Raspberry Pi and image processing based Electronic Voting Machine (EVM)

Md. Maminul Islam, Md. Sharif Uddin Azad, Md. Asfaqul Alam, Nazmul Hassan

Abstract— Electronic voting machine has already been developed and widely used in many developed countries. But most of them use Radio Frequency ID. In developing countries RFID for each person does not exist. And using RFID is still a costly solution. Some of the developing countries use image processing technique to detect citizens. But the problem is not solved yet due to high price of host device (e.g. computer) to run. Implementation of image processed toll systems are only limited in some places. Keeping these problems in mind we have developed this project where raspberry pi will be used as host. This minicomputer has the ability of image processing and control complete voting machine system. A camera will be used to take picture of citizens national ID card and identify that this user is valid voter for that region. If the citizen is valid and also didn't vote then the person will be allowed to submit his/her vote. Each voting machine is locked by finger print access module. As the user is identified his/her finger print will be sent to a specific machine for voting.each voting machine is networked with the central raspberry pi voting identification system.

Index Terms— Electronic voting machine, EVM, raspberry pi, image processing, finger print, automatic voting machine,IOT,NRF network.

1 Introduction

IN developing countries like Bangladesh the number of voters are increasing day by day. And a corruption free voting system is a burning question at present. There is hudge scope of corruption in these countries due to manual voting system. Each voting season lots of voting panel's vote get suspended due to corruption. Corruptions are like submitting someone else vote, same voter tries to vote again removing the voted ink mark from his/her hand. Lots of people do not come to participate in vote. Some corrupted persons take advantage of that and submit vote on behalf of absent people. Also sometime candidates submit unlimited amount of vote through bribe or arms. These types of corruptions can be stopped only through automated voting system. And the trust can be gained through a transparent voting system like ours one. There are two layers of protection in this voting system. At first user has to be proving himself as an candidate of that region. And then without the finger print of that person voting machine will not be unlocked. After unlocking the machine user will submit his vote through push button. And the voting machine will be locked again.

This system is also under internet of things as the voting machine is connected with internet through Wifi. To maintain the transparency each time a user submits a vote a tweet will be generated that specific user has submitted his vote and the total number of votes increases. This way any citizen who didn't submitted his/her vote can claim if any false voting occurred.

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2. Project Outline

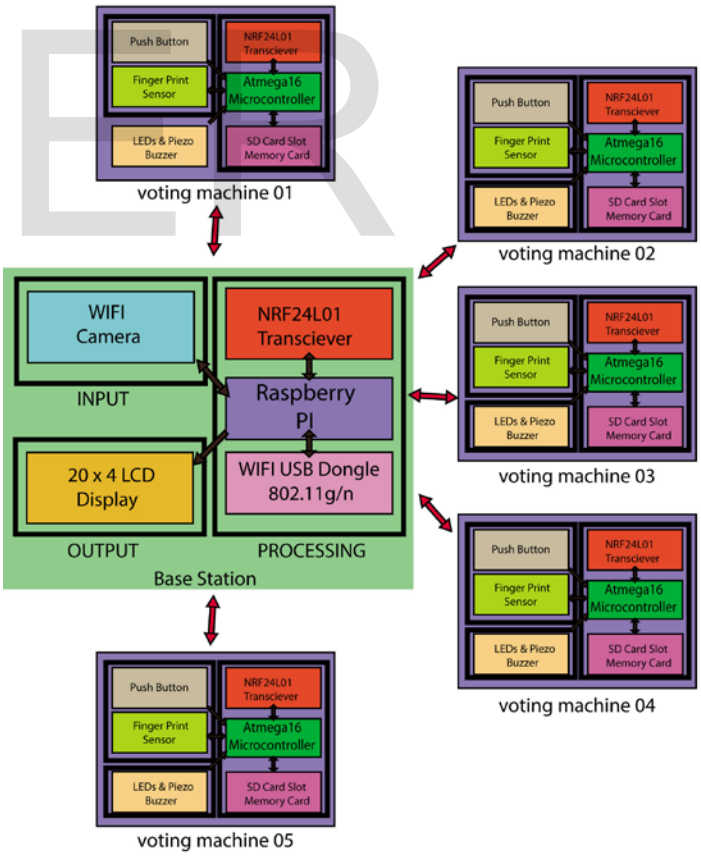

Fig1:- Complete project outline.

