<u>LP III : BlockChain</u>

<u>Mini Project</u>

Problem Statement:

Develop a Blockchain based application dApp (de-centralized app) for evoting system.

Software Requirements:

Operating System – Windows 10

Editor – Remix-Ethereum IDE

Coding Language – Solidity

Hardware Requirements:

2 GB RAM, 500 GB Hard Disk, PC / Laptop

Learning Objective:

To develop a blockchain based application for evoting system using solidity programming language.

Outcome:

Developed a blockchain based application for evoting system. A person can be reregistered as a candidate and others can vote for the person.

Theory Concepts:

Blockchain is a technology that is rapidly gaining momentum in era of industry 4.0. With high security and transparency provisions, it is being widely used in supply chain management systems, healthcare, payments, business, IoT, voting systems, etc.

Why do we need it?
Current voting systems like ballot box voting or electronic voting suffer from various security threats such as DDoS attacks, polling booth capturing, vote alteration and manipulation, malware attacks, etc, and also require huge amounts of paperwork, human resources, and time. This creates a sense of distrust among existing systems.

Some of the disadvantages are:

Long Queues during elections.
Security Breaches like data leaks, vote tampering.
Lot of paperwork involved, hence less eco-friendly and time-consuming.
Difficult for differently-abled voters to reach polling booth.
Cost of expenditure on elections is high.

Using blockchain, voting process can be made more secure, transparent, immutable, and reliable. How? Let’s take an example.

Suppose you are an eligible voter who goes to polling booth and cast vote using EVM (Electronic Voting Machine). But since it’s a circuitry after all and if someone tampers with microchip, you may never know that did your vote reach to person for whom you voted or was diverted into another candidate’s account?
Since there’s no tracing back of your vote. But, if you use blockchain- it stores everything as a transaction that will be explained soon below; and hence gives you a receipt of your vote (in a form of a transaction ID) and you can use it to ensure that your vote has been counted securely.

Now suppose a digital voting system (website/app) has been launched to digitize process and all confidential data is stored on a single admin server/machine, if someone tries to hack it or snoop over it, he/she can change candidate’s vote count- from 2 to 22! You may never know that hacker installs malware or performs clickjacking attacks to steal or negate your vote or simply attacks central server.

To avoid this, if system is integrated with blockchain- a special property called immutability protects system. Consider SQL, PHP, or any other traditional database systems. You can insert, update, or delete votes. But in a blockchain you can just insert data but cannot update or delete. Hence when you insert something, it stays there forever and no one can manipulate it- Thus name immutable ledger.

But Building a blockchain system is not enough. It should be decentralized i.e if one server goes down or something happens on a particular node, other nodes can function normally and do not have to wait for victim node’s recovery.

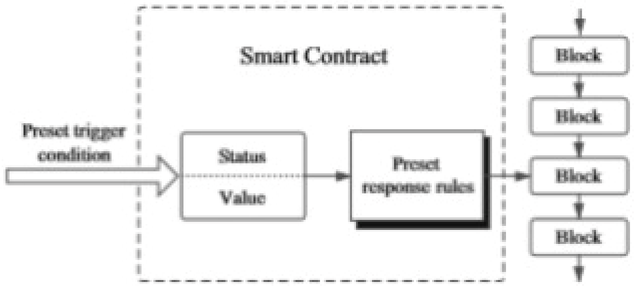
So a gist of advantages are listed below:

You can vote anytime/anywhere (During Pandemics like COVID-19 where it’s impossible to hold elections physically

- Secure
- Immutable
- Faster
- Transparent

All data is then encrypted and stored as a transaction. This transaction is then broadcasted to every node in network, which in turn is then verified. If network approves transaction, it is stored in a block and added to chain. Note that once a block is added into chain, it stays there forever and can't be updated. Users can now see results and also trace back transaction if they want.

Since current voting systems don't suffice to security needs of modern generation, there is a need to build a system that leverages security, convenience, and trust involved in voting process. Hence voting systems make use of Blockchain technology to add an extra layer of security and encourage people to vote from any time, anywhere without any hassle and makes voting process more cost-effective and time-saving.



