A STEP TOWARDS MAKING THE RIDE-HAILING INDUSTRY MORE SUSTAINABLE USING ARTIFICIAL INTELLIGENCE AND BLOCKCHAIN TECHNOLOGY IN INDIA

A study to know how Artificial Intelligence (AI) and Blockchain technology can help to make the ride-hailing industry more sustainable in Indian demographics with the help of neural networks.

Authors:

[1]Himanshu Meshram, MBA, Universal Business School, Karjat, Raigad, Maharashtra, 410201.

Email address: himanshumeshram2@gmail.com

[2]Prashant Chaudhari, MBA, Universal Business School, Karjat, Raigad, Maharashtra, 410201.

Email address: prashantchaudhari4296@gmail.com

[3]Hritik Nagdeve, MBA, Universal Business School, Karjat, Raigad, Maharashtra, 410201.

Email address: hritiknagdeve01@gmail.com

Corresponding author: [1]Himanshu Meshram

Abstract:

Ride-hailing services are becoming a significant part of day-to-day life. In the Indian setting, the use of ride-hailing services has skyrocketed in the last decade. Many ride-hailing companies had established their dominance in the targeted segment over the past decade. Even though the dominance of other companies over ride-hailing services in India, Uber is the market leader. In due time, technological advancement such as using technologies like Artificial Intelligence (AI), blockchain technology, cryptography, etc has revolutionized the ride-hailing service segment. Many frauds regarding fake rides and inflated ride fares have also increased. To mitigate such kinds of problems, the use of AI algorithms and blockchain technology can be used. This paper deals with the conceptual idea of using Artificial Intelligence and blockchain technology in the ride-hailing industry to leverage technological advancement and to improve the service quality to match the competitors through the use of AI and blockchain technology thereby contributing to sustainability. AI-powered ride allocation, Predictive maintenance, Blockchain-enabled data sharing, and Smart charging are some of the leverages through which ride-hailing can step towards sustainable practices.

Keyword:

Artificial Intelligence, Blockchain Technology, Ride-Hailing, Sustainability, India

Introduction

In recent years, the ride-hailing industry in India has significantly increased as the traditional taxi industry was not that convenient for riders to access. According to the data published on Statista, the user penetration for the ride-hailing industry is 7.3% in 2023 and is expected to increase to 7.5% by 2027. It has been projected that by 2027, the number of riders will amount to 110.30M overall ride-hailing segments, whereas the annual growth rate (CAGR) is expected to increase by 2.9%, which results in an increase in the market volume of 1.21 TN. The average revenue per user is expected to amount to Rs.10.60K [3]. The introduction of ride-hailing services in India has resulted in increased competition for traditional taxi operators. Ride-hailing services have several advantages over traditional taxis, such as ease of booking, affordable fares, and convenient payment methods. As a result, many customers have switched to ride-hailing services, causing a decline in demand for traditional taxis. As there were not enough platforms that were promoting the ease for the riders to book their rides, it was very difficult for normal people to book their taxis. The internet was also a reason that the taxi industry was not established properly and reached the targeted segment of their user [1]. After the launch of Reliance Jio, the ride-hailing industry boomed as the internet became available for users. The preference of consumers for ride-hailing services has also contributed to the decline in the taxi industry. Many customers started preferring the convenience and comfort offered by ride-hailing services, such as air-conditioned cars, GPS tracking, and real-time updates on driver locations. The operating costs of running a traditional taxi business have also increased in recent years. This includes the cost of fuel, maintenance, and insurance. This has made it difficult for traditional taxi operators to compete with ride-hailing services, which have a lower cost structure due to the use of third-party vehicles. The taxi industry in India is highly regulated, and government regulations have also impacted the industry. For example, the introduction of stricter emission norms and mandatory GPS tracking devices has increased the cost of running a taxi business, which has made it more difficult for traditional taxi operators to stay profitable. The offerings and the convenience provided by the ride-hailing industry disrupted the traditional taxi business in India. In India, Ola and Uber had dominance over the ride-hailing industry by having a market share of 30% and 50% respectively.

But even after the dominance in the market by ride-hailing services especially in India, Ola, and Uber, there are some places in India where the traditional taxi business still has dominance. According to a report by The Economic Times, Ola and Uber have a combined market share of around 20% in Jaipur, while local taxi operators continue to dominate the market. According to a report by The Financial Express, Ola and Uber have a combined market share of around 15% in Lucknow, with traditional taxi operators and auto-rickshaws being the primary mode of transportation. Cities like Kolkata where the taxi industry has a strong presence, with the iconic yellow taxis being a familiar sight on the streets. The local taxi unions have been able to resist the entry of ride-hailing services and have even gone on strike to protest them. Bhubaneswar is another city that has a large number of traditional taxis, and here also the taxi unions have been successful in limiting the number of ride-hailing vehicles allowed to operate in the city. The taxi industry is well-established in the cities like Chandigarh and Coimbatore, with local taxi drivers having a strong customer base and loyal following. They have been able to compete with ride-hailing services by offering personalized services and building strong relationships with their customers. Over a period of time, as the market for Ola and Uber in India has grown, it has been observed that there has been continuous advancement in the technology for becoming more customer-centric by losing the opportunity cost for not considering the employee side.

From the customer's perspective with the entry of new players and established taxi companies, the ride-hailing market has become more competitive. Customers now have more choices and can easily switch to a new service if they are dissatisfied with the current one as the switching cost is very low in this segment. One of the most common complaints from customers is surge pricing, where fares increase during peak hours or in high demand. This can result in significantly higher fares for customers, leading to dissatisfaction. According to a survey conducted by LocalCircles, 68% of respondents said they had experienced surge pricing on Ola or Uber. As customers have become more price-sensitive and may choose to switch to a competitor if they find a better deal. The companies must balance their pricing strategy to remain competitive while ensuring profitability by encouraging new-age technology such as blockchain technology. Safety is a major concern for customers using ride-hailing services in India. Incidents of harassment and assault by drivers have been reported in the past, leading to calls for stricter background checks and safety measures. According to a survey by YouGov, 61% of respondents said they were concerned about their safety while using Ola or Uber. It has been observed that despite efforts to improve safety, reports of harassment and assault by drivers have impacted the reputation of these companies. Customers are now more cautious about using ride-hailing services and may opt for other transportation options. Customers have also reported instances of rude or unprofessional behavior by drivers, leading to complaints and negative reviews. According to a survey by LocalCircles, 14% of respondents said they had faced issues with driver behavior on Ola or Uber. Payment-related issues, such as incorrect fares, payment failures, and refunds, are also common complaints from customers. According to a survey by LocalCircles, 20% of respondents said they had faced payment-related issues on Ola or Uber [4]. Here technologies such as Artificial Intelligence (AI) and Neural Networks (NN) can help companies to gain a competitive advantage and increase the barriers for new entrants by increasing the switching cost.

