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AI Blockchain Platform for Trusting News

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Abstract—An interdisciplinary effort is needed for solving the fake news crisis, because the solutions depend not only on AI, but also on social mechanisms. In this paper, we propose an AI blockchain platform to build a strong collaboration among AI blockchain researchers and news media to advance the research fighting against fake news. This platform will provide journalists with blockchain crowd-sourced and AI validated factual data on emerging news. This platform will gather blockchain traced data and AI tools that can provide pointers to the original data sources, news propagation path, AI analyzed experts to consult on a given topic. This will provide journalists with cheaper and reliable sources of information in the Internet social media age. So that factual-sourced reporting can outpace the spread of fake news on social media which will encourage factual news sources as a way to value and promote truth for society. The technical contributions of this paper are (1) mechanism building the factual news database, (2) mechanism generating the news blockchain supply chain graph, and (3) AI blockchain based crowd sourcing fake news ranking mechanisms (4) AI blockchain platform for trusting news ecosystem. (5) reviewing the state of fake news research from the technology and social aspects, and providing list of key research issues and technical challenges.

Keywords—*blockchain; blockchain crowd source fake news ranking; news blockchain supply chain graph; fake news; artificial intelligence; deep learning; distributed and parallel computing*

I. INTRODUCTION

The fast pace information traveling in social media raises concerns about the vulnerability of democratic societies to fake news, and further, the limited ability to contain it. An abundance of conflicted information sources from social media leads individuals to rely heavily on social cues in order to determine the credibility of information and to shape their beliefs. Benkler et al., 2017 [1] has suggested that the tendency of people to follow like-minded people leads to the creation of false shared reality and the forming consensus within isolated social groups. As a result, fake news can then be treated as fact which can exacerbate polarization and is very dangerous to society. In its 2013 report, the World Economic Forum pointed out that in high-tension social situations, the fake news dissemination of social media will cause great harm to national security [2].

Assessing the credibility of information on social media is very challenging due to the proliferation of fake news accompany with unreliable and biased social cues. Social media platforms provide a near perfect news propagation channels to anyone who can attract followers. This enables small numbers of individuals to distribute large volumes of fake news among unsuspecting users. A news press editor receiving a news over the social media has no opportunity to test its authenticity as he normally could/would in the case of a local report.

Fake news is widely defined as news articles that contain false information and/or created with deceptive intention to mislead readers [3]. Macquarie dictionary [9] name “Fake news” the word of the year 2016 and year 2018 due to the political divisions caused during and after the 2016 U.S. Presidential election [8]. The definition of fake news is becoming more blurred and much complicated due to the human perception and social behavior with the news in the digital age. Oxford Dictionaries has declared “post-truth” to be its international word of the year. Defined by the dictionary as an adjective “relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief” [10]. In the past and still in some regions today, only the governments and mainstream institutions have the power to manipulate news, manipulate public opinion, and advocate what is the "truth” [3]. Although the creation of the World Wide Web once shocked this old forces with the power of “truth" communication [4]; it is not until the rapid popularization of social media, this forces have been greatly weakened.

In this paper, we will focus on the “fact” and not directly on the “truth” which is somehow related to the emotion and personal belief in the age of “post-truth”. In our definition, “fact” is that things actually happened, and “truth” is that people think or believe that things happened. Our approach is to hopefully bring the consensus eventually of the “truth” to people mind by certifying and broadcasting “fact”.

The three interactive functions of social media - tracking, sharing and creating - empower users to keep abreast of

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popular information, to repost any news (e.g., special reports, news videos, latest research, etc.), to express subjectively determined facts, and to even host the live broadcast. Through the tracking, sharing and creation interaction among a large user base, social media has been able to shape the major civic activities. In many political elections (for example, the 2016 US presidential election, the 2017 French presidential election, and the recent Brazilian presidential election), it is found that social media platforms are full of fake news propagation using social robots, propaganda accounts with politically polarized positions, and fabricated news reports [5-7].

As technology advances and online community behavior changes, most people today have more and more ways to get news, such as social community forums, social communication software, and online media. These communication tools may be the hotbed of fake news. Some news media may grab articles directly from social media, but do not verify, and report it. Some news media are taking the pieces of information out of context in attempt to capture the reader's eyes. Some individuals might be subject to specific requirements to directly create false messages, which are then distributed from untraceable IP addresses. Everyone uses the communication software to spread the fake news, one pass ten, ten pass hundred, quickly fake news flooding and rogue. According to the statistical results reported by the researchers in Stanford University, 72.3% of the fake news is to modify the news originated from the standard factual news, that is, to envelop the content that you want to express into the prepared standard factual news [11-13]. Most of these news is conspiracy for certain purposes, such as political manipulation, so the content of the news is often easy to carry personal emotions and intentions, using the words of negative emotions.

