Summer Fellowship Report

On

Geth-Hired

(A DApp on the Ethereum Blockchain)

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We would like to thank **Ms. Usha Viswanathan** and **Ms. Vineeta Ghavri** for the administrative help and all other administrative people for making our stay here in IIT Bombay a pleasant memory.

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Contents

Chapter 1

Introduction

1.1 Purpose

The main purpose of the product is to help individuals to make their professional profile to showcase their education, achievements, experiences where each certificate can be validated to prove their genuineness from respective organizations.

The other aspect of this product is to provide companies/recruiters a platform where they can post their jobs and get the most authentic, legitimate, valid candidates suited as per their requirements in easier, faster and cost-effective ways.

1.2 Document Conventions

1.3 Intended Audience and Reading Suggestions

This document provides an overall view of 'Geth-Hired' website where anyone wants to work with the system he/she can be developer, tester or anyone with a basic knowledge of technology.

Primary target audience is

- Working professionals/Freshers/Graduates/Skilled Candidate/Interns
- Recruitment agencies
- Companies
- Online learning providers (edx, coursera, udemy, iitbx, spoken tutorials, etc.)
- Academic organisations (universities)

The ~~whole~~ document starts with the introduction, the purpose of this system for understanding the reason behind the system, as continue with document tells about the structure of the system in conventional UML formats where any developer, testers can refer to understand the whole workflow, each components purpose, functionalities.

1.4 Product Scope

- Easy profile building where anyone can showcase their true achievements with proper validation credential from certificate respective authorities and easy verification of certificates.
- To provide a platform for job searching, job applying in more secure transparent while considering candidate privacy.
- For recruiters to post jobs easily and come across verified genuine legitimate candidates.
- Incentives for certificate issuer/ validators of certificate on validate certificates and store signature credentials then in most secure, reliable, immutable way.

The main feature which makes it different from other job portal is that recruiters can verify shortlisted candidates in just one click as the certificates are verified beforehand from their respective authority.

User has control over his/her sensitive data like contact information, avoiding the misuse of user information.

Chapter 2

Overall Description

2.1 Product Perspective

This product build like existing job portal websites with add-on features of Blockchain to provide more features and to overcome the drawbacks of current hiring process. The main feature being validation and verification of job profiles of the candidates. Blockchain facilitates retaining of the data without any single point of failure, thus giving the product a long life-span. We allow the candidate to upload their experience certificates and other achievements and validate those achievements on our system by the validators already present on the system. These candidates get their profile validated and can directly apply for the jobs posted by the recruiters. The recruiters are given the facility to verify these profiles on the blockchain to check the authenticity thus removing the need of any extra background checks. The system rewards for task completion and charges certain amount to prevent spamming. Overall, the system is cost-effective.

2.2 Product Functions

There are two primary roles present in the system - a job seeker, validator/recruiter. The transactions happen in the form of tokens on the system.

- Candidate is onboarded on the platform and rewarded tokens on registering.
- The certificates and achievements uploaded are then requested for validation by The secondary roles being the validator, recruiter, administrator.the candidate which consumes tokens.
- The administrator forwards these requests to authentic authorities for signing. (This can be done on-chain or off-application but in this release it is on-application)
- The validators sign and rewarded with tokens. They can either sign or reject the incoming request. The status is stored on the database.
- After validating all the uploaded certificates, a candidate is eligible to apply for the job.
- Companies/recruiters post the jobs and get a listing of validated profiles.
- They can verify these profiles on the blockchain.

2.3 User Classes and Characteristics

The two main classes are - job seeker class and validator class

Subset of job seeker class include students, freelancers, tutors, etc. Mainly the system will be beneficial for job seekers who are either students looking for internship, freshers from college, or currently employed and looking for a job change.

Validator class consists of users like educational, academic institutes, companies, recruiters, course providers, etc. These are institutes looking for hiring and filling their open positions with valid profiled user. Other institutes are on boarded for validation and can also post their job openings.

2.4 Operating Environment

The product being a web application can be accessed on any device that has a browser for browsing through website. So hardware required would be any personal computer or mobile device. The software present must be browser.

2.5 Design and Implementation Constraints

Some design issues and implementation constraints are -

- All the certificates are uploaded on Swarm. The challenge would be to create own private network of nodes.
- Another challenge is to eliminate the use of centralised database. (Here, we are using MySQL, to store personal data because of the high costs of storage on blockchain)
- Reducing the transaction costs by optimizing smart contracts
- Making user experience better with Reactjs or any other UI library
- Making it more secure by data abstraction
- Porting the system to ethereum mainnet.
- Scaling the product
- Removing the administrator role

2.6 User Documentation

Documentation for reference -

- www.reactjs.org
- www.expressjs.com
- http://remix.ethereum.org
- https://www.trufflesuite.com/
- https://swarm-guide.readthedocs.io/en/latest/
- https://github.com/portis-project/web-sdk
- https://solidity.readthedocs.io/en/v0.5.3/
- https://github.com/fossee-ethera/Geth-Hired-UI

2.7 Assumptions and Dependencies

Some assumptions are -

- The system is effectively economical though the transactions costs are much higher for onboarding users.
- The validators are believed to be present on the system for attending validation requests.
- The users are interacting with the DApp using single wallet address.

Chapter 3

External Interface Requirements

3.1 User Interfaces

The User Interface of dapp follows standard website development conventions and is responsive to any web enabled device.

The Content of user Interfaces may vary according primary user roles of application.

User roles are chosen during first authentication and registration procedure.

Interfaces like Authentication, Registration , Account, Job Listings are common to both user roles job seeker and organization respectively. Job Application, Verified Profile including professional journey such interfaces are available to Job Seeker only, while Posting jobs for recruiting, validating certificates, shortlisting candidates are available to organization role.

Web Interfaces provided from application are developed using ReactJs library along with SemanticUI.

3.2 Hardware Interfaces

Geth-Hired does not require any special hardware component, any web enabled device with browser supporting to HTML and Javascript will be able to run applications smoothly.

3.3 Software Interfaces

Geth-Hired make use of application programming interfaces as well as software components to facilitate various functionalities.

Name	Description	Version
Web3.js	web3.js is a collection of libraries which allow you to interact with a local or remote Ethereum node, using an HTTP , WebSocket or IPC connection.	1.0.0
erebos.js	Javascript library and CLI for interacting with Swarm distributed database.	0.8.1

express.js	Web application framework for node.js used for connecting server-side with SQL database.	1.0.1
Swarm Ethereum	Swarm is a distributed storage platform and content distribution service, a native base layer service of the ethereum *web3* stack.	0.3
Npm	npm is a package manager for the JavaScript which used for node.js and react.js.	6.9.0
Solidity	Solidity is an object-oriented programming language for writing smart contracts to interact with blockchain platform.	0.5.0
MySQL	SQL database for storing user profiles and other relevant data of application	8.0.12

3.4 Communications Interfaces

All data transferred between the server and user roles is carried out using HTTP protocol. Interaction between Swarm and users is also performed using HTTP. Web browsers facilitates HTTP transfer between components.