From the employee's perspective, the companies have reduced driver incentives, leading to a decline in their earnings. According to a report by the Indian Express, many drivers struggle to earn a living wage, with some earning as little as Rs. 4,000 per month after accounting for expenses like fuel and vehicle maintenance. Ola and Uber have also faced criticism from drivers over commission cuts. Both companies take a commission on each ride, which has been the subject of protests and strikes by drivers in the past. According to a report by The Hindu, Uber, and Ola commission rates have been as high as 30%, which can significantly impact drivers' earnings [1]. Drivers have also faced reduced demand due to the pandemic, leading to financial difficulties. The emergence of new players and the possibility of central regulation has created uncertainty for drivers. They fear losing their jobs or being forced to join a union, which could impact their earnings. Drivers are not considered employees of the companies and are therefore not eligible for benefits such as health insurance, sick leave, or paid time off. This has led to protests by drivers and demands for better treatment. Safety is also a concern for drivers working for Ola and Uber. There have been incidents of violence against drivers, as well as reports of sexual harassment and assault of female drivers. A survey conducted by the Indian Federation of App-based Transport Workers found that 72% of drivers had faced harassment or violence while working for ride-hailing companies. After such employee issues, Ola started the initiative called 'Ola Pragati' where Ola company empowers the drivers to get on the board by providing loans through the SBI. Similarly, Uber initiated 'Uber Dost' which provides the rewards such as free insurance, benefits on health, and education subsidy for kids [2].

Even after such initiatives for the drivers, and focusing on riders as well, Ola, Uber and other ride-hailing providing services are still facing a lot of problems from the competition and new-age technology. It is very important to understand consumer behavior from the demographic perspective to sustain the high-age competition by adopting new technological advancements to bridge the gap between existing technology and the model used by the industry for providing the services.

Literature review

Yang Liu and Ruo Jia (2022) illustrated the use of machine learning in on-demand ride-hailing services. They first highlighted the spatiotemporal dynamics of urban traffic where they highlighted the macro-level ride-hailing algorithms that can be used to demonstrate the value in guiding the design, planning, and control of urban intelligent transportation systems. With the help of spatial-temporal patterns, the company uses order matching models which help in assigning the ride to the ideal and nearest driver to maximize the profit of the driver and to reduce the rider's waiting time of the passenger. With the help of vehicle dispatching algorithms, the ride-hailing company can manage the dynamic changes in demand and supply of the ride booked. Service provider divides their operating area into several units and uses the algorithm to forfeit the benefits from the driver and customer perspective. The authors mentioned that with the help of machine learning, several approaches and models are developed that can predict traffic and allows to route an alternative route for the destination. As well as some models are also developed that can be used and can help in assigning the rides to the drivers with the help of the supply and demand of the riders [5].

Toou Lyu and Peirong (2021), according to the author, at present, there are many machine learning algorithms that are being used to improve the service quality from the perspective of drivers and riders too. In the paper, the author mentioned that the majority of research on the ride-hailing sector is done majority on Spatiotemporal distribution and travel behavior (24.6%). The author gives an overview of how machine learning can result in improved service satisfaction. Through new machine learning or improvised machine learning algorithm, various factors such as urban travel patterns, urban mobility, and urban structure can be explored based on the rider's boarding point recommendations, route planning, traffic conditions forecast, travel time forecast, and destination forecast [6].

Dr. Ruchi Shukla, Dr. Ashish Chandra, and Mr. Himanshi Jain (2017) discussed the comparative study of India's leading ride-hailing service providers, Ola and Uber. The authors have given a comparative analysis of both the leading companies where they mentioned how Ola and Uber have a threat of low switching costs and the threat from new entrants and have unclear future of these companies as there is a lack of government regulations in India. They also discuss the initiative taken by Ola and Uber service providers to become employee-centric. According to the author, leading ride-hailing service providers can optimize their costs at all levels. The author also suggested that these companies should be more customer-centric and target oriented and highly innovative in their technology [2].

Ashish Khade and Dr. Vaibhav Patil (2018) examined the customer satisfaction level of Ola and Uber cab services in Pune, Maharashtra. According to the author's study in the Pune region, 59% of respondents have mentioned that they have to wait for the service for 10-15 min whereas 33% mentioned that they have to wait for 25-20min, which is sometimes not possible for the riders to board the service due to long waiting period and delay service offering due to external environment. The authors have also mentioned the complaints raised by the customer during their research. The major complaint includes the absurd rates at peak hours, and ride cancellation from the driver's side before reaching the rider's location. Authors suggested from their research that, ride-hailing service providers should not have the price surging during peak hours [7].

Shreya Nigotiya (2020) discussed the overall perspective of the leading companies in the ride-hailing industry, Ola and Uber. The author discussed the market competitors for both Ola and Uber. The author has mentioned the challenges faced by the industry and the issues from the customer's perspective. The author mentioned that the major challenges faced by the industry include the driver striking their own deal with the customers where the driver used to ask the rider to cancel the ride and pay them the fair directly, drivers' grievance where the percentage of gross booking fell down to 8% - 10% and due to company's changing policies reduced the incentives for the drivers which results to see a sharp fall down from Rs. 80,000 to Rs. 30,000 per month. According to the author's research, there were frequent strikes by drivers and they were leaving the network [1].

Research Gap

Author	**Research Work**	**Research Gap**
Yang Liu and Ruo Jia (2022)	Focuses on the use of Machine Learning to predict spatial-temporal patterns	The system lacks the algorithm to optimize the route
Tao Lyu, Peirong Wang, Yanan Gao, Yuanquing Wang (2021)	Traces on urban travel patterns, urban mobility, urban structure, route planning, traffic conditions forecast, travel time forecast, and destination forecast.	The research is unable to match the supply and demand of the riders and drivers because of low information flow within the closed system.

