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Integrating Artificial Intelligence with Blockchain for the Application of Training Autonomous Cars

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Abstract- **This paper describes the coalescence of Artificial Intelligence and Blockchain, the two booming technologies of the decade. These technologies are capable of a wide variety of applications both in our day to day life and in Industrial use. These technologies belong to different domains meaning both have their own unique architecture and purpose. We know that the autonomous cars are trained using machine learning algorithms, more specifically, they are trained through reinforcement learning. The process of learning can be tedious and time consuming as each and every car has to be trained before it can be out in the market. This problem of training each car can be overcome by Blockchain. Blockchain maintains a shared memory or logbook which stores the memory from all it's connected nodes. Therefore, you need to train only one car and the others can use its experience or training thereby greatly eliminating the time of training all the cars.**

Keywords: blockchain, self-driving, artificial intelligence, supervised learning

I. INTRODUCTION

There's no doubt that Artificial Intelligence and Blockchain are the two of the most trending technologies of recent times. Artificial Intelligence is helpful in automating our day to day to tasks. Integrating this technology with Blockchain will bring out a revolutionary advancement in the field of both Artificial intelligence and Blockchain. Here, Blockchain provides a convenient means of value embedded data exchange and AI puts the data into action without much human effort. [1]

Blockchain was popularized earlier by its usage in the cryptocurrency. Even though it started with cryptocurrency, its flexibility helped to integrate it in financial field and in banking thereby resulting in it's ever increasing popularity. The ways in which Blockchain can be integrated or incorporated into the business or technology field for potential applications still remains a mystery and needs to be explored.

Blockchain is simply a public electronic ledger which oversees the transactions occurring between all the nodes in the network. The activity in one node is noted into the ledger and automatically all other nodes store an identical copy of the ledger [1]. This decentralized nature of Blockchain makes it a powerful tool in information sharing as the knowledge of one node is available to all other nodes through the shared memory space.

II. PROBLEM STATEMENT

The purpose of this paper is to present a method to reduce the amount of taken to train the autonomous cars. This can be done by linking the autonomous cars that has to be trained in a blockchain network. The novel approach or the existing method is, a car has to be trained until it can drive safely without any accidents. This process, as it seems, is a cumbersome task since the car has to learn to drive as safely as a human does. This is the case for only one car. Imagine the case where hundreds or thousands of cars being manufactured in a bulk and training each of them individually until they become ready to drive safely on roads. All these cars have to be individually trained on the same training algorithms again and again.

In this paper we propose a technique where a single car in the blockchain is trained using AI algorithms and this experience or data is visible to all other cars in the network. In this way the need to train each car is eliminated. This greatly reduces the resources and human efforts thereby increasing the training speed.

III. LITERATURE SURVEY

Our proposed method involves technologies of two different domains so the literature survey is also a thorough research on these two domains. One research domain describes the techniques which are being implemented to train the autonomous cars and different ideas that are being used to further improve the efficiency while the other research domain involves the various ways in which blockchain can be applied and the case studies where it is used to simplify an otherwise difficult task.

In this paper, Pinyaphat Tasatanattakool, Chian Techapanupreeda [2] "Blockchain: Challenges and Applications", the various applications of Blockchain technology are discussed. The paper mainly stresses on how the blockchain is often used interchangeably with Bitcoin. Although Bitcoin uses Blockchain technology, it's only one of the many applications of it.

Shuai Wang, Jing Wang, Xiao Wang, Tianyu Qiu [3] in the paper "Blockchain Powered Parallel Healthcare Systems Based on the ACP approach" describes a method on how blockchain can be used to share data in a hospital management system with a decentralized log book which keeps track of all the activities taking place in the hospital.

Rahul A. R. [4] in the paper "AI in Blockchain Technology: The possibilities of integrating AI with Blockchain": proposes the various possibilities that can be brought out in our everyday life if these two domains are integrated.

A thorough research and analysis on a number of journals and research papers suggested that reinforcement learning with deep neural networks are being implemented to train the autonomous cars. The current approach still has a wide scope for development as the domain of AI is relatively new and so is the existence of autonomous cars.

IV. EXISTING METHOD

- Existing approach involves the training of each autonomous car separately until they are ready to drive on road without any accidents.
- Highly precise deep learning techniques are implemented to automate the process of learning.
- Reinforcement learning helps the car to perceive its surroundings and respond accordingly.
- The main drawback of this approach is that each car has to be trained separately one by one which requires lots of resources and human effort.
- The number of times the training process has to be implemented is equal to the number of self-driving cars produced.
- This is a tedious process from an industrial point of view as the production is in bulk (some hundreds or even thousands) and training of such number of cars separately costs large resources and time.

Due to the above reasons, there is a need to simplify the training process making it more efficient and faster.

