Citizens' Readiness to Adopt and Use Electronic Voting System in Ghana

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Abstract—The adoption and application of Information and Communication Technologies (ICTs) in government administration through e-government is expected to permeate all sectors of state/ public institutions as well as democratic institutions. One of such public institutions is the Electoral Commission of Ghana mandated by the 1992 Constitution to hold all public elections including presidential and parliamentary elections. As Ghana holds its 7th General Elections since 1992, on 7th November 2016, there are demands from key stakeholders for the Election Management Body, which is the Electoral Commission (EC) of Ghana to adopt and implement an electronic voting system. This case study, therefore, attempts to contribute significantly to the debate by examining influencing factors that would impact on citizen's readiness to adopt and use an electronic voting system in Ghana. The Technology Acceptance Model (TAM) was used as a theoretical framework for this study, out of which a research model and hypotheses were developed. Importantly, the outcome of this research finding would form a basis for appropriate policy recommendation for consideration of Government and EC of Ghana.

Keywords—Citizens readiness, e-government, electronic voting, technology acceptance model (TAM).

I. INTRODUCTION

THE modernizing of public administration through e-government is expected to bridge the gap between the citizenry and state institutions/government. E-government is the use and application of Information Technologies in public administration to integrate workflows and processes, to effectively manage data and information which would improve public service delivery and exposure to information for citizen engagement and empowerment [1]. The adoption and implementation of e-government by most governments around the world particular in Africa and Ghana are to encourage active citizen participation in the policy decision-making process. One of the critical decisions for every citizen to make in a democratic state is the onus and responsibility to participate in the democratic process through elections properly constituted by an Election Management Body (EMB). E-government is one of the very first "e"-developments, but there are other disciplines which show the relationship and interaction between Governments and its citizens [2]. The term "E-governance" is the large body while e-government is considered as one of its disciplines. Another related discipline for active participation is e-democracy. Although e-government is "only" a building block of e-Governance, it's none the less strongly influences all other disciplines because of

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the fundamentals laid down by e-government implementation act as the basis [2]. A critical factor in the area of e-democracy is electronic voting (e-voting). Electronic voting is a special application of e-government technologies which can be considered as the supreme discipline of all e-government applications due to its conflicting priorities of unique identification and perfect anonymity [2].

An electronic voting system is a voting system in which the election data of registered citizens as a voter is captured and recorded, stored and processed as digital information for the purpose of conducting an election. The Institute for Democracy and Electoral Assistance (IDEA) defined electronic voting as a system where the recording, casting or counting of votes in political elections and referendums involve ICTs [3]. Countries around the globe particularly, developing countries are considering adopting e-voting systems with the aim of improving various aspects of the electoral process and it is seen as means for advancing democracy, building trust in electoral management, adding credibility to election results and increasing the overall efficiency of the electoral process [3].

An electronic voting integrates ICTs in the front-end of the election machinery system, where an electronic device is used to record the voter's intention directly in a digital form on the device, which is much better compared with the conventional paper-based physical ballots, voters deal with electronic devices that has interface that presents virtual digital ballots [4]. The adoption of electronic voting has some advantages over the traditional paper-centered way of voting. These are; it increases the speed and accuracy of ballot tabulation, saves materials required for printing and distributing ballots, offer better accessibilities for people with disabilities [4]. The IDEA shares the same view that proper implementation of e-voting system could potentially eliminate common avenues for fraud; speed up the processing of results, increase accessibility and making a casting of ballots more convenient for citizens. These are high expectations of an e-voting system anywhere in the world, but unfortunately, not all e-voting systems succeed in delivering on these high expectations [3].

Basically, there are two types of an electronic voting system depending on where the voting occurs. This can be either poll-site (onsite at a fixed computer or system for voters to cast their vote) or remotely (at the convenient place or homes for voters to access through their computers or phones). The On-site poll system is described as Direct Recording Electronic Devices (DREDs). Poll-site electronic voting is supervised by a representative of Election Management Body (EMB) with electronic voting machines at the polling station while the remote e-voting is not physically supervised such as voting

from a computer device via the internet, by mobile phones, digital TV, and public kiosks. Ultimately, the goal of any electronic voting system could be viewed from two dimensions, which is an electronic method of casting a vote and electronic way of counting votes cast. It thus follows that any electronic voting system should stand the test to deliver these two dimensions since they are very critical and important to legitimizing the democratic decision process. It is expected that as a tool, electronic voting would make the electoral process more efficient and for increasing trust in election management body. E-voting system could be classified into six main components: voter's registration, authentication, voting and votes saving, vote management, vote counting and auditing. [5].

