Final Report

FYP22004
Blockchain in Insurance

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11 April 2023
Abstract

Flight delay insurance is essential to travellers as it gives the assurance of a covered accommodation and transportation in the event of a flight delay. However, the current claiming process is too slow as it is done manually. This report proposes a possible solution for this issue using the combination of blockchain and text recognition. Users will first upload supporting documents for their claim application. Then, important information will be extracted using text recognition and fed to the smart contracts. The pre-defined conditions in the smart contract will automatically approve or decline the claim application. It is expected to see this approach to outperform manual claim processing in flight delay insurance. In the long run, this will greatly reduce the operational cost of flight delay insurance providers. This project will deliver a web application to replace the insurance claim process in flight delay insurance using smart contracts and Google’s Optical Character Recognition (OCR) Engine.
Acknowledgements

I would like to express my gratitude towards Dr. Liu Qi, the supervisor of this Final Year Project, for his guidance and support. I sincerely thank the Department of Computer Science, HKU for providing this opportunity for me to work on this project.
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1 Introduction

This section discusses the current limitation of insurance claim process, followed by the objective of this project.

1.1 Background Information

With the recent relaxation of travel restrictions around the world, travellers are finally able to travel again after 2 years of global lockdown. A study carried out by the Airports Council International found that global passenger traffic is expected to improve significantly, reaching over 70% of what it was in the pre-pandemic era (Bates, 2022). However, this surge in passenger traffic resulted in a drop in flight punctuality. A recent survey carried out by the Forbes Advisor found that 61% of the survey respondents experienced flight delays or cancellations, and 83% of those lost money as a result (Lobb & Gollub, 2022). To better protect themselves against additional expenses caused by a flight delay, travellers will purchase a flight delay insurance.

However, the process of making a flight delay claim involves a series of time-consuming steps. First, travellers report a claim with all the supporting documents (e.g., receipts, flight ticket). Then, the insurance provider verifies the validity of claim with relevant airline company. Finally, claim will be paid out by the insurance provider. On average, insurance policyholder will receive their compensation anywhere between 1 to 2 weeks (TravelInsurance, 2022). If any issue arose during this process, it might take even longer for the policyholder to receive their payment. A long claim processing time often leads to unsatisfactory customer. Insurance Watch, a company specializing in life insurance found out that out of the all the reviews made by consumers, majority of them wanted faster payment of claims (Riskinfo, 2018). This implies that a fast and smooth claim process is critical for any insurance company to maintain customer satisfactory.

Even so, many insurance providers are still slow in realizing the importance of a smooth claim process. A study found that out of all the resources spent by insurance provider on improving their existing business model, innovation in claim processing only accounted for a mere 5 percent (McKinsey, 2017). There are a few reasons leading to a slow claim process. First, a high volume of insurance claim. As all the supporting
documents must be verified manually, it takes a lot of manpower to process the insurance claim. Second, the potential of insurance fraud. Insurance companies spend extra time and effort in reviewing every claim request before compensating the policyholders. The reason is because insurance frauds are causing insurance companies a huge cost. A study carried out by the Coalition Against Insurance Fraud found that it cost the United States $310 billion dollars annually on insurance fraud (Coalition Against Insurance Fraud, 2022).

1.2 Objective
Given the existing slow process in insurance claim, there is a need for a system with faster document reviewing process, as well as a way in preventing insurance fraud. This project therefore intends to build a web application using blockchain and OCR to replace the existing slow insurance claim process in flight delay insurance.

Smart contract, a self-executing contract stored on a blockchain can be used to automate insurance claim. Essentially, all the details of an insurance policy will be written in code into a smart contract. When all the predetermined conditions in the smart contract are fulfilled, payment will be made to the policyholder. As to counter insurance fraud, blockchain’s property of immutable transaction is perfect for this issue. Since all insurance claims are recorded to the blockchain, no repeated transactions will be allowed. Finally, a slow document reviewing process can be solved by utilizing OCR. Important information can be extracted and fed to smart contracts for verification.

