A Preview on Microcontroller Based Electronic Voting Machine

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Abstract—**Voting is most pivotal process of democratic society through which people determine it's government. Governments around the world are increasingly considering the replacement of traditional paper-based voting schemes with electronic voting systems. Elections of Bangladesh are conducted most exclusively using electronic voting machines developed over the past three years. In this paper we describe the design, construction and operation of a digital voting machine using a microcontroller profoundly. Again we also portray counting system of votes, market survey and cost analysis.**

Index Terms—**Voting system, atmega16l microcontroller, voting analysis, security of EVM.**

I. INTRODUCTION

Voting is a crucial device to reveal the opinion of a group on an issue that is under consideration. Based on the promise of greater e ciency, better scalability, faster speed, lower cost, and more convenience, voting is currently shifting from manual paper-based processing to automate electronic-based processing. The term "electronic voting" characteristically depicts to the use of some electronic means in voting and ensure the security, reliability, guarantee and transferency[1],[2]. Now a day the wide range of application of voting include its use in reality student body elections, shareholder meetings, and the passing of legislation in parliament. Perhaps the most important, influential, publicised, and widespread use of voting is its use in national elections. Compared to its traditional paper-based counterpart, electronic voting is considered to have many greater potential benefits. These benefits include better accuracy by eliminating the negative factor of human error, better coverage for remote locations, increased speed for tally computation, lower operational cost through automated means, and the convenience of voting from any location Whether or not electronic voting is a necessary replacement for the traditional paper-based method, it is irrefutable that the conduct of voting has been shifting to the use of electronic medium. To date, electronic databases are used to record voter information, computers are used to count the votes and produce voting results, mobile devices are used for voting in interactive television shows, and electronic voting machines have been used in some national elections. Generally, the term "electronic voting" refers to the definition, collection, and dissemination of people's opinions with the help of some machinery that is more or less computer supported. Despite the transition from traditional paper-based systems to electronic medium, the purpose and requirements for voting remain. Voting is a decision making mechanism in a consensus-based society and security is indeed an essential part of voting. The critical role in determining the outcome of an election, electronic voting systems should be designed and developed with the greatest care. However, a number of recent studies have shown that most of the electronic voting systems being used today are fatally defective [3], [4], [5] and that their quality does not match the importance of the task that they are supposed to carry out. Flaws in current voting systems, which were discovered through testing and other analysis techniques, have stimulated a number of research efforts to mitigate the problems in deployed voting systems. These efforts focused on ameliorating security primitives, such as the storage of votes [6], [7] and auditing [8], and on formally assessing and making procedures more effective [9], [10]. Finally, the standards that set the functional and performance requirements against which the systems are developed, tested, and operated have often been found to be inadequate [11], [12], [13]. Among the reasons for concern, critics include vague and incomplete security guidelines, insufficient documentation requirements, and inadequate descriptions of the configuration of commercial software.

