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BLOCKCHAIN BASED CARBON INVENTORY PLATFORM

[1]Shesha Sai Charan .R. ,[2] Dr. Manimala .S.

[1]Student, [2]Assistant Professor

[1]Department of Computer Science and Engineering

[1]JSSSTU ,Mysore ,Karnataka ,India

ABSTRACT

The subject of climatic change and global warming are one of the most important hurdles of this century. The challenge of reducing emissions of greenhouse gasses such as carbon monoxide has become an important issue for climate change mitigation. countries worldwide have looked for different ways to encourage corporate and individuals to reduce pollution and raise awareness about it. Carbon credits are one of the methods used by governments, corporates ,companies and civil society to create a source of savings that minimizes or gradually removes greenhouse gasses from the atmosphere. The method is to make use of the technological solutions that authorize households to make use of the improved cookstoves. With the help of improved cookstoves carbon savings are monitored that is with help of cutting edge technologies carbon credits that are tracked are used to provide benefit to householders and it also leads in reduction of gasses that are harmful to environment .A Practical solution to reduce greenhouse gas emissions is a globally stimulated market of carbon. From this perspective, carbon dioxide (or other greenhouse gas) emissions are considered a commodity that forms the carbon trading system. In this project we develop method through which we calculate carbon credit for cook stoves and store it in blockchain to increase credibility and implement it in real time which acts as one of way to counter climatic issue and improve efficiency of cookstove

Key Words : Blockchain, carbon credit ,gold standard algorithm, dashboard, cookstove

I. INTRODUCTION

The major goal of this project is to develop a Carbon Credit Ecosystem using smart contracts that is blockchain so that transparency ,accessibility and standards are preserved which helps in maintaining Carbon credits. Since 21 century emission of greenhouse gases have increased and that too in last 3 decade that have increased to a greater extent due to economies that are fast developing. Due to these issues, there have been huge increase in greenhouse gasses and their impact on environment such as acid rain and drought which affects life on earth in as negative manner .Gases such as Co2 and carbon monoxide are increasing in atmosphere even though measures are taken by countries of the world to mitigate them and they are causing global warming to a greater extent which causes melting of ice poles and other climatic issues . There is a need to counter them in order to protect environment

Blockchain Technology - Blockchain is a system in which manipulation of information that is stored in it is impossible and also transparent to users who are using it. It helps in storing of information which is almost impossible to manipulate it. In block chain each block contains transaction details and each time any new transaction is initiated then it is stored in public ledger which is transparent to all the users who are users of it ,this decentralization is known as distributed ledger technology backbone of the blockchain technology .

Carbon savings from the cookstove users is captured from IOT devices that is through the help of the sensors and then temperature of the cook stove data will be written to Immutable Distributed Ledger i.e Blockchain , In this Carbon Inventory we have Database and inside database we store all records of cook stove users ,number of cook stoves, number of hours cook stoves are used and inventory is maintained and reports on the performance of cookstoves will be provided through the help of dashboards to the users.

Here we use oracle block chain in blockchain implementation part and with the help of chain codes we write temperature data into blockchain which provides security and transparency .

In web interface we provide different reports generated to users with help of high charts leading to better understanding of data .We use REST API to fetch and store and display data from data base to web interface. We use POSTMAN in order to fetch data

Gold Standard Algorithm :The Gold Standard Simplified Algorithm which is used in this Carbon inventory project for Efficient Cookstoves.

- The Gold standard is a benchmark that are used in carbon credit projects for calculation of how much there is reduction in the gasses that are emitted with the help of related equations.
- This usage of this particular gold standard algorithm is widely trusted across reputed organizations across the globe.

$NP_{,y}$	Number of project cookstoves of each age group operational in the year y
P_y	Quantity of fire wood that is saved in the year y (tonnes per household in year y)
$UP_{,y}$	Usage rate for project cookstoves in year y, based on adoption rate and drop off rate revealed by usage surveys (fraction)
$fNRB,b,y$	1.Calculation of Emission reduction(s):

- $$ER_y = \sum_{fuel}^{kboy} N_{P,y} * P_y * U_{P,y} * f_{NRB,y} * (EF_{b,fuel,CO2} + EF_{b,fuel,non\_CO2}) * (1 - DF_{b,Stove,y})$$