Each voting machine is networked with a base station. From base station each voting machine receives and transmits data.

2.1 Base Station

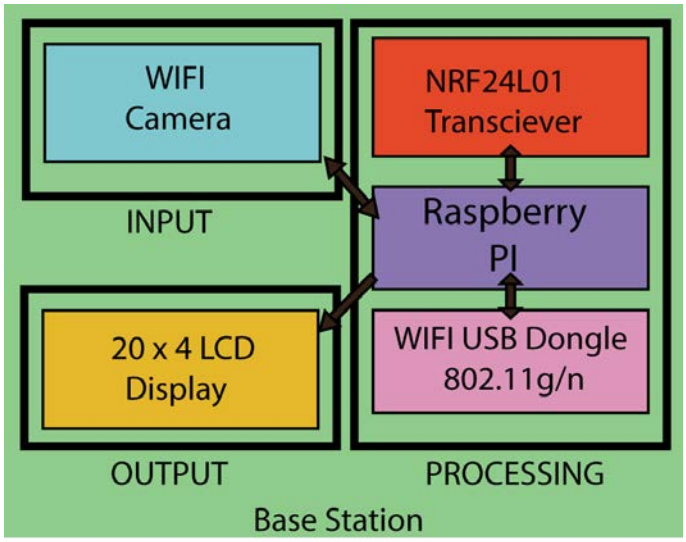

Fig2:- Project outline of Base station

There are two types of unit in this system. One is the base station where first step of identification process will occur and the second one is the voting machine.

Base station consists of wifi camera as input device. Under processing unit there are raspberry pi, nrf24l01 transciever, wifi usb dongle to connect with internet & camera. To display the total number of voter, user id and successful authentication 20x4 lcd display has been used. Operating system of raspberry pi is Linux.

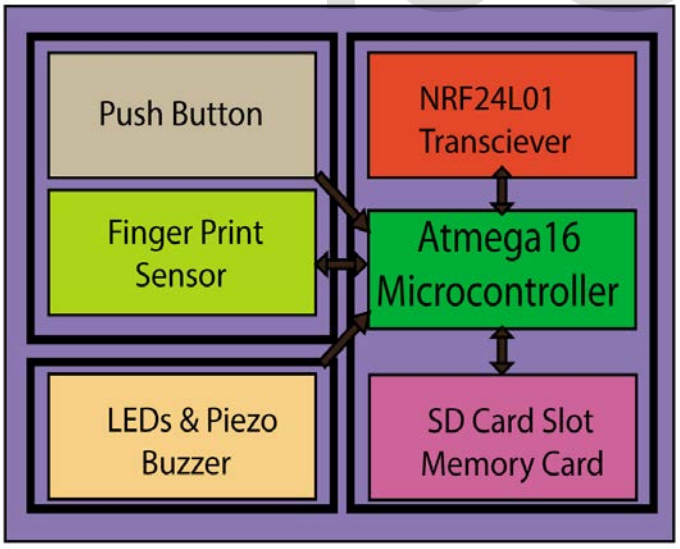

Fig4:- Electronic Voting machine

2.2 Voting Machine

Voting machine is consist of atmega16 microcontroller. To communicate with the base station NRF24L01 transciever is used. In order to unlock the device and as security a finger print sensor has been attached to the machine. To output leds and piezo buzzer is also used. To locally story the number of total voters a SD card memory is used.

3 Hardware Prototype

Raspberry Pi Model B has 512Mb RAM, 2 USB ports and an Ethernet port. It has a Broadcom BCM2835 system on a chip which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and an SD card. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and OpenVG libraries. The chip specifically provides HDMI and there is no VGA support. The foundation provides Debian and Arch Linux ARM distributions and also Python as the main programming language, with the support for BBC BASIC, C and Perl.

Fig3:- Raspberry Pi model B.