Smart contract:
A smart contract is a self-imposed contract that is embedded in a blockchain managed computer code. This code includes a set of rules governing the communication and decision on the contract between the parties, the contract will be enforced automatically once the already defined rules are met. Smart contract gives a framework for efficient control between two or more parties of tokenizes assets and access rights [1]. Fig 1 [1]; shows the working principle of smart contract. Blockchain is just a database that cannot be altered, without smart contract, which expands and leverages blockchain.

Code

```
pragma solidity ^0.4.25;

contract ElectionFact {

    struct ElectionDet {
        address deployedAddress;
        string el_n;
        string el_d;
    }

    mapping(string=>ElectionDet) companyEmail;

    function createElection(string memory email,string memory election_name, string
memory election_description) public{
        address newElection = new Election(msg.sender , election_name,
election_description);

        companyEmail[email].deployedAddress = newElection;
        companyEmail[email].el_n = election_name;
        companyEmail[email].el_d = election_description;
    }

    function getDeployedElection(string memory email) public view returns
(address,string,string) {
        address val =  companyEmail[email].deployedAddress;
        if(val == 0)
            return (0,"","Create an election.");
        else
            return
(companyEmail[email].deployedAddress,companyEmail[email].el_n,companyEmail[em
ail].el_d);
    }
}

contract Election {

    //election_authority's address
    address election_authority;
    string election_name;
    string election_description;
    bool status;

    //election_authority's address taken when it deploys the contract
    constructor(address authority , string name, string description) public {
        election_authority = authority;
        election_name = name;
        election_description = description;
        status = true;
    }

    //Only election_authority can call this function
    modifier owner() {
        require(msg.sender == election_authority, "Error: Access Denied.");
        _;
    }
    //candidate election_description

    struct Candidate {
        string candidate_name;
        string candidate_description;
        string imgHash;
        uint8 voteCount;
        string email;
    }

    //candidate mapping