V. PROPOSED METHOD

Our proposed method simplifies the training procedure of autonomous cars where a bulk of cars are trained simultaneously while training only one car instead of all of them separately.

This is possible by integrating the Artificial intelligence and Blockchain in the proposed system. The architecture of Blockchain provides a public ledger which is used as a shared memory space in the network. All the activities and transactions occurring in the nodes of the network are stored in the ledger. The transactions of one node are visible to all the nodes in the blockchain network. This decentralized memory space is the key element to the solution for the above stated problem. This system helps us to train a bulk of cars and distributing that information to the other cars in the network through the block chain network.

A. How Blockchain Technology Works?

Wikipedia defines blockchain as [7] "...a decentralized and distributed digital ledger that is used to record transactions across many computers so that the record cannot be altered retroactively without the alteration of all subsequent blocks and the collusion of the network". The public ledger is a shared memory that keeps track of all the activities occurring in the blockchain network. They are

storied in the form of entries. This is a helpful feature for the purpose of data sharing.

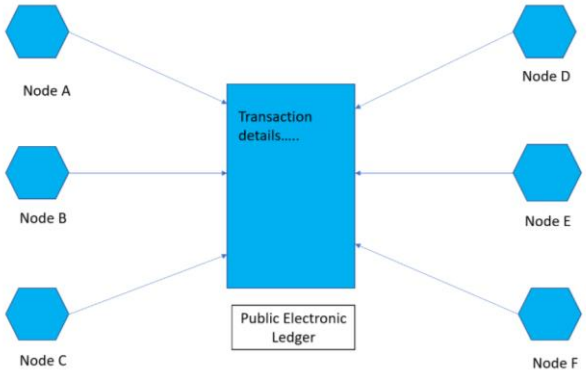

Figure 1: Concept of Public Ledger

The figure 1 shows a Blockchain network. All the activities are recorded in the public ledger and is visible to all the nodes of the network. Any change occurring in one of the nodes is automatically updated in the all the other nodes of the network.

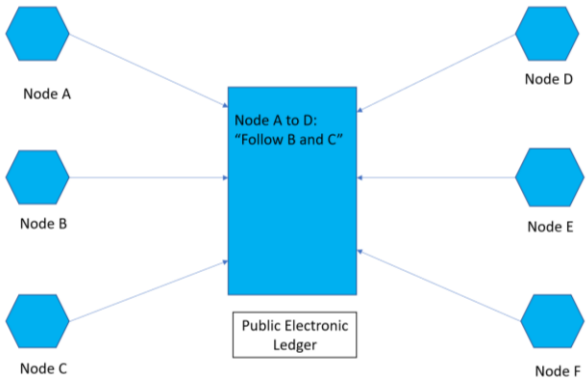

Figure 2: Storing Transactions

The figure 2, shows the event where node A wants to send a message "Follow B and C" to node D. The above transaction gets updates in not only in the Node D but also in all the other nodes of the network as they share a public ledger. Thus, the transaction is available to all the nodes therefore achieving data sharing. This is the key feature of our proposed method.

B. Using Blockchain to train Autonomous Cars

In our proposed system, we create a block chain network with a large number of autonomous cars. Then we train any one of these cars and since all the cars share a copy of the shared ledger, all of the cars can learn from the experience of one car. For instance, assume that you have to train the car to stop at red light. For this, all the cars are first put in a blockchain network. Then you train one car stating "stop if redLight==yes else you'll run into traffic". This trained car then updates this knowledge in its ledger which is automatically shared to all the other cars' ledger in the network thus training all the cars in the network with only one training procedure.

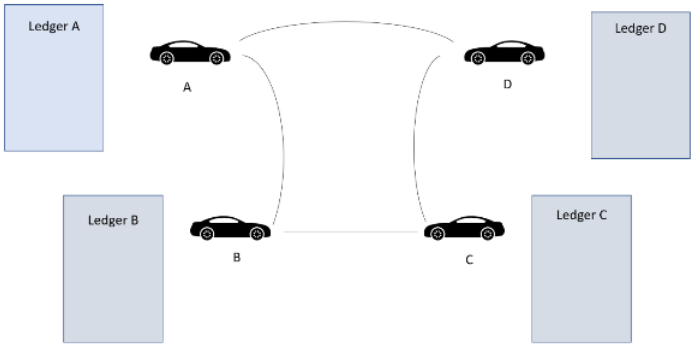

Figure 3: Autonomous cars connected in a Blockchain Network

The figure 3 shows four cars connected in a blockchain. Each car is provided with a copy of the shared memory space (ledger).