Dr. Ruchi Shukla, Dr. Ashish Chandra, and Mr. Himanshi Jain (2017)	Study of ola and uber in the Indian context.	Lacks the technological advancement of AI in the ride-hailing industry.
Shreya Nigotiya (2020)	Talks about changing policies resulting in unrest and dissatisfaction among drivers.	Lacks customer perspective
Rusul Abduljabbar , Hussein Dia , Sohani Liyanage and Saeed Asadi Bagloee	Ai for addressing traffic management, traffic safety and urban mobility	Lacks sustainability perspective through the use of AI

Research Methodology

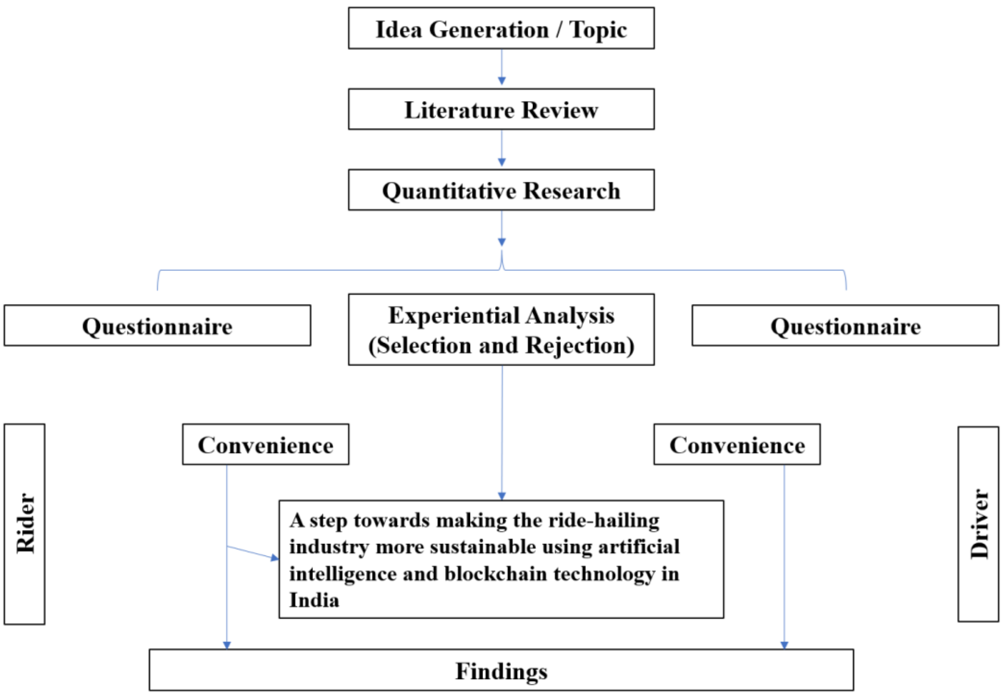

Figure 1 Research Methodology

Research Objective

To Study the use of Artificial Intelligence and Blockchain Technology in ride hailing industry in order to -

1. Empower both the customer and operator to bargain
2. Increase the reliability of ride-sharing
3. Contributing sustainable practices with the help of AI algorithm and blockchain networks

Data Collection

To understand the need and the area of improvement from both the rider's and driver's perspective, the data has been collected in two forms, viz. from the rider's perspective and from the driver's perspective. The random sampling technique was used to collect the data, and the survey was conducted across 20 states and covering 88 cities to collect the data from the rider's perspective. A total sample of 343 respondents gave their responses through the survey conducted by Google Forms. The survey was conducted by keeping the focus underlined as per the literature gap. The major questions asked to the riders through the survey were, what are their views on surge pricing and the pricing model followed by the ride-hailing service provider and asking what are their views if we introduced the negotiation in the fare which is charged by the centralized ride-hailing service provider, and other was about adding the preference given by the ride-hailing service provider's platform to have the gender preference for the ride-sharing option. The rest of the questions were backed by the problems faced by them starting from the booking of the ride to the completion of the ride.

A total sample of 59 respondents was collected through the random sampling technique to understand the driver's perspective. The data was collected from 6 states and covered 10 cities in India. The survey was conducted to understand the problems faced by the driver during their rides and by the ride-hailing service provider, they are working with. Two major questions were asked during this survey to identify the area of improvement from the driver's perspective. Firstly, the question was asked to know how much they are satisfied with the current income they are getting through the rides. And secondly, the question of how much they will favor if there is a decentralized system for charging the fare and there will a platform for the negotiation of fare from the rider's and driver's end. A few questions were asked about the satisfaction provided by the service provider.

Data Analysis

<u>Rider's Perspective</u>

From the data collected through Google Forms, to validate the hypothesis, we analyzed the data using the linear regression model. Linear regression helps to identify the direction and strength of the relationship between the dependent variable and the independent variables taking into the analytical considerations.

Inference01

Ho: There is no significant relationship between the choice given to the riders for gender preference while booking a shared ride.

Ha: There is a significant relationship between the choice given to the riders for gender preference while booking a shared ride.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.938[a]	.906	.886	.154

Table 1: Model Summary

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	101.402	9	11.267	56.659	<.001[b]
	Residual	66.219	333	.199		
	Total	167.621	342			

Table 2: Anova Test Result

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.012	.157		.078	.938
	Age	-.001	.002	-.014	-.401	.689
	Waiting_Time	-.240	.042	-.414	5.695	<.001
	Traffic_Problem	.056	.034	.065	1.671	.096
	Negotiation_Preference	.158	.045	.148	3.529	<.001
	Ride_Sharing	.300	.036	.322	8.349	<.001
	Difficulty	.301	.059	.317	5.094	<.001
	Gender_N	.065	.052	.046	1.250	<.001
	Use	.399	.048	.511	8.351	<.001
	Service	.005	.019	.009	.254	.800

a. Dependent Variable: Gender_Preference

Table 3 Coefficient Table

From Table 1, it can be inferred that the adjusted R-squared or the adjusted coefficient of determination value of 0.886 or 88.6% indicates that the predictor variables in the linear regression model explain a significant proportion of the variance in the outcome variable, suggesting that the model is a good fit to the data. The results suggest a strong relationship between the predictor variables and the outcome variable and support the use of this model for predicting the outcome variable based on the predictor variables.