    mapping(uint8=>Candidate) public candidates;

    //voter election_description

    struct Voter {
        uint8 candidate_id_voted;
        bool voted;
    }

    //voter mapping

    mapping(string=>Voter) voters;

    //counter of number of candidates

    uint8 numCandidates;

    //counter of number of voters

    uint8 numVoters;

    //function to add candidate to mapping

    function addCandidate(string memory candidate_name, string memory
candidate_description, string memory imgHash,string memory email) public owner {
        uint8 candidateID = numCandidates++; //assign id of the candidate
        candidates[candidateID] =
Candidate(candidate_name,candidate_description,imgHash,0,email); //add the values to
the mapping
    }
    //function to vote and check for double voting

    function vote(uint8 candidateID,string e) public {

        //if false the vote will be registered
        require(!voters[e].voted, "Error:You cannot double vote");

        voters[e] = Voter (candidateID,true); //add the values to the mapping
        numVoters++;
        candidates[candidateID].voteCount++; //increment vote counter of candidate

    }

    //function to get count of candidates

    function getNumOfCandidates() public view returns(uint8) {
        return numCandidates;
    }

    //function to get count of voters

    function getNumOfVoters() public view returns(uint8) {
        return numVoters;
    }

    //function to get candidate information

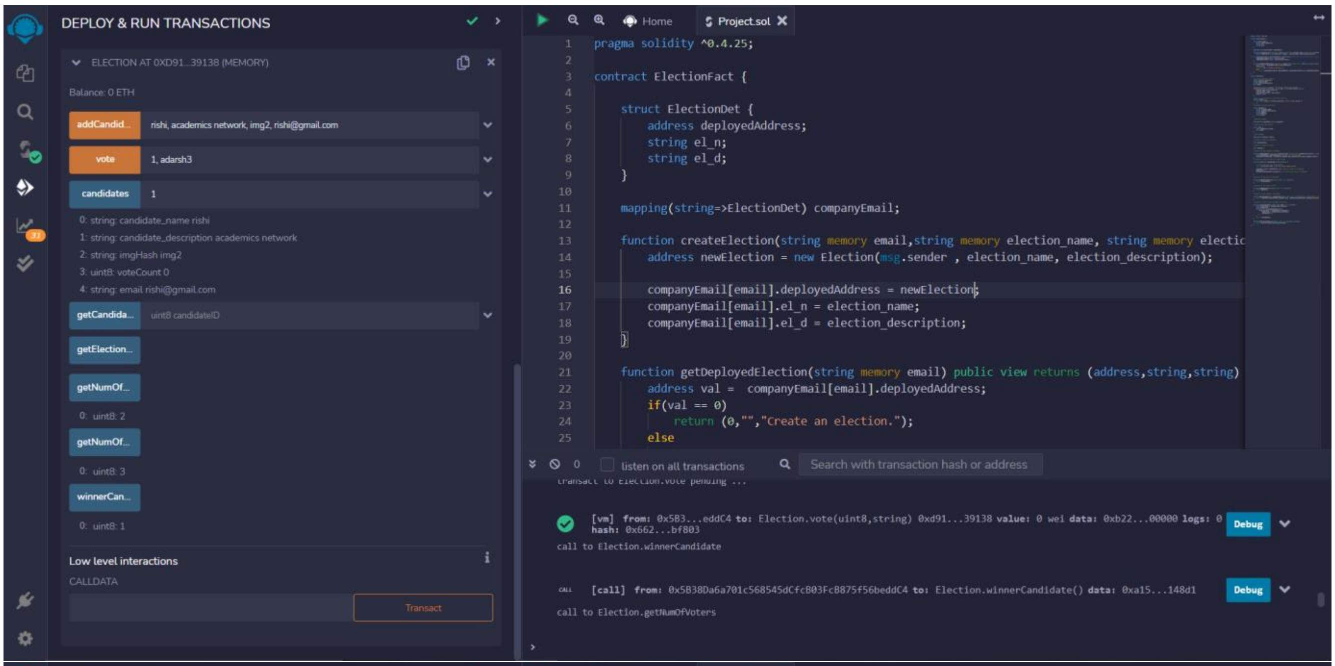
    function getCandidate(uint8 candidateID) public view returns (string memory, string
memory, string memory, uint8,string memory) {
        return (candidates[candidateID].candidate_name,
candidates[candidateID].candidate_description, candidates[candidateID].imgHash,
candidates[candidateID].voteCount, candidates[candidateID].email);
    }

    //function to return winner candidate information

    function winnerCandidate() public view owner returns (uint8) {
        uint8 largestVotes = candidates[0].voteCount;
        uint8 candidateID;
        for(uint8 i = 1;i<numCandidates;i++) {
            if(largestVotes < candidates[i].voteCount) {
                largestVotes = candidates[i].voteCount;
                candidateID = i;
            }
        }
        return (candidateID);
    }

    function getElectionDetails() public view returns(string, string) {
        return (election_name,election_description);
    }
}
```