Electronic voting could present a much better system then the manual paper-based system of voting and voters view the e-voting system as means of making their vote cast much easier [6]. The Independent EC of South Africa (IEC) in a study of Achieng and Ruhode on e-voting in South Africa, indicated that the IEC is of the view that although electronic voting is a good system, the risks and challenges of adopting and implementing such technology are high [6]. The study [6] further revealed that the citizens favored e-voting system to be useful because they perceived that e-voting system would reduce human error in the electoral process and by extension increase transparency in elections while some participants also perceived that the Ease of Use of electronic voting system could be hard to use or adopt particularly with regard to elderly citizens who may have no knowledge of an e-voting system.

There have been many studies on using ICTs through electronic voting to improve elections but these studies caution against the risks of moving too swiftly to adopt and implement electronic voting systems due to the software engineering challenges, insider threats, network vulnerabilities and challenges of auditing [7]. E-voting is a complex system involving many people at several different levels of the electioneering process, hence, a step by step approach makes it possible to gather experience and apply it to the improvement of electronic voting [8].

Ghana would conduct General Elections in November 2016 to elect a new President to run the affairs of the county and Parliamentarians to represent the people in Parliament. The election will be conducted by the EC of Ghana who is the Election Management body of Ghana mandated with the power and authority under the 1992 constitution of Ghana to organize elections for both the Presidential and Parliamentary elections. The EC of Ghana for the first time, in the history of elections in Ghana, adopted and implemented the use of biometric registration and voting with the biometric device in 2012 General Elections. But going into the 2016 elections, some political parties, leading national personalities and ordinary citizens have implored the EC of Ghana to go a step further, beyond the Biometric Voting System to an Electronic Voting System in the upcoming 2016 general elections.

The proposal for the EC to adopt e-voting systems for the 2016 elections has captured the attention of all major stakeholders and Think Tanks and the debate is whether the use of an electronic voting system for Ghana would enhance and provide more credible, transparent and free and fair elections which would be acceptable to all citizens, the major political parties, and the general public. The call to adopt an electronic voting is due to the perceived challenges encountered in the 2012 General Elections where the biggest opposition party had to resort to the law court (Supreme court of Ghana) to register their displeasure with the presidential election results and called for the annulment of votes at certain polling stations because of alleged electoral malpractices and irregularities at these centers. These election challenges have led to calls on the EC to initiate immediate adoption and implementation of an electronic voting system while the gradualist has suggested the EC should proceed cautiously by undertaking a detailed study of Electronic Voting best practices around the world for future implementation in Ghana. Hence, this study seeks to enrich the ongoing debate from the academic perspective by examining the Ghanaian citizen's readiness to adopt and use an electronic voting system. The main objective of this research is to understand influencing factors for the Ghanaian citizen readiness to adopt and use an electronic voting system in Ghana. Most importantly this study will contribute to the ongoing debate on whether Ghana should adopt an electronic voting system as it's widely used in Developed and Developing countries such as the USA, India, Namibia, and Brazil.

This study is significant because it intends to provide policy recommendations to the appropriate body in charge of elections in Ghana as well as for the attention of Government and also to provide useful insight for political parties who are the key stakeholders in matters of elections in Ghana. To achieve the ultimate goal of this study, the following research questions would be explored:

1. To what extent does Perceived Usefulness have a positive impact on Citizens Readiness to adopt and use an electronic voting system in Ghana?
2. Does Perceived Ease of Use have a positive impact on Citizens Readiness to adopt and use an electronic voting system in Ghana?
3. Do Perceived Free and Fair Elections have a positive impact on citizen Readiness to adopt and use an electronic voting system in Ghana?
4. Does Perceived Credible Elections have a positive impact on Citizen Readiness to adopt and use an electronic voting system in Ghana?
5. Does Perceived System Integrity have a positive impact on Citizens Readiness to adopt and use an electronic voting system in Ghana?
6. Does Citizen Trust in Election Management Body have a positive impact on Citizens Readiness to Adopt and Use an electronic voting system in Ghana?

