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Blockchain-Integrated Carpooling Platform

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***Abstract*— The proposed cab-sharing platform is developed to provide a secure, transparent, and equitable experience for every participant.. Unlike old-school ride-sharing, which often leaves people worrying about privacy, scams, or who to trust, this platform tackles those problems head-on. Everything runs on blockchain, so every ride or payment gets logged permanently. No one can tamper with the records or delete anything shady after the fact. Riders can all request cabs at the same time. The system gives each request a timestamp, then stores it on the blockchain right away, locking it in. It checks requests against available drivers, using things like car info, ratings, and reliability stats to help riders pick the right match. Once a ride's set, a smart contract takes over. It tracks the driver's route to the pickup spot and makes sure no one's cutting corners. The whole trip—route, fare, status—gets saved securely. Ratings and reviews stick around for good, too, so drivers and riders build real reputations that everyone can see. Under the hood, the system uses the DPOS algorithm and modern encryption to keep everything safe and efficient. There's another smart feature: drivers can pick up several riders heading in the same direction, which saves money and makes better use of each trip. The whole thing runs on Ethereum, with smart contracts running the show and privacy tools keeping user data safe. Tests show it runs smoothly—low overhead, strong privacy, and better efficiency—so it's not just safe and transparent, but actually affordable and ready for the future.**

***Keywords*— Block Chain, Car pooling, Delegated Proof of Stake, Smart Contract.**

I. INTRODUCTION

Our carpool DAPP brings together the security and openness of Ethereum's blockchain with the smarts of a Large Language Model. The result? A ride-sharing platform you can actually trust. Ethereum's public, decentralized network runs smart contracts that take care of rides, requests, and driver reviews — and no one can mess with the records or fake anything. Solidity smart contracts handle the whole process on a local Ganache blockchain while you're building—setting up rides, accepting requests, wrapping up trips, and saving reviews. On the frontend, Ethers.js steps in to connect with the blockchain and sign transactions without a fuss. Then there's the LLM, running on Ollama's LLAMA 3. It sifts through all those blockchain reviews, sums things up, spots trends, and even recommends drivers, all based on what people are actually saying. With this integration, the AI works with data that's already verified and set in stone, so its recommendations actually come from real, trustworthy information. By bringing blockchain and LLM together, the DAPP gives you a platform where every ride and review stays secure and out in the open—nobody can mess with it.

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Riders get smart tips for picking good drivers, so the whole carpooling thing just feels smooth and dependable. People are paying a lot more attention to blockchain technology in transportation and ride-sharing these days. It makes sense—it's decentralized, secure, and you can actually see what's happening at every step. Lately, researchers have started bringing blockchain and smart contracts into carpooling. They 're trying to fix problems like data tampering, privacy leaks, and having to trust big companies in the middle. The study in[2.1] rolled out a blockchain-based system for carpooling apps, handling both registration and authentication. They brought in AI to verify licenses and used blockchain to secure everyone's identity. So, only real, verified drivers and riders can use the app. This approach cuts down on fraud, makes rides feel safer, and honestly, just helps people trust the whole thing a lot more. let[2.2] built a decentralized car-sharing system that runs on the Ethereum blockchain. They used smart contracts to handle everything—creating rides, matching drivers and riders, and taking care of payments. The model eliminates the need for intermediaries such as centralized ride-hailing platforms, thereby reducing transaction costs and ensuring full transparency of operations. The decentralized ledger ensures that all ride records are tamper-proof, promoting accountability and fair service deliver.