An electronic voting machine has been designed by a microcontroller for which the code is written in assembly language. Various code protection schemes specified by the manufacturer of the microcontroller are used to prevent inadvertent or deliberate reading and reproduction of the code contained in the microcontroller. The election data contained in the EEPROM of the microcontroller can download into a central computer for tabulations. The security of data in this computer is enforced by generating digital signatures for each data file created. This process makes it impossible for anyone to substitute wrong or deliberately altered data files at any intermediate stage between the capturing of voter's intent by the machine and the final results tabulations.
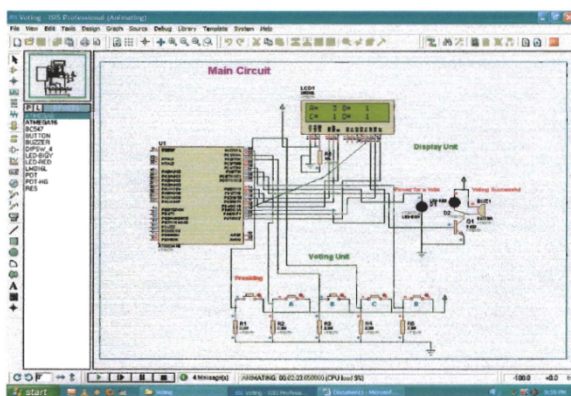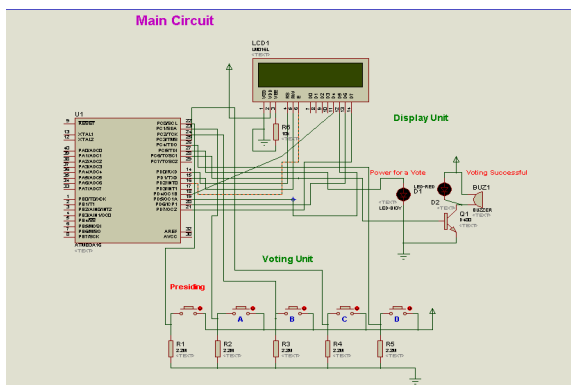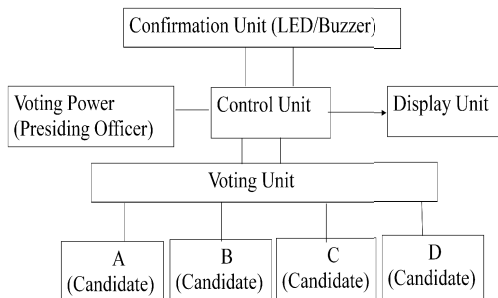
Prior to the election, all configuration data is set up on the counting server. The configuration is then transferred to the ballot-box server. Configuration data include: candidate names, polling station identity, and a list of barcodes. During the voting period, voters are authenticated as per the traditional paper-based voting, and asked whether they wish to vote electronically or use the traditional paper-based method. A voter choosing to use the traditional paper-based method proceeds by being given a ballot paper, casting the vote on the ballot paper, and placing the ballot paper in a ballot-box. On the other hand, a barcode is chosen at random and is given to the voter choosing to use eVACS. Voter authorisation on the electronic voting booth computer is by

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using the barcode. The electronic voting booth computer communicates the barcode to the ballot-box server for validation and to inform that the voting process is initiating. Upon validation of an invalid barcode, the ballot-box server returns an error message to the voting booth computer. Otherwise, the ballot-box server returns the equivalent of a ballot-paper containing the names of candidates to the voting booth computer. The voter may select the candidates in a particular preference ordering, and restart or complete their selection afterwards. The selection is displayed on the screen forconfirmation, and the voter is allowed to change or confirm their selection. The voting booth computer returns a warning given invalid selection or informal vote, however casting invalid or informal vote is allowed. The voter confirms the selection by using the barcode, and both the vote and a log of key sequence pressed are then communicated to the ballot-box server. The ballot-box server checks that the same barcode is used to initiate the server counts the votes, and produces a voting result.