AI technology, called deepfakes, can be easily used to create fake news and hoax. Stanford researchers [14] presented a novel approach for real-time facial reenactment of a monocular target video sequence (e.g., Youtube video). The source sequence is also a monocular video stream, captured live with a commodity webcam. The technology allows to animate the facial expressions of the target video by a source actor and re-render the manipulated output video in a photo-realistic fashion. It makes use of the deep learning technology to reconstruct the shape identity of the target actor by prerecorded training frames sequence. In January 2018, a desktop application called FakeApp [15-17]] was launched. The app allows users to easily create and share videos where the faces had been swapped. The app uses an artificial neural network and the power of the graphics processor and three to four gigabytes of storage space to generate the fake video. The program needs a lot of video sequences and images from the person in order to train the deep learning algorithm. The software uses the AI-Framework TensorFlow [18] of Google. In August 2018, researchers at University of California, Berkeley published a paper [19] introducing a fake dancing app that can replace an immature individual with an expert dancer using AI.

Deepfakes can combine and superimpose existing images and videos onto source images or videos has been used to create convincing but inauthentic content. The fake video created by deepfake shows a person doing or saying something never occurred in reality so vividly that it can no longer be differentiated whether the content is genuine or not. For examples, Deepfakes have been used to misrepresent well-known politicians [20] or chatrooms. For examples, the face of the Argentine President [21] was replaced by the face of Adolf Hitler [22], and Angela Merkel's face was replaced with Donald Trump's [23]. In April 2018, a deepfake using Barack Obama as a public service announcement about the danger of deepfakes [24]. AI technology sets us into a crisis in which we cannot determine whether what we saw in media is factual.

About two-thirds of American adults (68%) say they at least occasionally get news on social media, about the same share as at this time in 2017, according to a new Pew Research Center survey [25]. Many of these consumers (57%) are skeptical and say they expect the news they see on social media to be largely inaccurate. Even many (42%) among those who say they prefer to get their news from social media, say that they expect the news they see to largely be inaccurate. Still, most social media news consumers say getting news this way has made little difference in their understanding of current events, and more say it has helped (36%) than confused (15%) them.

In response to pressure from public opinion, Facebook proposed AI technology, in conjunction with the third party fact checking agency, to mark the content of suspected fake news. If a suspicious content is marked the chances of recurring in the future will be reduced by 80% [26, 27]. However, the challenge of AI technology is that the training materials are still insufficient [28]. West Virginia University USA build a fake news detection system [29]. Their approach utilizes a machine learning system to analyze text and generate a score that represents each article's likeliness that it is fake news. This score is accompanied by a breakdown that explains the rating and provides transparency. Google is struggling with fake news [30] by introducing fact-checking in news.google.com and Google News in the Weather app on phones and tablets. Duke University Reporter Lab reported Duke University's Bass Connections project [31] students pursue first-ever app providing 'pop-up' fact-checking in real time automatically. It also indicated that there are currently about 150 active fact check sites [32], a number that has more than tripled in the past four years. For example, Fake News Challenge [33] starts with a stance detection process that examines the perspective of news articles and compares them with other reports. It can detect if the two headlines are consistent or contradictory.

Facebook and Twitter have made numerous efforts in algorithmic, design, and policy changes to decrease the circulation of fake news. These efforts have suffered limited

success due to the insufficient of training data, hard to define what is a fake news, and the low cost of recreating the information. It is unlikely to have all the fake news checked and regulated. Moreover, readers are also unable to verify which information has been verified and to be factual. However, evidences show the volume of false stories circulated on such media remains high [1,2, 8-10]. Moreover, rely solely on a few social medial companies or governments for the news checking will have severe consequences for the freedom of speech. Nowadays, publishers are constantly adjusting their content and business models, trying to rely on the traffic that Facebook brings to them. It will have huge influence on the press and news media if Facebook has become a news inspector.

Civil corporation [34] built a blockchain platform as a community-owned journalism network based on transparency and trust. It believes that one way to avoid the bias position of the press and restore alignment between reporters and readers is to let readers buy the right to "vote" on whether a newsroom represents fair, quality journalism or not. The only way newsrooms can be challenged is if a majority of involved readers agree. The currency used in this process: Civil's cryptocurrency which will be based on the Ethereum blockchain.

This paper proposes to address the problem with a different solution angle. To detect and prevent the fake news and deep fakes, we should not put the factual news validation responsibility into a single (or limited numbers of business organizations) and not in the hands of government. Fake news can be created from AI technology, using AI technology itself is helpful to fight against, but is far from sufficient. Since the problem is resulting from the missed use of social media and its fast pace propagation among general population, the better solution should leverage the common supervising strength of society. This paper proposes an innovative AI blockchain platform which closely integrate AI and blockchain technology that can be employed to form a social media platform (more like Facebook than press paper) for journalists and general population to publish trusting news which can be validated its truthfulness by the entire society.