Chapter 4

System Features

4.1 Token System

The system uses ERC20 tokens to reward users upon successful registration. The validation requests raised by the candidates and job posted by the recruiters are paid in these tokens.

These tokens are also used to reward validators upon every validation request addressed by them.

4.2 Verified Profiles

The certificates and experiences claimed by the candidates are verified by the authorities who issued them. This way, no candidate can put any fake certificate or experience. Also, only the candidates who has all their certificates verified can apply to job posted by the recruiter’s. This will give recruiters a better choice of candidates.

4.3 Tamper-Proof

The requests raised by the candidates are stored in blockchain and only the authorities who issued that certificate can verify them. Even if someone else tries to validate them, he won’t be able to. Hence, the verified documents are genuine.

Chapter 5

Other Nonfunctional Requirements

5.1 Performance Requirements

- Response Time -
  Response time of Geth-Hired can be noted less where services and tasks are related to servers and conventional database, whereas response time increases while interacting with blockchain as block creation may require considerable time for given transaction.

- Scalability -
  The decentralized application can be scaled high for services concerning the conventional database part, while services involving blockchain and swarm distributed database won't get affected by scalability as they are distributed.

- Platform -
  Geth-Hired mainly runs on top of ethereum blockchain platform and distributed storage as well as traditional server which is needed to host on appropriate platform considering term of performance.

5.2 Safety Requirements

- Sharing of credential to Geth-Hired should be avoided as it may involve money through cryptocurrency.
- If password of Ethereum account is lost, account will also be lost along with currency.
- Must keep its database protected
- Must take regular backups for the extreme cases.
- Any transaction done on Geth-Hired cannot be reversed.

5.3 Security Requirements

User authentication is handled by Portis wallet. The user is logged in via portis and logged out the same way. The user needs to be logged into portis to access the DApp account. Only wallet addresses retrieved from portis are stored on local database to perform session checks. All the terms and conditions specified by portis must be accepted for accessing the DApp.

5.4 Software Quality Attributes

Some primary quality attributes are -

- The software is adaptable to all types of web browsers that is the website is responsive.
- The website once hosted is available with 99% server up time
- The software is portable and can be used on different IDEs
- Since, the system uses blockchain, it is reliable.
- Data is fetched from fast databases, therefore robust
- Simple UI for customers.

5.5 Business Rules

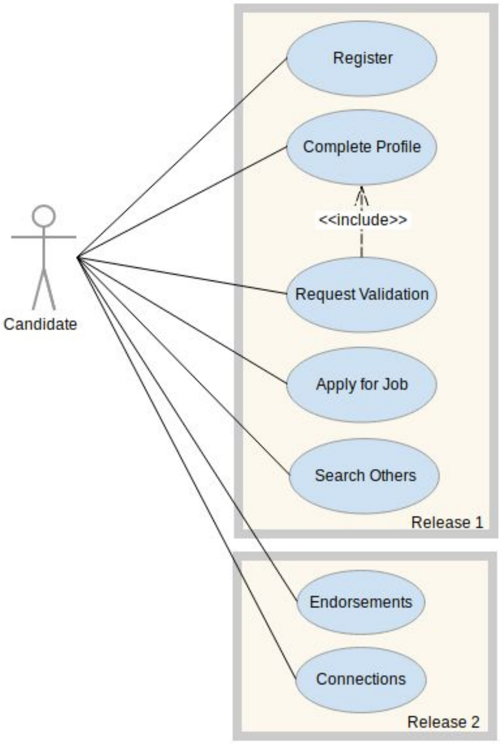
Company can possess only one single wallet address. Though the individuals handling the account maybe different. The jobs posted must be authentic. Only after profile of in dividual is validated, they can apply for jobs.