In [2.3] the paper discuss about the blockchain and attribute-based encryption (ABE) mechanism for privacy preserving ride services. This model pays the way for the passengers and the drivers to store their personal data on the blockchain in the encrypted form ,so that only authorised participants can access it. This approach keeps user privacy intact but still lets everyone verify what's going on. It tackles one of the big problems you see with centralised ride-sharing that is people worry about who's watching their data. In [2.4], they introduced a decentralized cab-sharing model built on blockchain and smart contracts. This setup handles bookings, payments, and data sharing all together. It keeps user identities and trip details encrypted, so nobody gets access to sensitive info unless they're supposed to. That way, the carpooling system stays fair—transaction logs are locked in, and anyone can check booking records when they need to. Then [2.5] took it a step further and built blockchain right into the carpool networks that were already running. With smart contracts, the system splits fares on its own and makes sure both riders and drivers keep their word. No more arguments about who owes what. The whole setup doesn't just make things clearer and smoother; it actually helps the environments too. More people share rides because the system is open and easy to trust . They came up with a system called B-Ride that puts more emphasis on privacy. This first appeared in version 2.6. With this update, they started using zero-knowledge proofs alongside blockchain. The goal? Keep every ride-sharing deal private and fair. The zero-knowledge proofs let users verify their identities. They handle everything without sharing any sensitive personal info. Smart contracts handle payments, making everything safer and easier to follow. You don't have to stress about security or confusion—they keep things clear and on track. In the end, it creates a ride-sharing platform that's fully decentralized. It's tough to mess with. Plus, it boosts privacy overall. Taking things a step further, [2.7] rolled out a secure, decentralized carpooling system that combines blockchain with advanced cryptography, like zero-knowledge proofs. The result? Users get real privacy and the system can actually scale. When people use it, their data stays safe during checks and transactions. Nobody has to give up personal info, but the blockchain still shows what's happening and keeps things traceable. Then in [2.8], the researchers focused on managing rides through smart contracts. These contracts took care of everything—figuring out fares, handling payments, even gathering feedback after each ride. By cutting out human involvement at these points, they took away chances for mistakes or cheating. Since blockchain locks every transaction and ride detail in place, users can trust the system's fairness and know their rides are on record for good. The system in [2.9] introduces a blockchain-powered carpooling platform that uses cryptographic encryption and smart contracts to keep ride-sharing safe and efficient. Riders and drivers can manage their identities securely, payments go through transparently, and every transaction gets stored in a way no one can change. This setup cuts down on arguments and helps everyone get a fair deal. In the end, [2.10] came up with a peer-to-peer carpooling system built on blockchain. No middlemen here. It's just drivers and passengers, talking directly and working things out themselves. They sort out fares, payments, everything, using smart contracts on the blockchain—totally transparent. This isn't only about saving money. It's about trust, fairness, and building a more sustainable way for people to move around, together.

II. Proposed System

A. System Architecture

Fig. 1 lays out how the blockchain-based carpooling system works with AI built in. It starts when a rider sends a request, then moves through steps like picking the driver, checking everything, and finally saving feedback. Every step keeps things transparent and secure. This setup breaks everything down, showing how each part works and how blockchain and AI team up to make the whole system run smoother, earn trust, and stay reliable.

When a rider wants a ride, they just send a request through the decentralized platform—simple as that. Right away, the system records it on the blockchain, so everything's transparent and locked in for good. First, drivers have to pass a license check. An AI model looks over their credentials and makes sure everything's legit. Once they're cleared, the system registers them on the blockchain network. Now they can start picking up ride requests. If there's more than one driver nearby, another AI tool steps in. It checks things like driver ratings, past ride behaviour, and how close each driver is to the rider. Then it picks the best match for the job. The blockchain logs who gets the ride, and the rider instantly sees the driver's details and location. Both the driver and rider get a confirmation email once they're matched, so everyone knows the ride's official. After the trip, the rider leaves feedback and a rating—this sticks around on the blockchain for good. Those ratings feed into a reputation system that keeps things fair and helps match people better for future rides. Bringing AI and blockchain together makes carpooling smarter, safer, and a whole lot more transparent. People can actually trust the system, knowing their data stays private and everything runs smoothly.

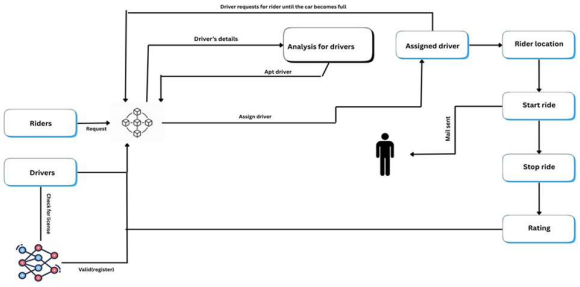

Fig .1: System Architecture

B. License fine tuning

The License Authentication Module checks if a driving license is real or fake using a 28-layer MobileNetV2 CNN model. When someone uploads a license image, the model sorts it out—real or not. If the driver passes, the system registers them on the blockchain with a smart contract. This way, nobody can mess with the driver's data, and everything stays locked in place.