Resolving the fake news crisis should be an interdisciplinary effort because it depends not only on AI but also on social and political involvement. “the problem is not technical one, but rather one to be solved by trust in information and journalism,” said AI researcher Alex Champandard [35]. The ultimate goal of our project is to create a trustworthy news ecosystem through building a trusting news platform by integrated AI and blockchain technologies. News rooms will be created on the AI blockchain platform. The truthfulness of all the contents in the news rooms will be ranked collectively by AI and blockchain crowd sourcing. News propagation path will be traced by AI and blockchain. The accountability and traceability of each news are provided which can prevent bias concerns that might be originated from traditional majority decided crowd sourcing mechanisms. AI blockchain platform creates a trusting news ecosystem which consists of news consumers, content creators, news fact checker, fake news detection AI code developers, and media publishers.

The technical contributions of this paper are (1) mechanism building the factual news database, (2) mechanism generating the news blockchain supply chain graph, and (3) AI blockchain based crowd sourcing fake news ranking mechanisms (4) AI blockchain platform for trusting news ecosystem. (5) reviewing the state of fake news research from the social aspects, and provide list of research issues and technical challenges.

This paper is organized as follow. A state of the fake news research is provided at section 2, followed by the description of the AI blockchain for trusting news at section 3, in which the rational of AI and blockchain in fighting against the fake news will be discussed. The AI blockchain system architecture will be described in section 4, in which a blockchain based trusting news ecosystem will be discussed. AI blockchain crowd sourcing fake news ranking mechanisms will be discussed in section 5, followed by modeling fake news propagation as blockchain data flow supply chain for ranking, traceability and accountability in section 6. Research issues and technical challenges will be provided at section 7, followed by a summary at section 8.

II. STATE OF THE FAKE NEWS RESEARCH

The research on the mechanisms fighting against fake news is just on its age of genesis. Nir Grinberg et.al., [36] of Northeastern University and Harvard University has indicted, after analyzing the Twister data generated during the 2016 US president election period, that most fake news comes from a handful but constantly changing of websites. The spread of fake news is driven substantially by bots and cyborgs (individuals who have given control of their accounts to apps). The concentration of fake news sources offers both a challenge for detection algorithms and a promise for more targeted interventions.

David Lazer (Northeastern University), Matthew Baum (Harvard University John F. Kennedy School), Nir Grinberg (Harvard jointly with Northeastern University), Lisa Friedland (Northeastern University), Kenneth Joseph (University at Buffalo), Will Hobbs(Cornell University), and Carolina Mattsson (Northeastern University) recently jointly published a report on Harvard University Shorenstein Center conference “on Combating Fake News: An Agenda for Research and Action” [37]. They had indicated that there are some possible pathways for reducing fake news, including: (1) indicating to users which news may be fake; (2) providing ideologically compatible sources to confirm news is fake; (3) detecting which news is generated by bots and cyborg accounts; and (4) identifying fake news sources and reducing sharing from those sources.

Craig Silverman (BuzzFeed News Media Editor) indicated that viral fake news generated more engagement on Facebook in 2017 than the previous year and provides a list of 50 of the biggest fake news hits on Facebook in 2017 [38]. Academics has research projects (Media Cloud, Volunteer Science, OpenSources) in providing multiple data sources of online activity both mobile and non-mobile [39-41].

Media Cloud [39] is a joint project of the Berkman Klein Center for Internet & Society at Harvard University and the Center for Civic Media at MIT. Media Cloud is an open source and open data platform. It makes use of crawlers to collect large amount of various media sources and build a media cloud database. It provides API allowing researchers to query the collected data and develop algorithms to answer complex social and news questions from the content of online media. Volunteer Science [40] is a project of the NULab for Texts, Maps, and Networks at Northeastern University. It is an online platform enabling anyone to participate in social science research, with subjects largely being recruited through paid advertising, word of mouth, social media, search, and Mechanical Turk. Volunteer Science advances the laboratory model in the social sciences by broadening the participant pool and taking advantage of information technologies for data collection.

OpenSources [41] is available for public users to assess the integrity and transparency of information on the internet to empower people to find reliable information online. It provides a continuously updated database of information sources for developers to fight against fake news. Each source in the database is maintained and analyzed by professionals. It categorizes and tags the Internet websites into Fake News, Satire, Extreme Bias, Conspiracy Theory, Rumor Mill, State News, Junk Science, Hate News, Clickbait, Proceed With Caution, Political, and Credible. Credible websites circulate news and information in a manner consistent with traditional and ethical practices in journalism. But even credible sources sometimes rely on clickbait-style headlines or occasionally make mistakes. No news organization is perfect, multiple news sources comparisons and digestion of a given information are always required. OpenSources domain topics experts make use these methods to evaluate the truthfulness of the website: (1) Title/domain analysis (If ".wordpress" ".com.co" appear in the title or any slight variation on a well-known website is usually a fake news website indicator), (2) About us analysis (Google every title/domain name/anyone listed in the "About Us" section to see if previously bad record reported), (3) Source analysis (verify details, facts, quotes, etc. with multiple sources which the website mention/link to), (4) Aesthetic Analysis. (many fake news sites utilize very bad style design), and (5) Social Media Analysis (Look up the website on Facebook, looking for clickbait and the headlines and social media descriptions).