II. HARDWARE DEVELOPMENT OF ELECTRONIC VOTING MACHINE

Fig. 1. Block diagram of digital voting system

Fig 2. Circuit diagram of the digital voting system

Fig. 3. Output circuit diagram of the digital voting system

A. Circuit Description

The high level digital voting machine built with ATmega16 Micro controller. The Micro controller port D uses for LCD display and port C.0 (pin 22) uses for voting power or presiding officers button. The candided button input from Port C.1 – C.4 (pin 23 to 26; 4 candided). The output LED and buzzer uses Micro controller port C.5 and C.6. The LCD backlight also connected to port C.7 via a transistor. At the starting of voting the election commission offices setup the machine at the centre. Then power on the switch and sealed it that nobody can power off. The presiding officer identifies the original voter of that particular area and pushes the voting power button. The voting power LED glow then and continue it until once press the candided buttons. The voter then goes to the secret room where Voting unit placed and press button beside his candided symbol. Voter can watch success of voting by glowing confirmation LED and beep indication. The presiding officer can also hear beep sound watch a confirmation LED. Same time the voting power goes down and nobody can vote again. Mainly when presiding officer press voting power button, Micro controller start scanning from pin 23 to pin 26. When get response from a specific pin, increase the counter one of that candided and stop scanning. So it is not possible to voting twice or more. All the counter result store at Micro controller EEPROM. When the voting is under process it will showed at display "Voting under Process". At the end of voting we need to know result. Then election commission or presiding officer presses the secret key (password). Now the Micro controller shows the result and supply the power to LCD backlight that it illuminated. If it needs to return voting process again one should press another secret key. There uses a transistor to operate buzzer and confirmation LED with proper current. There also uses a voltage regulator (7805) to supply 5v continuously. Here uses a dry cell 9V battery as power source. The power consumption of the system is very low (50mW-150mW varying). After collected data and need erase recorded data from EEPROM just broken the sealed on power button and power off the system. Now the system is ready for next election.

This measurement System includes the following components:
- Voting Unit
- Control Unit
- Confirmation Unit
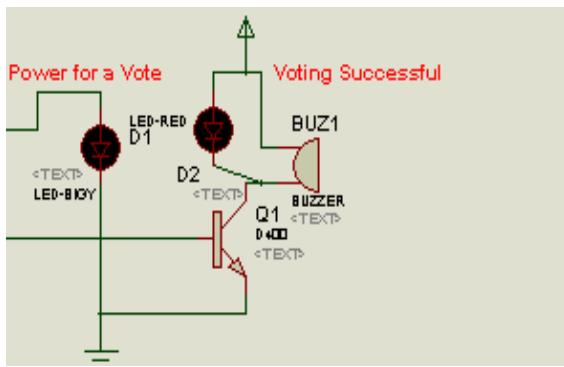- Display Unit (LCD)
- Power Supply Unit

B. Voting Unit

Fig. 4. Voting
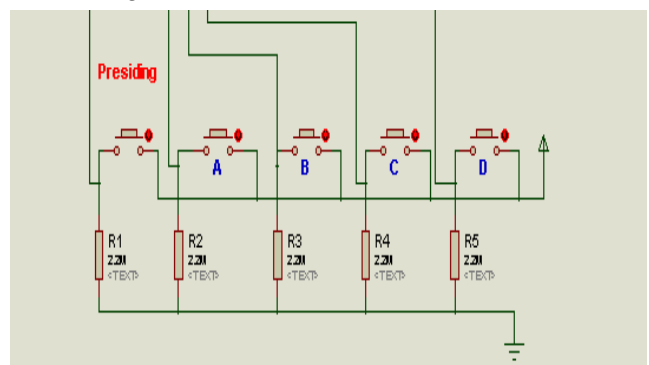
Fig. 5. Confirmation unit

In this Voting unit we have been used five button switch and five 2.2K resister which connected to the five button switches.

C. Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices. These devices are output transducers converting electrical energy. As power is applied this mechanical device will energize and by doing so interrupt the power source and the cycle continue until the power is removed. The frequency of oscillation is strictly dependent on mechanical inertia. The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz.
The Red lead is connected to the Input and the Black lead is connected to Ground.

D. Light Emitting Diode (LED)

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

When a light-emitting diode is forward-biased (switched on), electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. LEDs are often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime,

improved robustness, smaller size, and faster switching. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

Light-emitting diodes are used in applications as diverse as replacements for aviation lighting, automotive lighting (in particular brake lamps, turn signals, and indicators) as well as in traffic signals. LEDs have allowed new text, video displays, and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances

E. Controller Unit

A control unit in general is a central part of the machinery that controls its operation, provided that a piece of machinery is complex and organized enough to contain any such unit. One domain in which the term is specifically used is the area of computer design. In this work Microcontroller ATMEGA 16L is used as the controller unit which controls the sensed signal.