Chapter 6

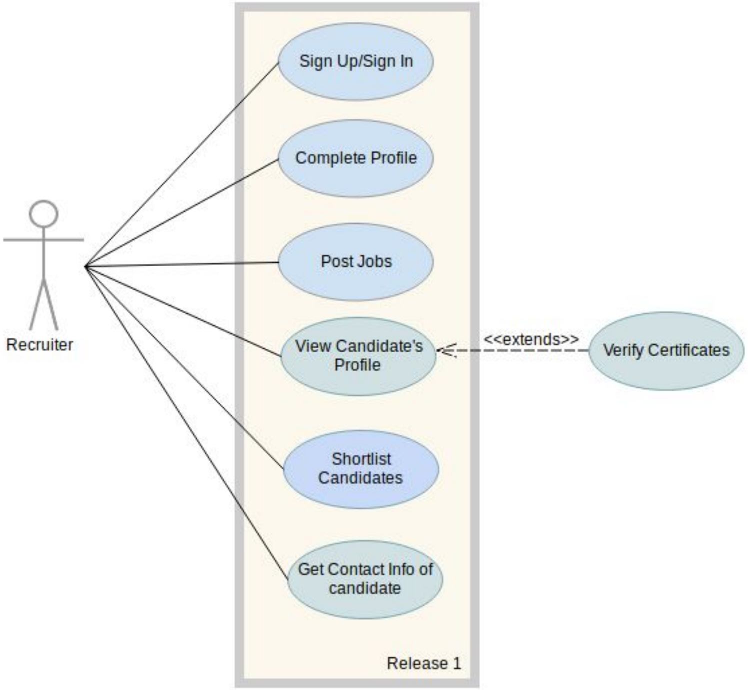
Design Requirements

6.1 Use Case Diagrams

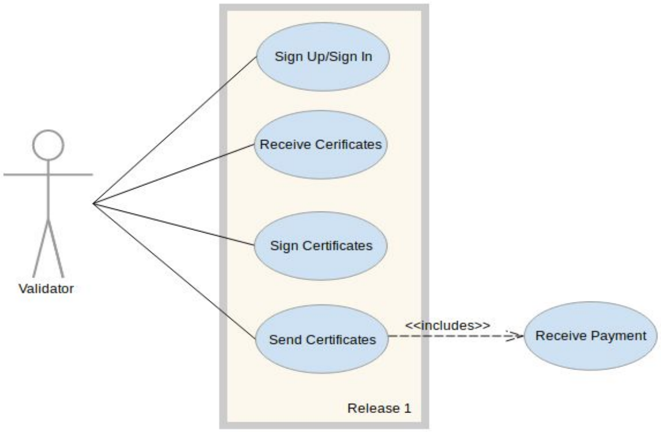
Candidate Use Case Diagram -



Recruiter Use Case

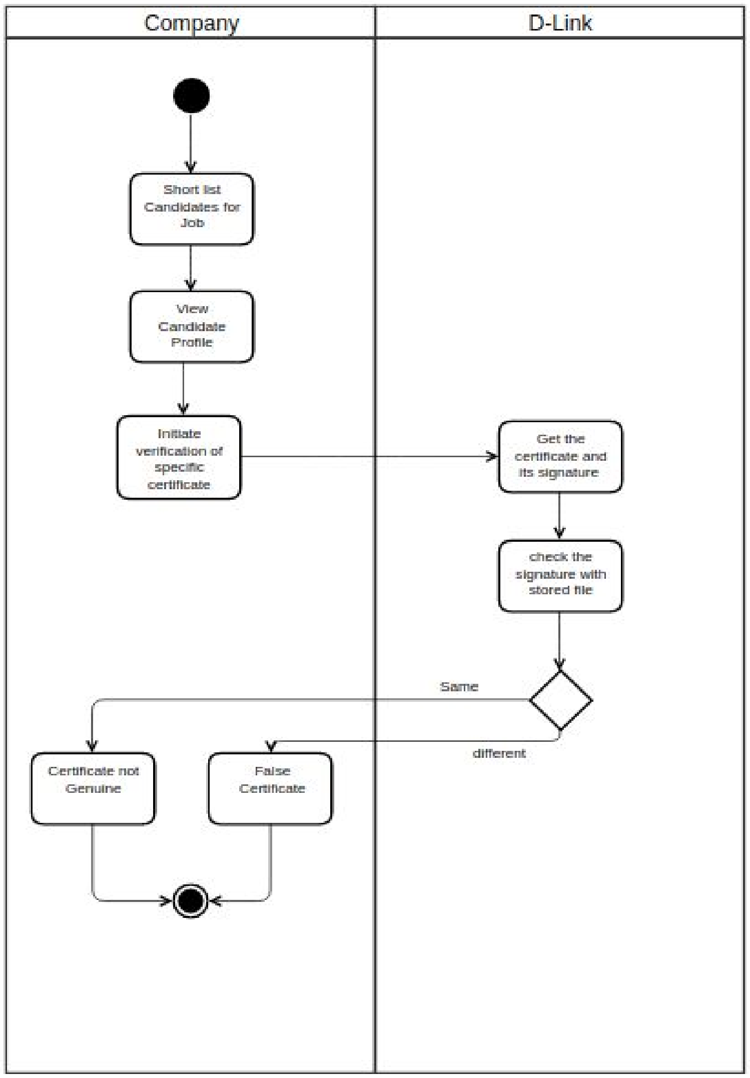


Validator Use Case

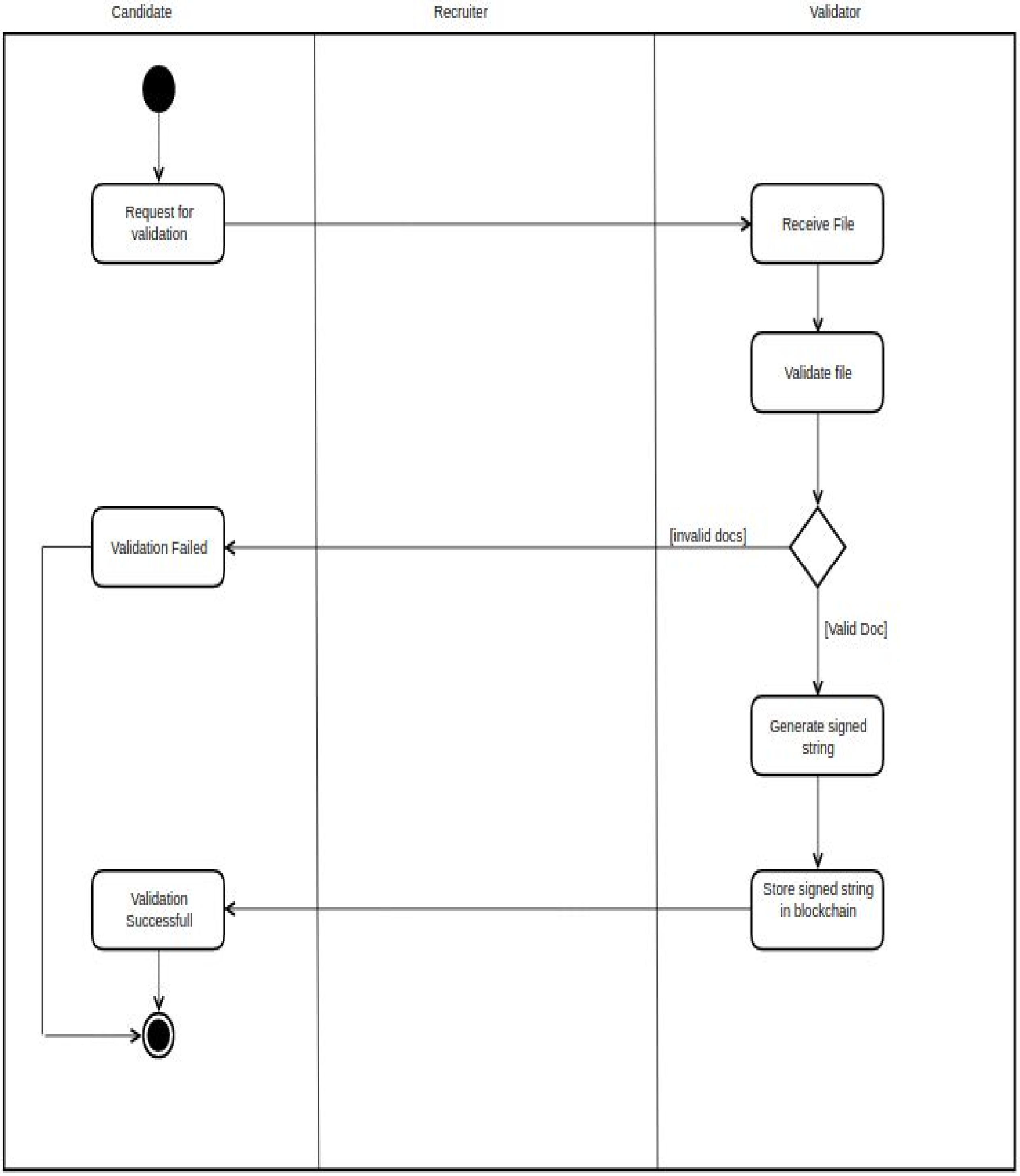


6.2 Activity Diagrams

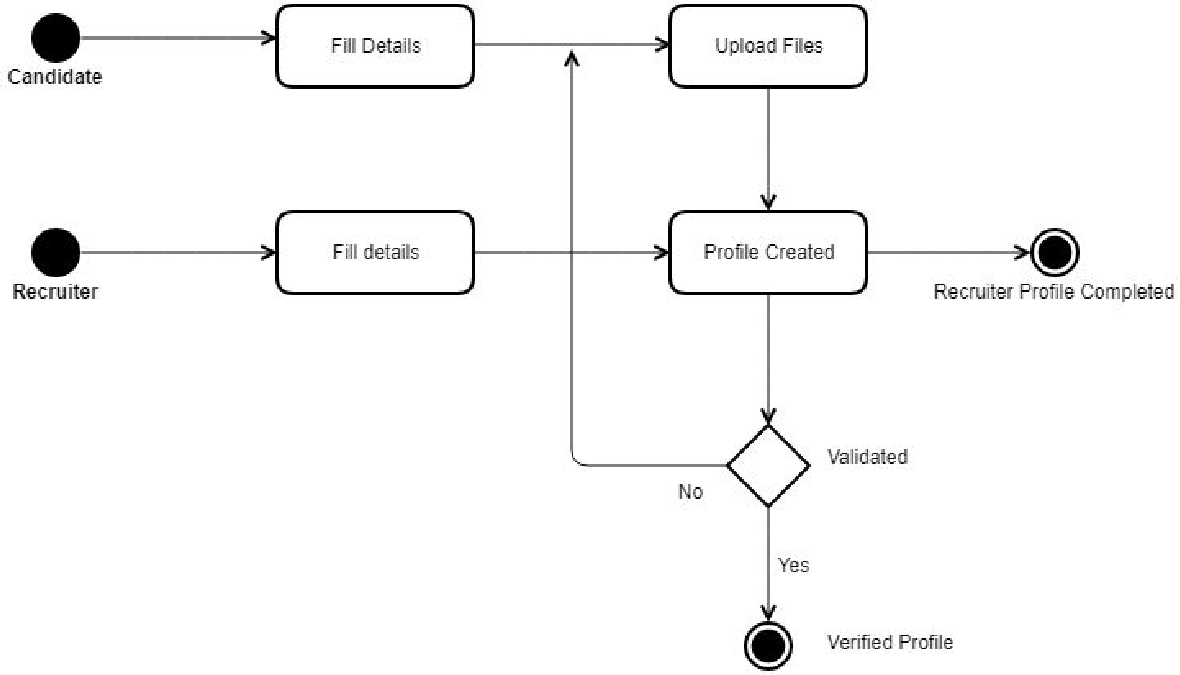