NewsGuard [42] provides a browser plugin displays ratings next to links on search engines and social media feeds (Facebook, Twitter, Google, and Bing). A news website is rated green if its content they believe is accurate, otherwise, it is rated red. NewsGuard also assigns a blue icon to sites that primarily host user-generated content, an orange icon to humor or satire sites that mimic real news, and a grey icon indicates that a website has not yet been rated. NewsGuard trained journalists to assess news websites for credibility and transparency. Trained journalists and experienced editors are doing the rating the website based on (1) publishes false content, (2) gathers and presents information responsibly, (3) handles opinion responsibly, (4) avoids deceptive headlines, (5) discloses ownership**,** (6) labels advertising, (7) reveals conflicts of interest**,** (8) provides the names of content creators**.**

In this paper, we propose an AI blockchain platform to build a strong collaboration among researchers and news media to advance the research fighting against fake news. This platform will provide journalists with crowd-sourced and AI validated factual data on emerging news. This platform will gather blockchain traced data and AI tools that can provide pointers to the data sources, meaningful topic statistics, and lists of experts to consult on a given topic. This will provide journalists with cheaper and reliable sources of information in the Internet social media age. So that factual-sourced reporting can outpace the spread of misinformation on social media.

III. AI BLOCKCHAIN PLATFORM FOR TRUSTING NEWS

The blockchain [43-46] is essentially a trusted mechanism built in a distributed manner, with the aim of rebuilding the trust relationship of the entire society. The blockchain can transform traditional trust patterns between people into trust in machines. Currently, the value transfer channel is based on a high-cost model of intermediaries (for example, Facebook provides fake news verification as a third-party middleman), and with the blockchain, a low-cost secure and trust channel can be created. At the same time, the governance model of the whole society can also be transformed from the traditional information technology-assisted model to the rule-based legal model enforced by smart contract [47-52], and finally realize the cross-industry business and social data integration.

The blockchain technology has developed rapidly over the past few years, mainly due to the success of Bitcoin cryptocurrency applications. The blockchain technology used by Bitcoin can be improved and applied in many financial and non-financial fields [53-57]. The blockchain technology consists of cryptography, mathematics, and algorithmic models, combined with peer-to-peer network relationships, and uses a distributed consensus algorithm to solve the synchronization problem of traditional distributed databases. The transaction data will be packaged into the block and protected by strict cryptographic rules. Once the data in the block has been tampered with, it can be easily detected.

The blockchain provides users with their own defined trading contracts called smart contracts. Smart contracts are programming languages that are applied to blockchain technology. Smart contracts are used to manage the access and use of data. Smart contracts can facilitate consent to the management process and aggregate data while protecting the privacy of the data. The irreversible modification and transparency of blockchain technology can reduce duplication of work and error rates, improve efficiency, and avoid human data tampering.

This paper proposes an innovative artificial intelligent blockchain mechanism which closely integrate AI and blockchain technology that can be employed to form a social media platform (more like Facebook than press paper) for journalism and general population to publish trusting news which can be validated its truthfulness by domain topic experts and general population of entire society.

Applying the technology of the AI blockchain to trusted news can solve many of the problems discussed above, including (1) the responsibility of verifying the factual of the news should not be placed in the hands of a single or a limited number of commercial organizations or even governments. Instead, the general population has the tools and platform to verify the authenticity of the news. (2) AI is tightly integrated with the blockchain, using AI to detect and prevent fake news and Deepfakes. AI can have the same information as humans, but it can cope with a lot of news and decipher its effectiveness without getting tired. People tend to have political or emotional tendencies, but AI does not. It is only used to solve problems that are trained to fight. (3) provide a trust platform for journalism and general population to publish trusting news by leveraging blockchain trust property.

IV. System Architecture

AI blockchain for trusting news platform consists of these technical components: (1) Blockchain based crowd sourcing fake news ranking component to rank all the news posted in the platform which uses AI algorithms as well as ecosystem models to provide incentive mechanisms for the general public working as trusting news validators; (2) Fake multimedia detection component which uses AI algorithms to detect the tampering of multimedia materials; (3) Fake text detection component which uses AI algorithms to detect the fake news text from the social and humanistic perspective; and (4) Mechanisms and system design research component to integrate AI and blockchain technologies for supporting the scalability of AI's smart contracts, trusting news validator, etc. The AI blockchain for trusting news platform is shown in Figure 1. Mechanisms and system design research component to integrate AI and blockchain technologies requires innovative mechanisms to transform blockchain into a distributed and parallel system which had been published in ICDCS 2018 [54] by the authors of this paper.

