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Blockchain based vehicle registration and ownership management system

Good morning dear madam, sir.
We are group Troyrangers.
I am Binari Dissanayake.
Our project is **Blockchain based vehicle registration and ownership management system.**

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These are our team members.

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Here you can see the table of Content.

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Our supervisor is DR. A.L.A.A.R.Thanuja
Mentor is Mr. H.M.A.Bandara

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Problem in brief

Ownership of a vehicle must not be changed by others unnecessarily. But when using a centralized database, unauthorized people can change data and we can't track those changes. Therefore, this is a huge security burden for this kind of high transparency needed system. This is our problem in brief.

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Background & Motivation

Background-:
Nowadays, the things in the real world are being digitized.we use this concept to vehicle for the purpose of changing their ownership online.

Motivation-:
Changing the ownership of the vehicle online has not been done before.So we are going to develop a new system regarding this concept.

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Aim
If we discuss our aim of the project, we are going to develop a system for registering and transferring the ownership of a vehicle from one person to another using blockchain technology.

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Objectives
Let's move to the objectives of the project,

1. to study the problem.

2. to facilitate digitizing the system.

3. to create the ability to generate a digital id.

4. to design the appropriate system including all user requirements.

5. to develop the system for solving the problem.

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Existing Software

When we talk about the projects and applications which are similar to our system, we were able to find three projects.

The first one is Vehicle Registration and Information Management using Blockchain Based Distributed Ledger from Bangladesh Perspective. It is a proposed system in Bangladesh to replace the existing motor vehicle registration procedure by the Bangladesh Road Transport Authority.

This is only a concept, and this project has not been implemented. And also, NFTs are not used in this project. And also they are created this without any standard.

Sandbox is the second application which we found. In this application they deal with a virtual land. Users can buy and sell Lands via NFTs. The difference between the Sandbox project with ours is that they are selling and buying virtual assets (land) instead of real assets. But in our project, we are dealing with real physical assets.

Third one is the opensea, it is the world's first and largest digital marketplace for crypto collectibles and non-fungible tokens. The difference

between this project with our one is that they are selling and buying virtual assets like graphics instead of real assets. But in our project, we are dealing with real physical assets like vehicles.
These are the similarities and differences with our project and above mentioned projects.

Thank you Binari.

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Proposed Solution

Main intention of our proposed solution is to digitize the registration and ownership management system of vehicles.

To do this we are going to implement a system as shown in the diagram. Due to the security is the most important factor; we use blockchain rather than using a centralized database.

The main task of our system is to convert a physical asset into a digital asset. As an example, in our system we convert vehicles into NFTs.

First of all we are creating an NFT when registering the vehicle.Then the NFT issuing officer issues an NFT after handing over the information of vehicle and save it in the polygon blockchain.

In the current situation, we have to identify a person legally on the internet. But there is not a proper way to show a person's digital identity. Because of that we have to issue a digital verifiable ID for the person. We issue an SSI when a general user hands over their personal information to the SSI issuing officer.The Self sovereign identity that means SSI is saved in Indy blockchain after issuing.

We create a vehicle marketplace to provide the facility of selling and buying vehicles. In this process, transferring the ownership of the vehicle happens through the NFT.

As we can identify the vehicle owner through SSI, we can use SSI to login the digital vehicle marketplace. When login the marketplace, general user have to present their SSI and verify it.

When the lifetime of the vehicle is over, we have to remove the vehicle of use. In that case we can burn-out related NFT. But the information related to that NFT will remain forever with that blockchain.

This is our overall proposed solution.

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Now let's talk about the technologies we used to develop our system. We divided these technologies as web2 , web 3 and devops technologies for the ease of our further discussion.

When we are talking about the Web2 technologies, we use React js, Next Js, React Native, Django, postgresql.

ReactJS and NextJS

React is a JavaScript-based frontend UI library developed by facebook. This uses HTML, CSS and JS.When taking the NextJS,it is a JavaScript framework for building server-rendered and statically generated web applications.

There are four major reasons to use NextJS for our project. According to that server side rendering, automatic code splitting, static exporting, and routing can be done easily using NextJS on top of ReactJS.

As alternatives for react and nextjs, we can list out Angular and Vue.js. When taking Angular alongside react, There were two reasons to choose react instead of Angular.
First one is that to use Angular we must have to use Typescript and therefore there is a larger learning curve for Angular compared to react.
And the second reason is that when comparing the popularity and the support for these two, react has more support due to the high community it uses.