From Table 2, the ANOVA table shows a highly significant F- value ($p < 0.001$), indicating that the regression model is a very good predictor of the outcome variable. The predictor variables in the model explain a significant amount of the variation in the outcome variable and the model provides a good fit to the data. These results suggest that the model is a useful tool for predicting the outcome variable based on the predictor variables.

From Table 3, the coefficient table shows a highly significant p-value ($p < 0.001$) for the predictor variable such as the questions asked in the survey regarding the waiting time for the cab to arrive after booking a ride, how frequently the rider uses the ride-hailing service, based on gender, the difficulty of finding the cab service in the area, whether the rider uses ride-sharing or not, and if the riders are given the negotiation authorship in the fare while booking the ride, indicating that it is a strong and significant predictor of the outcome variable. The regression coefficient provides information on the direction and magnitude of the relationship between the predictor variable and the outcome variable, and the highly significant p-value suggests that this relationship is not due to chance. These results suggest that the predictor variable is an important factor to consider when predicting the outcome variable.

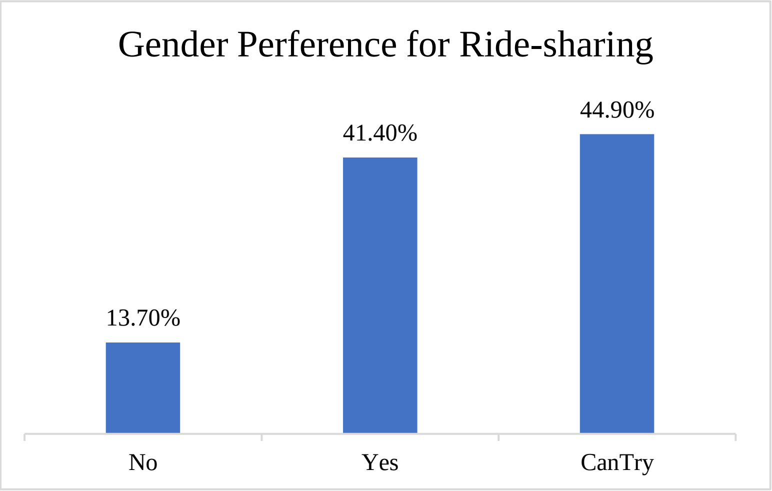

Figure 2: Graph - Gender Preference for ride sharing

Gender Preference option with Gender bifurcation	**% Breakdown**
No	**13.70%**
Female	7.00%
Male	6.71%
Yes	**41.40%**
Female	22.74%
Male	18.66%
Can Try	**44.90%**
Female	23.62%
Male	21.28%

Table 4-Gender Preference option with Gender bifurcation with % Breakdown

Hence from the above analysis, it can be inferred that the liner regression model analysis rejects the null hypothesis and gives that there is a significant relationship between the choice given to the riders for gender preference while booking a shared ride and this analysis provides that there should be a technological improvement in the existing system that the rider should get the information based on the gender of another rider who will be sharing the ride to decide whether to accept the ride or not. This can be linked to sustainability where the riders are getting the information of their ride-shared partner so that they can use the ride-sharing option more frequently, reducing the carbon emission as fewer vehicles will be used for transportation comparatively. The cost and safety factors are also associated with this technological improvement, as the cost per ride for the riders will be less and safety will be ensured because of the transparency in the information flow. Also from the data collected through the survey, 86% of the respondents were in favour of this when they had given the choice of whether they will prefer the sharing ride if there is a platform that enables you to choose the sharing ride according to their convenience of gender. The majority of the female population given the survey had shown positive responses towards this (From Table 04, Figure 02).

Inference02

Ho: There is no significant relationship between the choice given to the riders for negotiation preference while booking a shared ride.

Ha: There is a significant relationship between the choice given to the riders for negotiation preference while booking a shared ride.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.896[a]	.835	.813	.145

Table 5- Model Summary

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	52.096	9	5.788	20.066	<.001[b]
	Residual	96.062	333	.288		
	Total	148.157	342			

a. Dependent Variable: Negotiation_Preference

b. Predictors: Ride_Hailing_Service, Gender_Preference, Age, Traffic_Problem, Gender, Use_of_Service, Ride_Sharing, Difficulty_in_Ride_Finding, Waiting_Time

Table 6- Anova

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.873	.184		4.755	<.001
	Age	-.002	.002	-.032	-.712	.477
	Waiting_Time	-.109	.053	-.200	2.058	.004
	Gender_Preference	.229	.065	.243	3.529	<.001
	Traffic_Problem	-.047	.041	-.057	1.149	.025
	Ride_Sharing	.125	.047	.142	2.646	.009
	Difficulty	-.632	.065	-.708	9.704	<.001
	Gender_N	.063	.062	.048	1.010	.313
	Use	.270	.062	.367	4.383	<.001
	Service	.021	.023	.043	.936	.350

a. Dependent Variable: Negotiation_Preference

Table 7- Coefficient Table

From Table 5, it can be inferred that the adjusted R-squared or the adjusted coefficient of determination value of 0.813 or 81.3% indicates that the predictor variables in the linear regression model explain a significant proportion of the variance in the outcome variable, suggesting that the model is a good fit to the data. The results suggest a strong relationship between the predictor variables and the outcome variable and support the use of this model for predicting the outcome variable based on the predictor variables.

From Table 6, the ANOVA table shows a highly significant F- value ($p < 0.001$), indicating that the regression model is a very good predictor of the outcome variable. The predictor variables in the model explain a significant amount of the variation in the outcome variable and the model provides a good fit to the data. These results suggest that the model is a useful tool for predicting the outcome variable based on the predictor variables.