The goal is to build an AI blockchain platform which can leverage AI and blockchain accountable and traceable crowd sourcing mechanism to rank and detect fake news. The system we propose is like Facebook, but it uses the collective crowd sourcing trust checking mechanism to provide factual news. Within the blockchain platform, each record is signed and easy to track. Can't deny that he/she has created this news. The record is immutable and any changes are easy to detect. People create fake news can be easily identified and located for accountability. As a result, the current very difficult issues of fake news tractability and accountability due to changing IP addresses and generating the news from the servers abroad can be mitigated. AI blockchain technology creates accountability and traceability which can prevent bias concerns that might be originated from traditional majority decided crowd sourcing mechanisms.

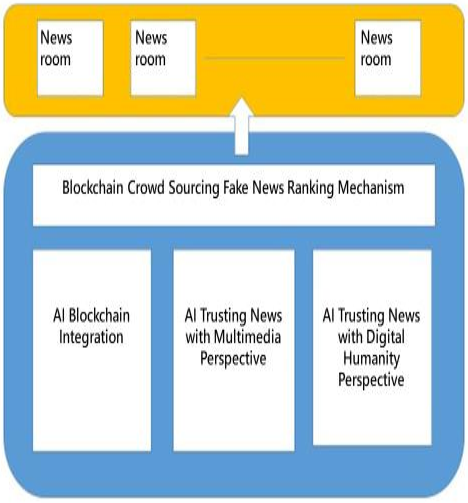

Figure 1. AI blockchain for trusting news system architecture.

V. AI blockchain Crowd Sourcing Fake News Ranking Mechanisms as well as Ecosystem

News rooms are created on the AI blockchain platform. The content of the news rooms can either refer to other news/contents of external published news media or social media. Identification verified persons can also create contents and make comments on the posted news in the news rooms. The truthfulness of all the contents in the news rooms will be ranked collectively by AI algorithms and blockchain crowd sourcing. News propagation path will be traced by AI blockchain platform. Fact checking inspectors and artificial intelligence program can use available and trusted tools to detect fake news, adding some weight to establish a crowd sourcing trust check mechanism. AI blockchain platform create a trusting news ecosystem which consists of news consumers, content creators, news fact checker, fake news detection AI code developers, and media publishers as illustrated in Figure 2.

In general, the news platform is built according to the needs of the news production process which consists of editing and distribution platforms. News production process: (1) planning (2) survey (3) setting interview topics (4) data collection (5) on-site interview (6) writing (7) review (8) publication. The editing platform should refer to the stage after the reporter completes the on-site interview, from the compilation of the internal materials to the completion of the writing. Mainly based on the facts, the message is conveyed to the public in easy-to-understand words or language. Distribution platform refer to the publication actions consisting the verification of the message after the editing process.

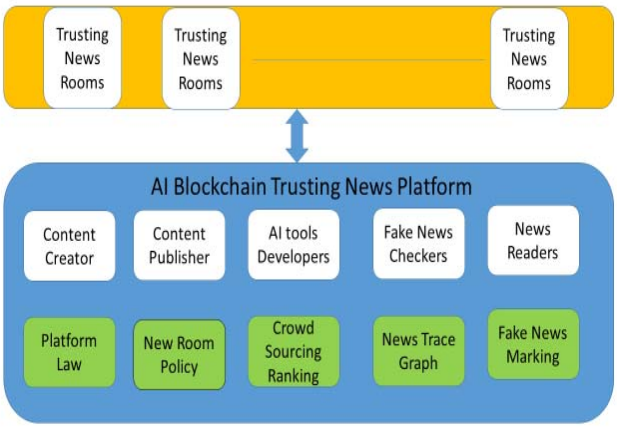

Figure 2. AI blockchain for trusting news ecosystem.

The AI Blockchain trusting news platform does provide both a distribution platform and an editing platform. The ranking mechanism is also installed on both the distribution platform and the editing platform. Each news publisher (government, news agency, journalist or individual) can apply to set up a distribution platform. The AI Blockchain trusting news platform provides a mechanism for creating a distribution platform. There will be smart contracts for authentication and crowd sourcing review process to allow for the establishment of a trusted distribution platform in the blockchain platform.

