GSoC Proposal for S-Chain - SCoRe

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I am a second year student, studying computer engineering at Thapar Institute of Engineering and Technology, Patiala. I will be completing my semester by may-end, after which I'll be starting with my summer vacations in which I would be able to give around 40 hrs per week on this project.

Useful Links-

1. Github - https://github.com/kush-daga
2. LinkedIn - https://linkedin.com/in/kushdaga
3. Medium - https://medium.com/@kushdaga1494
4. https://www.kush-blog.netlify.com
5. Gitter Username - kush-daga

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Overview

S-Chain as the name suggests is a project aimed at easing the supply chain process and making it more trustable and secure. This comprises a full solution for maintaining a supply chain. All the parties that take part in the process will be visible and make the whole process transparent. Supply chains are a part of every product's lifecycle, but here I will be focusing only on food origin/transport tracking systems.

Goals

1. Identify the various parties involved in the Tea (can be any food item) supply chain and the components of the supply chain.
2. Build a complete layout to track the product from its origin to the end consumer and identify all sources of inputs required. (For example - QR Code Tracking)
3. Learn about the existing hyperledger sawtooth supply chain template and understand all the changes required for our use case.
4. Set up a complete network of Hyperledger Sawtooth.
5. Build the smart contract required for the execution and complete the rest api for blockchain.
6. Draft the design (wireframe and adobe xd) required for the web and app clients.
7. Building the web and mobile clients for users to communicate with the blockchain platform.

Features

Overview of Hyperledger Sawtooth Supply Chain Transaction family

Hyperledger sawtooth works in a way in which you are required to build transaction processors and transaction families to understand the various components of the blockchain network.

I will be building up on the existing supply chain transaction processor provided by hyperledger sawtooth which is open source and built exactly for purposes like these.

There are two components to this system:

1. **Supply chain transaction family**

   According to the official documentation:

   The SupplyChain Transaction Family is implemented by a Transaction Processor that manages ledger(global state) representation and integrity.

   It provides a mechanism for storing records of asset ownership. There are 3 states or SCTP (supply chain transaction processor) objects that are stored and addressed in the global state

Agent

An agent represents owners or custodians of goods. An owner is the Agent that legally owns the good, whereas a custodian is the Agent that is currently in the possession of the good. An owner and a custodian may be the same at a given time.

In the example it has been defined as follows-

```
message Agent {
    string identifier = 1; // the hex-encoded public key of the Agent
    string name = 2; // a human readable name
}

// Container for on-chain Agents.
// Allows multiple to be saved at a single address in case of hash collision.
message AgentContainer {
    // List of Agents - more than one implies a state address collision
    repeated Agent entries = 1;
}
```

Fig 1

Record

A record represents the actual good or the material that is being tracked in the system, in our case it may be tea or tea leaves.

It has been defined in the example as follows-

```
message Record {
    string identifier = 1; // the natural key of the record, serial number or
    // attached sensor identifier

    int64 creation_time = 2; // the time the record was created

    message AgentRecord {
        string agent_identifier = 1; // the public key of the agent
        int64 start_time = 2; // the time the agent started in the role
    }
    repeated AgentRecord owners = 3; // list of the owners, ordered from oldest
    // to newest. The first by definition is the creator of the record.
    // The last is the current owner of the record.
    repeated AgentRecord custodians = 4; // ordered list of custodians.
    // Same ordering as the owners list.

    bool final = 5; // is the record finalized, finalized records cannot be
    // changed.
}

message RecordContainer {
    repeated Record entries = 1;
}
```

Fig 2

The identifier string defined above may be used to uniquely identify the product and it may be attached with some identifier that can be received with a IOT based mechanism for tracking.

Records exist in a modifiable state until they are finalized. Once a Record is finalized, it can be thought of as destroyed. A finalized item has either been consumed in manufacturing, lost, or the victim of an unfortunate accident.