As we can see in the above diagram that the gold standard takes number of factors while calculating how much emission is reduced ,in this project every cook stove has 1 data point generated every ten minutes ,with the help of the data generated we will calculate carbon saved

$p_y = B_{by} * (1 - n_b / n_{py})$

Where :

p_y=Quantity of firewood that is saved in the year y(tonnes per household in year y)

B_{by}=Quantity of firewood consumed in baseline scenario during year y(tonnes per year household per year)

n_{py}=Efficiency of project cook stove in the year y(fraction)

n_b=Efficiency of baseline cookstove being replaced(fraction).A default value of 10% is used as the replaced cookstove is a three stone fire or a conventional device without a grate or a chimney i.e. no improved combustion air supply.

y= Year of the crediting period

$_{py} = n_p * (DF_n)^{y-1} * 0.94$

Where:

$_{py}$= Efficiency of project cookstove in year y (fraction)

n_p=Efficiency of project cookstove (fraction) determined at the start of project activity

DF_n=Discount factor to account for efficiency loss of project cookstove per year of operation (fraction) - Default value 0.99

0.94 Adjustment factor to account for uncertainty related to project cookstove efficiency test.

II. ARCHITECTURE AND DESIGN

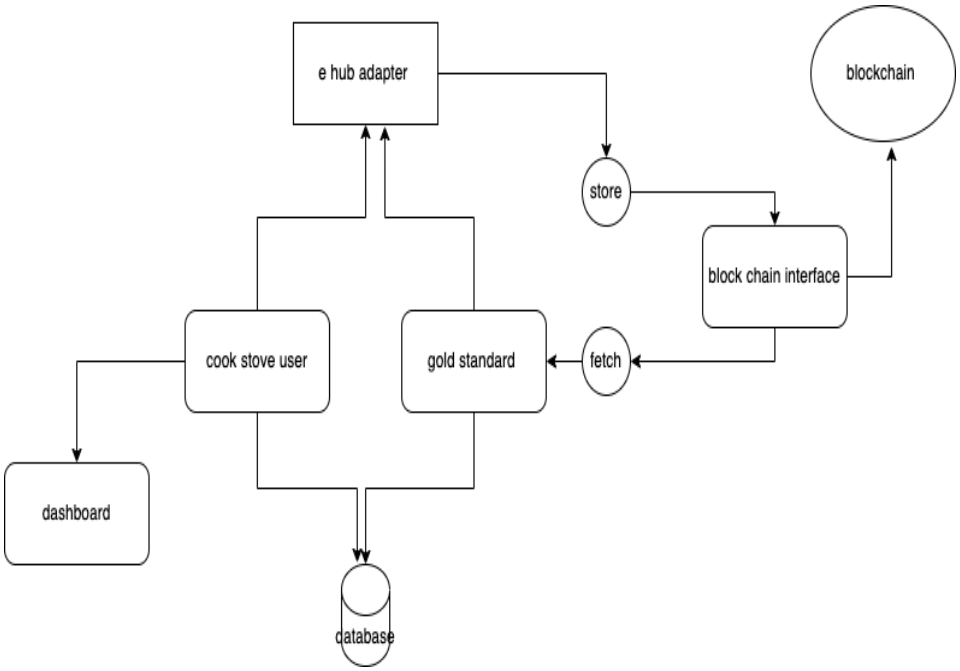

Fig 1 Architecture of carbon inventory platform

As we can see through the figure Carbon savings from the cookstove users is captured from IOT devices that is through the help of the sensors and then temperature of the cook stove data will be written to Immutable Distributed Ledger i.e. Blockchain , In this Carbon Inventory we have Database and inside database we store all records of cook stove users, number of cook stoves, number of hours cook stoves are used and inventory is maintained and reports on the performance of cookstoves will be provided through the help of dashboards to the users. of data .We use REST API to fetch and store and display data to web interface. We use POSTMAN in order to fetch data from e hub adapter.

III. METHODOLOGY AND IMPLEMENTATION

The implementation is divided into following modules in accordance to architecture of project:

3.1 eHub adapter:

1. Generic Module to get raw cooking data from the IOT devices. It does data interpretation based on the type of input. Pass on the raw cooking data to the Blockchain interface module to store in the immutable ledger - Blockchain.