From Table 7, the coefficient table shows a highly significant p-value ($p < 0.001$) for the predictor variable such as the questions asked in the survey regarding the waiting time for the cab to arrive after booking a ride, how frequently the rider uses the ride-hailing service, based on gender, the difficulty of finding the cab service in the area, whether the rider uses ride-sharing or not, and if the riders are given the preference to choose the gender according to their wish while having a shared ride, indicating that it is a strong and significant predictor of the outcome variable. The regression coefficient provides information on the direction and magnitude of the relationship between the predictor variable and the outcome variable, and the highly significant p-value suggests that this relationship is not due to chance. These results suggest that the predictor variable is an important factor to consider when predicting the outcome variable.

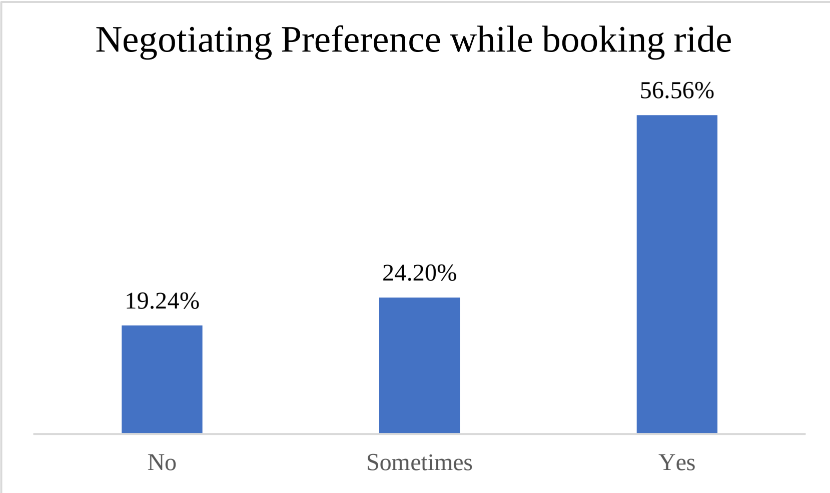

Figure 3-Negotiating Preference while booking ride

Price Negotiation against Satisfaction for existing fair charged by the service provider	**% Breakdown**
No	**19.24%**
Sometimes, but don’t like the dynamic pricing system	3.79%
Not satisfied with the existing fair algorithm	6.71%
Yes, it is less than the local transport service	8.75%
Sometimes	**24.20%**
Sometimes, but don’t like the dynamic pricing system	18.37%
Yes, it is less than the local transport service	5.83%
Yes	**56.56%**
Sometimes, but don’t like the dynamic pricing system	1.46%
Not satisfied with the existing fair algorithm	51.02%
Yes, it is less than the local transport service	4.08%

Table 8-Price Negotiation against Satisfaction for existing fair charged by the service provider with % Breakdown

Hence from the above analysis, it can be inferred that the liner regression model analysis rejects the null hypothesis and gives that there is a significant relationship between the choice given to the riders for negotiation preference while booking a shared ride and this analysis provides that there should be a technological improvement in the existing system that the rider should be an opportunity to rider to negotiate the fare with the driver. Also from the data collected, the majority of the respondent was in favor of negotiating the fair as they find the existing fair breakdown algorithm is charging them high. Almost 80% of the respondent showed a positive response when asked if they had been given the price negotiation option for bargaining the fair for their ride.

Correlations

		Gender_N	Gender_Preference
Gender_N	Pearson Correlation	1	.847
	Sig. (2-tailed)		<.001
	N	343	343
Gender_Preference	Pearson Correlation	.847	1
	Sig. (2-tailed)	<.001	
	N	343	343

Table 9 - Co-relation between Type of Gender and Gender Preference

From Table 9, there is a significant relationship between the choice asked whether they will favor choosing gender preference while booking the shared ride and the gender. There is a strong positive relationship between the two parameters.

Correlations

		Negotiation_Preference	Ride_Sharing
Negotiation_Preference	Pearson Correlation	1	.801
	Sig. (2-tailed)		<.001
	N	343	343
Ride_Sharing	Pearson Correlation	.801	1
	Sig. (2-tailed)	<.001	
	N	343	343

Table 10-Co-relation between Gender Preference and the ride sharing option

From Table 10, there is a significant relationship between the choice asked whether they will favor choosing gender preference while booking the shared ride and the ride-sharing option. There is a strong positive relationship between the two parameters.

Correlations

		Negotiation_Preference	Use
Negotiation_Preference	Pearson Correlation	1	.823**
	Sig. (2-tailed)		<.001
	N	343	343
Use	Pearson Correlation	.823**	1
	Sig. (2-tailed)	<.001	
	N	343	343

**. Correlation is significant at the 0.01 level (2-tailed).

Table 11 Co-relation between the negotiation preference and the use of shared mobility

From Table 11, there is a significant relationship between the choice asked whether they will favor if they are given the option for negotiation of fare with the driver and ride-sharing. There is a strong positive relationship between the two parameters.

Correlations

		Gender_Preference	Ride_Sharing
Gender_Preference	Pearson Correlation	1	.941**
	Sig. (2-tailed)		<.001
	N	343	343
Ride_Sharing	Pearson Correlation	.941**	1
	Sig. (2-tailed)	<.001	
	N	343	343

**. Correlation is significant at the 0.01 level (2-tailed).

Table 12 Co-relation between the negotiation preference and the use of shared mobility

From Table 12, there is a significant relationship between the choice asked whether they will favor if they are given the option for negotiation of fare with the driver and the use of shared mobility per rider. There is a strong positive relationship between the two parameters.

From the correlation established from the data collected from the rider's perspective, it can be inferred from statistical analysis that there is a strong relation between the questions asked to the rider for the improvement in the current system.

Driver’s Perspective

Inference 03

Ho: There is a significant relationship between the choice given to the drivers for fare negotiation preference while booking a ride.