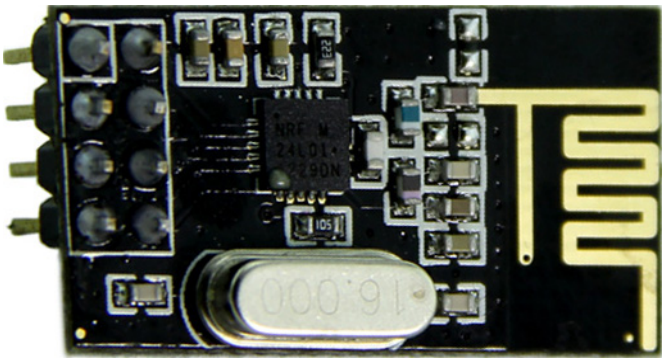

Fig5:- NRF24L01 transciever.

A NRF transceiver can communicate with 6 devices at a time as there are 6 different pipe lines each transceiver contains for communication. Each transceiver contains a Rx address and Tx address. But the Rx and Tx address are same. In order to send data to or receive data from the SPI port on the 24L01 the CSN pin on the 24L01 must be high to start out with. Then, bringing the CSN pin low to alert the 24L01 that it is about to receive SPI data. Once transmitted or read all of the bytes that needed, bringing CSN back high. To execute the R_REGISTER instruction on TX_ADDR register, which will read the contents of the TX address register out of the 24L01 and into mi-

cro. The TX_ADDR register is 5 bytes wide and 5-byte addresses is used. First, bringing CSN low and then send the command byte '00010000' to the 24L01. This instructs the 24L01 that needs to read register 0x10, which is the TX_ADDR register. Then five dummy data bytes are sent and the 24L01 will send back to you the contents of the TX_ADDR register. Finally, bringing the CSN pin back high.

Fig6:- Wifi Module.

Wifi dongle is connected through USB port. With wireless speeds of up to 300Mbps and advanced MIMO technology, works seamlessly with existing IEEE 802.11b/g networks. this tiny adapter to work as a virtual wireless Access Point. Compatible with Wi-Fi Protected Setup™ (WPS), establish a WPA2 secure connection, more secure than WEP encryptions.

4 Circuit Analysis

Heart of this project is raspberry pi minicomputer. To interface with NRF24l01 raspberry pi has SPI. MISO, MOSI, SCK & SS pins of NRF transceiver is connected with MISO MOSI, SCK & SS pins of raspberry pi. Wifi dongle is connected through USB port. Lcd display is connected through GPIO pins. The complete system is running on Linux ARC platform.

At the voting machine terminal atmega16 microcontroller has been used. All the push buttons are connected through GPIO pins. 8 push buttons are connected with PORTA. 8 leds are connected with PORTC. Nrf24l01 is connected with atmega16 by spi interface. MISO, MOSI, SCK & SS pins of nrf24l01 is connected with atmega16 MISO, MOSI, SCK & SS pins. Finger print sensor is connected by usart baud rate 9600. RX pin of finger print sensor is connected with Tx of atmega16 & TX of atmega16 is connected with Rx of atmega16 microcontroller. They all share the same Vcc +5v and same ground. Constant 5v is achieved by LM7805 voltage regulator IC. Which takes 12v – 30v as input and gives constant 5v output.Link between base station and voting machine is established by NRF24L01 transciever. The data transmission rate between them is 1MBPS.

5 Main Technology Used

Image processing is the key factor of this project. In this project matlab is used to process the image [4]. In this project template matching algorithm is used. Here is the flow chart

