IncentiveChain: Blockchain Crypto-Incentive for Effective Usage of Power and Water in Smart Farming

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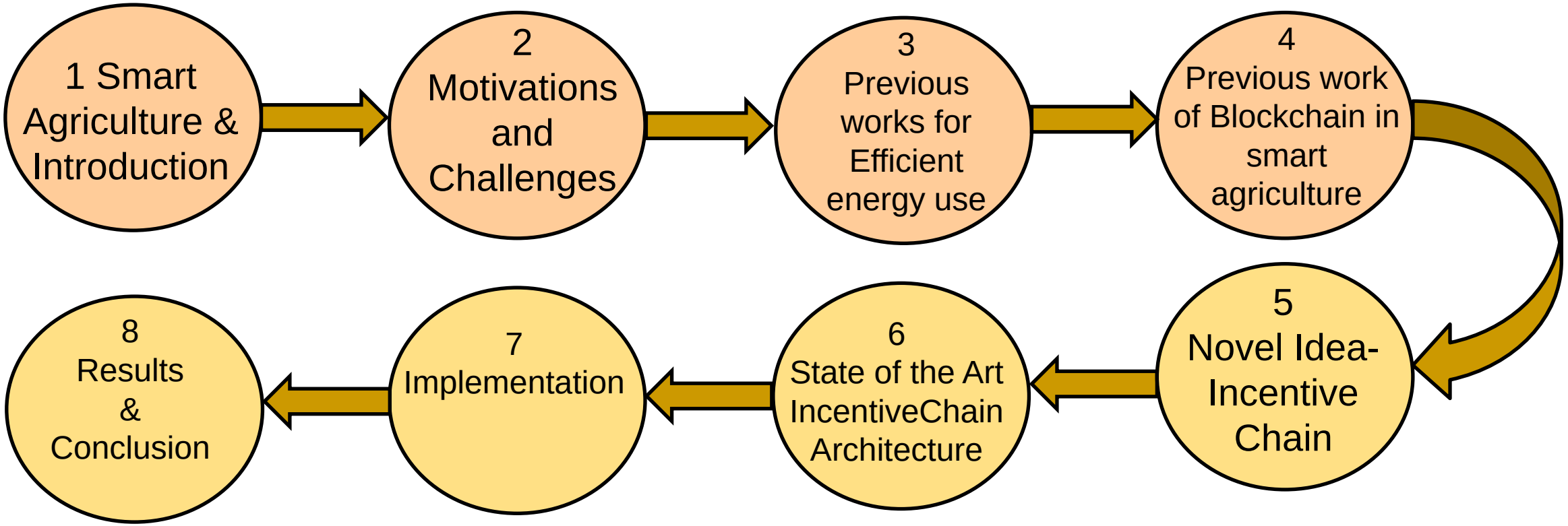
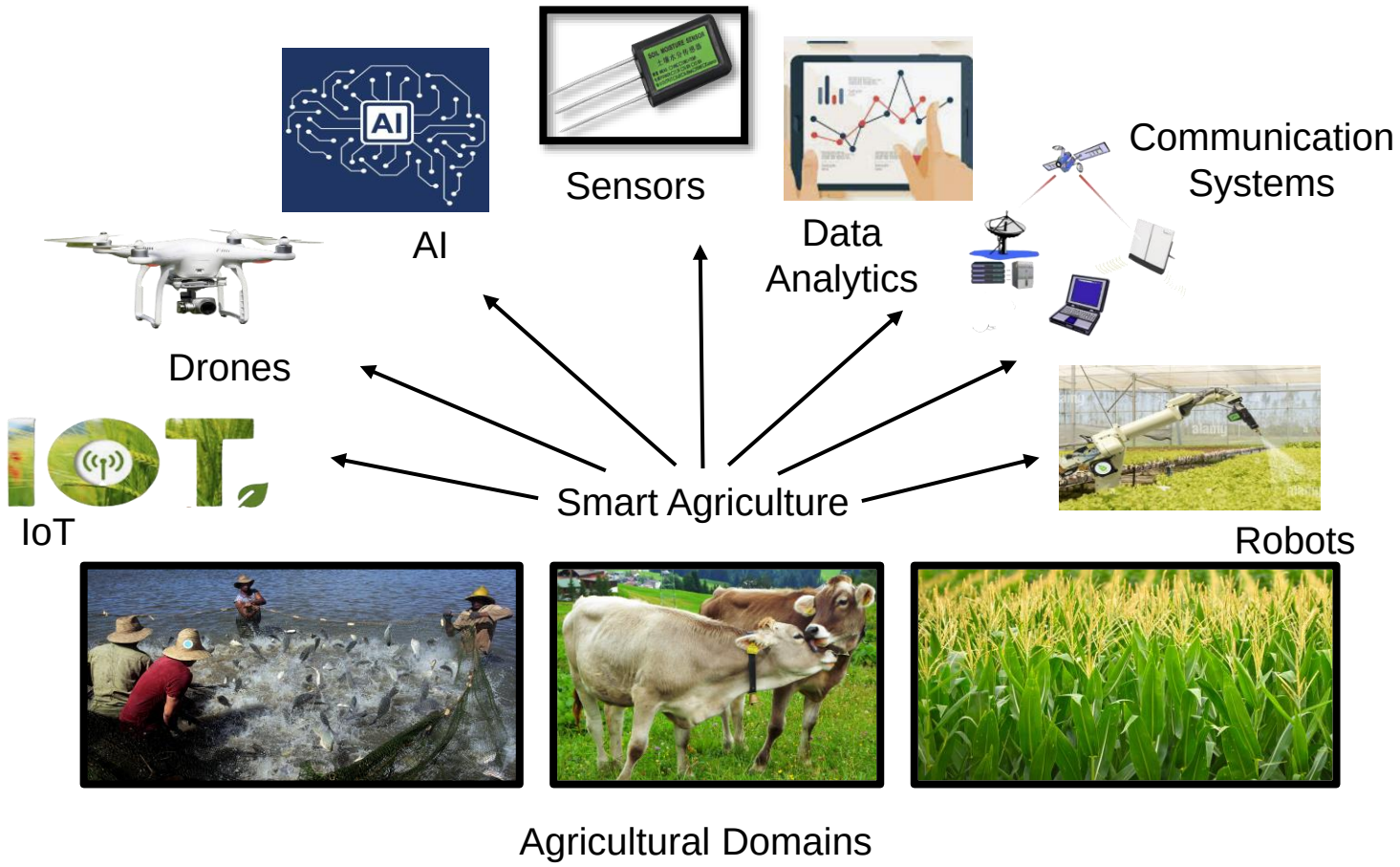
Talk Outline