Application

An Application is an offer from an agent to change the Custodian or Owner field of a Record. Agents can only have one open application of a type at a time.

```
message Application {

    string record_identifier = 1; // the natural key of the record
    string applicant = 2; // public key of the applicant
    int64 creation_time = 3;

    // Whether the application is a request for ownership or custodianship
    enum Type {
        OWNER = 0;
        CUSTODIAN = 1;
    }
    Type type = 4;

    // The current acceptance status of the Application
    enum Status {
        OPEN = 0;
        CANCELED = 1;
        REJECTED = 2;
        ACCEPTED = 3;
    }
    Status status = 5;

    string terms = 6; // the terms of the application. Human readable.
}

message ApplicationContainer {
    repeated Application entries = 1;
}
```

Fig 3

Applications can only be created by the applying Agent and then transitioned to either an Accepted state, which means the proposal has been executed and the role on the Record has been updated, or a closed state (Rejected/Canceled) if either of the Agents involved do not want the application.

Transactions

The various transactions involved in this SCTP are :

1. Create Agent
2. Create Record
3. Create Application
4. Accept Application
5. Reject Application
6. Cancel Application
7. Finalize Record

There may be more transactions that could be added as per the requirements.

2. Rest API

This will comprise of various requests that can be made to the backend to get all the aspects of the blockchain.

For example - Get Agents, Get Records, Get Applications etc. based on the requirements.

Final Features

As per the goal number 1 and 2, I will be identifying the additional features required in the client and the web api. The basic features that are required in the projects are as follows:

1. A fully functioning blockchain platform with a Rest Api to communicate with the clients.
2. A client for the parties involved with features as follows:
    a. Verifying the integrity of the product till now.
    b. Entering a record for the current stage in the chain.
    c. Track the product, see the progress and update it in the chain.
    d. Map based system for location based services.
    e. Entering the next stop required and transferring the custody to the next person involved in the supply chain.
3. Ability for an end user to just scan the end product and track its real origin.

As a **PROOF OF CONCEPT:**

Here is an overview of the code structure in this git repository of mine - https://github.com/kush-daga/sawtooth-supply-chain

Also here is a demo working application (Built as an example by hyperledger sawtooth for fish tracking) that will be similar to what I will be building -

https://demo.bitwise.io/fish/#!/

Also here are some designs that I created in Figma for the Web app:

https://bit.ly/schain-design

End Goal

Have a trustworthy and reliable system that makes all the people involved confident to produce their products and being able to track all the steps involved in the process.

Timeline

- ### Before June 1
    - Community Bonding Period
    - Get familiar with Score Labs process and requirements
    - Get familiar with Hyperledger Sawtooth and the requirements.
    - During this period I will be in constant touch with my mentor and the community to discuss the future process and finalize any modifications needed.

- ### June 1 - June 7
    - Get started with building the network.
    - Generate the protobuf files and get the network up and running, with queries possible to the blockchain.
    - Understand fully the structure of our app and it's working.
    - Work on documentation.

- ### June 8 - June 20
    - Start with the Backend API.
    - During this period I will try to build a fully functional backend for communicating with the client application.
    - Define all the routes and end points that are required for the same.

- ### June 21 - June 29
    - Documentation and complete the Backend work (if any).
    - Start with the design of the client web app for the parties involved (agents).
    - Get the design reviewed by the mentors.
    - Start building the client app.
    - First evaluation round.

- ### June 29 - July 5
    - Complete the client web app, with all functionalities

- Document the client web app work.
- Phase 1 Evaluation complete.

- **July 6 - July 13**
  - Start with the mobile app design.
  - Get the design reviewed by the mentors.
  - Make changes in Client web app (if required) after review from mentors

- **July 14 - July 27**
  - Start building the mobile client app for end users and agents.
  - Add all the functionalities required.
  - Get it reviewed by the mentors.

- **July 27 - July 31**
  - Document all the work.
  - Phase 2 Evaluation.
  - Complete all the required work and submit a final draft to the mentors.

- **July 31 - August 10**
  - Week kept as a buffer to make sure everything is done as per the requirements.
  - Complete the documentation.

- **August 10 - August 31**
  - Build the final project.
  - Bug fixes and modifications.
  - Adding any additional features if needed.
  - Host it if possible.
  - Submit the project for final evaluation.

During the whole period, I'll be in constant communication with the mentors (either physical meets or virtual) and make sure that their feedback is valued and implemented.