II. RESEARCH METHODOLOGY

In carrying out this study, both qualitative and quantitative approach will be adopted to conduct this research. Quantitative provide a more logical and data-led approach which provides a measurement from a statistical point of view. It also enables the gathering of a large amount of data that can easily be organized

and manipulated for analysis purposes. Unlike the quantitative approach which depends on numbers and data, qualitative research is more focused on with concepts and ideas with open questioning. A questionnaire instrument of 5 Likert scales would be designed to collect data from prospective respondents to solicit answers to the research questions in terms of their Perceived Usefulness, Perceived Ease of Use, Perceived Free, and Fair Elections, Perceived Credible Elections, Citizens Trust in Election Management Body and Citizens Readiness to adopt and use an Electronic Voting System. The questionnaire would also seek to gather demographic information such as gender, age, educational level and IT knowledge of respondents. Designed questionnaire is expected to be administered randomly to 300 potential respondents from Universities, Public Sector Institutions and some selected communities as the targeted population for this study. The data captured will be analyzed with SPSS and Excel Spread Sheet.

III. BACKGROUND OF ELECTIONS IN GHANA

Ghana is considered one of the most stable countries in West Africa and the whole of Africa since its transition to multi-party democracy in 1992. Ghana in 1957 was the first sub-Saharan country to have attained independence with Dr. Kwame Nkrumah as its first President and Head of State. The population of Ghana is around 25 million (2010 census) and it has 10 administrative regions with Accra as its capital city. Internet users in Ghana are 5,171,993 which count for about 19.56% of internet penetration rate in Ghana [9]. The Literacy rate in Ghana is 76.6%.

Since 1992, the EC of Ghana, the body constitutionally mandated to conduct general elections in Ghana, has successfully conducted six 6 consecutive elections which widely have been recognized to be 'free and fair". The upcoming 2016 November 7 would be the 7th elections the EC will conduct. The EC is the official body in Ghana responsible for all public elections (Presidential, Parliamentary, and District and Municipal Assembly elections). It has seven

members headed by a Chairman, Charlotte Osei who is the first lady to occupy this prestigious position. The Electoral Commission Act (Act 451) of 1993 is the act which established the commission. There are 24 registered political parties in Ghana [10]. The multiparty system in Ghana is about 24 years old since its inception while the country has also gone through a period of a military system for 21 years and one party system for six years.

The EC is mandated to conduct both presidential and parliamentary elections once every four years. In the conduct of elections in Ghana, the EC goes through processes such as voter registration, voter register exhibition, actual voting, vote counting, collation and publication of results [11].

- *Registration of voters*. This process allows for the eligible and qualified potential voters to get their names captured into the election register as Voters. To be eligible, a voter must be 18 years and above and of a sound mind.
- *Exhibition of the voters' register:* The name of voters captured during the registration period is considered as provisional register. It is then exhibited at each pollution station for the general public to cross-check their registration details for errors or discrepancies.
- *Voting (actual voting-manual):* This is the actual process of casting a ballot for potential candidates on the ballots on Election Day. A voter goes to a registered polling station where his/her name is checked by showing a voter identification card to the polling station official for inspection. If well checked, the voter is permitted to cast the vote.
- *Vote counting and the announcement of results:* the voting day close at 5 pm and then counting of votes is manually done with results collated through the district level to the constituency and then to the national level at the EC headquarters.
- *Publishing of results:* The 1992 constitution mandates the EC to publish and gazette all elections result within a period of time after the counting and declaration of results.