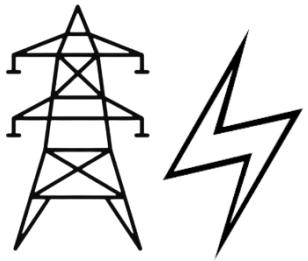


Smart Agriculture?

- Smart agriculture is an advanced procedure of conducting agricultural activities using technologies such as internet of things (IoT), sensors, artificial intelligence, and robots to increase farm productivity.
- It is an innovative way to reduce human effort and make the best use of available resources.



Introduction



Electricity

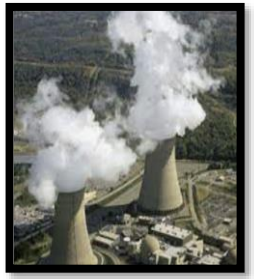
Water

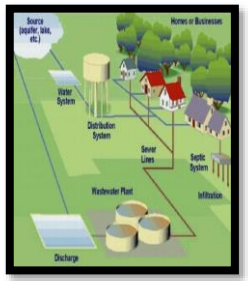
Wastage reasons

Climate Change

Overpopulation

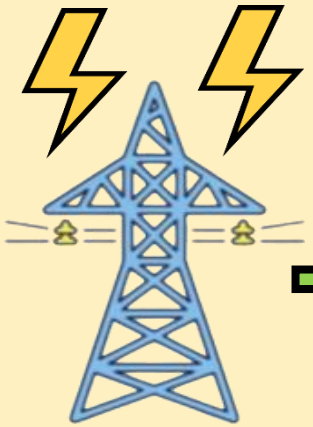
Farming





- Importance of Water & Electricity
- Water & energy use in different domains.
- Present Scenario: Electricity & water wastage
- Farming as main source for water and energy wastage.
- Recognizing farmers as main entity in farming.

Motivation for IncentiveChain



Electricity Grid

Electricity to pump water

Motivations

Excessive Energy Usage

Excessive Water Usage

Water Contamination

Increased electricity Rates

Economic State of Farmers

Banking third party vulnerabilities

Agricultural fields

Livestock

Fisheries

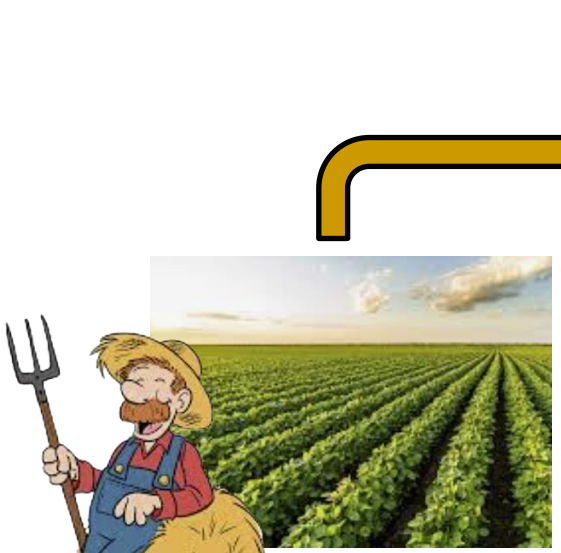
Existing works for efficient use of water & electricity in farming

Application	Technology	Incentive to Farmers	Maintenance
UAV Application [9]	 UAV	No	Very High
IoT Application [10]	 IoT	No	Very High
WSN Application [11]	 WSN	No	Very High
Sensors [12]	 Sensors	No	Very High
IncentiveChain [Current]	 Blockchain	Yes	Very low & easy to use.

