the voter may access and use. While author's i-Election System fueled by hybrid QR Code Technology is used to link to the COMELEC's main database, making it safer, more secure, and less expensive.

Table 5. Newzoo's 2020 Global Mobile Market Report, 2020 Ranking

Rank	Country/Region	Total population	Smartphone penetration	Smartphone users
1	United States	331M	81.6%	270M
2	United Kingdom	67.89M	78.9%	53.58M
3	Germany	83.78M	77.9%	65.24M
4	France	65.27M	77.6%	50.66M
5	South Korea	51.27M	76.5%	39.2M
6	Italy	60.46M	75.9%	45.92M
7	Russia	145.93M	68.5%	99.93M
8	China	1.44B	63.4%	911.92M
9	Vietnam	97.34M	63.1%	61.37M
10	Iran	83.99M	62.9%	52.81M
11	Turkey	84.34M	61.7%	52.06M
12	Japan	126.48M	59.9%	75.77M
13	Indonesia	273.52M	58.6%	160.23M
14	Mexico	128.93M	54.4%	70.14M
15	Thailand	69.8M	54.3%	37.88M
16	Brazil	212.56M	51.4%	109.34M
17	Philippines	109.58M	37.7%	41.31M
18	Bangladesh	164.69M	32.4%	53.3M
19	India	1.38B	31.8%	439.42M
20	Pakistan	220.89M	18.4%	40.59M

Table 5 shows the nations with the highest smartphone penetration in 2020. This data was adopted from Newzoo's Global Mobile Market Report enumerating top countries in terms of smartphone ownership by percentage of the population. With 37.7% smartphone penetration and 41.31 million smartphone users out of 109.58 million inhabitants, the Philippines is ranked 17th. This indicates that 41.31 million Filipinos own a smartphone. This research indicates that 68.27 million Filipinos who may be facing a digital gap or who have been impacted by ARMS of technology should be examined, as this will have a significant impact on the successful implementation of the i-Election System, if adopted.

Triangulation Analysis of Data

The data sources of the study were assessed and analyzed, which included voter/respondent responses to the survey questionnaire from various regions in the Philippines, the mapping of the theoretical principles and framework used by several authors, as well as their results, and the gaps identified by the researchers in their studies.

The author mapped different studies to identify potential gaps, as shown in Table 1 (Voting System Adopted by Some Southeast Asian Countries) and Table 4, and based on this analysis, adopted some of the applicable theories to the study, such as the Digital Divide, which demonstrates the Philippines' historical problem with technology, particularly the internet, and material accessibility. The Van Dijk's (2005) cumulative and recursive approach to successive types of access to digital technologies (Figure 2) was also examined, resulting in the design of the i-Election System (Figure 1) based on the connection and integration of various technologies such as QR Code Technology (Figure 4), Facial Recognition (Figure 5), Fingerprint identification (Figure 6) with Web-based technology for monitoring purposes, which resulted in the author's concept, the "Whole of Techmocratic Approach to Governance." After analyzing the numerous data of different research, the author identified the primary elements contributing to the increase in digital divide, which are ARMS of Technology (Figure 3).

The purpose of developing the i-Election System is to ensure voter equality, which is based on the principle of "one voter, one vote," meaning each person's vote should be equally weighted. A ballot is considered fair in the electoral system if it adheres to the principles of equality and liberty, as well as the confidentiality and secrecy of voting.

This analysis confirms the existence of a digital divide, which may impede the successful adaptation and implementation of the i-Election System. People want to exercise their right to vote, but the government must find other ways to protect them from the pandemic. Several authors have experimented with using technology for election registration or casting of votes, and the current author examines their findings to strengthen the development of the i-Election System by determining the best technology to combine that is not overly expensive or burdensome to the government while adhering to the thrust of digital transformation.

CONCLUSION AND RECOMMENDATION

In today's world, technology is one of the primary drivers of communication and productivity for all people, including education, food delivery, online shopping, and work, among other things. Technology enables society to maintain interactions, particularly with the government in providing assistance and services to its citizens.

In this study, hybrid technology is critical in the development of the i-Election System because it combines various types of technology to create a sophisticated but sustainable system. This is not a band-aid solution to the never-ending challenges and election-related issues that people face and experience during every election season. This study will give the government something to think about, an alternative to consider, and a practical way to increase voter turnout.

The author ensures that hybrid QR Code Technology is a secure technology that cannot be hacked because it only connects to the COMELEC's main system. As a result, the probability of the system being compromised is easily determined under this design because only few authorities have access to the system's main server, which can only be modified or unlocked with the simultaneous approval of five different officials. In the absence of one official's authorized access or code, the system remains closed.

The web-based feature of the i-Election System is only for monitoring and notification of vote archiving. The system's web-based support, like the QR Code, merely bridges data from the core system for viewing and monitoring purposes. This procedure will ensure that the data delivered to the main server is secure and free of human manipulation.

The i-Election System also seeks to bridge the digital divide by urging the government to adopt a "Whole of Techmocratic Approach to Governance." This system provides voters with complete control over who they vote for, allowing them to vote from the comfort of their own homes or anywhere else without force or influence from others. It is techmocratic because it mixes several types of technology to create a single system that allows people to vote remotely at their convenience, free of fear, election-related violence, and coercion.