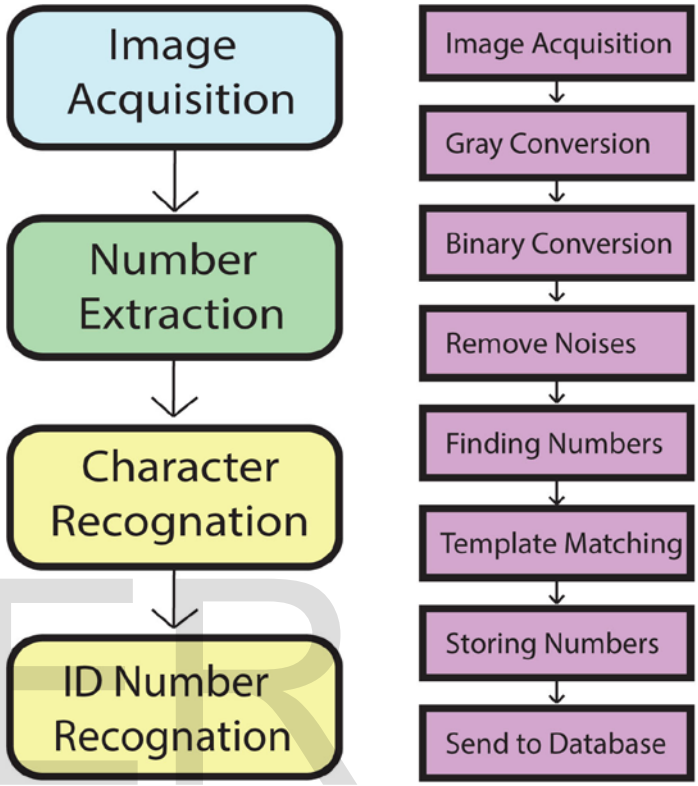

Fig7:- Algorithm of optical character recognition.

At first the National Id number is captured through webcam and it crops an approximate area where the number. Matlab code for these operations is

```
vid = videoinput('winvideo', 1, 'YUY2_640x480');
vid_src = getselectedsource(vid);
vid.ReturnedColorspace = 'rgb';
start(vid)

image=getsnapshot(vid);
imshow(image);
imagen= imcrop(image,[655 1153 560 85]);
```

Fig8:- Cropped image of ID card.

After converting it to grayscale & then binary image it looks almost same. Then the noise as the high pen is removed from the image.

Fig9:- binary image removing noise.

Through template matching in bangle the letters are saved in English in excel file. Here is the image of the output optical read digits.

	A	B	C
1	National ID card Number	Voter	Voted
2	232813	dhaka	No
3			
4			
5			

Fig10: ID card numbers stored in excel.

Now this ID card number is sent to database for finding its voting location and already voted or not from users account.

6 HARDWARE IMPLEMENTATION

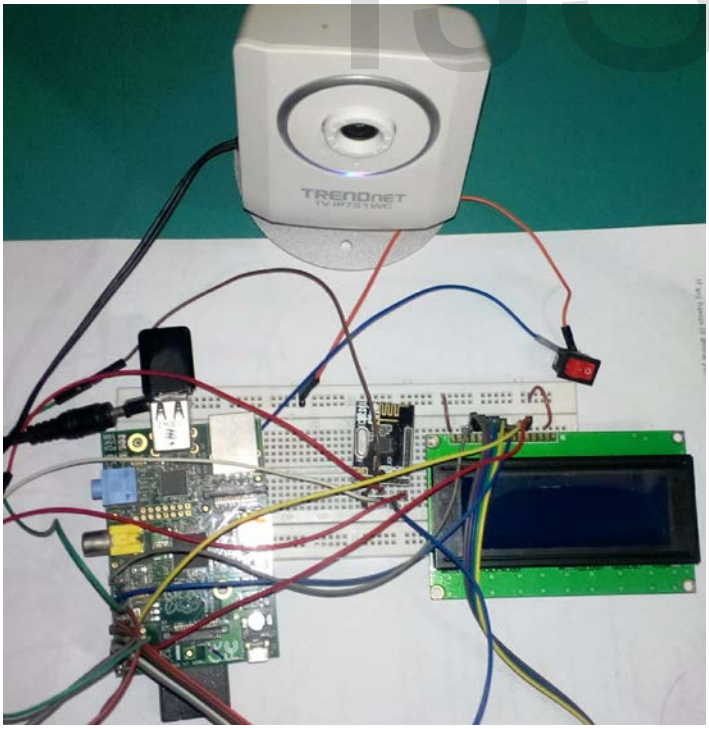

Fig13:- hardware of base station.