Company Verification Activity


Company
D-Link
Short list Candidates for Job
View Candidate Profile
Initiate verification of specific certificate
Get the certificate and its signature
check the signature with stored file
Same
different
Certificate not Genuine
False Certificate

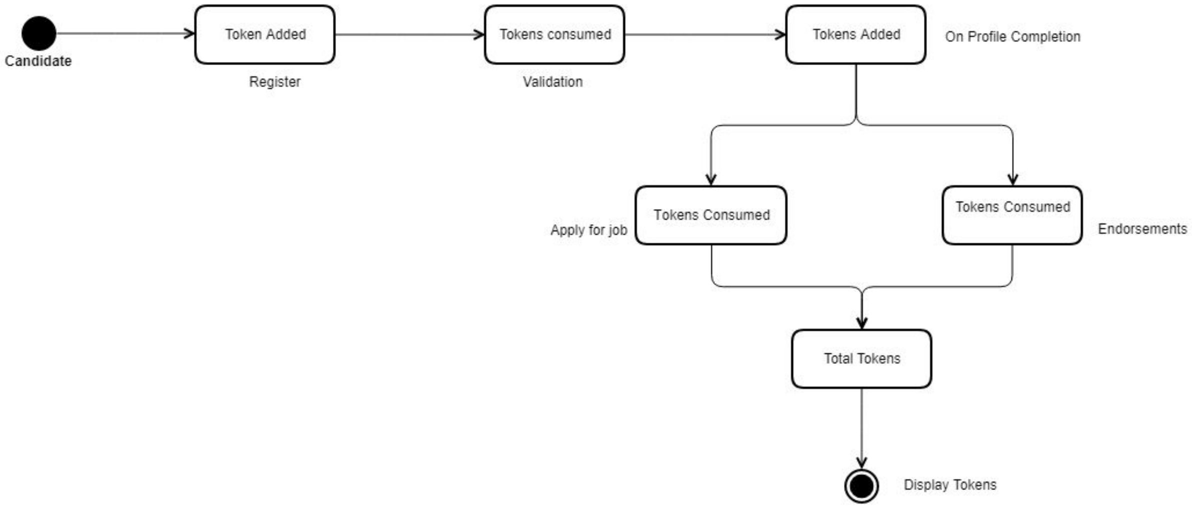
Candidate Validation process activity diagram