3.2 Computation:

In this module we compute the decrease in carbon emission, performance of the cook stove etc. with the help of gold standard algorithm. This module is divided to sub modules namely

3.2.1Gold Standard Module:

In this sub module we assert whether the case is gold standard on the action. If it is asserted that the case is gold standard, we call the gold standard action .php and we check the flags error message and success message based on the execution of gold standard_action module

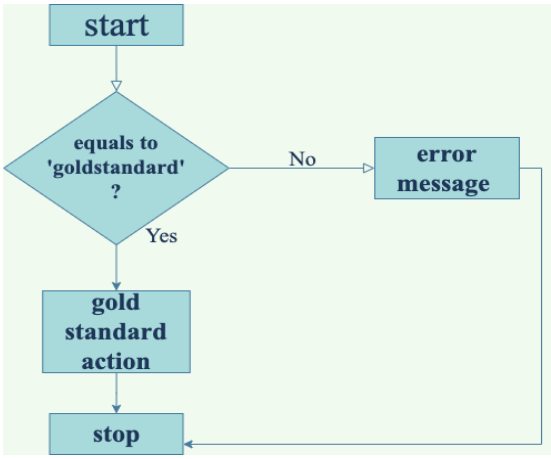

Fig 2 Flow chart of Gold Standard module

3.2.2 Gold Standard_action Module:

In this sub module on call from gold standard module we check if the user id and name exist and then we take the parameters respected to that particular user id that are the parameters related to gold standard algorithm and we pass those parameters to get the respective results.

In case we need to update the gold standard parameters we write a query to update the value of gold standard parameters and we store it in the update log. On successful completion of this we set the flag as success and return it .

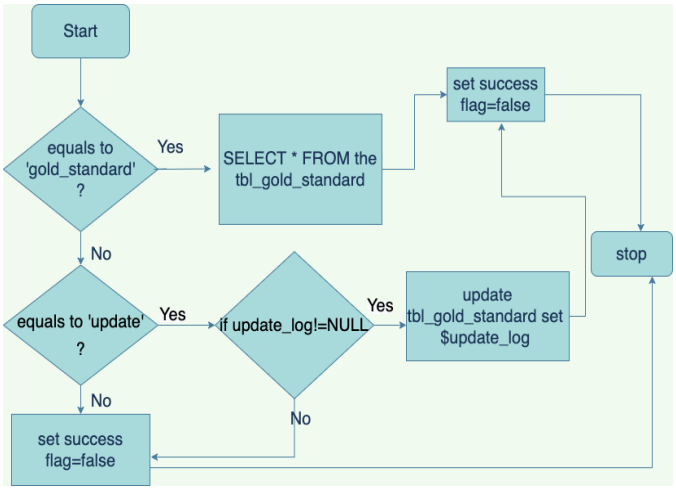

Fig 3 Flow chart of Gold Standard Action module

3.3User Management

This module mainly deals with management of user details and cook stove details .In this module admin can update or add user details .This is divided to sub modules and they are

3.3.1Cook stove user module

In this sub module we assert for multiple cases . There are two scenarios or cases here if we want to add details of user second scenario is when we want to edit user data .On successful completion of cases successful flag is set else upon any error an error flag is set. This module calls Cook stove user module

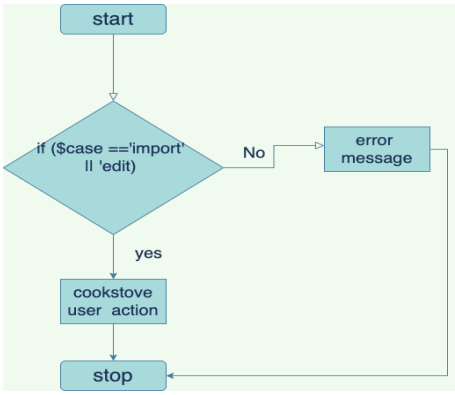

Fig 4 Flow chart of Cook stove user module

3.3.2Cook stove user action module

In this module when case add is called we check if the user data already exist by asserting existence of user id .If user id and name does not exist an array is created. where every field related to user are declared and upon submission of the form each and every detail of the user is stored in the database in which tables are previously created.