TABLE I
PRESIDENTIAL ELECTION RESULTS 1992-2012

Year	Registered Voters	Total Votes (Voter Turnout)	Invalid Votes	Total Valid Votes	System
Dec 7.1992	8,229,902	4,127,876 (50.2%)	149,811	3,978,065	Manual
Dec 7.1996	9,279,605	7,266,693 (78.3)	120,921	7,145,772	Manual
Dec 7.2000	10,698,652	6,605,084 (61.7%)	104,214	6,500,870	Manual
Dec 28.2000*	10,698,652	6,459,003(60.4%)	77,616	6,381,387	manual
Dec 7.2004	10,354,970	8,813,908 (85.1%)	188,123	8,625,785	manual
Dec 7.2008	12,472,758	8,671,272 (69.5%)	205,438	8,465,834	manual
Dec 28.2008*	12,472,758	9,094,365 (72.9%)	92,886	9,001,478	manual
Dec 7.2012	14,158,890	11,246,982 (79.43)	251,720	10,995,262	Manual & BVD

*means the elections for the year December 28, 2000, and December 28, 2008, went into a second round because of the failure of contesting candidates to garner the required 50% plus one vote mandated by the 1992 Constitution for a candidate to be successfully elected as President.

Since 1992, the EC has used the manual system to conduct all elections in Ghana with it attendant challenges. Particularly, the challenges encountered in the 2008 general elections was what led to the proposal by key stakeholders for the EC to adopt Biometric Verification Devices (BVD) for the conduct of the 2012 general elections. The BVD was to ensure that every

voter's finger print was biometrically verified before one is allowed to cast his/her votes and also to eliminate the challenge encountered in the 2008 elections. The EC with support from Government acquired the biometric technology system and implemented it with a backing law passed by parliament for the conduct of 2012 elections but less than four years of the BVD

use in Ghana, there have been calls again for the country to change to an electronic voting system over the internet.

Table I illustrates Presidential elections results of Ghana from 1992-2008 [12] and 2012 elections results [13]. Ghana has conducted elections by means of the manual system since 1992, which is more than 20 years but in the 2012 elections the Biometric Verification Device and the manual system was both applied.

The 2012 General Elections presidential result [14] depicting the two major and dominant political parties in Ghana, National Democratic Congress (NDC) and New Patriotic Party (NPP) is shown in Fig. 1.
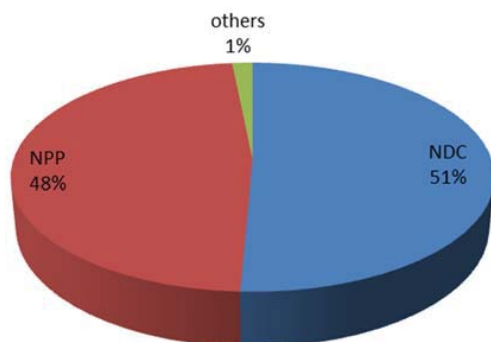

Fig. 1 2012 Presidential Election Results [14]

Even though there are other small political parties in Ghana, the 2012 election result in Fig. 1 paints a picture of Ghana gradually transforming into a two-party system or state. Other smaller political parties only obtained 1% of the total votes cast in the elections. Ghana currently has 275 parliamentary seats in parliament with NDC having 148 seats (majority), NPP 121 seats (minority) while other small parties and independent candidates have 6 seats in the Legislature of Ghana. Ghana has a unicameral Legislature with an Executive President who is mandated by the Constitution to appoint a majority of Ministers from Parliament.

IV. COUNTRIES WITH ELECTRONIC VOTING SYSTEM

Countries which have adopted and implemented an electronic voting system mostly are considered developed countries while the developing countries hardly adopt it for the conduct of elections. This could be due to the huge financial and infrastructure investment needed for the adoption of an electronic voting system. This notwithstanding, the developing including the least developed countries could learn from the challenges as well as the success stories of implementing an e-voting system in Developed countries for the purpose of bringing transparency and credibility in election outcomes. Particularly citizens confident and trust in the election management process. The Electoral Knowledge Network [15] as depicted in Table II, as at 2010 the listed countries had adopted an electronic voting system, either the direct voting machines or remote internet voting and a mixture of the two systems for conducting elections.