Once the distribution platform is built on the AI blockchain platform, the distribution platform can create a set of News Rooms, each of which has a theme, and each distribution platform will enable journalists who pass their authentication to create articles in News Rooms (editing platform). After the editing process is completed, the author of the article can make the article publicly available for readers to view. Depending on the policies of the individual distribution platform. All articles in the newsroom will be evaluated and ranked by crowd sourcing trust check mechanisms within the AI blockchain platform.

As mentioned above, there are two layers of trust checking mechanisms, one is the creation of the publishing platform, and the other is the editing platform for all articles, each of which is hosted by the publishing platform and managed by various smart contracts. The distribution platform will be responsible for the trust of its content creators. The editing platform will be responsible for the trust of its content. This entrusted responsibility of design can find an intermediate position between freedom of speech and prevention of social security issues caused by false news. On the one hand, legitimate people can create a newsroom where they can express their opinions without the influence of commercial or political positions. (For example, advertising impact on Facebook or Google or other news organizations or current social media). Therefore, everyone's freedom of speech can be maintained. On the other hand, the creation of the distribution platform and the articles published on the editing platform are strictly evaluated by the establishment of a crowd sourcing trust checking mechanism managed by smart contracts. Therefore, it is possible to effectively prevent fake news.

In order to establish high standards of high quality content, all participants in the AI blockchain platform agree to abide by the AI Blockchain Platform Management Act, which is a self-management code of conduct. This will not only help maintain high quality filters, but will also introduce economic incentives to reward individuals for flagging behaviors that do not meet the standards of the AI Blockchain Platform Management Act. As the community grows, so will the demand for new artificial intelligence software tools, fake news detection tools and professional services, and begin to develop an economy similar to the app store that motivates and screens ethical developers. All these system components will be managed and enforced by various smart contracts to enhance its creditability and trust of the news provided.

VI. Model Fake News Propagation as Blockchain Data Flow Supply Chain for Ranking, Traceability and Accountability

The well recognized blockchain applications are the supply chain applications. Currently, all blockchain supply chain applications are workflow process type with pre-configured workflow architecture as illustrated in Figure 3, e.g., Enterprise task process supply chain, food safety supply chain, and product delivery process supply chain, etc.

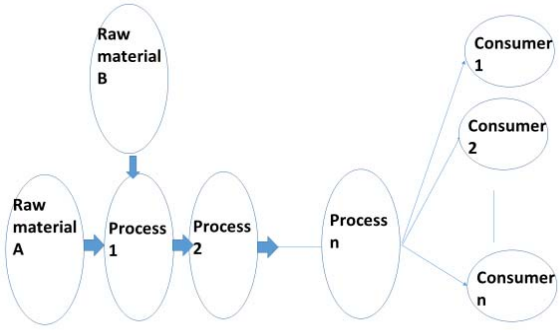

Figure 3. Architecture of blockchain process supply chain

In this model, the consumers just consume the outcome of the workflow and do not involve into the workflow. It would be surprised to persons new to the field that blockchain is only providing the data security only after the data is recorded into blockchain ledger. It is the external system responsibility to make sure the data write into the blockchain is trustworthy and correct. This critical requirement for the blockchain system results in that there is no one size fit all blockchain supply chain solution. Each supply chain solution therefore needs dramatic customization. This customization issue has been the key engineering task in building a trustful and useable blockchain supply chain.

These current workflow process type of blockchain supply chains consist of pre-configured limited number of processing steps and the blockchain network architecture is therefore can be pre-fixed. Consequently, to design a solution ensuring the correctness for external data into the supply chain has become relatively easier engineering task to achieve flow traceability and responsibility due to the fix network architecture with small scale.

This paper proposes to model the news propagation in the Internet as the news data supply chain in order to leverage the knowledge gained from the implementation of current process type blockchain supply chain to achieve the news data flow traceability and accountability. To our point of view, a news propagation blockchain supply chain can lay out a much clear and achievable path to rank the news, prevent the fake news propagation and create a trusting news environment for our society. The news propagation supply chain has much complicated and dynamic network architecture with large scale network graph and consumers are involved into the process nodes and become entities of the network graph. The network architecture is shown in Figure 4.

