Introduction:

In the pharmaceutical industry there has been a lot of counterfeiting drugs that has increased the amount of medicine trafficking. The World Health has shown that 11% of medications sold in developing countries have been counterfeit, resulting in 144,000 annual deaths(White, 2022). Drug counterfeiting is a $200-billion business which is financially damaging to the authentic manufacturers and is life threatening to patients(Miller & Duggan, n.d.). One of the most commonly counterfeit drugs are weight loss drugs such as Lipitor(Haiken, n.d.).

To prevent counterfeit drugs, the pharmaceutical industry needs an efficient supply chain management system to protect the consumers of the medicine. This would avoid counterfeit medical drugs from entering the global market.

Prototype:

This prototype is a Smart contract agreed upon by all stakeholders, the smart contract will contain conditions such as the legality and reliability of the source of the drug and its components. If the conditions are met the drug proceeds through the supply chain.

With the assistance of the TraceLink Prototype, the owner of the drug that is created by the manufacturer is being changed if and only if every property of the drug is the same, if for some reason the drug has had ingredients added into it then the smart contract will pick up on that and throw and error before creating a new block. This applies to all properties of the drug. If nothing has changed then a transaction of ownership is made along the supply chain and that transaction is recorded in the blockchain network. I have set up the prototype to have predetermined stakeholders so the drug can only be transferred in one ordered series between the stakeholders, this is how a supply chain would behave in real world logistics.

Key Tools:
1. Solidity Ethereum programming language
2. Remix Ethereum IDE

Going forward:
1. To extend from this prototype we could attach a QR code to the drugs information as mentioned in the pitch.
2. The drug has to be sold from one stakeholder to another not just merely transferred so we could transfer Ethereum cryptocurrency between the stakeholders. This could be done by making more contracts.
3. We could better associate the digital asset of the drug and the physical drug so that this blockchain management system would be more effective in this use case.
4. We could use a smart contract to prevent false drug information from entering the blockchain network so that we don't get false results all the way through.
5. The identity of each stakeholder could be verified before transactions occur so drugs do not end up in the wrong hands

6. Stakeholders should also be able to join the network since supply chains are a flexible environment.
7. Voting could be implemented on the smart contract before transactions occur

Why TraceLink:

The traditional supply chain management system is prone to hackers and makes it hard to track transactions. As a result products would be easily counterfeit. By introducing the use case of blockchain technology we can manage this trustless system as it allows us to easily trace the drug to the manufacturer and therefore it cannot be counterfeit.

This Blockchain based decentralised system allows for immutability, traceability, and transparency so every stakeholder involved in the supply chain has information of the source and the trading history of the drugs. This helps every stakeholder to distinguish between the safe reliable drugs from the counterfeit dangerous drugs and allows them to see the source of those counterfeit drugs.

Final Demonstration:

Link to Code: https://github.com/ngfelixxx/Trace-Link/blob/main/TraceLinkCode.sol
Link to Demonstration: https://youtu.be/4-cWJauZMhw
Link to Website: https://felixng2003.wixsite.com/tracelink

Critical Making & 3 Paradigms of HCI:

The concept of critical making is clearly represented in my prototype because in the making of TraceLink the whole logistics company is involved in the decision making around whether a certain product is authentic and is allowed through the network. This supports inclusion of all sorts of minds within all the different industries regardless of age, gender, ethnicity, and sexuality. This gives everyone a voice in to confront issues in logistics whether from a social view or from a technical view. An example of this is it was observed a very positive uptake when encouraging involvement in females in the electronic workshops they were participating, as they felt a lot more included in technology compared to males. (Gathering, 2021)

TraceLink clearly implements the first paradigm of HCI which is man to machine coupling that is meant to reduce human error. By using Ethereum smart contracts we automate the job of the middleman to enforce this trustless system between stakeholders therefore removing the need of the middleman and as a result removes that human error. (Schulz, 2017)

The second paradigm is Dual processing whereby there is an interaction between the human processor and the computer processor. TraceLink implements this because now instead of recording information in a traditional database system members of the network can store data in a quick and reliable way without trust concerns via the TraceLink API which

all it needs is a QRcode to add a block to the network. This makes human to computer interaction much quicker and friendlier. (Schulz, 2017)

