PESU Center for Information Security, Forensics and Cyber Resilience

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Summer Internship Project Demonstration

- Project Title: Vaccination System using Blockchain
- Project ID: 3
- Project Guide: Vineetha B
- Project Team:

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Project Abstract and Scope

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- The recent pandemic has given rise to a need for a foolproof vaccination system.
- Fraudulent methods of vaccination demands for a transparent and secure approach for the same.
- A blockchain approach to vaccination system.
- Smart contracts are defined to administer vaccines based on priority and generate certificates after completion.
- A transparent and tamper-proof side effects self-reporting solution associated with each person and the vaccine administered.
- The suggested system can provide a bridge to a distributed, immutable, and decentralized vaccination system.

Design Approach

- The required vaccination system was implemented using smart contracts
- Solidity is high-level, OOP language used for creating smart contracts
- Despite being new, due to its similarity to common languages like JavaScript, C++ and Python, it is an easy language to grasp
- On the other hand, it has much fewer resources to refer to for debugging
- MetaMask is a software cryptocurrency wallet used to interact with the Ethereum blockchain. It allows users to access their Ethereum wallet through a browser extension, which can then be used to interact with decentralized applications.
- The alternate approach to creating a blockchain based system is the use of Hyperledger.
- The key difference between the two is Ethereum is public, which means anyone can access the Blockchain network, and no permission is needed to access the network. Hyperledger, on the other hand, is a private Blockchain, meaning only the authorized participants can access the network. The network is limited to a predefined community of participants with permission

Design Constraints, Assumptions & Dependencies

This project is implemented in three sections, each of which has the following assumptions:-

1. Registration of each individual is already done, and those who have already received vaccination cannot register.
    a. The vaccine stock is assumed to be taken care of by the hospital itself. Therefore, the vaccine availability is not checked with the respective hospital.
2. The health record of each patient is stored during the registration only. Based on the stored health records, there are two categories created:
    a. 1st priority list includes senior citizens, pregnant women and people who are more vulnerable to the disease.
    b. 2nd priority list includes all the remaining individuals.
    c. Only after individuals on the 1st priority list are ensured to be vaccinated, the 2nd priority list are queued for vaccination.

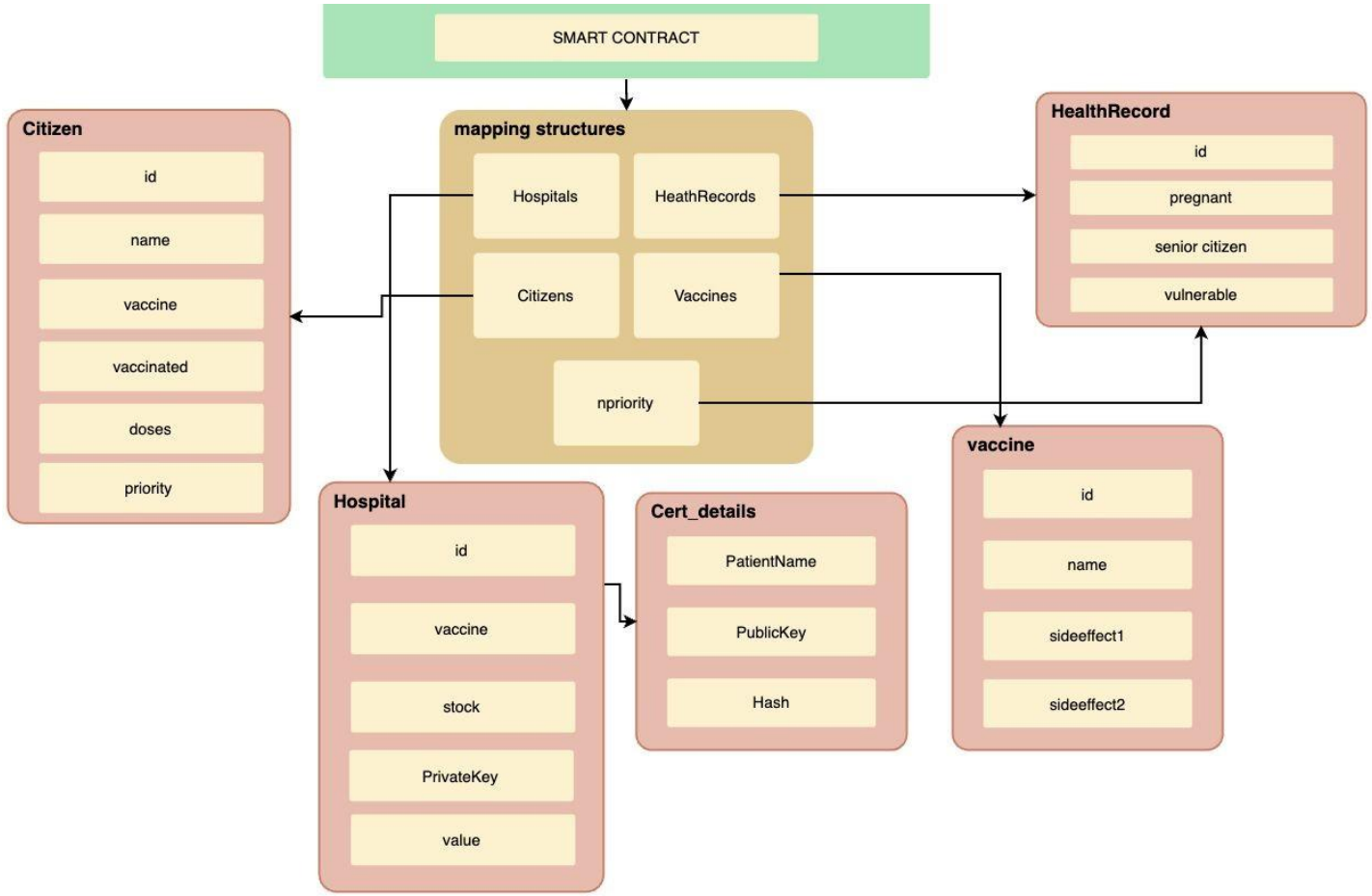
Design Constraints, Assumptions & Dependencies