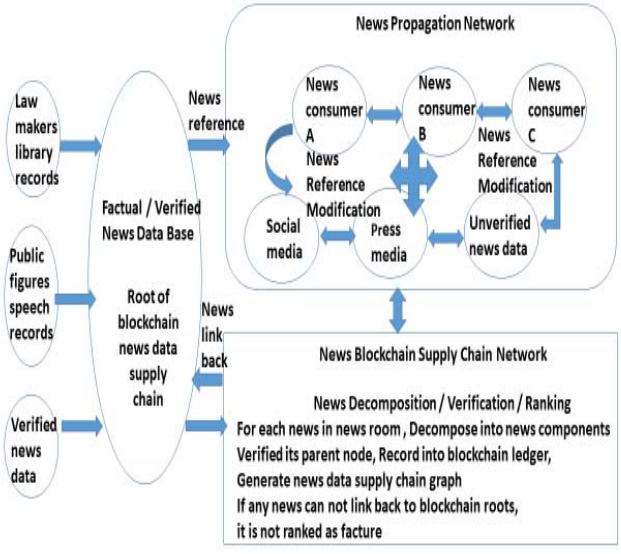

Figure 4. Architecture of news blockchain supply chain

In our model as shown in Figure 4, the news propagates among news consumers (general population), social media, and press media. Each news propagate from one entity to other entity will be recorded as a transaction in the blockchain ledger. The news propagation operation can be either simply relaying the news or the news can go through various types of modifications with different intents including, for examples, mixing, splitting, merging, and inserting.

Our system model consists a "factual database" as a root of blockchain data architecture for us to trace back during the process of analyzing, tracing, and ranking the news. This factual database, in which all records are considered factual, provides the ground truth and corner stone for our system. News in the Internet will be divided into two groups: one group is able to trace back to the factual database in the news blockchain supply chain graph, and the other group cannot (that is, this group can only be traced back into some un-verified news data sources).

Not all news, which can be linked back to the factual database, are considered factual. Each news propagating within news blockchain supply chain graph, at a given time, viewed by the different person can be gone through different news data path rooting from the "factual database". At each individual news propagation path, the news can be forwarded with/without modification per the given person's intent. Since the news propagation recorded in blockchain which becomes completely transparent, we can now rank the news based on the degrees of modifications along the news propagation path when it traced back to the factual database.

We will focus on the "fact" and not on the "truth" which is somehow related to the emotion and personal belief in the age of "post-truth". Note that everyone can change their position often and say something one day and change to something totally contradicted tomorrow. Our system considers both contradicted statements are factual since it is actually happened (not necessary considered to be truth to some people due to their personal subjective view and opinion). It is just different opinions, position, or statements at the different time. That is, our system only consider it is factual if something has been indeed said and done. The system does not care which way/position/point of view it has been said. We believe that this approach will promote neutral and objective statements and increasing the speed of factual news propagation, and eventually out pacing the fake news propagation. Only factual news can be stored in the factual database which is managed by the blockchain smart contract for security and no one can modify.

The factual database needs to be built from all the factual news. This is a critically important and quite a challenging task. We propose that, at the beginning, the database only consists of the facts which we can take it for granted as fact in nature and do not need any tool or person to verify. Some of the factual news data sources that we currently consider are,

for examples, the library of speech records of law makers, and the official speech records of presidents and public figures. The information in these public records considered above should have been officially validated as facts and can be used to provide a basis of ground truth of facts.

The system news rooms will make use Internet crawlers to collect news. The system will also provide mechanisms for person to refer and/or report news published in other media sources into the news rooms for the discussion and the blockchain platform will provide news ranking and verification using various tools and mechanisms, e.g., AI tools, news supply chain trace model, domain topic experts, and blockchain crowd sourcing mechanisms. If the news is verified to be factual, then it can be added into the factual database as well. Such that the factual database can be growing into a powerful trusting news engine as factual root of news blockchain supply chain graph.

The system consists of a blockchain network in Figure 4 to conduct the blockchain transactions and create the news supply chain graph. Given a news reported by a person into the news room, the system will start the ranking process. The system will start by creating a blockchain transaction for the reported news in the blockchain network for this person. Each blockchain transaction requires at least two end points. The system will then analyze the news content searching and discovering the parent references which the news is created, and if any, mapping the discovered parent references as the 2nd blockchain end point for the news transaction. This process will create a blockchain transaction and form a graph link from the current account into the referred parent account in the blockchain network. This process will also identify which parts of the news are created/modified by the current person. If referenced parents are found, then they can be used to trace back in the news blockchain supply chain graph in which the complicated news propagation path (mixing, splitting, merging, and inserting) can be discovered. The trace distance of graph from its root to the current reported news and the degree of the modifications (and its factualness) are generated along the path can then be used to rank the factualness of the news. Tracing the root to the person who creates fake news can help inform people about the factual issues at hand and eliminate much of the fake news propagation.

Fact-checking by domain topic experts are the current main mechanisms used for fighting against the fake news. Facebook partners with fact-checking organizations to deliver warnings before people share disputed articles [27]. However, the scalability of current domain topic expert fact-checking approach is questionable. The construction of news blockchain supply chain graph proposed in our system can be useful in identifying the potential domain topic experts by AI analyzing the history of blockchain ledger to identify the fact news creators of a given domain topic as the potential domain topic experts. This can help to increase the domain topic experts of fact-checking pools, and dynamically suggest a group of domain topic experts to a given topic in real time when news emerges.