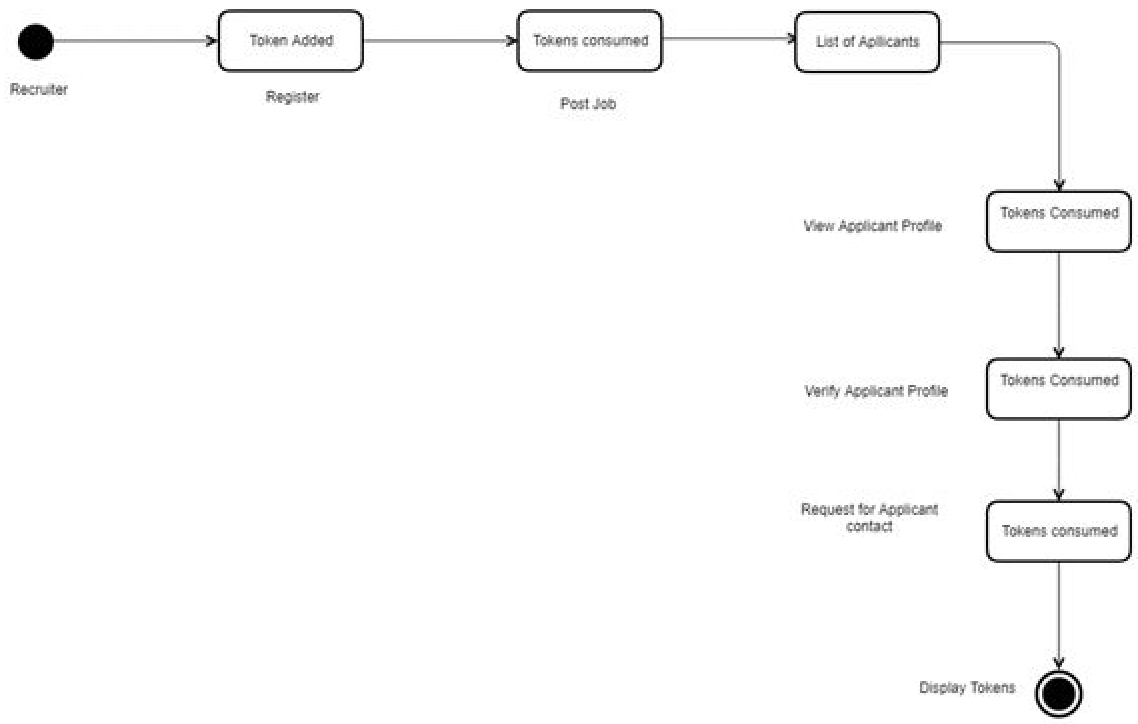


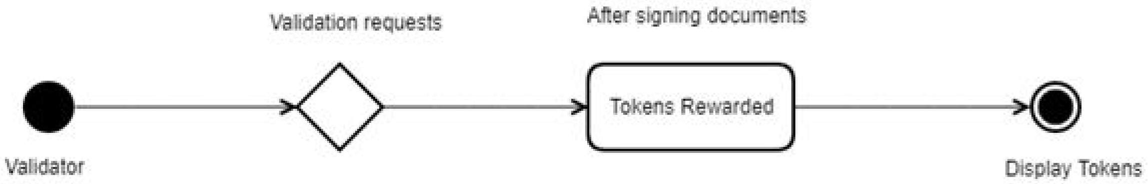
Candidate profile activity



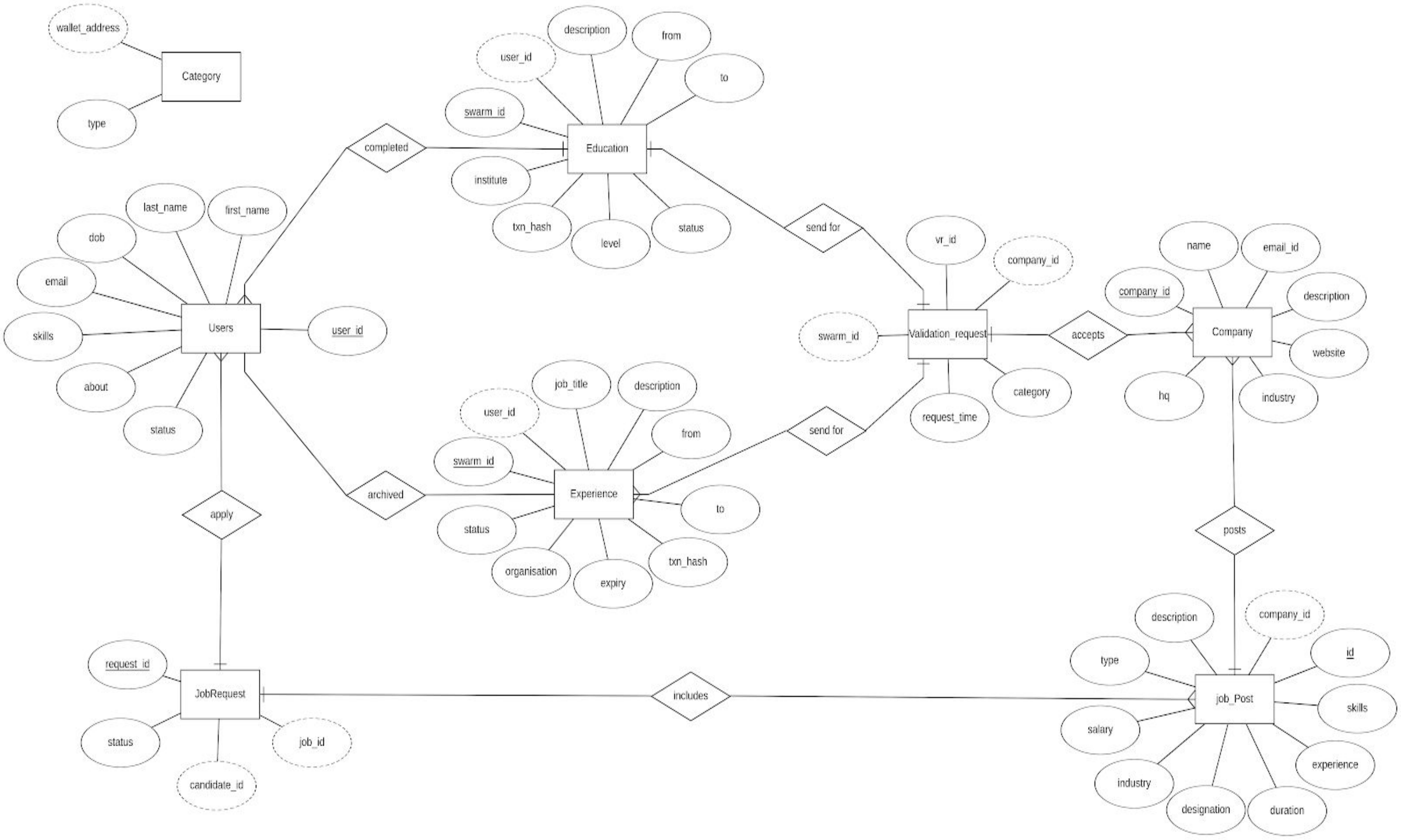
Token flow



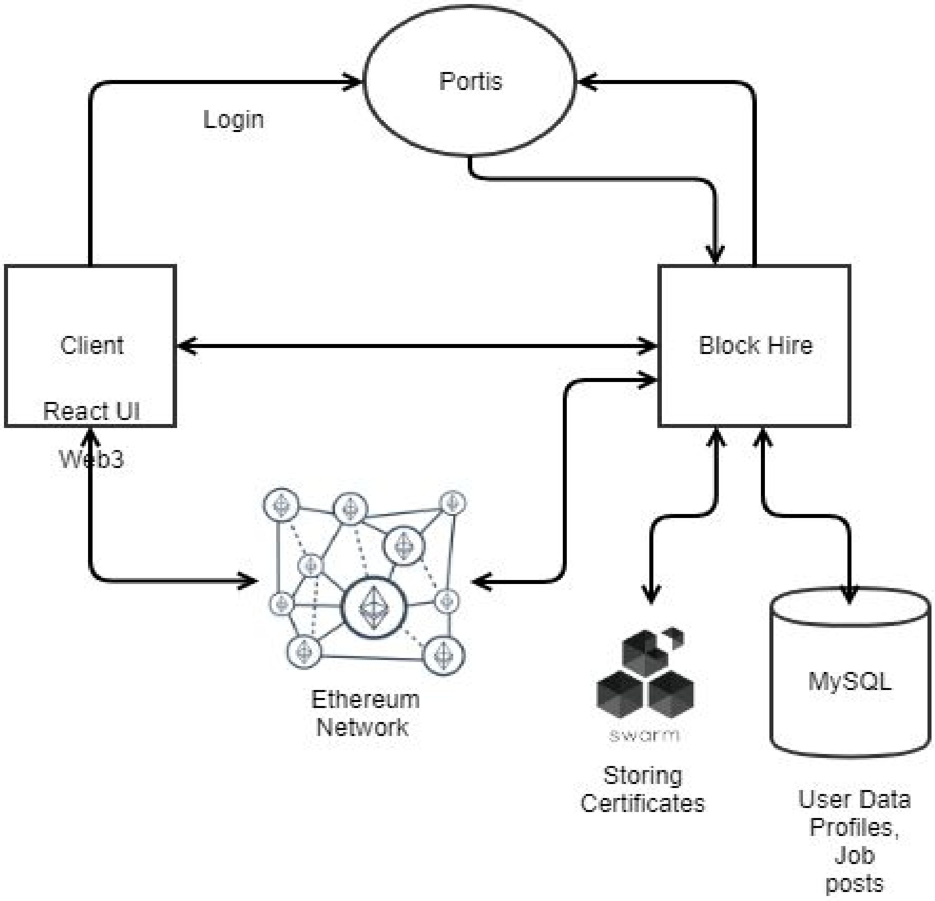

Recruiter
Token Added
Register
Tokens consumed
Post Job
List of Apllicants
View Applicant Profile
Tokens Consumed
Verify Applicant Profile
Tokens Consumed
Request for Applicant contact
Tokens consumed
Display Tokens


Validation requests
After signing documents
Validator
Tokens Rewarded
Display Tokens