More about me:

I have been working on blockchain for around 5 months and am familiar with frameworks like hyperledger fabric. I have also worked on Ethereum development, and have in fact won a bounty of $1000 in ETHIndia online hackathon for my project CourtLedger.

I love contributing to open source and also to give to the community. For the same I have held various workshops in my college and gave talks on various topics like React, Web Development, Blockchain development. I have been the winner of various hackathons including Smart India Hackathon 2019 and have been a finalist for Singapore India Hackathon 2020.

Reference -

1. Are you a SCoRe contributor/ Have you contributed to SCoRe before?

I have been trying to stay active in the Score Lab community since the start and have been contributing in various projects.

I have one pull request merged in the Senz project.

I also submitted an issue in the same repository.

I have also been communicating in the Fact-Bounty and the Go-social projects (issues and discussions).

I have been very active in the community and will continue to do so even after GSoC regardless of me being selected. I have been working with SCoRe without it being officially announced in GSoC 2020 list as well.

2. How can we reach you (eg: email) if we have questions about your application?

My email is - kushdaga1494@gmail.com

Gitter Id - kush-daga

3. What is your github username(s):

kush-daga : https://github.com/kush-daga

Project Specific Questions

4. Which SCoRe GSoC project are you applying for (please submit separate applications for each project):

I am applying for the S-chain project listed in the projects list of SCoRe.

5. What do you plan to accomplish over this summer for this project? (Please tell us

a. What project you want to work on,

b. How you will approach that project portion (with your milestones))

a. I would like to work on the S-chain project
b. I have described this in the proposal above the links to the same:
    i. The goals are: Goals
    ii. The Milestones with timeline: Timeline

6. If you have your own project to propose, please describe it here:

No.

7. Projects related details. (Have you tried that project you selected from SCoRe project list? What problems, if any, were presented? What prevented you from getting the entire system up and running?)

I have started a small POC for the project, I'm new to hyperledger sawtooth, and setting up a basic architecture is taking up some time. I had Ubuntu 18.04, and the project required Ubuntu 16.04, so that is one of the challenges, I will be updating my system to work with the same.

8. List down any plans you have during this summer(over the time period of GSoC, such as classes, job, vacation plans, thesis, etc.)

I have my summer vacations starting from 25th May till Mid July, so I'll be totally free and will be at home (Pune) at that time.

9. Education:

What year are you in school?

2nd Year

What programming courses have you taken?

I am familiar with full stack development and have also done a course on udemy for the same, I've also worked with hyperledger fabric and Ethereum smart contracts, learnt them via various sources including(but not limited to) Nptel, Udemy, Youtube etc.

What is your major?

Computer Engineering

Have you done group projects (programming or otherwise)?

Yes, I've been an active participant of hackathons and have always tried working in groups and collaborating with others.

What was your primary contribution to/role in the group?

Mostly I was in charge of the full stack development and also pitching and presentation at the end.

10. Do you have work experience in programming? Tell us about it.

Yes, I have been programming for 4 years now, I started out with C++ and basic OOPS concepts, after that I tried my hand in ML and android development. I switched to full stack development later on and now I am into blockchain.

11. Do you have previous open source experience? Briefly describe what you have done.

I have been involved in open source since the start, I have an active commit history in github and almost all my projects are open-source. Also regardless of my project, I have actively tried to contribute to various Projects of SCoRe. Please go through my github to know more about my contributions in open source (SCoRE or otherwise) - https://github.com/kush-daga

I also have an issue opened in multipass - https://github.com/canonical/multipass/issues/1455

12. Tell one interesting fact about yourself.

I love to listen to songs and can go upto 9hrs+ listening to just various types of music, in fact I can't sleep without songs. Also I am a huge fan of TV series (My favourites - Dark, Witcher, B99). I have also recently started documenting all the work that i'm doing, and will be putting it out soon on an instagram page made for this, it will be showcasing me learning various technologies and how im passing this quarantine period.
Here is the instagram page: https://www.instagram.com/dev_kid/

Resources:

1. Official Documentation for Hyperledger Sawtooth Supply Chain example.
2. https://www.allthingssupplychain.com/the-amazing-supply-chain-of-a-cup-of-tea/
3. https://developers.google.com/open-source/gsoc/timeline