Output:



DEPLOY & RUN TRANSACTIONS

ELECTION AT 0XD91...39138 (MEMORY)

Balance: 0 ETH

addCandid... rishi, academics network, img2, rishi@gmail.com

vote 1, adarsh3

candidates 1

0: string: candidate_name rishi
1: string: candidate_description academics network
2: string: imgHash img2
3: uint8: voteCount 0
4: string: email rishi@gmail.com

getCandida... uint8 candidateID

getElection...

getNumOf...

0: uint8: 2

getNumOf...

0: uint8: 3

winnerCan...

0: uint8: 1

Low level interactions

CALLDATA

Transact

Home | Project.sol

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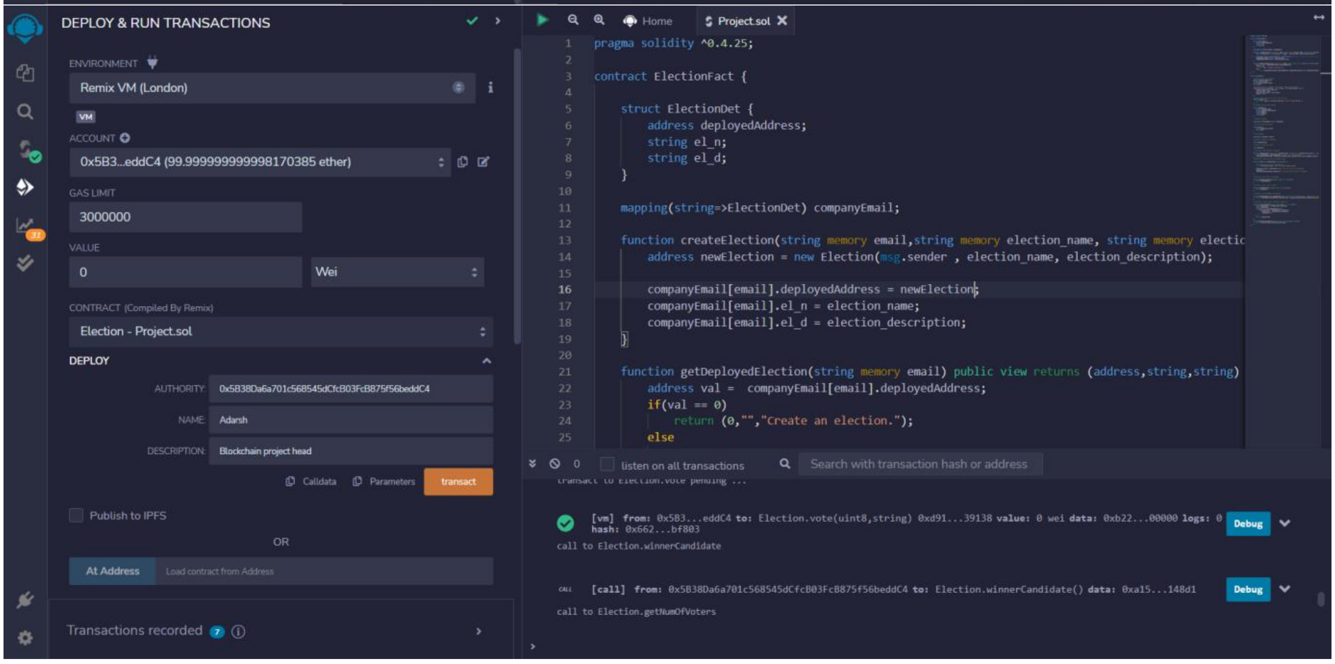
    }

    function getDeployedElection(string memory email) public view returns (address,string,string)
        address val =  companyEmail[email].deployedAddress;
        if(val == 0)
            return (0,"","Create an election.");
        else
```

```
0   listen on all transactions   Search with transaction hash or address
transact to Election.vote pending ...

[vm] from: 0x5B3...eddC4 to: Election.vote(uint8,string) 0xd91...39138 value: 0 wei data: 0xb22...00000 logs: 0   Debug
hash: 0x662...bf803
call to Election.winnerCandidate