C. Algorithm of Delegated Proof of Stake

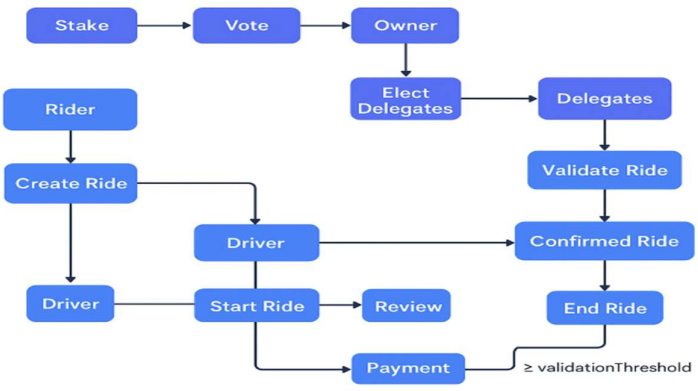

Fig.2: Flow of DPOS algorithm

Step 1: First, anyone in the system can sign up to be a candidate delegate—just call the registerAsCandidate() function. Once you do, the system saves your address and puts you on the list of eligible participants.
Step 2: Stakeholders put their tokens into the smart contract by using the stake() function. The more tokens they stake, the more voting power they have during the election.
Step 3: Stakeholders vote for their favorite candidates through the vote(address c) function. The more they stake, the more weight their vote carries. Each candidate's votes add up as people cast them.

Step 4: Once voting ends, the system owner runs the electDelegates(n) function. This picks out the top n candidates with the most votes. The system then adds them to the delegate list—they're now the official delegates.
Step 5: After delegates get elected, they start validating ride transactions. Each one can check a ride just once by calling delegateValidateRide with the ride's ID. The system tracks if a ride's been validated and bumps up the total validation count every time.
Step 6: Once enough delegates validate a ride—let's say 66% or more—the system automatically marks the ride as confirmed by delegates. It flips the confirmedByDelegates variable to true and triggers the Ride Finalised event.
Step 7: The contract owner can use the setValidationThreshold(uint256 pct) function to change how many delegate approvals are needed for consensus.
Step 8: Every so often, the whole thing starts over. Stakeholders get another shot to re-stake, cast their votes, and pick new delegates as the system changes. This setup keeps things fair, open, and truly decentralized.

D. Encryption and re-Encryption

Step 1: The rider takes their ride details—pickup spot, destination, identity, all of it—and encrypts everything off-chain with Ciphertext-Policy Attribute-Based Encryption (CP-ABE). They use an access policy to lay out exactly which drivers can unlock and read this info.
Step 2: The rider calls submitEncryptedRideOnchain() to upload the ciphertext and access policy to the blockchain. The system stores this encrypted data in encryptedRides, tying it to the right ride ID.
Step 3: The admin or backend finds the right driver for the ride using the matching algorithm, then saves the match with the matchEncryptedRide() function.
Step 4: The admin handles proxy re-encryption off-chain. They take the original ciphertext and turn it into a re-encrypted version that only the matched driver's private key can unlock.
Step 5: Once the system re-encrypts the ciphertext, it uses the publishReEncrypted() function to put it on-chain. Now, the matched driver can access it directly.
Step 6: The driver grabs the re-encrypted ciphertext with the fetchReEncrypted() function, then decrypts it off-chain using their private key. That's how they get the original ride details, safe and sound.
Step 7: Once the ride's done or the data's pulled, the admin just uses removeEncryptedRide() to clear out those encrypted records and free up space.

III. IMPLEMENTATION

A. Rider Module

With the Rider Module, users can set up trip requests by entering where they want to go, where they're starting from, and when they need the ride. The system locks in these details with a timestamp, which keeps everything in order and stops anyone from submitting the same request twice. Once a request goes in, the system processes it and logs it on the blockchain. That way, everything stays transparent and can't be changed or tampered with. With this decentralized setup, nobody can mess with the data. Riders get matched with nearby drivers in a way that's actually fair and easy to check. Once someone picks a rider, the system looks at where they're going and where they're starting, then figures out the price on the spot — and it nails it. Before you lock in your ride, you see the fare right away—no surprises, just clear numbers. Every detail about your trip lands on the blockchain, so there's no messing with the records. Everything stays real, trackable, and safe. That kind of transparency builds trust, plain and simple. If you've got questions about booking or payments, there's a chatbot ready to help, fast. The whole setup blends smart AI help with rock-solid blockchain records. In the end, it just makes carpooling easy, open, and reliable.

B. Driver Authentication

The License Authentication Module checks if a driving license is real or fake. It uses a MobileNetV2 CNN model that's been fine-tuned just for this task. The team trained it on two sets of images: one with real licenses, the other with fakes. They also used tricks like data augmentation and balanced the classes so the model gets better at telling the difference .Once you upload a license image, the trained model gets to work. It checks out all the visual details and decides if the license is real or fake. No more sorting through images by hand—this system cuts out human error and makes it a lot harder for fake licenses to slip through. Letting only users with real licenses sign up makes the carpooling system way more secure and reliable. It stops fake drivers from slipping

through and keeps the ride-sharing platform honest. Honestly, this one step does a lot to protect everyone involved.