3. Vaccination certificates are already assumed to be verified, hence only retrieval and generation is done.
   a. Each individual is provided with a private key, through which they can retrieve their certificate if they wish to do so.
   b. A transaction hash is created after the payment is done, and is displayed along with the certificate.

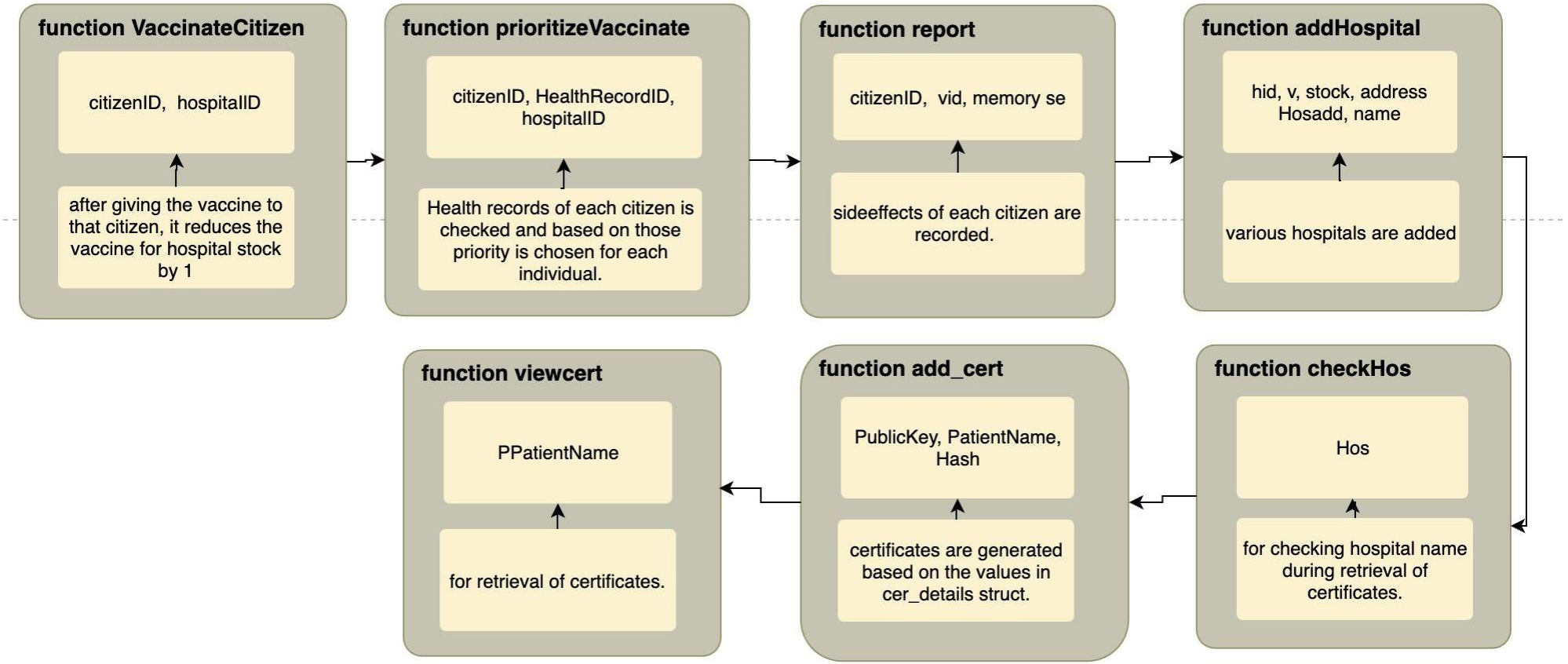
Dependencies:

Transaction is done using MetaMask as Ethereum Wallet. As MetaMask has an integrated ShapeShift, and Coinbase exchanges to make it easy to exchange ETH and other ERC-20 tokens. And, it comes with an intuitive user interface inclusive of a reliable customer support.

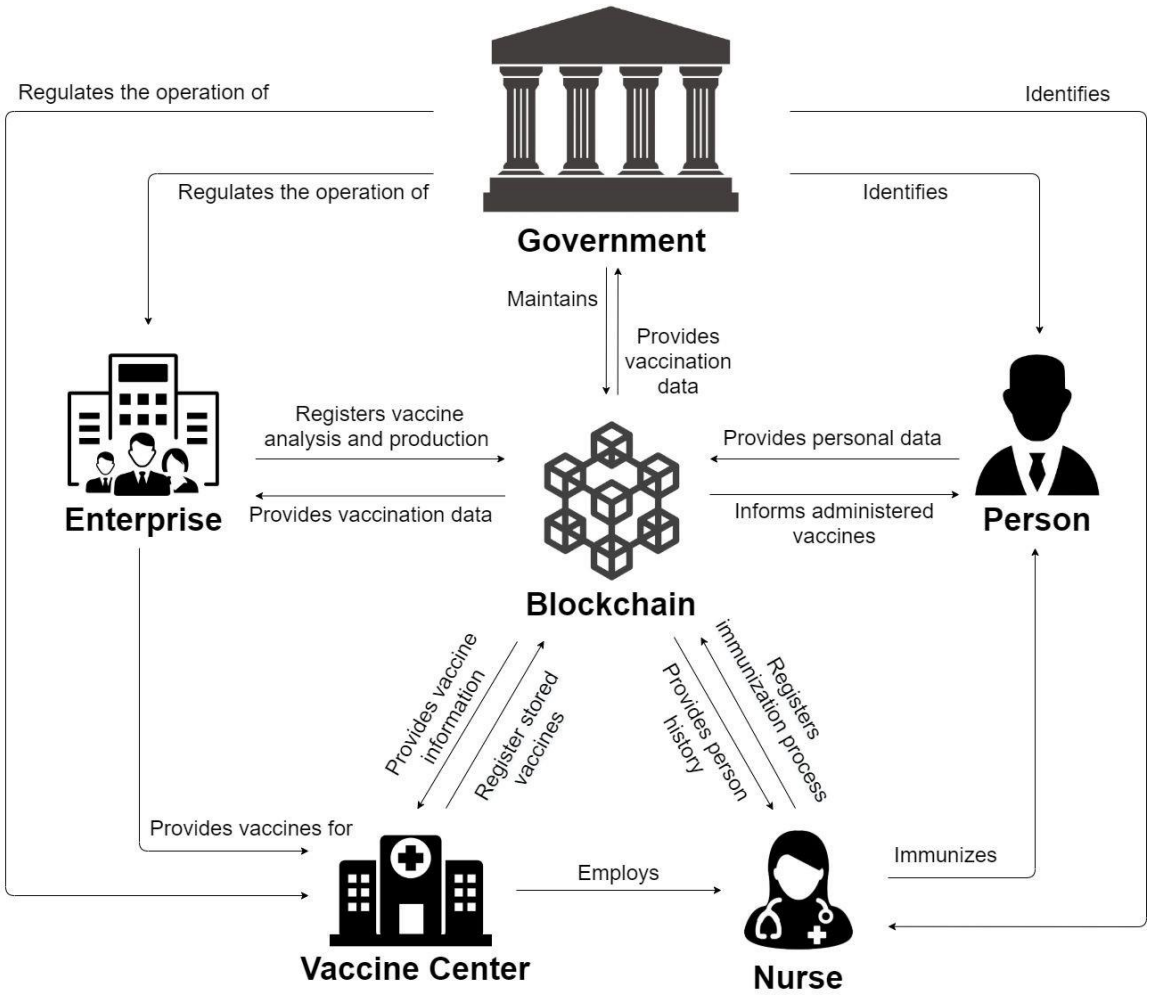
Design Description



Methods Defined



Use Case Diagram



Technologies Used

- Blockchain technology
  - Ethereum
  - For better data coordination.
  - Rapid deployment
  - Interoperability and open source.
- Remix IDE - Metamask extension
- Language-Solidity

Project outcome

With a vaccine distribution network powered by blockchain

- Manufacturers can proactively monitor for adverse events and improve recall management
- Distributers can gain real-time visibility and enhanced ability to respond to supply chain disruptions
- Hospitals can improve inventory management and safety monitoring
- Citizens can trust the vaccines and confidently return to society

Project Demo: Dataset

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HOSPITAL				
id	vaccine	stock	PrivateKey	value
19853	Covishield	315	EAKB	
95871	Covishield	389	CIFX	
17834	Covishield	800	UOZX	
77708	Covishield	907	RWZC	
17941	Covishield	991	UACN	
11476	Covaxin	683	SHPC	
75901	Covaxin	576	LYYF	
73782	Covaxin	684	UYPR	
29254	Covaxin	569	UIOG	
74210	Covaxin	164	NEQR	

CITIZEN					
id	name	vaccine	vaccinated	doses	priority
376055605769	anita devi	Not Vaccinated	false	0	0
759547437077	shiv prakash	Not Vaccinated	false	0	0
285046425639	vikram singh	Covaxin	true	2	0
850068738705	pooja jayshwal	Covaxin	false	1	0
175333688134	shakshi sagar	Not Vaccinated	false	0	0