CALL [call] from: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 to: Election.winnerCandidate() data: 0xa15...148d1   Debug
call to Election.getNumOfVoters
```



DEPLOY & RUN TRANSACTIONS

ENVIRONMENT

Remix VM (London)

VM

ACCOUNT

0x5B3...eddC4 (99.999999999998170385 ether)

GAS LIMIT

3000000

VALUE

0 Wei

CONTRACT (Compiled By Remix)

Election - Project.sol

DEPLOY

AUTHORITY: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4

NAME: Adarsh

DESCRIPTION: Blockchain project head

Calldata Parameters transact

Publish to IPFS

OR

At Address Load contract from Address

Transactions recorded 7

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call to Election.getNumOfVoters
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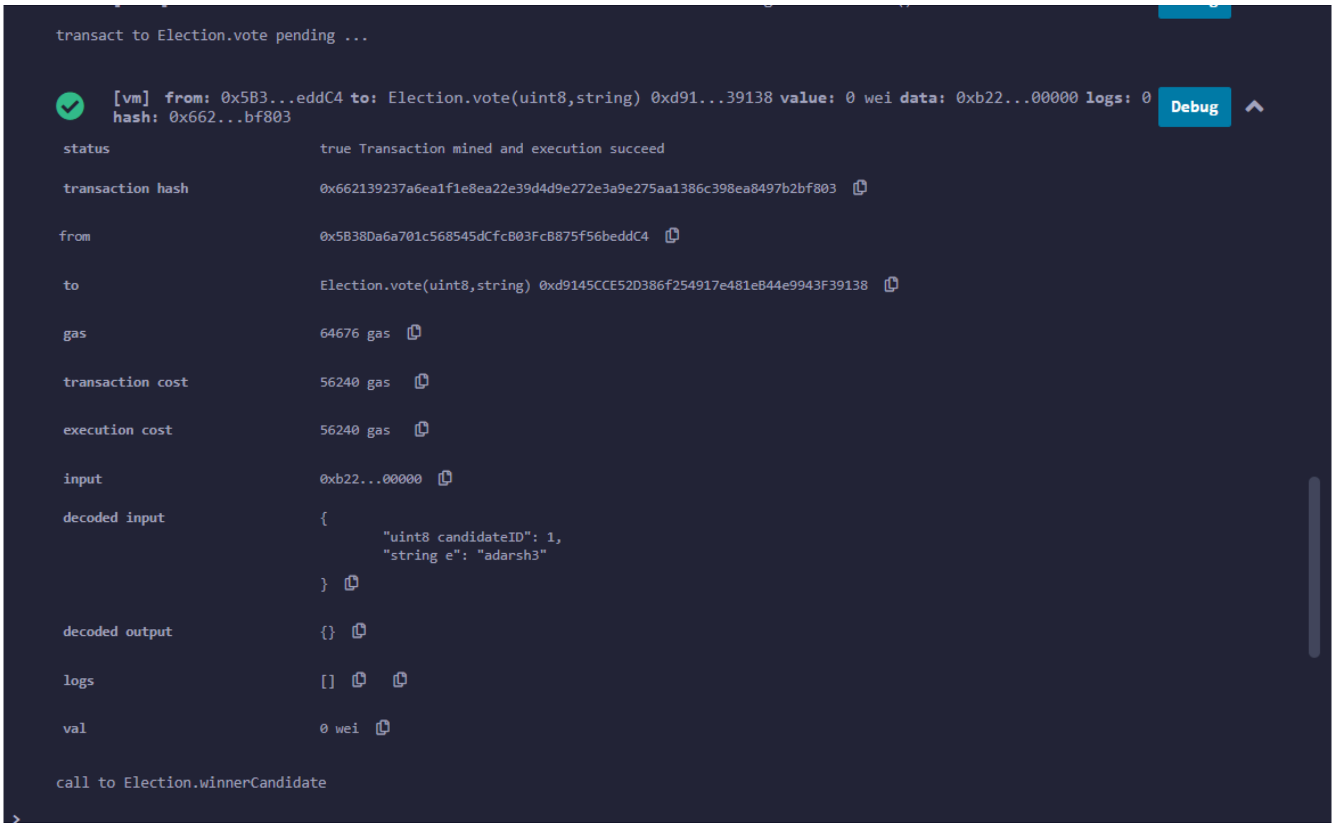

```
transact to Election.vote pending ...

[vm] from: 0x5B3...eddC4 to: Election.vote(uint8,string) 0xd91...39138 value: 0 wei data: 0xb22...00000 logs: 0
hash: 0x662...bf803
status                  true Transaction mined and execution succeed
transaction hash        0x662139237a6ea1f1e8ea22e39d4d9e272e3a9e275aa1386c398ea8497b2bf803
from                    0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to                      Election.vote(uint8,string) 0xd9145CCE52D386f254917e481eB44e9943F39138
gas                     64676 gas
transaction cost        56240 gas
execution cost          56240 gas
input                   0xb22...00000
decoded input           {
                                "uint8 candidateID": 1,
                                "string e": "adarsh3"
                        }
decoded output          {}
logs                    []
val                     0 wei

call to Election.winnerCandidate
```

Conclusion:

Successfully developed a blockchain application for evoting system.