Ha: There is no significant relationship between the choice given to the drivers for fare negotiation preference while booking a ride.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.895[a]	.800	.773	.165

Table 13- Model Summary

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.535	7	.791	29.218	<.001[b]
	Residual	1.380	51	.027		
	Total	6.915	58			

Table 14- Anova Result

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.027	.354		5.729	<.001
	Gender	.254	.124	.207	2.056	.045
	Number of rides done in a day	.367	.064	.606	5.714	<.001
	Type of vehicle	.090	.074	.139	1.206	<.001
	How much you will rate for the commission charged by your ride-hailing company?	-.046	.059	.115	5.790	<.001
	Age	-.001	.002	-.035	.509	.561
	Which ride-hauling company are you associated with?	.029	.039	.209	1.751	<.001
	How much satisfied you are with the company you are working with in accordance to service, and pay you get?	.356	.052	.604	6.823	<.001

a. Dependent Variable: If given to negotiate the fare through ride hailing company

Table 15- Coefficient Table

From Table 13, it can be inferred that the adjusted R-squared or the adjusted coefficient of determination value of 0.773 or 77.3% indicates that the predictor variables in the linear regression model explain a significant proportion of the variance in the outcome variable, suggesting that the model is a good fit to the data. The results suggest a strong relationship between the predictor variables and the outcome variable and support the use of this model for predicting the outcome variable based on the predictor variables.

From Table 14, the ANOVA table shows a highly significant F- value ($p < 0.001$), indicating that the regression model is a very good predictor of the outcome variable. The predictor variables in the model explain a significant amount of the variation in the outcome variable and the model provides a good fit to the data. These results suggest that the model is a useful tool for predicting the outcome variable based on the predictor variables.

From Table 15, the coefficient table shows a highly significant p-value ($p < 0.001$) for the predictor variable such as the questions asked in the survey regarding the driver’s perspective on the pay they get from the current algorithm used by the ride-hailing service provider, indicating that it is a strong and significant predictor of the outcome variable. The regression coefficient provides information on the direction and magnitude of the relationship between the predictor variable and the outcome variable, and the highly significant p-value suggests that this relationship is not due to chance. These results suggest that the predictor variable is an important factor to consider when predicting the outcome variable.

Negotiation Preference against Satisfaction with existing Commission algorithm	**% Breakdown**
Accept	**86.44%**
Poor	66.10%
Satisfied	15.25%
Fair enough	5.08%
Not accepted	**13.56%**
Fair enough	13.56%

Table 16-Negotiation Preference against Satisfaction with existing Commission algorithm with % Breakdown

Hence from the above analysis, it can be inferred that the liner regression model analysis failed to reject the null hypothesis and gives that there is a significant relationship between the choice given to the drivers for negotiation preference while booking a ride and this analysis provides that there should be a technological improvement in the existing system that there should be the involvement of driver to negotiate the fare with the rider (From Table 16).

Correlations

		If given to negotiate the fare through ride hailing company	Number of rides done in a day
If given to negotiate the fare through ride hauling company	Pearson Correlation	1	.736**
	Sig. (2-tailed)		<.001
	N	59	59
Number of rides done in a day	Pearson Correlation	.736**	1
	Sig. (2-tailed)	<.001	
	N	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

Table 17- Co-relation between negotiation of fare and the number of rides done in a day by the driver.

Correlations

		If given to negotiate the fare through ride hailing company	Type of vehicle
If given to negotiate the fare through ride hauling company	Pearson Correlation	1	.858**
	Sig. (2-tailed)		<.001
	N	59	59
Type of vehicle	Pearson Correlation	.858**	1
	Sig. (2-tailed)	<.001	
	N	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

Table 18- Co-relation between negotiation of fare and the type of vehicle

Correlations

		If given to negotiate the fare through ride hauling company	How much you will rate for the commission charged by your ride-hailing company?
If given to negotiate the fare through ride hailing company	Pearson Correlation	1	.847**
	Sig. (2-tailed)		<.001
	N	59	59
How much you will rate for the commission charged by your ride-hailing company?	Pearson Correlation	.847**	1
	Sig. (2-tailed)	<.001	
	N	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

Table 19- Co-relation between negotiation of fare and the satisfaction level for the commission given by the service provider to the driver.

Correlations

		If given to negotiate the fare through ride hailing company	How much satisfied you are with the company you are working with in accordance to service, and pay you get?
If given to negotiate the fare through ride hailing company	Pearson Correlation	1	.804**
	Sig. (2-tailed)		<.001
	N	59	59
How much satisfied you are with the company you are working with in accordance to service, and pay you get?	Pearson Correlation	.804**	1
	Sig. (2-tailed)	<.001	
	N	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

Table 20- Co-relation between negotiation of fare and the satisfaction level with the company on the service provided to the driver.

From Table 17,18,19,20 it can be inferred that there is a strong positive relationship between the negotiation preference as the drivers are not happy with the pay, they get from the ride-hailing service provider regardless of the service provider.

Hence, from the analysis and interpretations, it can be inferred that there is a need for technological improvement and revised service operations in the ride-hailing industry to mitigate the gap between rider and driver needs.

RESEARCH OUTCOME:

From the data collected and analyzed, we can trace that there can be a number of permutations and combinations for optimizing the experience of both the parties involved in ride hailing industry viz. passenger and driver.

- Bargaining option for both the rider and driver.
- Route optimization for avoiding traffic congestion.
- Sharing options with gender preference.

Bargaining option for both the rider and the driver.

The ride-hailing industry has seen significant growth and competition in recent years, driven in part by advances in artificial intelligence and blockchain technology. These technologies have the potential to improve the bargaining ability of both drivers and riders, leading to a more efficient and equitable market. By using AI-powered algorithms, ride-hailing companies can better match riders with drivers, improving the overall user experience and reducing wait times. Additionally, AI can help companies optimize pricing strategies, ensuring that both drivers and riders receive fair compensation for their time and resources.

Blockchain technology can also play a role in improving bargaining power. By using decentralized platforms, riders and drivers can transact with each other directly, without the need for a central intermediary. This can reduce transaction costs and increase transparency, leading to more equitable outcomes for all parties involved (Figure 04).