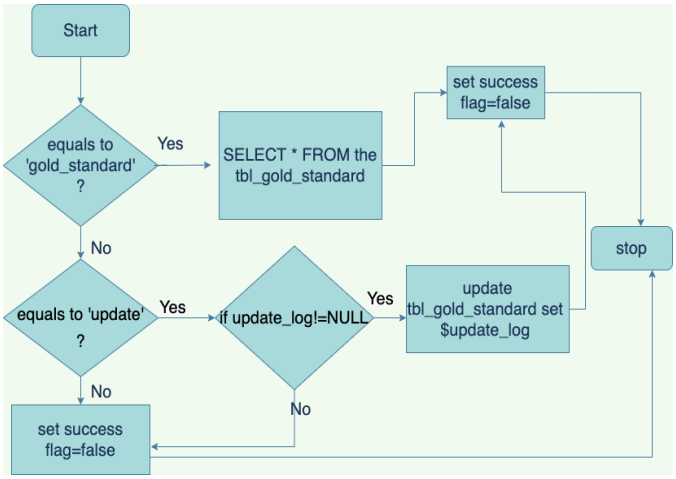

Fig 5 Flow chart of Cook stove user action module

3.4Web interface

This module deals with interaction of user with system with help of web interface. From user perspective user can view data related to cookstoves, its performance etc.

In this module charts that are related to cook stove performance, time , date and each and every detail of cook stove and user is displayed on the web interface.

3.4.1 Dashboard module

In this sub module we mainly write queries to fetch the details of cook stove user and cook stoves from their respective tables.

Some of the queries are about total cook stove count,household count, start_time of cookstove usage,types of cook stoves etc and these fetched values are plotted in highcharts in another module.

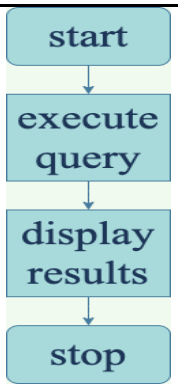

Fig 6 Flow chart of dashboard module

3.5 Blockchain Module

- The algorithm described by the flowchart is as follows. It begins by importing the necessary dependencies (the libraries required for the program).
- SmartContract function and other user structures are initialised.
- If the function equals createuser, then create user is returned which is a struct with information about the keyid, Prekey, typr, data and others. Then the program is terminated.
- Else if the function equals queryAllUser, then queryAllUser is returned. The program is then terminated.
- If neither of these conditions are met, then an error message is printed and the program is terminated.