TABLE II
COUNTRIES WITH AN ELECTRONIC VOTING SYSTEM

Country	Type of E-voting system	Year commenced
Brazil	*Voting Machines* – was developed in 1995 but used first in municipal elections in 1996	1985
Canada	*Remote Internet Voting* -	2003
Estonia	*Remote Internet Voting* – discussion on Internet voting first started in 2001 but was given legal status in 2001	2003
Germany	*DRE voting machines*	2009
India	*Electronic voting machines & Remote Internet voting* – the voting machines have been in use since 2002 but was first piloted in 1982 while the first remote internet voting was experienced in 2011	1982
Norway	*Remote Internet Voting-* though the Government of Norway through Parliament decided to use the e-voting in 2008, first experimented in the local government elections in ten municipalities in September 2011.	2008
Switzerland	*Remote Internet Voting-*	2000
The Netherlands	*Voting Machines*	1960
USA	*Electronic Voting Machines (DRE)-* even though the USA has adopted DRE machines, it also has other forms of voting systems such as Hand-counted Paper Ballot, Paper Ballot with Optical Scan, Punch Card and Mechanical Lever Machine for conducting its elections	1980

Table II shows that no African country as at 2010 has started the adoption and implementation of an electronic voting system for the purpose of conducting elections. But Namibia has broken this record by adopting and implementing an electronic voting system (e-voting machine) for its presidential and parliamentary elections on 28th November 2014, which is the first on the Africa continent. Its adoption enhanced free and fair elections in Namibia and most importantly simplified the Namibian electoral processes. Discussion for the introduction of the EV machines commenced in 2004 but was given a legal status in the 2009 Electoral Act as a result of challenges encountered in counting and tabulation process in the country's 2009 elections. For the first time in Namibia 1.2 million voted electronically in the country's fifth election since independence. The voters cast their ballots for both presidential and parliamentary candidates on separate machines, chunky slabs of green and white plastic with the names and images of candidates and their party affiliations made a loud beep after each vote. The voting machines speed up counting and reduce long queues for the Namibia's 1.2 voters [16]. The Electronic voting machines (EVM) are standalone machines composed of two components; the Control Unit and Balloting Units. The Control Unit is the section which is only operated by the mandated official polling station officers. The control unit is shown in Fig. 2.
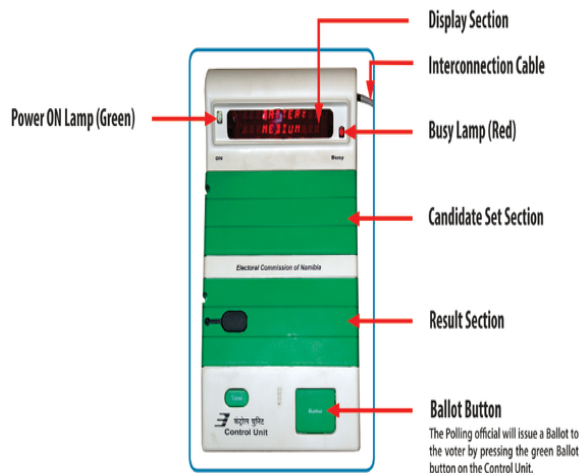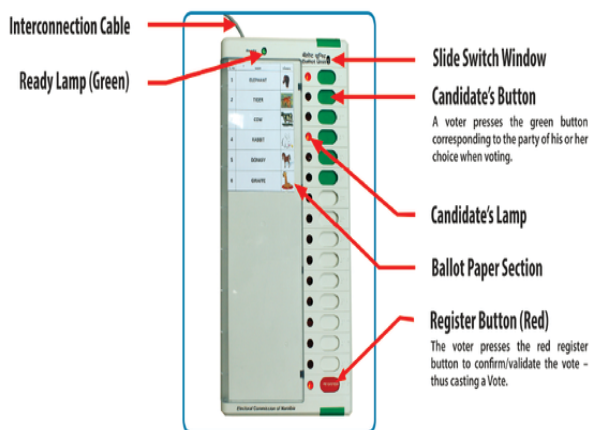
Fig. 2 Control Unit [17]

Fig. 3 Ballot Unit [18]

Fig. 4 Electronic Voting Machine-Control Unit and Ballot Unit [19]

The Ballot Unit in Fig. 3 is the voter interface and a voter only interact with this unit and not he Control Unit. It consists of a permanently fixed interconnecting cable which connects the Ballot Unit to the Control Unit. The EVMs are not connected to any computer or network/wireless and hence cannot transmit/send or received any signal which prevents the possibility of votes been intercepted or tampered with. It is powered by batteries which make it suitable to operate in catchment areas with no electricity without replacement during the voting process and counting.