1.3 Outline
Section 1 introduces the background information of this project, followed by the objectives of this implementation. Then, Section 2 provides more information on blockchain and OCR. Project methodology of this project, both frontend and backend will be shown in Section 3. Section 4 discusses the web application in detail. The limitation of this project is discussed in Section 5. Finally, Section 6 provides a conclusion of this project.
2 Literature Review

This section provides more information on blockchain and OCR and their relation to this project.

2.1 Blockchain

A blockchain is a type of Distributed Ledger Technology. Different from a typical database which store data in only one location, blockchain stores information in a decentralized way. On top of that, blockchain transactions are immutable because of its data structure. It consists of a growing list of nodes, securely linked using cryptography. Each node contains their own unique hash value, and a cryptographic hash to the previous node (see Figure 1). Whenever someone attempts to edit any node in a blockchain, all the subsequent nodes must be updated as well or else it would be noticed by other participants of the network and rejecting this update. For an example, in Figure 1, if the attacker attempts to modify block no. 2, the hash value will no longer be “6BQ1”. It will be immediately noticed by block no. 3 and this modification will be rejected. Therefore, it is computationally impossible to tamper a blockchain, thus effectively prevent the issue of double claiming.

This project will utilize blockchain to deliver a system free of fraud. The immutable blockchain transaction property eliminates the possibility of double claiming in all insurance claim application.

Figure 1: Anatomy of blockchain (Cherednichenko, 2020)
2.2 Optical Character Recognition

OCR is a method used in text recognition. An OCR program can extract data from scanned documents, camera images and image-only pdfs. Upon inputting a scanned-in image, the image is analysed for light and dark areas. Only dark areas are processed as it represents the characters. Then, it is further processed to find alphabetic letters or numeric digits. Finally, pattern recognition or feature recognition algorithm will be used to obtain the desired result (IBM Cloud Education, 2022).

Using OCR, the supporting documents from an insurance claim can be processed much faster. This aligns with the project’s objective of delivering a faster insurance claim process.
3 Project Methodology

This section presents both application workflow and implementation of this project in detail.

3.1 Application Workflow

Users will login with their username and password. Depending on whether the policyholder wants to purchase a new policy or review their existing policies, different window is shown.

3.1.1 Purchase policy

After selecting a new insurance policy and filing in required information, user will be directed to a payment page. The cost of premium includes the cost of writing smart contracts to the blockchain, the cost of using a third-party blockchain oracle and the cost of premium of the insurance plan.

3.1.2 Review policy

All the policies owned by the user will be shown in a table. The address of the smart contracts associated with the insurance policy, and the status of the policies are included in the table as well. When the policyholder wants to submit a claim request, they will first be directed to upload all the supporting documents. Upon successful verification, compensation will be made.

3.2 Implementation

The following section provides an overview of each technology and the justification behind the choice.

3.2.1 Upload supporting documents

To extract data from user uploaded documents, an OCR engine will be used. Tesseract OCR Engine, an OCR maintained by Google is chosen as it is widely used in the industry and has a lot of resources provided by the community. Since the frontend of this project will be built using ReactJS, Tesseract.js, a wraparound library on Google’s Tesseract OCR Engine is selected. Tesseract.js works in the browser using plain script
tags with a CDN. This will save a lot of time as compared to manually connecting this project and Google’s Tesseract OCR.

3.2.2 Off-chain data & Automation
To verify a flight delay claim, a real time data of flight information is compulsory. A custom flight data feed will be built using Chainlink library. On top of that, Chainlink Automation will be used to enable conditional execution of smart contracts through their decentralized platform.

3.2.3 Blockchain: Polygon
Polygon is chosen as the blockchain choice for this project due to a few reasons. First, Polygon shares the decentralized security of Ethereum by check-pointing all the transactions on its chain (MATIC chain) to the Ethereum. Second, transactions in Polygon are much faster at 7,000 per second as compared to Ethereum’s 15 transactions per second (Polygon, 2022). These properties of the Polygon blockchain ensures all the blockchain transactions are safe and fast, which is essential to this project.

3.2.4 Backend: Hardhat, Solidity, Express & NodeJS
The backend server will be created using Express, a minimalist web framework for Node.js. Node.js is selected as the server-side programming language as it has high built-in functionality. As for the development of smart contracts will be done using a combination of Hardhat and Solidity. Hardhat is an Ethereum development environment whereas Solidity is a programming language designed to target the Ethereum Virtual Machine. This combination will speed up the entire development for the smart contracts.