Existing works of blockchain in Smart agriculture

Application	Domain	Technology
G-DaM [16]	Smart Agriculture	IPFS+Ethereum SC
Traceability System [17]	Smart Agriculture	Ethereum SC
Crop Insurance[18]	Smart Agriculture	Ethereum SC
Traceability in agri-food supply chain[19]	Smart Agriculture	Ethereum & Sawtooth
IPFS: Interplanetary File System SC: Smart Contract		

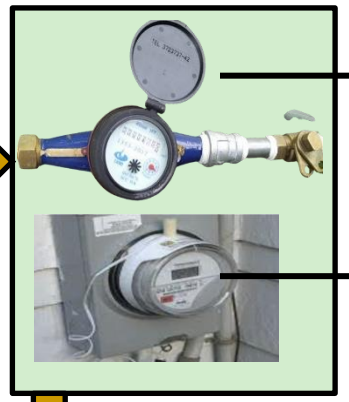
Novel Idea-IncentiveChain



Farming fields

Farmer

Using water & electricity on farms



Water meter

Electricity meter

No of Units saved during farming

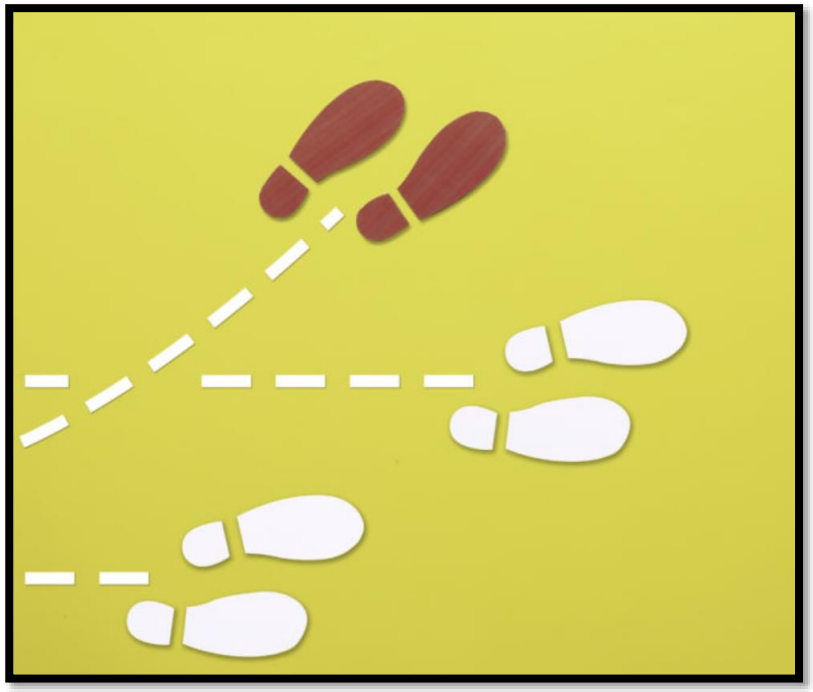
Converting saved units to ether cryptocurrency

Providing ether rewards to farmers for saving resources

Why IncentiveChain?