To ensure voter confidence and trust in the EVMs, a Voter-Verified Paper Audit Trail (VVPAT) was included as parts of the voting process. It was designed to allow voters to verify that their vote was cast correctly for their intended candidates in order to detect possible election fraud and tampering with election results.

The challenges and success emanating from Namibia use of e-voting system could be useful for other Africa countries contemplating of adopting an electronic voting system for its general elections.

V. RESEARCH THEORETICAL FRAMEWORK

The TAM developed by Davis [20] is among one of the theories applied by most researchers to understand and predict citizen/user acceptance or determinate of technology applications. Other TAMs are the Theory of Reasoned Action (TRA) [21], Theory of Planed Behavior (TPB) [22], Extension of the Technology Acceptance Model (TAM2) [23], Diffusion of Innovation (DOI) [24] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [25].

The TAM model considers two very important variables; perceived usefulness and perceived ease of use as relevant to explain the adoption of technology. Davis defined perceived usefulness as the prospective user's probability that using a specific technology application will enhance his or her job or life performance. That is the use of specific technology would be useful in achieving users expected outcome/completed and expected tasks. The degree to which a user/citizen anticipates or expects that the use technology application to be free of challenges and free of effort is known as Perceived Ease of Use. These two factors are the most critical factors in determining actual system usage. The Perceived Ease of use also affects Perceived Usefulness. The perceived usefulness has an effect on adoption Intention while Perceived Ease of Use has immediate and an indirect effect on adoption intention through perceived usefulness. The TAM by Davis is depicted in Fig. 5.

The study of [26] provided the support for the contention that a customer attitude performs a mediating role in the link between perceived usefulness, ease of use, security and privacy and customer adoption. [27] evaluated the acceptance of eLearning systems by teachers using the TAM model. [28] developed a model based on TAM to understand mobile service adoption which states that perceived ease of use is the strongest factor in technology adoption. [29] developed a model to predict the acceptance of e-commerce by adding a new factor trust and perceived risk. [30] developed a new model based on TAM which is called Shopping Acceptance Model to study online shopping behavior. TAM was also used by Abdullah and Ward [31] as a grand theory to develop a General Extended TAM for E-learning (GETAMEL).
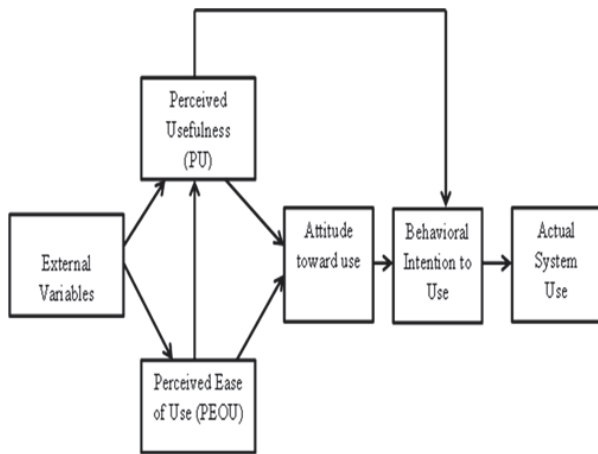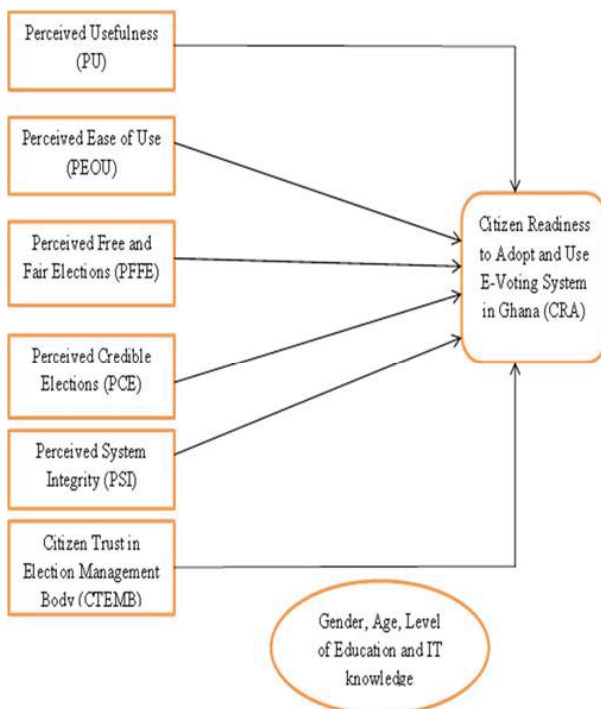
Fig. 5 TAM [32]