The system was designed by the author to encourage people to fully participate in the election process and to restore trust in the election results, leading to good governance. This approach will provide the government with the option of achieving a long-term solution to the challenges and issues encountered in previous elections. The author, on the other hand, believes that the proposed system is not a perfect system because there is no such thing as perfect technology. It is a solution that has the potential to increase voter turnout while also restoring Filipinos' confidence and trust in the Philippine electoral system. If adopting this hybrid election process for the 2022 National election is not possible due to time constraints, the author suggests that the Philippine government may consider it for future elections. This system is completely contactless, from registration to campaigning, voting, and generating election results.

Furthermore, because it directly points to the COMELEC main data base, adopting this system can easily determine who will cause election irregularities. If there are any irregularities, the government can track down the people who are authorized to maintain and safeguard the record, as well as the programs that are installed in the system.

As the saying goes, "a single stone can tip the scale." meaning a single vote can make a significant impact (asiasociety.org, 2013). Therefore, it is important that all Filipinos eligible to vote can freely cast their vote with ease.

References:

Alim, M. Affan, Misbah M. Baig, Shahzain Mehboob, and Imran Naseem. Method for secure electronic voting system: Face recognition-based approach. chrome-extension://oemmndcbldboiebfnladdacbdfmadadm/http://iss.uni-saarland.de/workspace/documents/1.pdf

asiasociety.org (2013). Asia 21 Philippines Discussion Series: Youth and Responsible Voting. https://asiasociety.org/philippines/asia-21-philippines-discussion-series-youth-and-responsible-voting

Bryman, Alan. (2004). Triangulation and measurement. Retrieved 11 Feb. 2013 from http://www.referenceworld.com/sage/socialscience/triangulation.pdf

Charan. S, k. Hari Prasanth, and D. Anand Joseph Daniel. (2020). Smart voting system using Fingerprint Scanner. IJARIIE-ISSN(O)-2395-4396. Vol-6Issue-2. chrome-extension://oemmndcbldboiebfnladdacbdfmadadm/http://ijariie.com/AdminUploadPdf/Smart_voting_system_with_fingerprint_scanner_ijariie11545.pdf

Dimple, Prasad, Sangale Shradha, Shinde Sandhya (2014). E-voting System Using QR code and Mobile OTP based on Android platform for Modern Individuals. International Journal of Scientific & Engineering Research, Volume 5, Issue 10, October-2014. ISSN 2229-5518

Dooc, Manny (2021). The significance of the 2022 national elections. Business Mirror. https://businessmirror.com.ph/2021/05/14/the-significance-of-the-2022-national-elections/

Falkner, Stefanie, Peter Kieseberg, Dimitris S. Simos, Christina Traxler and Edgar Weippl. (2014). E-voting Authentication with QR-codes. T. Tryfonas and I. Askoxylakis (Eds.): HAS 2014, LNCS 8533, pp. 149–159, 2014. Springer International Publishing Switzerland

Friday, Catherine, Andrew Garner, Permenthri Pillay, and Arnauld Bertrand (2021). How can clever governments choose to close the digital divide?. Ernst & Young Global Limited. https://www.ey.com/en_au/government-public-sector/how-can-clever-governments-choose-to-close-the-digital-divide

Hazzaa, Firas and Seifedine Kadry (2012). New System of E-Voting Using Fingerprint. International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 10,October 2012)

Hegde, Apoorva. 2020. QR Codes for Election Campaigns: How Can They Be Used? beaconstac.com. blog.beaconstac.com/2020/07/qr-codes-for-election-campaigns/

Kaspersky (undated). QR Code Security: What are QR codes and are they safe to use? https://www.kaspersky.com/resource-center/definitions/what-is-a-qr-code-how-to-scan

Marr, Bernard (2019). Facial Recognition Technology: Here Are the Important Pros and Cons. Forbes. https://www.forbes.com/sites/bernardmarr/2019/08/19/facial-recognition-technology-here-are-the-important-pros-and-cons/?sh=3f9181ee14d1

Muñoz, Analiza. (2020). System Development of Market Mobile Application for Sustainable Local Industry in the Philippines DOI: 10.13140/RG.2.2.18158.02885.

Philippines. (2002) Republic of the Philippines Commission on Elections COMELEC. Philippines. Retrieved from the Library of Congress, https://www.loc.gov/item/lcwaN0003729/.

Valsamidis, Stavros. (2017). A Web e-voting system with data analysis component. Journal of Systems and Information Technology Vol. 20 No. 1, 2018 pp. 33-53 © Emerald Publishing Limited 1328-7265 DOI 10.1108/JSIT-01-2017-0002

Van Dijk JAGM. 2005. The Deepening Divide: Inequality in the Information Society. London, UK: Sage Publications. https://books.google.com.ph/books?hl=en&lr=&id=AwGJCgAAQBAJ&oi=fnd&pg=PP1&ots=vKw8Mq6o53&sig=ayVcZ1SvYaxIAaD9iZLCLIhFLbA&redir_esc=y#v=onepage&q&f=false

Veale, Michae. (2021). The English Law of QR Codes: Presence Tracing and Digital Divides. https://michae.lv/law-of-qr/

Vinayachandra, K., Geetha Poornima, M., Rajeshwari & Krishna Prasad, K. (2020). Role of Technology in the Development of Smart and Secure Public Voting Systems – a Review of Literatures. International Journal of Management, Technology, and Social Sciences (IJMTS), 5(1), 298-317. DOI: http://doi.org/10.5281/zenodo.3934439.

Wolf, Peter, (2017) Introducing Biometric Technology in Elections. International IDEA. chrome-extension://oemmndcbldboiebfnladdacbdfmadadm/https://www.idea.int/sites/default/files/publications/introducing-biometric-technology-in-elections-reissue.pdf