C. Driver Module

The Driver Dashboard Module shows every registered driver and their info, all pulled straight from the blockchain so everything stays transparent and real. Drivers can see every ride that's been posted, check the status, and jump in to accept or manage trips without any hassle. The dashboard tracks how much each driver earns, updating their totals automatically through smart contract transactions. If a driver tries to mess with their ratings or fake feedback, the system spots it right away and sends out an alert to keep everything fair. This real-time alert system stops fraud before it happens and helps everyone trust the platform. The Driver Dashboard keeps things fair, protects your data, and makes it easy for drivers and riders to stay in touch. All of this builds a carpooling community that's open, honest, and accountable.

D. Driver Assignment and Notification Module

The Driver Selection Module looks at each driver's past performance on the blockchain—things like ratings, how often they cancel, and whether they finish trips. By focusing on real data, the system makes sure reliable drivers get picked first for ride assignments. It checks each driver's reliability, availability, and overall record, then puts together a clear summary for the rider to see. That way, everything stays transparent. The system looks at all the options and picks the best driver for each rider, making the whole process quick and fair. As soon as the ride starts and the rider hits Start, the map pops up so they can follow their trip in real time. We added an SOS button that, with one click, sends your location to your backup email for safety and tracking. This feature makes rides safer and easier to track. It also helps you pick trustworthy drivers and keeps communication smooth while you're on the road.

E. Review Module

With the Ride Review Module, riders can share feedback and give ratings right after their trip ends. This keeps things open and holds everyone accountable. When the ride wraps up, the rider just writes a review, picks a rating, and that's it — both get locked into the blockchain, so no one can mess with them later. Decentralized storage keeps every piece of feedback real and easy to check. These reviews let people judge how drivers are doing and help keep service quality steady, all based on what riders actually experience. On top of that, the system runs the feedback through the LLAMA language model, turning a bunch of reviews into clear, useful summaries. Riders get these summaries right away, so they can quickly size up a driver's reputation and track record. The Ride Review Module keeps things fair, protects the data, and uses AI to analyse feedback—making carpooling a lot more reliable.

IV. PERFORMANCE EVALUATION

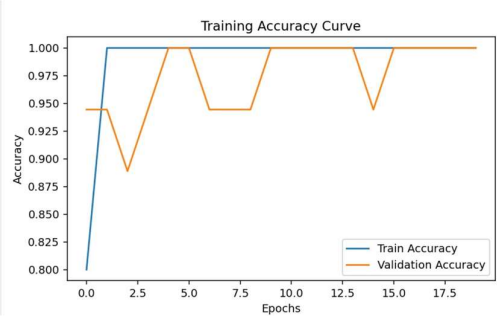

Fig.3: training accuracy reaches 100% while validation accuracy fluctuates, showing potential overfitting or dataset imbalance.

This table shows the results of the license training using MobilenetV2 CNN

TABLE I: RESULTS FOR LICENSE VERIFICATION

Image Name	Confidence Score	Predicted Label
License_1.jpg	0.1234	Real License
Fake_3.png	0.8765	Fake/Not License
License_5.jpeg	0.3421	Real License

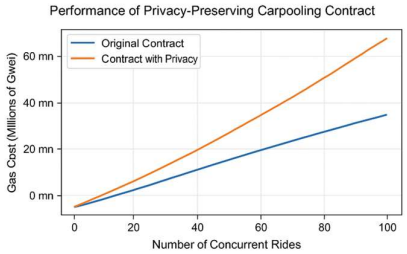

Fig. 4: Performance of DPOS vs Other Consensus Algorithms

This shows the comparison between various consensus mechanism

TABLE II: CONSENSUS PERFORMANCE COMPARISON BETWEEN DPOS, POS, AND POW

Parameter	DPOS	POS	POW
Average Blok Time(s)	1.5	12	600
Transactions per Second	250	100	15
Energy Efficiency	High	Moderate	Low
Delegate Confirmation	97.5	91.3	89.4