3.2.5 Database: MongoDB
MongoDB is a non-relational database for this application. It is chosen as it has smooth integration with both NodeJS and Express. It will be used for verified access to the web application and to store insurance policies owned by the users in the form of smart contract address.
3.2.6 Frontend: ReactJS

As a web application will be built for this project, the frontend library developed by Facebook, React.js will be used. Depending on the user group, different interfaces will be shown. The web application will use the backend API to perform different operations such as Create, Read, Update and Delete.
4 Results

This section discusses the step by step workflow of the web application in detail.

Step 1: Register Account
First time user will have to register an account with their personal information.

![Figure 2: Registration form](image)

Step 2: Landing Page
After logging into their account, user will arrive at the landing page where two options will be presented, one leading to purchasing a new insurance policy while the other leads to a page where the user can review their existing plans.

![Figure 3: Landing page](image)
Step 3: Purchase A New Plan

User can choose between two different plans. First, annual plan covers 99 journeys with each journey covered up to 90 days from the day of departure. This plan is designated for frequent travellers. However, user might find the annual plan overkill, which is why the single plan is offered to provide more flexibility to user. Single plan also covers longer with 182 days from the day of departure.

The pricing of both single and annual plan includes the cost of maintaining backend services such as real-time flight data API and publishing smart contracts to the blockchain.

Figure 4: Annual plan vs Single plan
Step 4: Personal Information

Before proceeding to payment, user will be asked to fill in their personal information such as name and email. These information will later be used in the validation of insurance claim. For annual plan insurance, user can choose the starting date of their insurance coverage. As for single plan insurance, user will have to fill in the airline company, flight number and the date of departure.

Figure 5: User to fill in the starting date of their insurance coverage.

Figure 6: User to fill in the their next flight information
**Step 5: Payment**

Upon successful payment, a confirmation email will be sent to the user.

![Payment](image)

*Figure 7: Payment*

**Step 6: Review Existing Plans**

A table containing the smart contract address and current status of the insurance plan will be shown. To submit an insurance claim, user simply have to press the button located next to their respective insurance plans.

![Information of plans](image)

*Figure 8: Information of plans owned by the current user*
**Step 7: Upload Boarding Pass**

To submit a claim, user simply have to upload their boarding pass. The information on the boarding pass will be extracted out using Google OCR Engine. Before proceeding to submission, user can first review the extracted information and make changes accordingly. Upon submission, a notification will pop out in the top right corner to indicate the status of claim. Payment will be reimbursed to the user through their payment method.

*Figure 9: User upload supporting documents*
5 Limitations

This section discusses the limitations of the project, followed by corresponding solutions.

5.1 Validation System

Currently, there is no way to verify the ownership of the supporting documents uploaded by the users. A potential solution to this issue is to request identification document from the user when they make an insurance claim. User would have to upload two documents, namely, identity card and a selfie with biometric matching.

Figure 10: Example identity card and selfie with biometric matching
5.2: OCR Engine

As OCR simply extracts all the information of a document and returns a string, there is no simple way to extract useful information consistently from the uploaded documents as each document has different layout (See Figure 11, 12, 13 & 14). Even if a model with higher accuracies is used, it is still not possible to achieve the desired outcome. A solution to this issue will be by extracting personal information on the boarding pass through the QR code located on each boarding pass. However, this will require cooperation from the airline companies.

Figure 11: Sample boarding pass

Figure 12: Extracted information from Figure 11.

Figure 13: Sample boarding pass
Figure 14: Extracted information from Figure 13.
6 Conclusion

This report has proposed a possible solution for slow insurance claim processing in flight delay insurance. A web application was built by utilizing smart contracts and OCR to deliver a faster and smoother claim process. However, there are a few limitations, first, there is no way of validating the ownership of the uploaded documents. Second, due to the limitation of OCR, there is no simple way to extract useful information consistently from the uploaded documents as each document has different layout. A solution to both of these problems is to cooperate with airline companies to obtain personal information of travellers. With these information, the overall efficiency of the claim process will increase substantially.
References