Fig. 6 Research Model

The study of [33] used TAM to explore the critical factors influencing user's intention to adopt mobile payment from a trust perspective. The findings indicated that structural assurance, ubiquity, perceived ease of use and perceived usefulness affect trust which by extension "Trust has a significant effect on intention" [33]. Ahmad [34] also adopted the TAM to undertake an empirical study on adoption of e-government in developing countries with attention on Jordan and concluded that e-government service adoption can be explained in terms of perceived usefulness, perceived ease of use, computer self-efficacy, and perceived credibility.

VI. RESEARCH MODEL AND HYPOTHESES

A. Research Model

This research will use the research model depicted in Fig. 6. The dependable variable for this study is Citizens Readiness to Adopt and Use Electronic Voting System in Ghana while the Independent variables are Perceived Usefulness, Perceived Ease of Use, Perceived Free and Fair elections, Perceived Credible and Transparent Elections, Perceived System Integrity and Security and Citizen Trust in Election Management Body.

B. Research Hypotheses

The research would seek to investigate the following hypotheses:

- **Hypothesis One (1):** Perceived Usefulness (PU) has a positive impact on Citizen Readiness to Adopt and Use an electronic voting system in Ghana.
- **Hypothesis Two (2):** Perceived Ease of Use (PEOU) has a positive impact on citizen Readiness to adopt and use an electronic voting system in Ghana.
- **Hypothesis Three (3):** Perceived Free and Fair Elections has a positive impact on Citizen Readiness to adopt and use an electronic voting system in Ghana
- **Hypothesis Four (4):** Perceived Credible Elections has a positive impact on Citizen Readiness to adopt and use an electronic voting system in Ghana
- **Hypothesis Five (5)**: Perceived System Integrity has a positive impact on Citizens Readiness to adopt and use an electronic voting system in Ghana?
- **Hypothesis Six (6):** Citizen Trust in Election Management Body has a positive impact on Citizens Readiness to Adopt and Use an electronic voting system in Ghana

VII. FUTURE WORK

This work is an ongoing research, and it's currently at the stage of data collection processes. In the next process, the study will focus on the following:

Firstly, based on the theoretical framework and research model, a questionnaire instrument would be designed containing seven variables. Perceived usefulness (3 items), Perceived Ease of Use (3 items), Perceived Free and Fair Elections (5 items), Perceived Credible and Transparent Elections (4 items), Perceived System Integrity and Security (5 items), Citizen Trust in Election Management Body (5 items) and Citizens Readiness to adopt and use Electronic Voting system in Ghana (4 items). In all, there will be 24 questions in the questionnaire instrument and it will be measured on a five-point Likert scale from strongly disagree (1) to strongly agree (5). The designed questionnaire instrument would be pre-tested and piloted before the actual distribution of it for data collection. It will be printed out and administered to potential respondents in government establishments, universities, selected communities etc.

Secondly, the data collected will be analyzed using SPSS and Excel Spread Sheet to test the hypotheses outlined above.

Finally, based on the findings, conclusions would be made and policy recommendations would be prescribed for the

attention of appropriate institutions in Ghana.

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