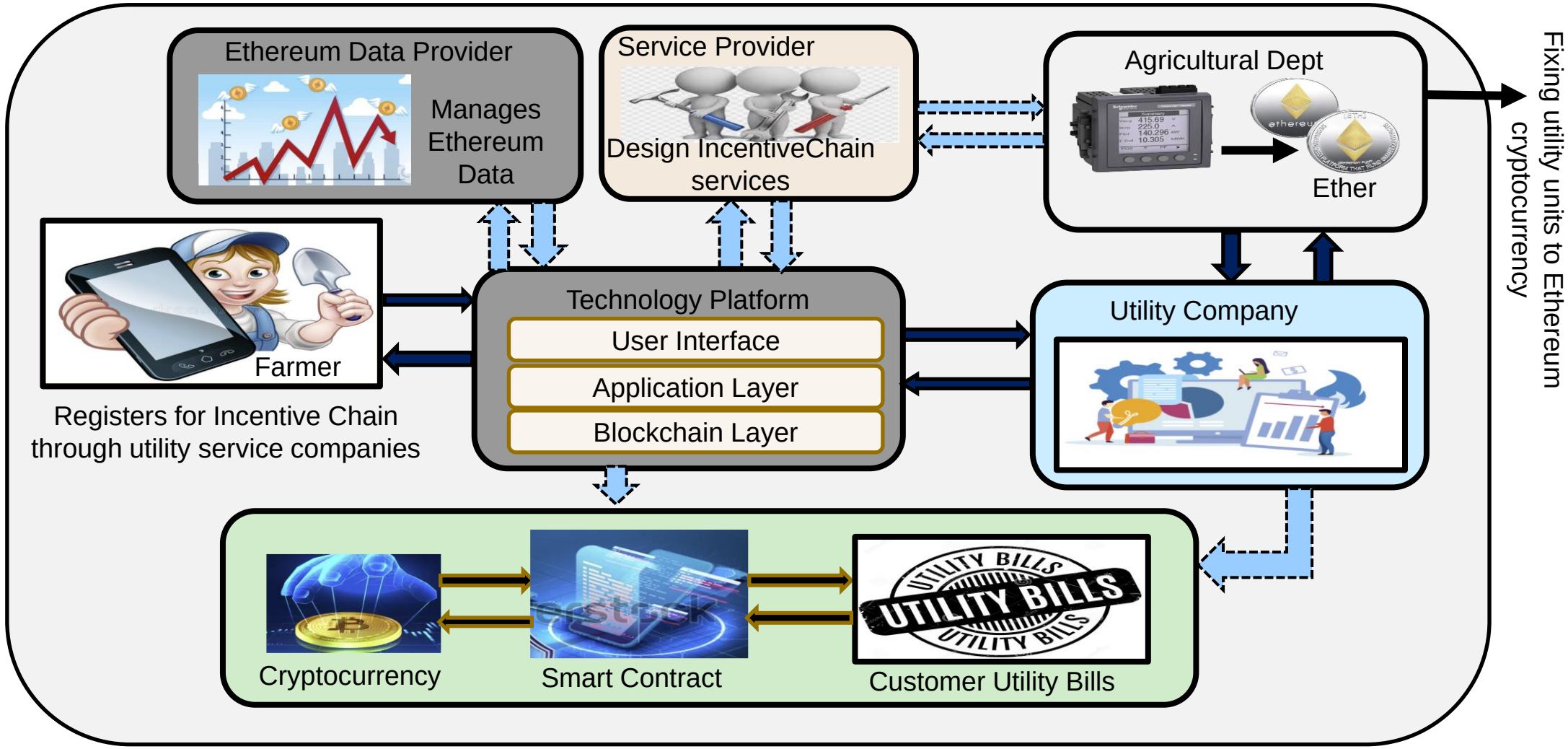
- Attracting farmers through money inducements for saving resources during farming.
- Increasing the economic status of the farmers by introducing financial rewards.
- Introducing security in banking transactions by distributing cryptocurrency.
- Increasing trust among participants for the data transferred.

Novelty in IncentiveChain



- Novel architecture incentivizes farmers for efficient water and electricity usage in farming.
- State of-the-art approach for consistency, standard, and trust in communication between relevant parties using the blockchain.
- Distribution of cryptocurrency for introducing more security in bank transactions.
- Implementation of the system using a decentralized blockchain approach.

State-of-the-art IncentiveChain Architecture



Data Flow in Proposed System

- Farmer:
  - Registers for IncentiveChain scheme using Utility service companies.
- Ethereum Data provider:
  - For managing Ethereum Data.
- Service Provider:
  - Design IncentiveChain services.
- Agricultural Dept:
  - It makes laws and rules for farming.
  - It fixes utility units to ether cryptocurrency.

Data Flow in Proposed System

- Utility Company:
  - Ties up with agricultural and technology department.
- Technology Platform:
  - It has User, Application and Blockchain layer.
  - A Smart contract to control the application endpoints, to control access.

Proposed Algorithms

- Farmer Registration

Algorithm 1 Farmer Registration

1: $str[F_o] \leftarrow (id, name, A_n)$.
2: $SP_{key} \leftarrow (SP_{id}, F_{id})$.
3: $D_b \leftarrow store(SP_{key}, str[F_o])$.
4: $B_n \leftarrow D_b$

- Retrieving details

Algorithm 2 Retrieving Details

1: $SP_{key} \leftarrow (SP_{id}, F_{id})$.
2: Search(SP_{key}) in (B_n).
3: **if** exists **then**
4: Retrieve desired str[F_o].
5: **else**
6: Return Error.
7: **end if**
8: End the process.

Proposed Algorithms

- Smart Contract

Algorithm 3 Smart Contract

1: $str[P] \leftarrow (P_{\text{id}}, name, bill, U_{\text{saved}}, Eth_{\text{g}})$.
2: $str[PC] \leftarrow (PC_{\text{id}}, P_{\text{id}}, Eth_{\text{g}}), Acc_{\text{I}}, Date_{\text{p}}$.
3: $D_{\text{b}} \leftarrow store(str[P], str[PC])$.
4: $B_{\text{n}} \leftarrow D_{\text{b}}$
5: End the process.