Thank you. Now I give my chance to Upeksha Herath to continue the rest.
It's over to you Upeksha.

React Native

To develop our SSI mobile Wollet we use React-native. In our Mobile SSI Wallet,we have to maintain different code bases and have to go for a hybrid system.For that,Flutter,ReactNative and Xamarin can be taken as suggestions.

- React and React Native are similar and also the learning curve for React Native is less. And also other members in our group use React, so when doing the development all the members can contribute to both web application and mobile application. To get that advantage we use React Native.
- And other than that, Although Flutter is faster, it turns into a huge file size. But in our project,speed is not a burden. Therefore react native is more suitable than flutter for this mobile application.
- And the other thing is that React Native has higher community support because of the ease it provides by incorporating JavaScript. And therefore It saved a lot of time for developers' saving them from learning a whole new language like dart.

- When comparing react native with Xamarin, community support for react native is higher. And also the learning curve for Xamarin is a bit higher than react native.

Therefore,out of all these choices,the most suitable one for our SSI mobile wallet is ReactNative.

Django

When developing SSI Issuer and SSI verifier we use Django as the backend framework. By using django, it is possible to handle a heavy request load and this framework is very supportive and comfortable for rapid development. Instead of django we can use springboot with java programming language and nodejs with javaScript programming language also. But out of all these alternatives django with python has high support for block chain development. According to that hyperledger indy has a clear documentation written specially for python SDK.

And when comparing django with sprigboot, springboot uses java as the programming language and it somewhat has a larger learning curve to use java than python. Therefore due to these reasons out of spring boot and Django we chose Django.

And when taking nodejs and Django, the Django web framework is more suitable than Node. js since it is faster and more dynamic than nodejs. And also, Nodejs is less economical than Django since it requires more functioning time. Also when taking the security side then also django is more suitable than nodejs.

PostgreSQL

PostgreSQL is a powerful, open-source object-relational database system. It is highly customizable, allowing users to write custom functions and extensions in a variety of languages.We use PostgreSQL because Django is very supportive for this database.

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Now let’s talk about the Web3 technologies which we are using to develop our system. Those are,

1. Blockchain
2. Aries Cloud Agent - Python
3. MetaMask Wallet

In Here, we use three different blockchains. Those are Indy, Polygon and IPFS.

We use blockchain technology because Blockchain is decentralized and immutable. And that makes it easier to track assets and record transactions in a corporate network.

For Aries Cloud Agent - Python and MetaMask Wallet we couldn’t find any alternatives. Because these are very new technologies. And still there are no competitors for these products.

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Now let’s see what are the Devops technologies that we used to develop our system. Those are, Docker, Docker Compose, Git and Github

Docker and Docker Compose
Docker is a container which we can use to manage our development environment easily.

When we taking Docker, LXD that means Linux daemon by Ubuntu is an alternative.But LXD heavily depends on the features of the operating system for storage and networking. But Docker doesn't depend on them and Docker has made it easier for developers to create, run, test, and deploy applications.Therefore, we use Docker.

GitHub
Git is the tool which we use for version controlling. Github is the hosting platform for git. Bitbucket is an alternative for github. But when taking the popularity and features provided by github, we came to a final decision to use github as our version controlling system.Even though we use bitbucket

or github as the hosting platform we have to use git as the tool to integrate with github or bitbucket.

Ok, next I give my chance to Sadini to continue the rest.

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Software Process Model

We use the Waterfall model as our software process model.

Our company “Crede Technologies” provides us all the requirements correctly and clearly. Therefore, all the requirements were clear enough to give a full idea of the whole project and we were provided with a tight deadline to complete this project.

As a team, we have to complete tasks one by one instead of doing those activities concurrently. Our project development team does not consist of professionals and therefore most of the work is done as a team, instead of doing things individually.

Also, **we have a learning curve to follow and It is hard to communicate with our customers regularly. As system requirements are clear , there are no changing requirements**

Considering all these facts and due to the correct and clear SRS it is better to use the waterfall model as the software process model.

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Project Management Plan

Jira

We use Jira for planning our project management.
It helps team planning, assign, track, report, and manage work and brings teams together.

Slide 18-Gantt Chart
This chart shows how we divided our works in work breakdown structure and how it is gone.

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Version Controlling System

Let’s take a quick look at our version controlling system.

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Now let’s take a quick look at the diagrams.

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This is the UseCase Diagram of our system and it shows the interactions between the system and the actors.

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This is our Class Diagram. it displays the relationships between the objects and describes what those objects do and the services that they provide.