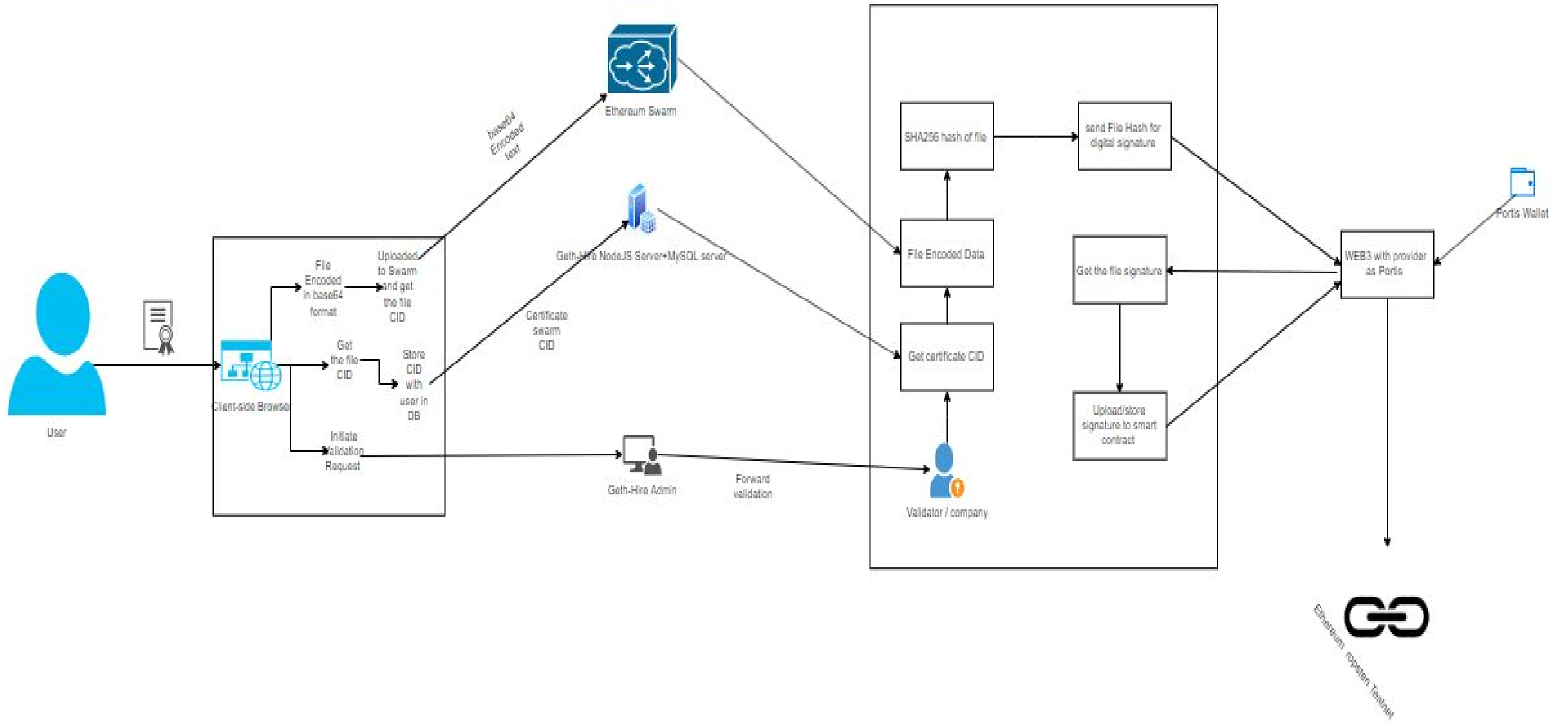
6.4 ER diagram



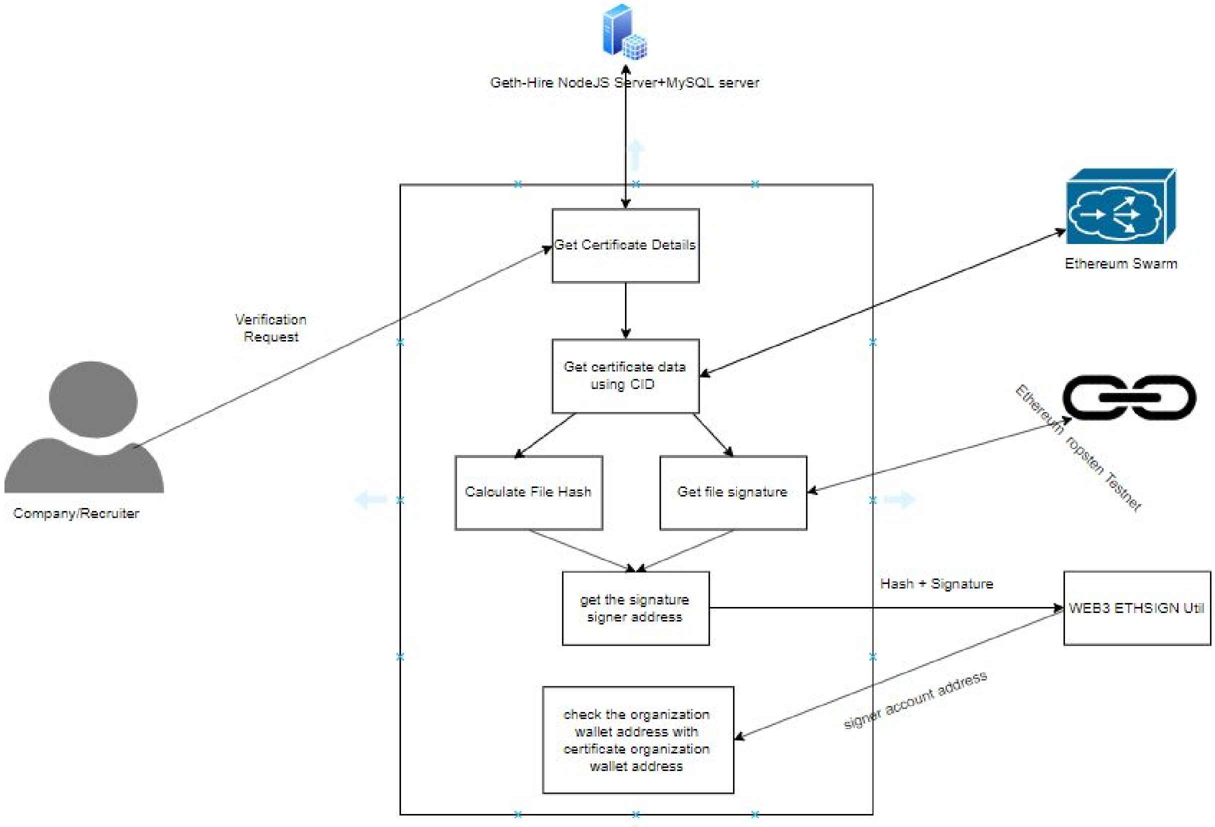
6.4 Architecture and Program flow diagrams



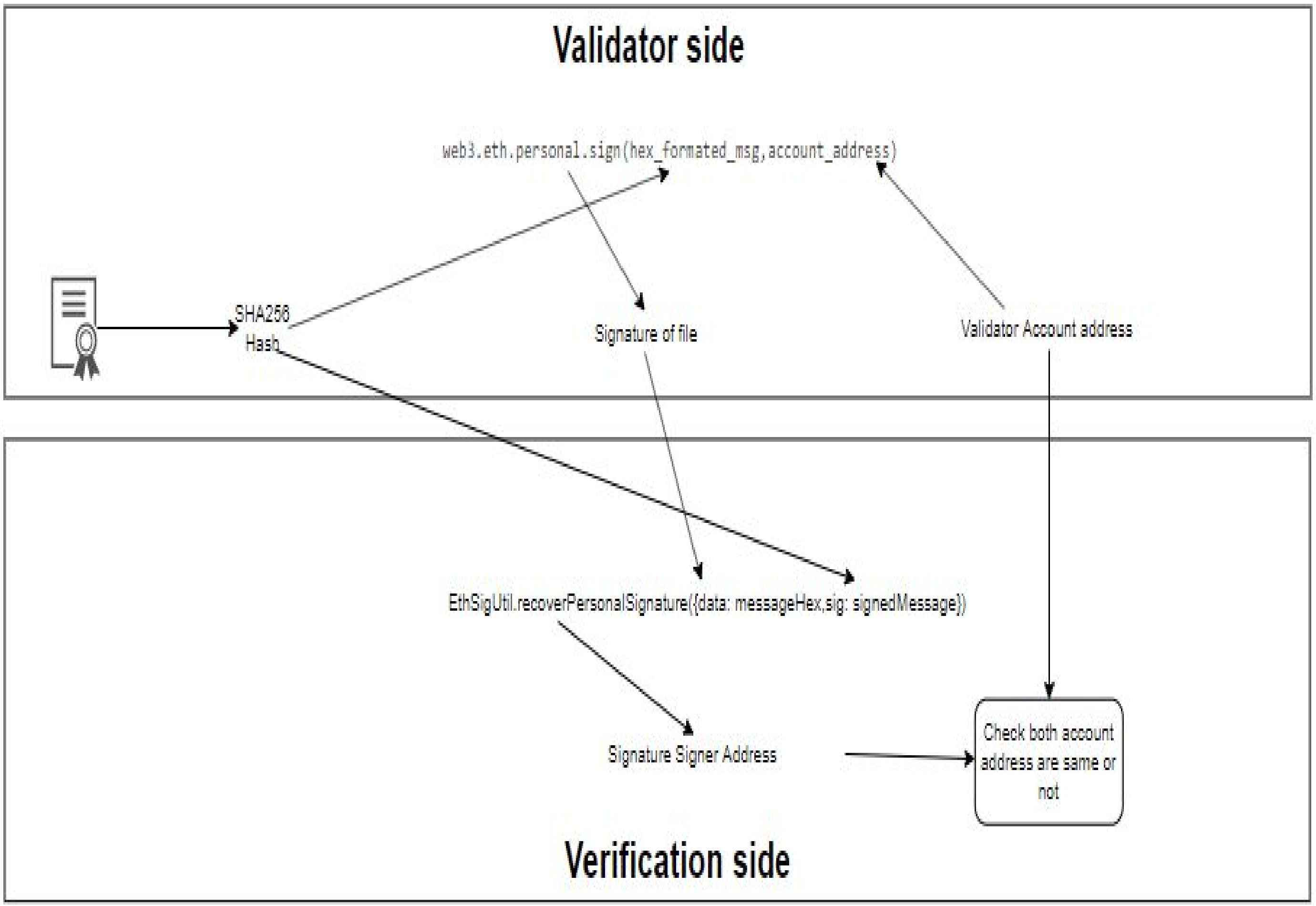
Certificate upload and Validation process


Ethereum Swarm
base64 Encoded text
User
Client-side Browser
File Encoded in base64 format
Uploaded to Swarm and get the file CID
Get the file CID
Store CID with user in DB
Initiate Validation Request
Geth-Hire NodeJS Server+MySQL server
Certificate swarm CID
Geth-Hire Admin
Forward validation
SHA256 hash of file
send File Hash for digital signature
File Encoded Data
Got the file signature
Get certificate CID
Upload/store signature to smart contract
Validator / company
WEB3 with provider as Portis
Portis Wallet
Ethereum ropsten Testnet