836805166304	neeraj kumar	Not Vaccinated	false	0	0
687788116354	jamil khan	Not Vaccinated	false	0	0
543633341946	kanika kathuria	Not Vaccinated	false	0	0
615454318790	riya masi	Not Vaccinated	false	0	0
942394132209	mohd ataullah	Not Vaccinated	false	0	0
287498365283	priya jain	Covishield	false	1	0
765316158525	rajkumar chawla	Not Vaccinated	false	0	0
947687109769	priyaki rav	Not Vaccinated	false	0	0
145016619591	ramdin verma	Not Vaccinated	false	0	0
854954750730	shiv prakash	Not Vaccinated	false	0	0
600580821959	vikram singh	Not Vaccinated	false	0	0
146945615146	tapas das	Not Vaccinated	false	0	0
502261944549	rijul aggarwal	Not Vaccinated	false	0	0
748089935340	mohd shakib	Not Vaccinated	false	0	0
992760597616	nitu kumari	Covishield	false	1	0
126005092396	rahul kumar	Covaxin	true	2	0
402109038906	md mustafa	Covaxin	false	1	0
539962965595	nidhi kumari	Not Vaccinated	false	0	0
946746432410	har parsad	Not Vaccinated	false	0	0
549702375218	shelender yadav	Not Vaccinated	false	0	0
963535879632	deeya kumari	Not Vaccinated	false	0	0
679507810120	anjali juneja	Covishield	false	1	0

HEALTHRECORD				
id	pregnant	eniorcitize	vulnerable	
376055605769	0	0	0	
759547437077	0	0	0	
285046425639	0	1	0	
850068738705	0	0	0	
175333688134	1	0	0	
836805166304	0	0	1	
687788116354	0	1	0	
543633341946	0	1	0	
615454318790	0	0	0	
942394132209	0	0	0	
287498365283	0	0	0	
765316158525	0	0	0	
947687109769	0	0	0	
145016619591	0	1	0	
854954750730	0	0	0	
600580821959	0	0	0	
146945615146	0	0	0	
502261944549	0	1	0	
748089935340	0	1	0	
992760597616	0	0	1	
126005092396	0	0	0	
402109038906	0	1	0	
539962965595	1	0	0	
946746432410	0	0	0	
549702375218	0	0	0	
963535879632	0	0	0	
679507810120	1	0	0	