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This is the ER Diagram of our system,

For the usability and email verification of the system,We have to maintain a database. **This is the only requirement to use a database in this system**

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This is link for the Activity & Sequence Diagrams of our system.Due to time constraint If you required,we will show diagrams after the presentation.

UI Design

Lets get a quick look about our UI Design

Implementation

From here on words,we are going to show some coding parts which we have completed up to now.

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Further work-:

This is our further work list.

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- Get archive data from Polygon blockchain
- Process of buying NFT

- Process of designing NFT smart contract
- Hosting Our application like SSI Issuer, SSI Verifier, NFT Minter, NFT Marketplace in a server
- Deploying two smart contract in the Polygon blockchain

Future work-:
When we move to the future work which will be done after completing the whole project. we are expecting to introduce a new cryptocurrency to do transactions in the marketplace when selling and buying vehicles.

Andalso, we are expecting to add a verification with the database maintained by the government with vehicle details parallel to the manual verification process.

Install Kubernets for production.

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Now let's move to the Individual Contribution.

I give my chance to Binari Dissanayake.
It's over to you Binari.

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204047J

Thank you …….

In our system I assigning for NFT minting process
I contributed to the designing phase by drawing usecase diagram, class diagram, sequence diagram, activity diagram, ER diagram.

I started designing some Login & NFT minting forms using React as frontend developmenmt. I started learning in NFT, smart contract and blockchain as backend implementation.

I give my chance to Upeksha Herath.

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204074M

Thank you Binari.

In our system
I contributed to the designing phase by drawing usecase, class, sequence, activity and ER diagram.
I completed learning react native and started designing signup using react native
For the Backend development I found and tested an exact working API to work with indy blockchain.

Ok, next I give my chance to Hansa Jayathilaka.
It's over to you Hansa.

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204087F

Thank you Upeksha.

In our system I am assigned for the NFT marketplace module.
I contributed to the designing phase by drawing use case diagram, class diagram, sequence diagram, activity diagram, ER diagram.

I have created a smart contract for NFT marketplace and deployed for testing. There will be minor changes in future.
I created a Proof of Concept for buying and selling NFT. Its working fine with the mumbai polygon test network.
Now I am transforming it according to the requirements for our system.
That's all I have done up to now.
I give my chance to Sadini Pathirana to carry out the rest.
It’s over to you Sadini.

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204150T

Thank you Hansa.

In our system I am assigned for the SSI verifier module.
I contributed to design diagrams like use case diagram, class diagram, sequence diagram, activity diagram, ER diagram.

- I started to design frontend using the Django template engine
- I started learning Django.
  These are the work i have done up to now.

I give my chance to Dasuni Rathnayaka.
It’s over to you Dasuni.

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204179N

Thank you Sadini.

In our project I was assigned to develop the SSI issuer module.

I contributed to the designing phase by drawing use case diagram, class diagram, sequence diagram, activity diagram, ER diagram.

I am started to learn Django framework for the development of the backend.
I am started to design the Login of the SSI issuing officer & SSI Issuing request form using HTML, CSS, and JS.

That's all I have done upto now.

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Thank you

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Q & A

Now it's time for the Q and A.
We are happy to answer for the questions.

Extra Details

- **<u>Descriptions for each diagram</u>**

1. **Usecase**
    - There are 9 actors.Those are General person, vehicle owner, vehicle seller, vehicle buyer, SSI issuer, NFT minter
    - Blockchain actor is specialized into two child actors as Indy and polygon.
    - General person actor is specialized as vehicle owner,vehicle seller, vehicle buyer

General person : Request SSI

SSI issuer : 1. Issue SSI
2. To issue an SSI; general person must request a SSI

Vehicle owner: 1. Log into NFT marketplace
2. After validating his SSI by indy blockchain display valid/invalid.
3. Request NFT

NFT minter : 1. Mint NFT for vehicle
2. To mint NFT; vehicle owner must request an NFT

Polygon : 1. Save NFT
2. To save the NFT; NFT minter must mint an NFT

Vehicle seller: 1. Log into NFT marketplace
2. After validating his SSI by indy blockchain display
3. Sell the vehicle

Vehicle buyer: 1.Log into NFT marketplace
2. After validating his SSI by indy blockchain display
3. Buy the vehicle
4. To buy the vehicle; seller must sell the vehicle

5. **Class**
6. **Activity**
7. **Sequence**
8. **ER**

- **<u>Version controlling vedio clip explanation</u>**
- **<u>Code explanation</u>**
- **<u>Possible questions asked by the panel</u>**