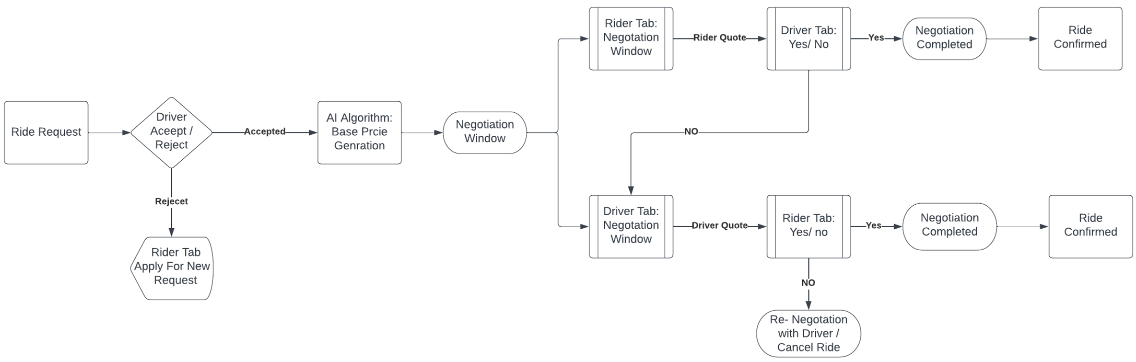

Figure 4 Framework for Bargaining option for both the rider and the driver

Route optimization for avoiding traffic congestion

The use of artificial intelligence and blockchain technology for route optimization in the ride-hailing industry has significant potential to improve the efficiency and profitability of transportation services. By analyzing vast amounts of data in real time and utilizing algorithms that incorporate factors such as traffic patterns, passenger demand, and driver availability, AI-powered routing can help ride-hailing companies reduce wait times, increase customer satisfaction, and minimize operational costs. The incorporation of blockchain technology can provide additional benefits by enabling secure and transparent transactions between drivers, passengers, and ride-hailing companies. Blockchain can also enhance the accuracy and reliability of data analysis by providing a tamper-proof and decentralized ledger of all relevant information (Figure 05).

Figure 5 Process Layout for Route optimization with the help of AI

1. Data Collection:

- Data related to traffic conditions, historical ride patterns, road networks, and real-time updates are collected from various sources, such as GPS devices, traffic sensors, and ride-hailing platforms.

- This data provides information about road congestion, average travel times, and optimal routes.

2. Data Storage on Blockchain:

- The collected data is securely stored on a blockchain network, ensuring immutability, transparency, and decentralization.

- Blockchain technology ensures the integrity and accessibility of the data for AI algorithms to process.

3. AI-based Route Optimization:

- AI algorithms analyze the stored data and perform route optimization calculations.

- These algorithms consider various factors, including traffic conditions, distance, road quality, and user preferences.

- By considering these factors, AI algorithms determine the most efficient routes for ride-hailing vehicles and provides driver with multiple routes that can be taken into consideration to reach the destination.

4. Real-time Updates:

- The optimized routes are continuously updated based on real-time data, such as traffic congestion, accidents, or road closures.

- AI algorithms dynamically adjust the routes to provide the most optimal path for the driver to follow.

5. Driver Guidance and Navigation:

- The optimized routes are communicated to the driver through a navigation system or a mobile application.

- The driver receives turn-by-turn instructions and real-time updates to navigate the chosen route effectively.

6. Improved Efficiency and Reduced Travel Time:

- By utilizing AI-based route optimization, ride-hailing companies can significantly reduce travel time for drivers and passengers.

- Efficient routes lead to quicker pick-ups, drop-offs, and shorter overall travel durations.

7. Enhanced Customer Experience:

- Passengers experience shorter wait times and faster rides, leading to improved satisfaction.

- Reduced travel time and efficient routes contribute to a smoother and more comfortable ride experience.

This block diagram illustrates the process of using blockchain and AI for route optimization in the ride-hailing industry. It starts with data collection, which is stored on the blockchain for secure and transparent access. AI algorithms perform route optimization, taking into account real-time updates, and provide guidance to drivers for efficient navigation. The result is improved efficiency, reduced travel time, and an enhanced customer experience.

Sharing option with gender preference

The combination of artificial intelligence and blockchain technology can significantly improve the ride-hailing industry's efficiency, safety, and cost-effectiveness. AI can help to optimize routes, reduce wait times, and provide a more personalized experience for riders. At the same time, blockchain technology can increase transparency and security, ensuring that transactions are completed securely and without the need for intermediaries.

Furthermore, ride-sharing platforms can leverage blockchain technology to build a decentralized system that eliminates the need for intermediaries and enhances the security of transactions. Blockchain-based ride-sharing platforms can also enable users to earn cryptocurrency tokens for sharing rides, incentivizing more people to participate in the service (Figure 06) .