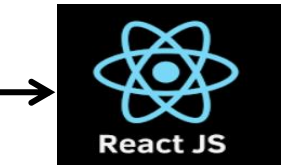
- Issue a Payment

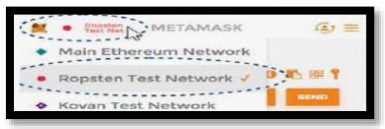
Algorithm 4 Issue a Payment

1: SP checks the authenticity of all the entities involved and confirms farmers eligibility for ethreum payment through SC.
2: SP checks if the Payment client (str[PC]) already exists in B_n .
3: SP calculates ethereum for no. of utility units saved through SC.
4: **if** all checks valid **then**
5: Proceed Payment .
6: **else**
7: Return Error.
8: **end if**
9: Store in D_b
10: $B_n \leftarrow D_b$

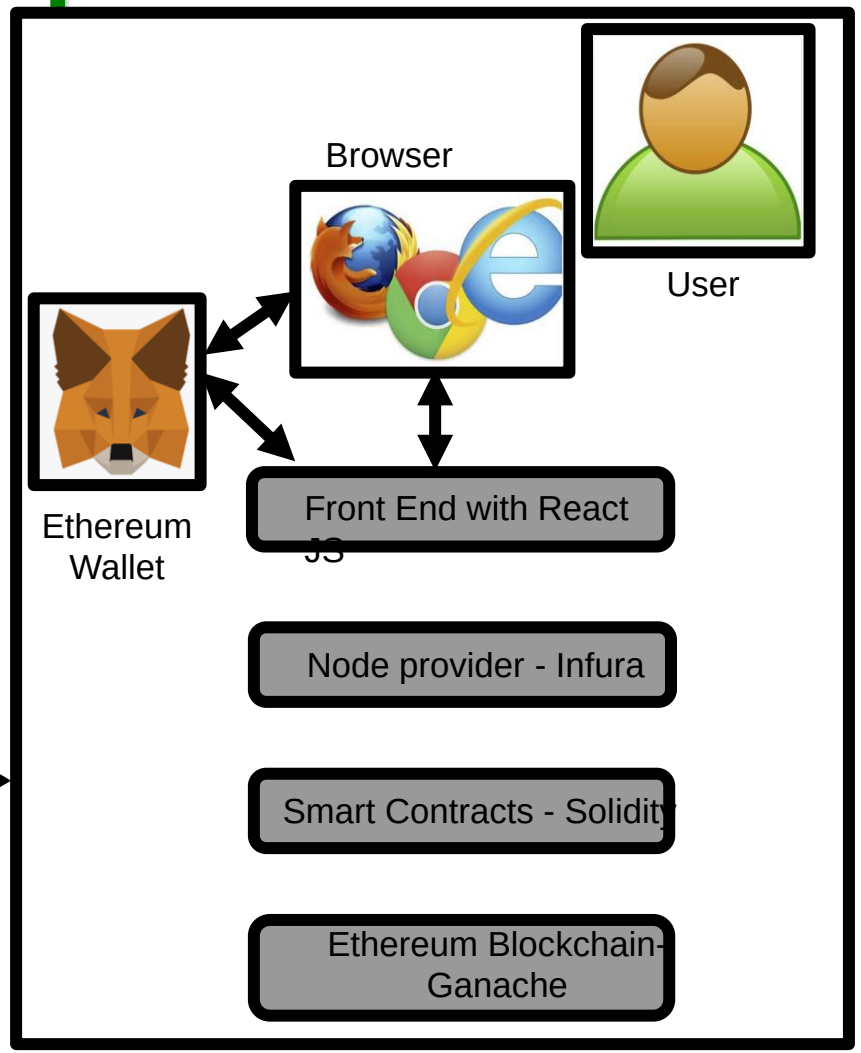
Technologies used for Implementation

- React JS for Front end
- BC: Smart Contract (SC)
- Ropsten Test Network
- Ganache public BC
- Truffle framework
- Metamask-Ethereum Wallet

