How Rumors Can Be Slowed Down by Using Consensus Mechanism

Jiacheng Guo
Department of Electrical and Computer
Engineering
New York University
jg5315@nyu.edu

Abstract— Rumors has always been a rough topic since ancient time. With the development of social media, people like to post their thought and life details on the internet. But that cost misinformation on some topics. The outbreak of COVID-19 is an example. Such spread of misinformation is masking healthy behaviors and promoting erroneous practices that increase the spread of the virus. And the development of Blockchain technology also provides a new way to solve this problem to some extent. An experiment is designed to prove the feasibility of implementing blockchain technology in this problem. And in conclusion, the consensus mechanism will help to prevent the spreading of rumors.

Keywords—Rumors, Consensus Mechanism

I. INTRODUCTION

Nowadays, people spend plenty of time on smart devices. There are more channels for people to get news besides the news report and the official document. Social media give people a larger platform to share their lives and exchange information. And Twitter, Facebook, Weibo, and all other social media platforms have become a place where the message could be delivered in a short time. More information means there will be more misinformation, especially when there is something bad happens. These messages will rapidly propagate to many people and might share the fear and create turbulence in society. So it becomes crucial to delay the misinformation and get time for AI or mankind to handle these messages.

For many years people focused on both modeling techniques and the avoidance mechanisms of rumor spreading. And most of the studies cannot find a generally effective approach to the dissemination of rumors[1]. And coming up with new techniques gives researchers more inspiration on implementing them in different projects. Blockchain is one of the technologies implemented to prevention on rumors from spreading. It is well-known by Bitcoin, which was proposed to enable the decentralized digital currency [2]. Blockchains are tamper-evident and tamper-resistant digital ledgers implemented in a distributed fashion and usually without a central authority[3]. The concept of blockchain is important. But the core algorithm is the consensus mechanism.

In this paper, we will design an experiment by using the concept of the core algorithm — consensus mechanism — to implement into rumor detection and prevention. This experiment will help to prove the capability of blockchain technology in this area. The organization of this paper is as follows: Section II will introduce basic concepts of related works; Section III will describe the design of the experiment; Section IV will explain the experiment result; Section V will conclude and discuss possible further work and improvement.

II. RESEARCH RELATED

Past research gives several approaches to the modeling of rumor spreading and how to control the damage. As for rumors spreading, they can spread as a graph or they can spread like some stochastic processes. And in some latest studies, rumor spreading can be considered similar to the spreading of a virus or epidemic disease.[1] The SIR (Susceptible, Infected, and Recovered) epidemiological model can be modified to suit the rumor-spreading model.[4] In this model, the spreading process is classified as susceptible, infected, and recovered. It is a good simulation. Because in practice, humans have immune systems against viruses and common sense to distinguish rumors, a human can get infected if they don't have any antibodies and humans also can be misled by some misinformation if they don't know a specific area. People will be cured after infection, and they also can be corrected by learning from refuting the rumor.

But from the aspect of refuting a rumor, that will be much more difficult than curing people or getting antibodies from the immune system themselves. Because people won't realize it is a rumor if they don't intend to learn more about the information. So the recovering part can be simplified or removed considering the reason above. Furthermore, based on the work that will be done in this research, the model can be simplified in one more step. People can get influenza again and again, but they can be deceived by the same rumor with a pretty low probability. So the "reinfection" of the same rumor won't be considered in this project. So slowing down the spreading of rumors can be considered as slowing down the pace from Susceptible to Infectious.

This project will try to use the consensus mechanisms of blockchain to verify whether adding an autonomous filter will prevent the large spreading of rumors and discuss the rationality of picking one of them. So the structure of Blockchain or how to use it is not important. The term consensus mechanism refers to the entire stack of protocols, incentives, and ideas that allow a network of nodes to agree on the state of a blockchain. [5] There is plenty kind of consensus mechanisms for now. Bitcoin uses Proof-of-Work (PoW). Other consensus mechanisms are Proof-of-Stake (PoS), Proof-of-Activity, Proof-of-Authority, Proof-of-History, Proof-of-Importance and etc.

Due to the characteristic application of this project, the most proper one for slowing down rumor's spreading is Proof-of-Stake. It is a sustainable, energy-efficient consensus protocol.

III. PROPOSED METHODLOGY

In this section, we hypothesize the consensus mechanism can have a better performance than voting for nothing.