A single highly integrated chip that contains all the components comprising a controller. Typically this includes a CPU, RAM, some form of ROM, I/O ports, and timers. Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task -- to control a particular system. As a result, the parts can be simplified and reduced, which cuts down on production costs. Microcontrollers are sometimes called embedded microcontrollers, which just mean that they are part of an embedded system that is, one part of a larger device or system.

F. Power Supply Unit

Power supply is a very important part of electronic circuit this circuit required fixed +5 V supply so to fix this voltage we needed voltage regulator. In this work used 7805 Voltage regulator which output fixed +5 volt.
A voltage regulator generates a fixed output voltage of a preset magnitude that remains constant regardless of changes to its input voltage or load conditions. There are two types of voltage regulators: linear and switching.

A linear regulator employs an active (BJT or MOSFET) pass device (series or shunt) controlled by a high gain differential amplifier. It compares the output voltage with a precise reference voltage and adjusts the pass device to maintain a constant output voltage.

G. Display Unit

Display device shown the result of the measuring instrument. A observer can see the result and observe the temperature of electrical machine. In this work we used a 2x16 character LCD (LM016L) display. A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals.

H. Printed Circuit Board

A printed circuit board, or PCB, is used to mechanically

support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. It is also referred to as printed wiring board (PWB) or etched wiring board. A PCB populated with electronic components is a printed circuit assembly (PCA), also known as a printed circuit board assembly (PCBA). Printed circuit boards are used in virtually all but the simplest commercially produced electronic devices.

PCBs are inexpensive, and can be highly reliable. They require much more layout effort and higher initial cost than either wire wrap or point-to-point construction, but are much cheaper and faster for high-volume production; the production and soldering of PCBs can be done by automated equipment. Much of the electronics industry's PCB design, assembly, and quality control needs are set by standards that are published by the IPC organization.
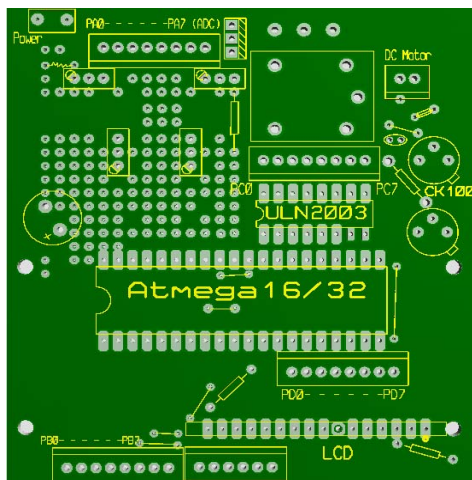

Fig. 6. Printed circuit board (pcb) of this voting system

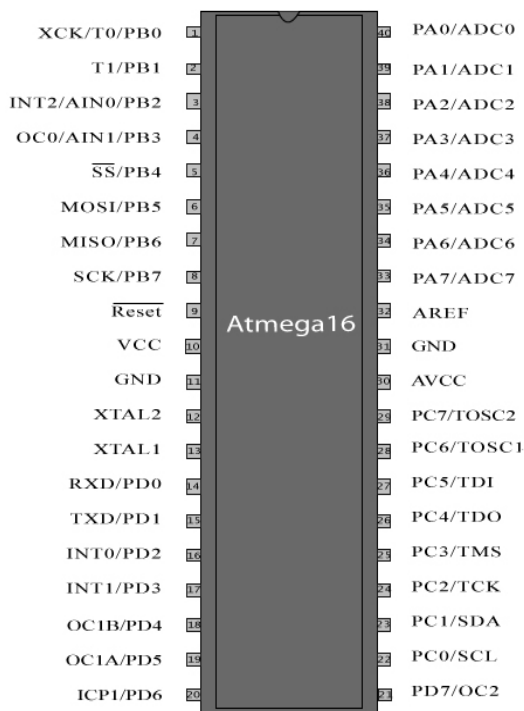### I. Pin Configurations Discription

Fig. 7. Pin configuration of Atmega16L microcontroller[14]

Pin descriptions of ATmaga16L Microcontroller
VCC: Digital supply voltage.
GND: Ground.