Certificate Verification process



Digital Signature Process


Validator side
web3.eth.personal.sign(hex_formated_msg,account_address)
SHA256 Hash
Signature of file
Validator Account address
EthSigUtil.recoverPersonalSignature({data: messageHex,sig: signedMessage})
Signature Signer Address
Check both account address are same or not
Verification side

Chapter 7

Project Scope

- The main prospect of the product is made certificate verification process more easy, secure, reliable, tamperproof.
- Based on certificates users can make their professional profiles where certificates can be uploaded and validated.
- For each validation check, validator/certificate authority incentivized for their work and validation signature gets uploaded.
- Once any certificate gets uploaded and validated it can be modified in future, total immutable.
- It's also work as a job portal for job seekers and for the recruiter to get verified, genuine legitimate candidates.
- Verification of shortlisted candidates(check their certificate) in just one click.
- In each function call (validation, verification, job posting, job applying, etc) includes blockchain transaction and payment happened in terms of GH tokens.
- Give user's privacy is in hand of the user where he/she controls the visibility of his profile's sensitive information.
- The main feature which makes it different from other job portal is that recruiters can verify shortlisted candidates in just one click as the certificates are verified beforehand from their respective authority.
- Concept of Incentivized Endorsements based on reputation model will help to understand a person's skill proficiency.
- Online Learning Platforms can use our platform for issuing certificates which will keep the validity of certificates on Blockchain.
- Search: Candidates can be searched on the basic skills recommendation and candidates can search job posts based on their skills.

Chapter 8

8.1 Software Development Framework

A software framework is an abstraction in which software providing generic functionality can be selectively changed by additional user-written code, thus providing application-specific software. A software framework provides a standard way to build and deploy applications. A software framework is a universal, reusable software environment that provides particular functionality as part of a larger software platform to facilitate the development of software applications, products and solutions. Software frameworks may include support programs, compilers, code libraries, tool sets, and application programming interfaces (APIs) that bring together all the different components to enable the development of a project or system.

The most widely used agile-methodologies include-

- **Agile Scrum methodology -** Scrum is a lightweight Agile project management framework that can be used to manage iterative and incremental projects of all types. In Scrum, the Product Owner works closely with their team to identify and prioritize system functionality by creating a Product Backlog. The Product Backlog consists of whatever needs to be done to successfully deliver a working software system

- **Lean Software Development -** Lean Software Development is an iterative Agile methodology that focuses the team on delivering value to the customer through effective value stream mapping. It is a highly flexible, evolving methodology without rigid guidelines, rules, or methods.

- **Kanban -** Kanban is a highly visual workflow management method that is popular among Lean teams. In fact, 83% of teams practicing Lean use Kanban to visualize and actively manage the creation of products with an emphasis on continuous delivery, while not adding more stress to the software development life cycle. Like Scrum, Kanban is a process designed to help teams work together more effectively.

- **Extreme Programming(XP) -** XP is a disciplined approach for high-quality agile software development, focused on speed and continuous delivery. It is intended to improve software quality and responsiveness in the face of changing customer requirements. It promotes high customer involvement, rapid feedback loops, continuous testing, continuous planning, and close teamwork to deliver working software at very frequent intervals, typically every 1-3 weeks.

- **Crystal -** Crystal family addresses the realization that each project may require a slightly tailored set of policies, practices, and processes in order to meet the product ‘s unique characteristics. It is not only the people or the processes that are important, rather the interaction between them that is most important.

- **Dynamic Systems Development Method -** The DSDM methodology has evolved to provide a comprehensive foundation for planning, managing, executing, and scaling Agile process and iterative software development projects. DSDM is based on eight key principles that direct the team and create a mindset to deliver on time and within budget. These agile principles primarily revolve around business needs/value, active user involvement, empowered teams, frequent delivery, integrated testing, and stakeholder collaboration.

- **Feature Driven Development -** Feature Driven Development is a model-driven, short-iteration process that was built around software engineering best practices such as domain object modeling, developing by feature, and code ownership.The blending of these practices that resulted in a cohesive whole is the best characteristics of FDD.

8.2 Project Management and Progress Tracking Tool

8.2.1 JIRA and Confluence

- **JIRA -** It is a proprietary issue tracking product developed by Atlassian that allows bug tracking and agile project management.
  Jira is offered in three packages -
  - **Jira Core** is intended as generic project management
  - **Jira Software** includes the base software, including agile project management features (previously a separate product: Jira Agile)
  - **Jira Service Desk** is intended for use by IT or business service desks.

Jira is a commercial software product that can be licensed for running on-premises or available as a hosted application. Components are sub-sections of a project; they are used to group issues within a project into smaller parts. Components add some structures to the projects, breaking it up into features, teams, modules, subprojects and more.

- **CONFLUENCE -** Confluence is our content collaboration tool used to help teams collaborate and share knowledge efficiently. It lets organize content using spaces, pages, and blogs which can be commented on and edited by all members of the team easily thanks to collaboration features. It can display all sorts of content thanks to the rich text editor and attachments. Permissions and restrictions allow you to control the visibility of content at the space or page level so only the right people have access to the right information. Confluence has also been designed to prevent duplicates and only display the last updated information.

  Confluence and Jira were designed to complement each other, and have a number of integration points built-in, giving Confluence users the ability to view, interact with, and reference Jira issues from a wiki page. Confluence would be used for project collaboration, functional specification gathering, project discussion while viewing Jira issues or creating new ones without ever leaving Confluence.

Chapter 9

Project Risks and Assumptions

Project Risks -

- Sharing of credential to Geth-Hired should be avoided as it may involve money through cryptocurrency.
- If password of Ethereum account is lost, account will also be lost along with currency.
- Must keep its database protected
- Must take regular backups for the extreme cases.
- Any transaction done on Geth-Hired cannot be reversed.
- Bad network may create problems since blockchain transactions are processed slowly.

Some assumptions are -

- The system is effectively economical though the transactions costs are much higher for onboarding users.
- The validators are believed to be present on the system for attending validation requests.
- The users are interacting with the DApp using single wallet address.

Chapter 10

Reference

For Developers

- Basic to full details about Ethereum Blockchain
  - Ethereum White Paper(Basic)
    https://github.com/ethereum/wiki/wiki/White-Paper
  - Ethereum Yellow paper(Advance)
    https://ethereum.github.io/yellowpaper/paper.pdf
- Ethereum Smart Contract
  https://solidity.readthedocs.io/en/v0.5.3/
- Swarm file system
  https://swarm-guide.readthedocs.io/en/latest/introduction.html
- Web3JS
  https://web3js.readthedocs.io/en/1.0/
- Portis Docs
  https://docs.portis.io/#/

For project specific details you can refer the GitHub repository
https://github.com/fossee-ethera/Geth-Hired-UI