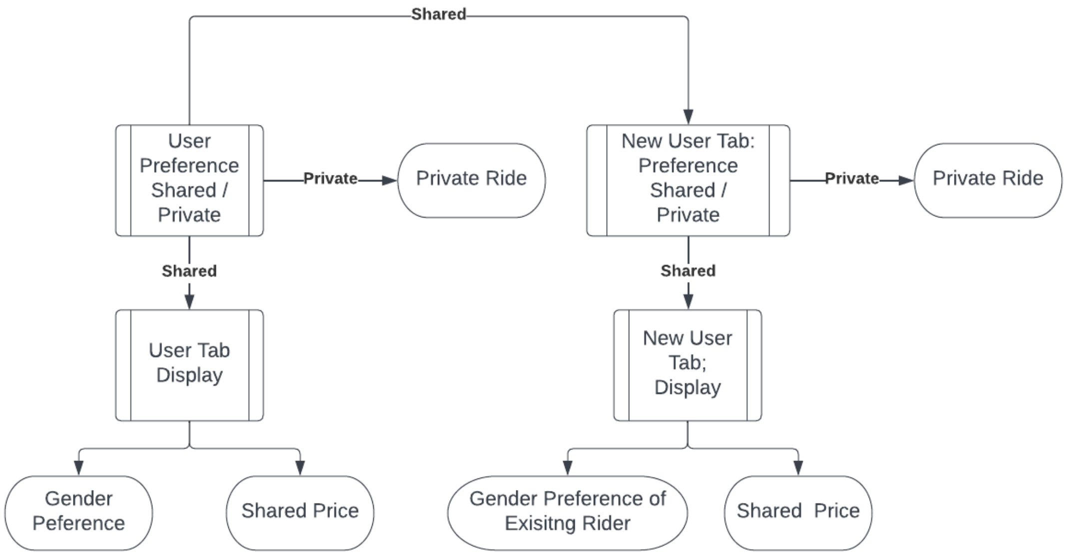

Figure 6 Flow Chart for Sharing option with gender preference for the rider

A suggested framework on the basis of research outcomes using Blockchain and AI

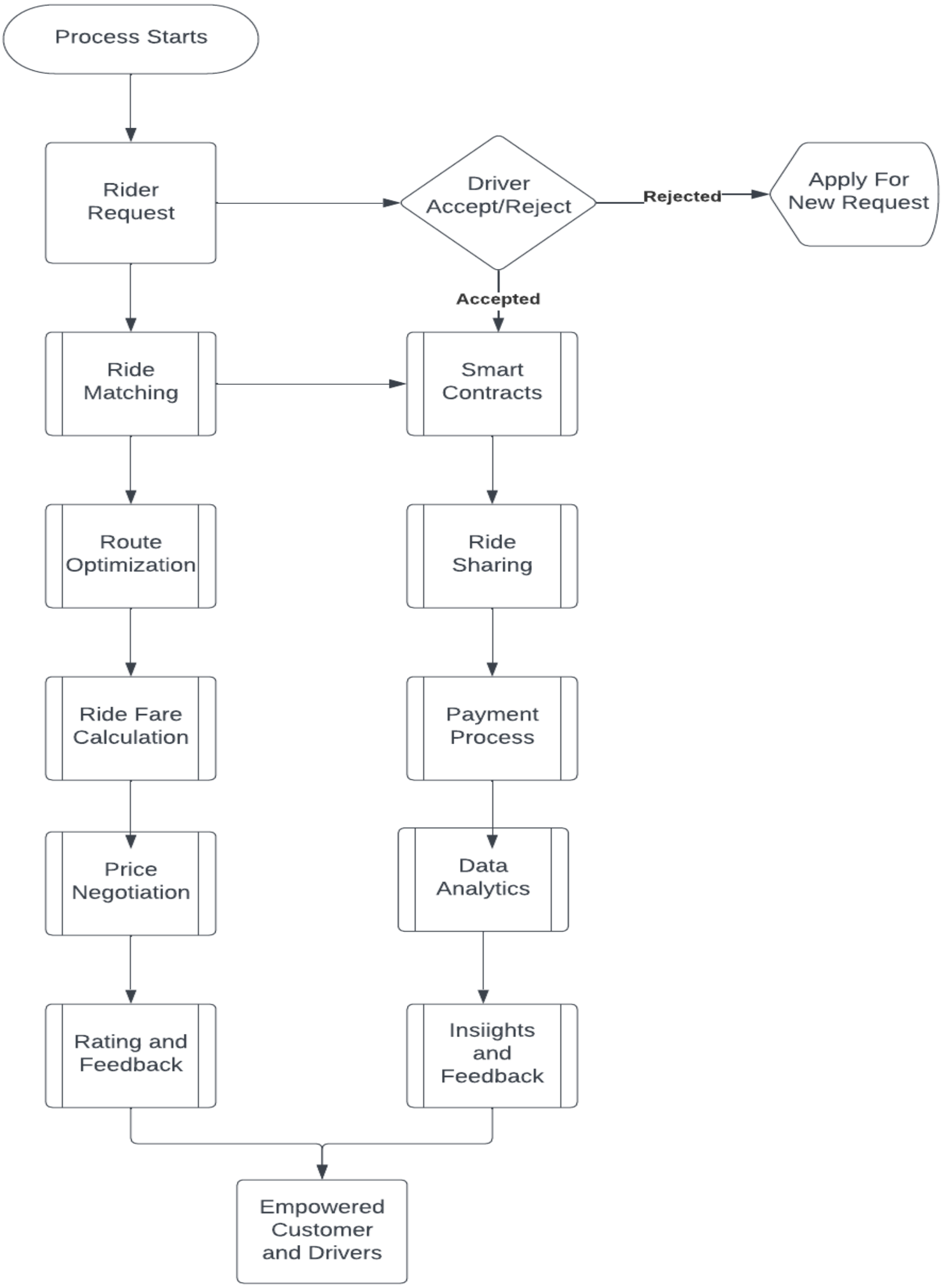

Figure 7 Suggested framework on the basis of research outcomes using Blockchain and AI

1. Rider Request and Driver Acceptance/Rejection:

- The process begins with a rider requesting a ride and drivers receiving these requests.

- Drivers have the option to accept or reject the ride based on their availability and preferences.

2. Ride Matching and Smart Contract:

- The ride request is matched with an available driver using AI algorithms that consider factors such as proximity, availability, and driver ratings.

- A smart contract is created on the blockchain to record the ride details, including the driver, rider, and agreed-upon terms.

3. Route Optimization:

- AI algorithms analyse various parameters such as traffic conditions, distance, and estimated travel time to optimize the route.

- The optimized route is determined based on real-time data, ensuring efficient and timely rides.

4. Ride Sharing:

- AI algorithms identify potential ride-sharing opportunities where multiple riders are heading in the same direction.

- The system suggests ride-sharing options to riders and drivers, enabling them to share the ride and split the fare.

5. Ride Fare Calculation:

- The ride fare is calculated based on factors such as distance, time, surge pricing (if applicable), and the number of shared riders.

- The fare calculation is transparent and determined using predefined algorithms recorded on the blockchain.

6. Price Negotiation:

Ai algorithms will quote the base price for both raider and driver, the price negotiation window will be available for the driver as well as to the raider, once the negotiation is done ride will be confirmed.

7. Payment Process:

- Blockchain technology facilitates secure and transparent payment processing.

- The smart contract automatically triggers the payment process upon ride completion, ensuring fair compensation for drivers and accurate charges for riders.

8. Rating and Feedback:

- After the ride, both riders and drivers have the opportunity to provide ratings and feedback on their experience.

- The ratings and feedback help maintain service quality and provide valuable information for future ride matching.

9. Data Analysis and Insights:

- AI algorithms analyse the data collected from ratings, feedback, ride patterns, and user preferences.   - Insights are generated, including market trends, customer behaviour, driver performance, and demand-supply dynamics.

10 Empowering Drivers and Riders:

With the help of AI Algorithms and Blockchain both the rider and the driver will be benefited as:

- Drivers and riders receive access to information and tools that empower them to make informed decisions.

- Drivers can optimize their earnings, choose efficient routes, and access real-time market insights.

- Riders benefit from transparent pricing, enhanced service quality, and personalized experiences. (From Figure 07)

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