Port B (PB7...PB0)

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port B also serves the unction's of various special features of the ATmega16.

Port C (PC7...PC0)

Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5 (TDI), PC3 (TMS) and PC2 (TCK) will be activated even if a reset occurs. Port C also serves the functions of the JTAG interface and other special features of the ATmega16.

Port D (PD7...PD0)

Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega16.

Port A (PA7...PA0)

Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

RESET

Reset Input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

AVCC

AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if

the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter

AREF

AREF is the analog reference pin for the A/D Converter.

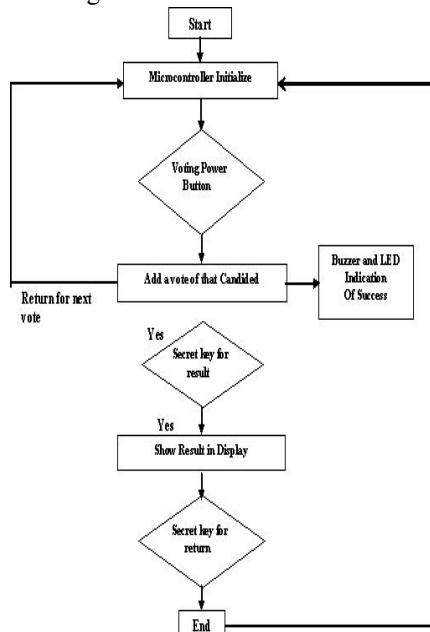## III. SOFTWARE DEVELOPMENT FOR ELECTRONIC VOTING MACHINE

Flowchart of Program:

Fig. 8. Flowchart of program

IV. RESULTS AND ANALYSIS

This work contributed to three very basic research questions arising: in the context of verifiable elections. First, we discussed the problem of keeping ballot secrecy to a certain extent in the case of a corrupted doting machine or voting authority. Our contribution to this is an approach where all secret information is encapsulated in the voting machine. Second, we considered the attack of receipt stealing and manipulation of the corresponding votes. Here we proposed a novel approach of linking all receipts by a hash chain such that each single receipt guards the integrity of all receipts issued previously. Together with a display in the polling place this approach shortens the time window in which an adversary can perform the ballot stealing attack without almost zero risk. Third, we discussed in detail the possibility of contesting an election based on the evidence provided by the verifiable election scheme. We compared the situation for Bingo Voting to the evidence provided by paper based schemes. We shortly sketched an approach to prove an error or a manipulation in the voting booth without violating ballot secrecy. However, this was only a proof of concept and for a practical application the usability of this approach needs to be further improved.

V. CONCLUSION

As part of these exercises, we devised a testing methodology, developed new tools that are specifically tailored to the security analysis of these systems, and learned a number of lessons, all of which should be of use to other user. In both of the systems that we analyzed, we found major security vulnerabilities that could compromise the confidentiality, integrity, and availability of the voting process. The results of our study suggest that there is a need for a drastic change in the way in which electronic systems are designed, developed, and tested. Researchers, practitioners, and policy makers need to define novel testing approaches that take into account the peculiar information flow of these systems, as well as the combination of computer security mechanisms and physical procedures necessary to provide a high level of assurance. Electronic voting software is not immune from security concerned. Here we describe Hack-a-vote, a simplified DRE voting system that we initially developed to demonstrate how easy it might be to insert a Trojan horse into a voting system. In case of a discrepancy, there either must be a row with the fresh random number. But without a mark of the voter or the alignment information on the ballot and on the receipt must differ. The proof consists either of a row containing the fresh random number but no mark without revealing which row this is or the proof consists of the two differing alignment bar codes without showing the mark at all. After the publication of the receipts the situation is analogous to the paper based schemes above as the voter possesses a correct receipt as electronic evidence. In addition to using unforgivable receipts with a special paper one can assume a trusted printer containing a chip card this printer could have the chip card and print the signature to the receipt. Having two in dependent ways to proved receipt to be not a forgery is a big advantage.

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