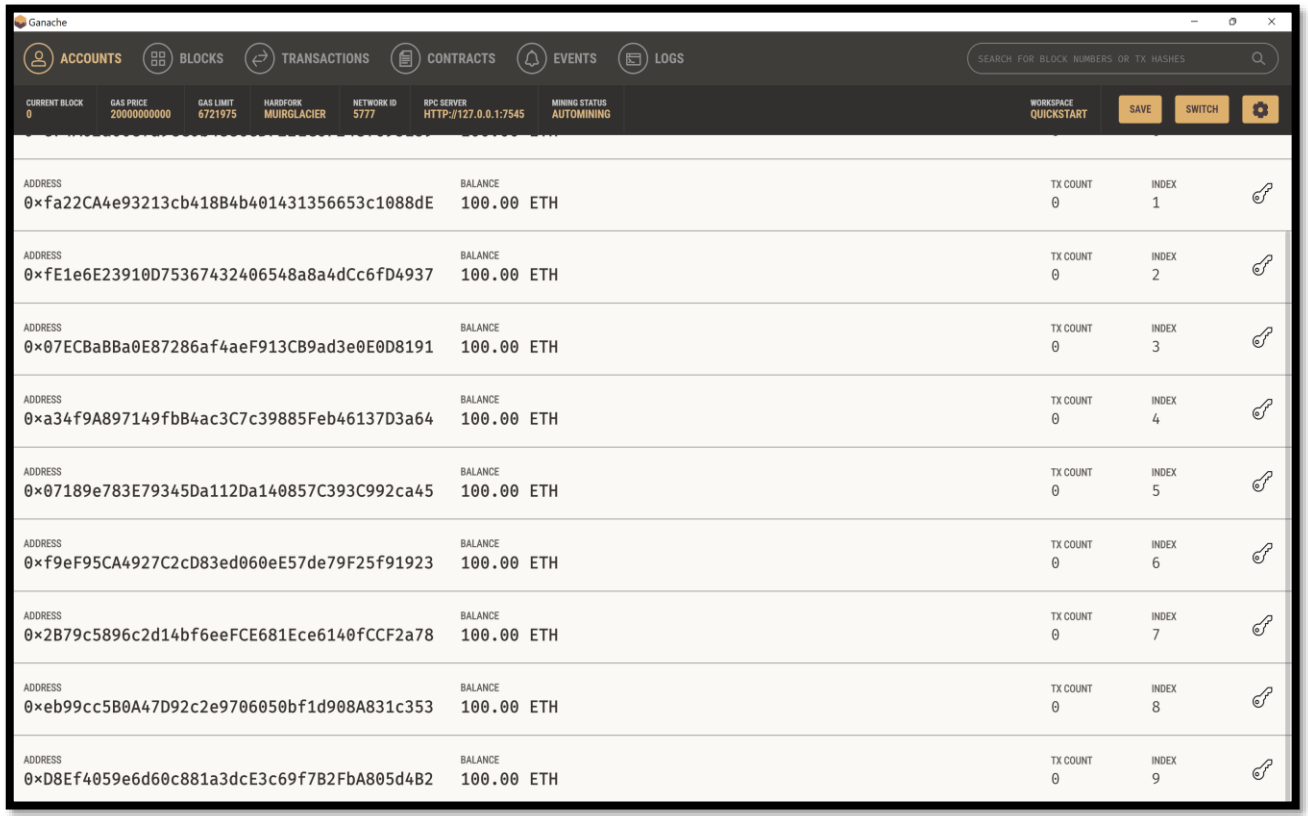




Design Flow



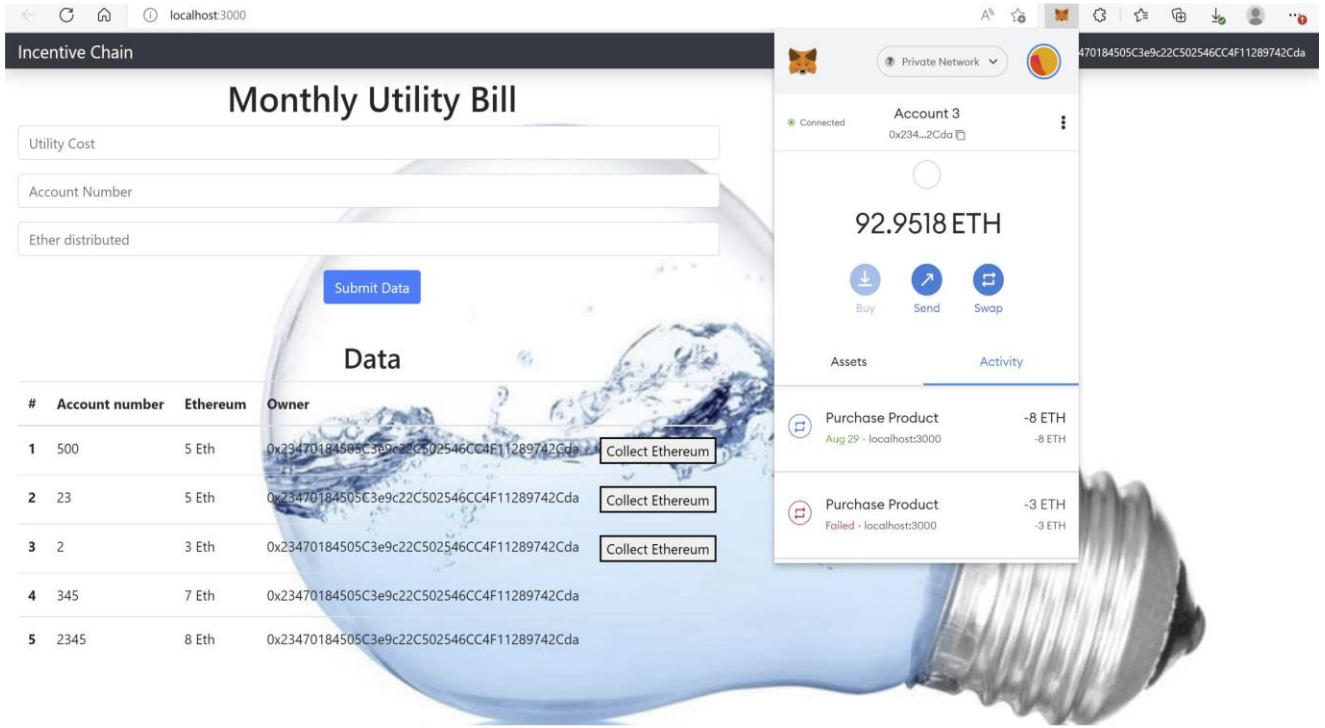
Ganache Public Blockchain



- Ganache mirrors actual blockchain.
- Provides 10 free Accounts with each 100Eth.
- In IncentiveChain we create three accounts:
  - Farmer
  - Utility Company
  - Deployer