TraceLink implements the third paradigm because it acknowledges the human error involved within the logistics system just like all other systems involving humans. There is a lack of trust between stakeholders, and there is concern around human error. So TraceLinks blockchain platform allows for all stakeholders to agree upon a smart contract that will replace the middleman between transactions of a good. This accommodates for the human nature of mistakes and lack of trust. (Schulz, 2017)

Regulations:

TraceLink being blockchain technology acts very much like an accounting system, it keeps track of transactions by recording them in the network. Legal frameworks around this technology appear to be challenged as claimed that neither legal codes or technical codes alone can prove to be effective. (Yeoh, 2017)

It is suggested that the public sector enables public regulatory influence to flow through the combination of legal and technical codes. Some issues included in a decentralised network is that there is no clear way of shutting down the system which complicates the legal landscape. That is one reason why there is also concern around blockchain technology used in criminal activities. (Yeoh, 2017)

The supporters of decentralised systems wish for a system that is free from centralised authority. Governments may do better by regulating technologies like blockchain and acting as a collaborative peer with society rather than having a hierarchy of governance. This means regulation itself could become decentralised. (Yeoh, 2017)

What would be beneficial to all stakeholders in a logistics supply chain is the introduction of a blockchain specialised lawyer, whereby legal agreements are made between stakeholders on the exchange of the product, acknowledging that the government is also involved in this supply chain, this is a regulation that is already in place of current supply chain systems. TraceLink implements this through its smart contracts. (Hawkins, 2022)

With the use of a smart contract the middle man is removed from the system, this could potentially mean that with less participants in the system the less regulations are going to be in place. This could reduce regulations around supply chains.

One of the common problems that logistics companies face with supply chains is keeping up with demands. This was especially true during COVID19 isolation. When people were not able to see their doctors the only way to get prescriptions was through an email or other digital means, this meant there was less security around prescriptions being assigned. The smart contracts are able to handle the regulations around prescriptions in a COVID isolation environment since they are a digital entity. This could prevent the over prescription of drugs that could deplete manufacturer resources.

Legislations:

The New Zealand Government has made a commitment to consider introducing modern slavery legislation to address exploitation in supply chains. Legislation that requires businesses to report publicly on transparency in supply chains, to help eliminate practices of modern slavery. Current challenges with this legislation include mapping intricate supply chain relationships, tracing final products and individual components, identifying where and to what extent child labour occurs. TraceLink complies with these legislations directly and resolves all listed issues surrounding the implementation of the legislation.(Safety, Addressing modern slavery and worker exploitation in supply chains: agreement to release public consultation document, 2022)

The smart contract being used for transaction of the products through the supply chain can be governed by all stakeholders but there requires a separate legal contract on the implementation, governance, funding and maintenance of the supply chain using blockchain technology. (Casper et al. , 2021)

The same idea applies to sub suppliers such as the suppliers of ingredients to drug manufacturers. There must be a contract between which sub suppliers can join the blockchain network and in doing so we can expand the depth of our logistic system. (Casper et al. , 2021)

Disclosure of information from a specific stakeholder must be agreed upon by all stakeholders when entering the network with acknowledgement of the immutable decentralised nature of the system. (Casper et al. , 2021)

If payments are automatically made via the smart contract then product acceptance needs to be very precise, if this is not the case consequences can include lawsuits being filed for breach of contract. (Casper et al. , 2021)

Some members of the network may use force majeure as an excuse for not complying with the smart contract as they claim to have been forcefully removed from the network, in which case all members must agree on thresholds or conditions that prevent a member from claiming force majeure. (Casper et al. , 2021)

In the event of termination of the smart contract there must be another contract in place which protects the rights and responsibilities of every member. Conflict between the smart contracts and other blockchain terms and conditions as well as other supply agreements involved must be resolved in a contract agreed upon by all members. (Casper et al. , 2021)

On the service level agreements, data from the blockchain is considered trusted, so that data may be used by members as a part of that agreement. For example time of transport of the drugs from one stakeholder to another. (Casper et al. , 2021)

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