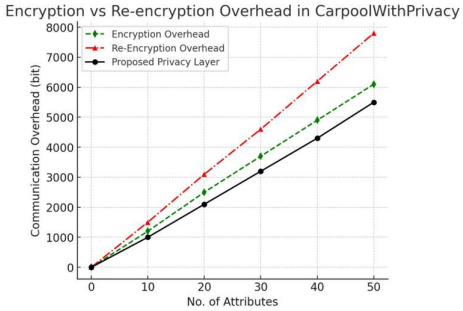

Fig.5: Comparison of encryption, re-encryption, and proposed privacy layer overhead with varying attributes in the Carpool With Privacy system

TABLE III: ENCRYPTION AND RE-ENCRYPTION PERFORMANCE COMPARISON

Operation	Average Time(ms)	CPU Usage(%)	Security Level
CP-ABE Encryption	142	22.3	High
Proxy Re-Encryption	158	23.7	High
Decryption	95	18.9	High
Traditional AES Encryption	78	14.1	Medium

V. EXPERIMENTAL RESULTS

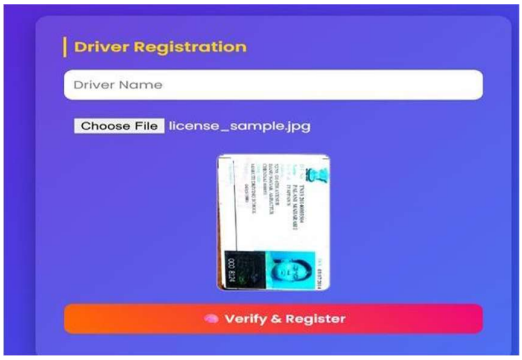

Fig.6:Driver Registration

This screen enables drivers to register by entering their name and uploading a valid driving license. The system verifies the license authenticity using the AI-based license verification model before confirming registration.

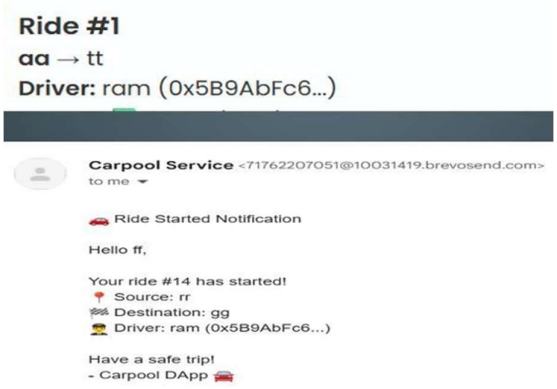

Fig.7:SOS mail to registered EmailId

This feature automatically sends an SOS alert email to the registered contact in case of emergencies during a ride. The mail includes essential details such as ride ID, driver information, and trip status to ensure timely response and safety.

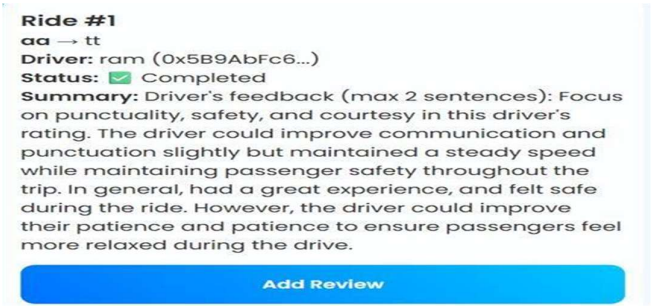

Fig.8:Feedback given by the rider

This screen displays the feedback submitted by a rider after a completed trip. Riders can provide short comments and ratings based on punctuality, safety, and communication, contributing to a transparent reputation system for drivers.

V. Conclusion

This blockchain-powered carpooling platform shakes up the old cab-sharing model. It's not just more secure—it's open, decentralized, and you don't have to blindly trust anyone. Thanks to blockchain and smart contracts, every ride and payment gets tracked, and both riders and drivers build up real, unchangeable reputations. Matching happens in real time, and you can share rides on the fly. Drivers get picked based on how well they've done, not just who's nearby. All this cuts costs and wastes less time and fuel. Because the system keeps a permanent, transparent record and uses a clear rating system, people actually trust it and stick around. In short, blockchain turns ride-sharing into something you can count on—cheaper, safer, and ready for what comes next. Privacy, trust, transparency? It covers them all.

Future Scope

Including AI and predictive analytics makes rider and drivers connect instantly—no more waiting around or empty seats. Additionally can include lock down privacy with zero-knowledge proofs, and real-time vehicle tracking comes in thanks to IoT. There's space here for electric cars and even self-driving ones, too. Plus, if we fine-tune smart contracts and get the system working across different blockchains, everything runs better, scales faster, and more people everywhere can use it.

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