IncentiveChain Functional Verification

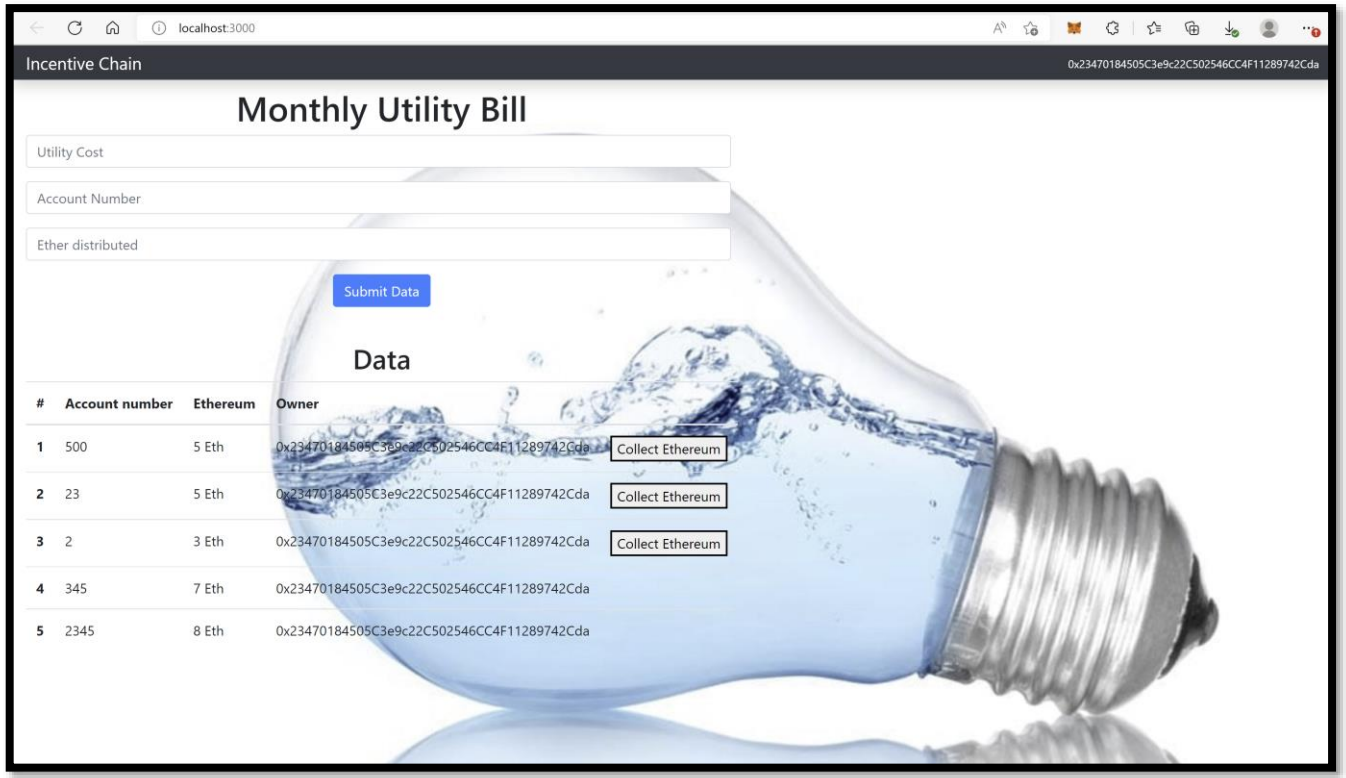
- From Utility Company account we successfully add the number of Ether to be collected by farmer.
- Metamask browser is used for completing transactions between utility company and farmer.
- From farmer account we successful collect the Ether.