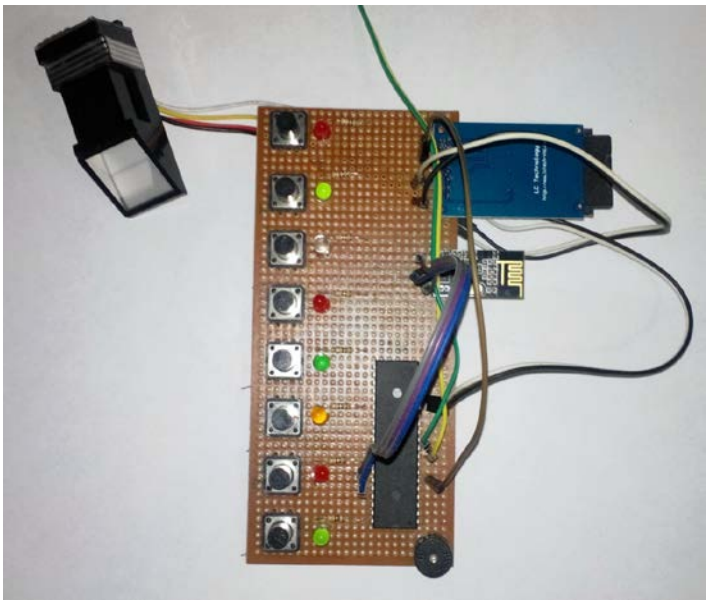

Fig11:- Hardware implementation of voting machine

Once the base station confirms the voter as valid member it transmits finger print of the voter to a specific voting machine. A finger print sensor is connected with the device which samples the finger print of the voter. When the finger print matches the voting machine gets unlocked and ready to accept the vote otherwise it will remain locked.

Fig12:- Finger print sensor

The complete system is connected with internet. After each vote the system transmits an update to tweeter. All the errors or users information is stored in data base also. But for repair, hardware faults or user fault each booth sends a tweet to main voting head office tweet account.

First need to install some required packages. Open up a terminal on the Raspberry Pi and install the Python development headers and the pip package manager:

Sudo apt-get installs python-pip python2.7-dev.

7. FURTHER APPLICATION

- Automated train ticket system.
- Automated bus ticket system.
- Unauthorized vehicle detection system.
- Traffic signal breaking detection system.
- Parking lot automation.

8. CONCLUSION

Corruption can be minized through honesty and sincierity. This system is a small contribution for a fair election. But corruption in voting system can not be completely erased through this system if there is no sincierity.

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REFERENCES

[1] An experience in testing the security of real-world electronic voting systems by Balzarotti, D. ; Eurecom Inst., Sophia Antipolis, France ; Banks, G. ; Cova, M. ; Felmetsger, V. published in Software Engineering, IEEE Transactions on (Volume:36 , Issue: 4) July-Aug. 2010. Page(s):453 – 473

[2] Hack-a-vote: Security issues with electronic voting systems by Bannet, J.; Rice Univ., Houston, TX, USA ; Price, D.W. ; Rudys, A. ; Singer, J. in Security & Privacy, IEEE (Volume:2 , Issue: 1) on Jan.-Feb. 2004 pages: 32 – 37.

[3] A Three-Ballot-Based Secure Electronic Voting System by Santin, A.O. ; Costa, R.G. ; Maziero, C.A. Security & Privacy, IEEE (Volume:6 , Issue: 3) May-June 2008. Pages:14 – 21.

[4] Evaluating Electronic Voting Systems Equipped with Voter-Verified Paper Records. Ansari, N. ; New Jersey Inst. of Technol., Newark, NJ ; Sakarindr, Pitipatana ; Haghani, E. ; Chao Zhang. Security & Privacy, IEEE (Volume: 6 , Issue: 3). May-June 2008. Pages: 30 – 39.

[5] The state of the art in electronic payment systems. Asokan, N. ; IBM Zurich Res. Lab., Ruschlikon, Switzerland ; Janson, P.A. ; Steiner, M. ; Waidner, M. Computer (Volume:30 , Issue: 9) Sep 1997. Page(s) : 28 - 35 .

[6] Electronic information security. Gifford, E.A. ; Dept. of Electr. Eng., Oregon State Univ., Corvallis, OR, USA. Potentials, IEEE (Volume:7 , Issue: 4). Dec. 1988. Page(s):26 - 30