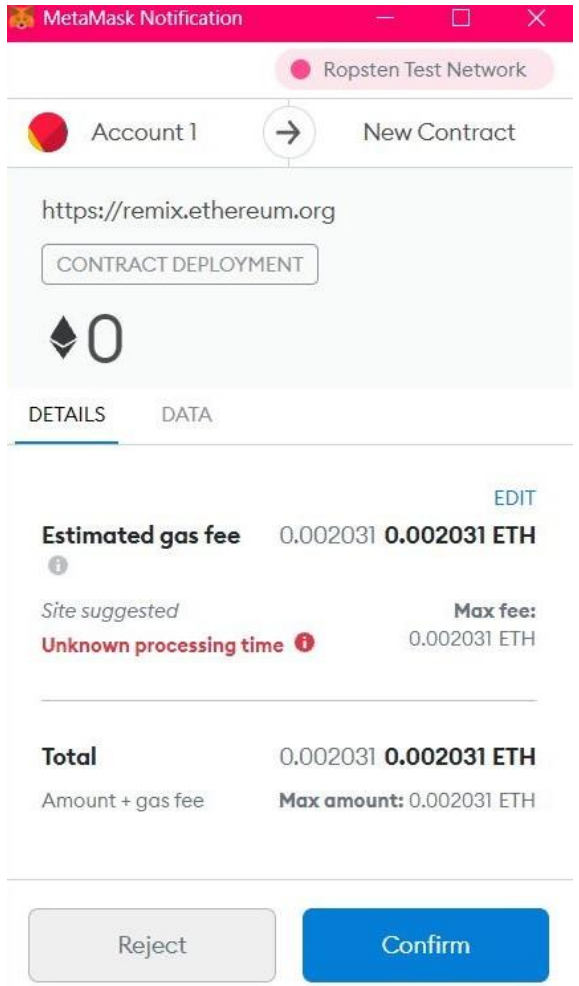
VACCINE			
id	name	sideeffect1	sid
12101	Covishield		
12149	Covishield		
22113	Covaxin	About 15 minutes after r	Acute appe
22180	Covaxin	extreme fatigue, dizziness,. could not	
22169	Covaxin		
22113	Covaxin		
22144	Covaxin		
22112	Covaxin		
12101	Covishield		
12188	Covishield		
12193	Covishield	Hives on left arm close the injection	
12149	Covishield		
12165	Covishield		
22180	Covaxin		
22144	Covaxin		
12179	Covishield		
22123	Covaxin		
22180	Covaxin		
12188	Covishield		
12199	Covishield	Felt a little nauseous and a little heac	
22180	Covaxin	Soreness at site of inject	Redness, te
22144	Covaxin	Swelling, warmth, induration, itchy. A	
22172	Covaxin		
12109	Covishield		
12179	Covishield		
22180	Covaxin		
12134	Covishield	Hot and lightheaded	

Project Demo: Code

Home | Vaccination_System.sol

```
1  pragma solidity ^0.4.6;
2
3  contract Vaccination_System {
4      struct Hospital {
5          uint id;
6          string vaccine;
7          uint stock;
8          string PrivateKey;
9          bool value;
10     }
11
12     struct Citizen {
13         uint id;
14         string name;
15         string vaccine;
16         bool vaccinated;
17         uint doses;
18         uint priority;
19     }
20
21     struct HealthRecord {
22         uint id;
23         bool pregnant;
24         bool seniorcitizen;
25         bool vulnerable;
26     }
27
28     struct Vaccine{
29         uint id;
30         string name;
31         string sideeffect1;
```

Project Demo: MetaMask



Project Demo: Contract Deployment

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```
creation of Vaccination_System pending...