The experiment is conducted by using Python programming language. It makes the implementation easier. And many packages can help us to construct the code easily.

A. Rumor Generation

First of all, there should be many messages that need to be identified. Here we use 100 messages. And due to the characteristic of the experiment, detailed information is not important. So we generate messages directly showing rumors and truth. The generated message is indicated by labels -1 and 1. -1 means rumors and 1 means true.

B. User Decision

Then the users need to give their opinions on each message. People are diverse and they are familiar with different fields. They can give a more accurate response to agree or disagree with the information if they are familiar with the topic. But the proportion of topics that they know is limited. The majority of topics cannot be identified easily by them. So we assume that the decision user made for the topic is obeying Gaussian distribution. Most decisions they make regarding the topics are vague, with only a small number of topics can be confirmed. So the decisions made by users are generated by using a random gaussian function embedded in the Numpy package.

The main factors of gaussian distribution are mean μ and variance $\sigma 2$. μ is uniformly randomly distributed between 0 and 1, which indicates the random areas users are familiar with. And we select 0.6 for $\sigma 2$. It is based on multiple trials and the distribution in Fig. 1 below.

The most important is voting, the consensus mechanism we choose in this experiment is Proof-of-Stake. In this experiment, 10 users vote to have a consensus on whether the message is a rumor or not. So we can simply sum the users' decisions to imply group decisions.

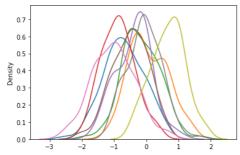


Fig. 1 Gaussian Distribution with Random Mean and 0.6 variance

After user generating the prediction on different messages, we set a threshold 0.7. User's prediction above 0.7 can be same as labels. Rest value generated in gaussian distribution will assigned into sigmoid function and then classify them into -1 and 1 based on the sigmoid function output.

IV. EMPIRICAL EVIDENCE

A confusion matrix, which is also known as an error matrix and is mostly used in Machine Learning Problems and especially in statistical classification. This table can evaluate the performance when we use a consensus mechanism to limit the rumors spreading. By comparing the matrix with and without the consensus mechanism in Table I, there is an obvious improvement to limit the rumors. The precision to identify rumor with consensus mechanism is 1.0 in this sample case, and recall is 0.97.

Table I. Confusion Matrix

Without Consensus Mechanism			
	Predict Positive	Predict Negative	
Label Positive	22	29	51
Label Negative	19	30	49
	41	59	F1-score: 0.55
With Consensus Mechanism			
	Predict Positive	Predict Negative	
Label Positive	52	0	52
Label Negative	1	47	48
	53	47	F1-score: 0.98

V. CONCLUSION AND FURTHER WORK

In the previous section, we have proved that the consensus mechanism of blockchain can have a good performance in preventing the spreading of rumors in a statistical method. So it is feasible for people to implement this mechanism in rumor prevention.

There will be some improvements to this experiment. For example, in reality, we cannot ask everyone to vote for a message, because that will cost lots of time and it has already spread. So the number of voting people should be limited. 3 or 4 well-known individuals might be a good choice. So the consensus mechanism might change to Proof-of-Stake and Proof-of-Authority. And implementing blockchain technology can be more practical than implementing a consensus mechanism. The SIR model also can be used for evaluating the performance of preventing rumor spreading.

REFERENCES

- Y. Chen, Q. Li, and H. Wang, "Towards Trusted Social Networks with Blockchain Technology," 2018, [Online]. Available: http://arxiv.org/abs/1801.02796.
- [2] E. Zaghloul, T. Li, M. W. Mutka, and J. Ren, "Bitcoin and Blockchain: Security and Privacy," IEEE Internet Things J., vol. 7, no. 10, pp. 10288–10313, 2020, doi: 10.1109/JIOT.2020.3004273.
- [3] D. Yaga, P. Mell, N. Roby, and K. Scarfone, "Blockchain Technology Overview," 2019, doi: 10.6028/NIST.IR.8202.
- [4] L. Zhao, H. Cui, X. Qiu, X. Wang, and J. Wang, "SIR rumor spreading model in the new media age," Phys. A Stat. Mech. its Appl., vol. 392, no. 4, pp. 995–1003, 2013, doi: 10.1016/j.physa.2012.09.030.
- [5] "Consensus mechanisms," ethereum.org. [Online]. Available: https://ethereum.org/en/developers/docs/consensus-mechanisms/. [Accessed: 09-Dec-2022].