User Interface for Incentive Chain

Validation

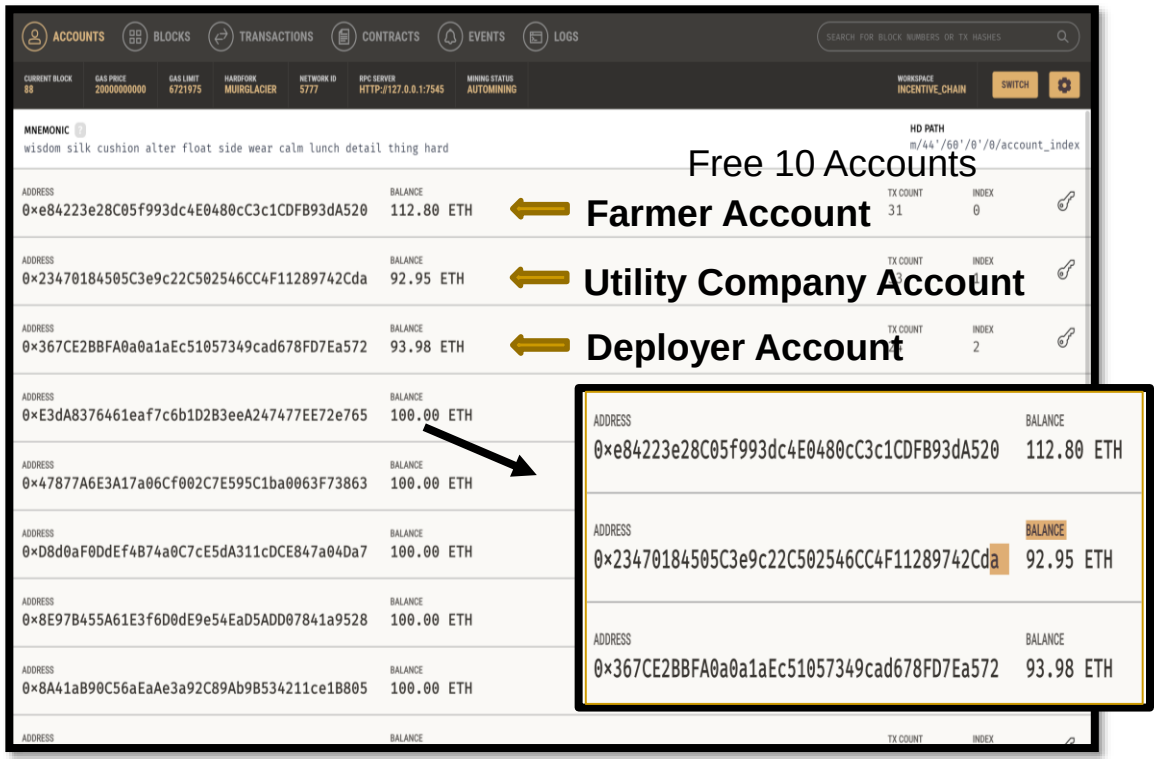
- Once Ether amount is collected by farmer, the account address changes from utility account address to farmer address.
- We avoid third party banking vulnerabilities.
- Increase trust and quality of data through BC.



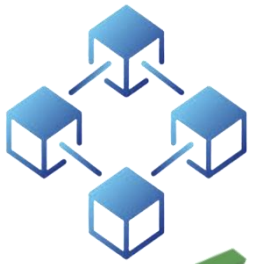
User Interface for Incentive Chain

Experiment Results of IncentiveChain

Account Holder	Account Address	Before Tx	Balance after Tx
Farmer	0xe84223e28C05f 993dc4E0480cC3c 1CDFB93dA520	100 Eth	112.80 Eth
Utility Company	0x23470184505C 3e9c22C502546C C 4F11289742Cda	100 Eth	92.95 Eth
Deployer	0x367CE2BBFA0a 0a1aEc51057349c ad678FD7Ea572	100 Eth	93.98 Eth



Conclusion



- Novel idea for incentivizing farmers.
- Proposes a state-of-the-art architecture.
- Application is built with distributed architecture evading central and cloud limitations.
- The application is successfully implemented to move the ether cryptocurrency from utility company accounts to the farmer accounts.
- Avoids third party banking vulnerabilities while distributing money to farmers.
- Increases data trust and Quality among nodes.

Future Work

- This system requires:
  - Robust design for incentives.
  - Responsible participation from farmers.
  - Efforts from national (agricultural) and local levels(utility) companies.
- Automation to the system.
- Can be enhanced and connected to the real time systems to see the actual performance in the true world.


Thank You!