[block:11234189 txIndex:24] from: 0x6fd...b1609 to: Vaccination_System.(constructor) value: 0 wei data: 0x608...40029 logs: 0 hash: 0xb17...fba87

status                      true Transaction mined and execution succeed
transaction hash            0xb173fb4bfaec444f762cedf44f04979b7fdf8642d22a60fb8d6660b7b64fba87
from                        0x6fd57Ec5F0D9Db161731f46DC66E1Ec4407b1609
to                          Vaccination_System.(constructor)
gas                         2030682 gas
transaction cost            2030682 gas
hash                        0xb173fb4bfaec444f762cedf44f04979b7fdf8642d22a60fb8d6660b7b64fba87
input                       0x608...40029
decoded input               {}
decoded output              -
logs                        []
value                       0 wei
```

Project Demo: Blockchain

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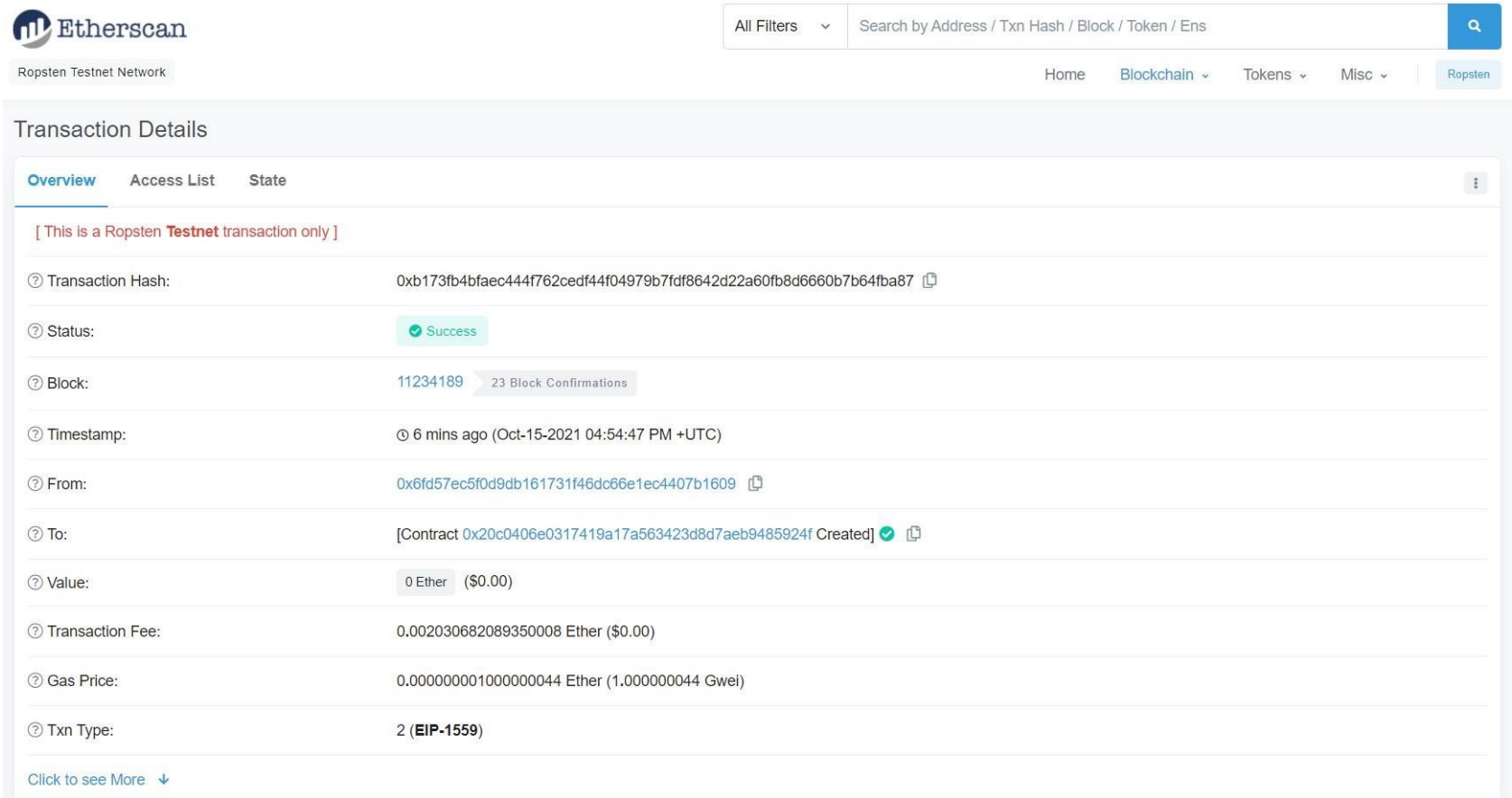

Project Demo: Functions

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Thank you