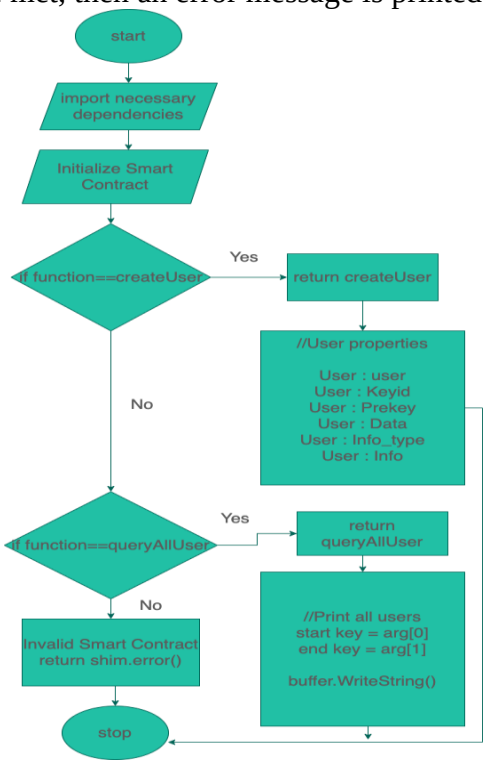

Fig 7 Flow chart of dashboard module

IV. RESULT AND SCREENSHOTS

Dashboard

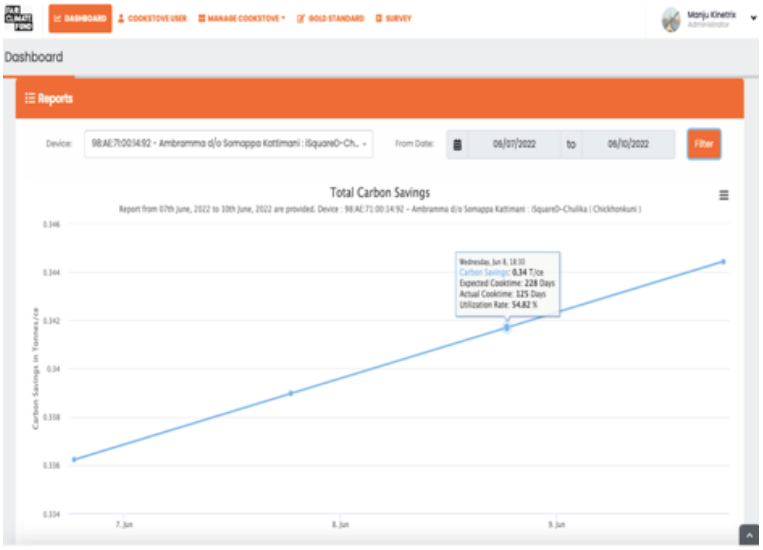

Fig 8 Screenshot of dashboard module

Fig 9 Screenshot of dashboard module

Gold Standard Configuration

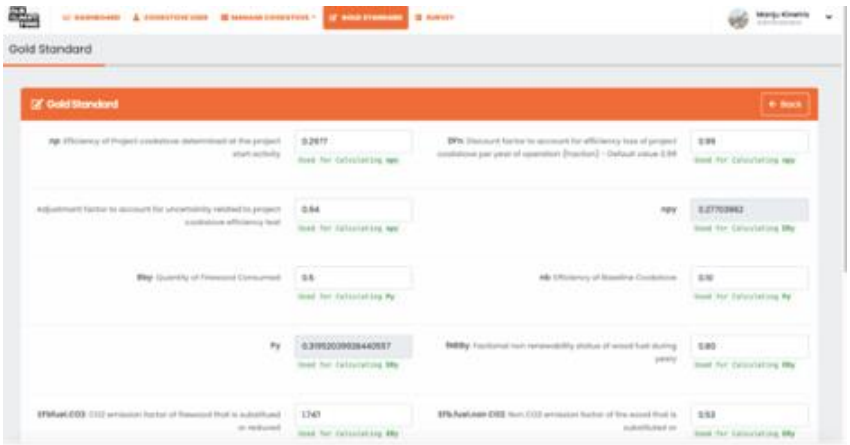

Fig 10 Screenshot of gold standard module

Cookstove Usage Chart: Weekly Data

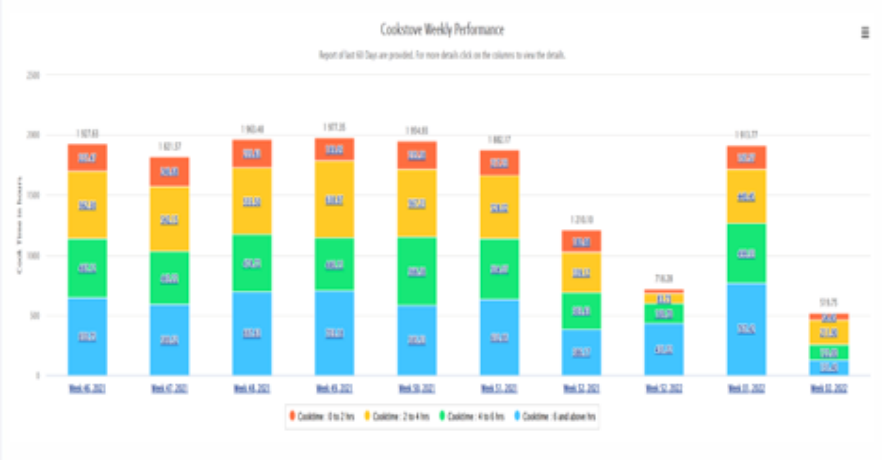

Fig 11 Screenshot of cookstove usage.

V. CONCLUSION AND FUTURE WORK

This carbon inventory platform can be used as an initiative in order to reduce impact of greenhouse gasses which in turn addresses the issue of climatic change . This project improves quality of cook stoves that are used in households which in turn benefit the household users.

Since this project uses blockchain to store the data it helps in following ways

- **It leads to transparency** - With the use of blockchain data that is being written to it cannot be modified .
- **It provides credibility** - Since blockchain is Secure it provides credibility to both stack holders and users
- **It provides efficiency** - WIth help of blockchain carbon inventory platform is designed and implemented in a systematic way which in turn increases efficiency

In future payment gateway for carbon credits ,sales management and certification of carbon credits can be added to make existing system much more feasible.

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