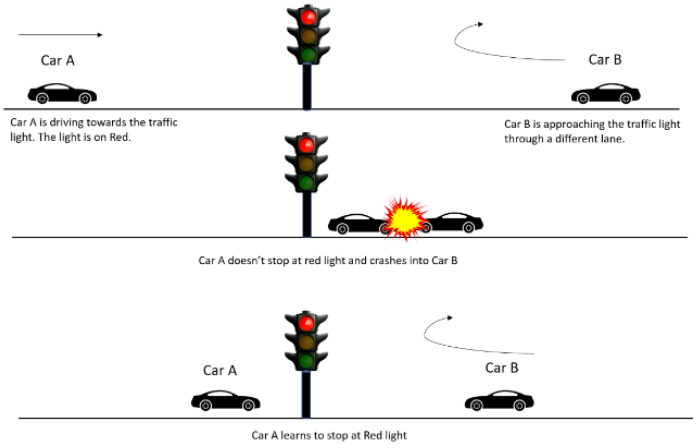

Figure 4: Training a car to stop at Red light

Figure 4 shows the training of a car to stop at red light. During this training, the car learns to stop whenever the red light is 'ON'. The training is implemented using various deep learning algorithms. Once the car has learnt this, the knowledge is stored in its ledger.

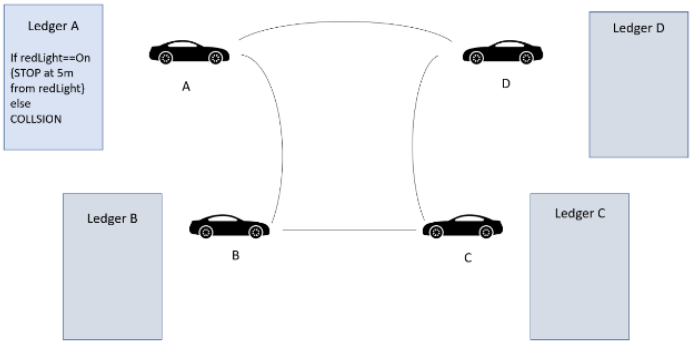

Figure 5: Car A updates it's knowledge into the ledger

Figure 5 shows that the car has learnt from the training that "if redLight STOP at 5m from redLight else COLLISION".

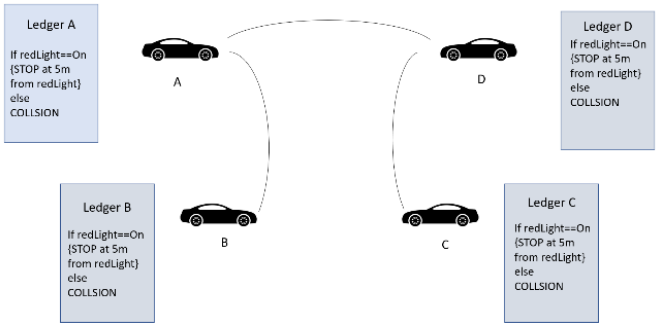

Figure 6: Information sharing on all other ledgers of the blockchain

Figure 6 shows that the transaction occurring in ledger A is automatically copied to all other ledgers of the network. Now all the cars have the knowledge of the trained car in their ledgers. We can see that only car 'A' was being trained and all of the other cars in the network shared this information and got trained simultaneously thus eliminating the need for individual training. In this way we can achieve faster training of autonomous cars irrespective of their large number.

C. Achieving modularity in the training process

Our proposed system not only decreases the number of training procedures but also opens a scope for modularity of the process making it more efficient and flexible. As all the cars use a shared memory, each one of them can be used for a different task simultaneously and all of them can learn a different task from each other. If one car is trained to stop at red light the other can be used to apply brakes when it sees a wall or how to respond when it sees a moving vehicle. This feature opens another wide set of possibilities all the while reducing the complexity.

The proposed system paves way to an intelligent intersystem communication without much of human involvement. It is more like a group of intelligent cars talking to each other, sharing their piece of information with each other.

VI. CONCLUSION

Since a large number of cars are learning simultaneously through the training of one, the training time and complexity are greatly reduced. The complexity is reduced from n to 1 where n is the total number of times the training is to be repeated.

TABLE 1. COMPARISON BETWEEN EXISTING AND PROPOSED SYSTEM

Parameters	Existing Method	Proposed Method
No. of cars to be trained	250	250
No. of times the training has to be repeated	250	1
Relative Complexity	N	1

The proposed system is better as it:

- eliminates the need to train each and every car individually.
- provides a platform for a huge number of cars to interact and share information.
- significantly reduce the amount of human effort, money and time.
- provides the scope for modularity in the training process.

Thus, the learning process of autonomous cars is greatly enhanced by integrating blockchain features into the process.

VII. FUTURE SCOPES

We have proposed the integration of blockchain technology and artificial intelligence for the purpose of training autonomous cars. In the future the research would be focused on integrating the training algorithms in the blockchain network to physically implement the proposed system. Further research would also be carried to find out the extent

to which modularity of this system can be achieved making the training process easier to implement and flexible.

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