The construction of news blockchain supply chain graph as well as the topic based news rooms is very useful in identifying the groups/communities persons belong to. The graph is also useful to understand the interaction process of digesting the contradiction fact within the groups after the fake news has been identified within the groups/communities. Research raises doubts [37] about the role of fact-checking and the effectiveness of corrections. The literature suggests that direct contradiction is counterproductive, as it may serve to entrench an individual in their beliefs if done in a threatening manner [58]. Since our system will do the continuously monitoring and recording the effectiveness of the fake news propagation after the fake news has been confirmed and reported to the new rooms and groups/communities. This will allow researcher to investigate and develop the effective mechanisms of social and cognitive interventions. Moreover, there is traceability and accountability built in the AI blockchain trusting news platform, our system can easily identify and report who created the fakes news as a mechanism to encourage the generation of factual information and discourage those who provide false content.

The fake news intervention can become more effective if statements come from similar individual or groups, especially their own self-interest is at stake. So it would be useful to identify all the groups each individual is participating which our system can provide. This information is important for researchers to build bridges across communities/groups in order to develop and investigate more effective mechanisms to prevent the fake news propagation by the production of more neutral and factual content [37]. People have the tendency to become similar to those they interact with, it's essential to communicate with people across groups.

VII. Research Issues and Technical Challenges

There are full of research issues and challenges for fighting against the fake news propagation both from social and technical aspects. AI algorithms and social interventions to reduce the spread of fake news have suffered limited effects [11, 26-30, 37, 59-65]. More research is needed in order to explore society interventions with technologies to encourage a culture that values and promotes truth. Our approach proposed in this paper is to design a platform which can encourage and reward factual news sources for society. Key research issues and technical challenges to build the platform are described in the precious section. We will describe a few additional harder research issues and technical challenges in this section. AI technology and social media can create fake news propagation, but it also offers a potential for mitigating it more effectively by crowd sourcing ranking. Moreover, we need to investigate mechanisms to minimize the impact of fake news before it has been propagated and disputed. This imposes a hard technical challenge which requires fake news prediction algorithms to

anticipate the onset of a fake news propagation before it is actually propagated and disputed.

Personalization of the fake news intervention mechanisms among different groups/communities or even among different persons is another social and technical challenges. There is no single size fit all solution for general population to the fake news intervention mechanisms. Not all individuals will have similar effectiveness to a given intervention mechanism. People are asymmetrical updaters [58]. Some may only be receptive to evidence that supports their view, but some might more receptive if the evidence is strong enough which can be more easy to win over to prevent fake news creation at near its source. This might be the most effective mechanism for fight against fake news propagation in the long term. It is therefore important and highly challenged to identify, tag, and categorize the different personal characteristics for individual or different groups/communities, and develop various intervention technologies accordingly. The personalization intervention technology can be developed leveraging the AI blockchain trusting news platform.

The model we described in this paper demands a high performance blockchain network since the news propagation path is globally connected and distribute operate. All the global population can be the potential users of the news blockchain supply chain network. Moreover, the system demands a scalable smart contract running in blockchain solution and effective distributed integration of AI and blockchain. Further, each news blockchain supply chain system requires to build a trustful data entry mechanism into the blockchain. The proposed AI news blockchain supply chain system has a very complicate data flow graph which make the trustful data entry mechanism potentially complicated. The trustful data entry mechanism to ensure the truthfulness of this news supply chains presents critical challenges.

In summary, these are a few key technical challenges required to build an AI blockchain platform for trusting news: build the factual news database, create the trustful news blockchain supply chain graph, develop blockchain crowd sourcing fake news ranking mechanism, develop scalable distributed smart contract blockchain network, and establish a practical business model for building up a trusting news ecosystem. For a long term strategy, to develop fake news prediction models before the fake news propagates, and to research on the effective personalization intervention mechanisms.

VIII. Summary

This paper proposes an AI blockchain platform for fighting against the propagation of fake news and to explore society interventions with technologies to encourage and reward factual news sources as a way to value and promote truth for society. We describe steps for building the factual database, generating the blockchain supply chain graph, and developing the blockchain based crowd sourcing fake news ranking mechanisms. We also review the state of fake news research from the social aspects, and provide research issues and technical challenges which additional interdisciplinary research is needed to get more understanding the fake news propagation phenomenon.

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References

[1] Benkler, Y., Faris, R.Roberts, H., & Zuckerman, E.. "Study: Breitbart-led right-wing media ecosystem altered broader media agenda", 2017. http://www.cjr.org/analysis/breitbart-media-trump-harvard-study.php

[2] WEF report on fake news, 2018. http://reports.weforum.org/global-risks-2018/digital-wildfires/

[3] Shu, K., Sliva, A., Wang, S., Tang, J., & Liu, H.. "Fake News Detection on Social Media: A Data Mining Perspective", SIGKDD Explorations Newsletter, 19(1): 22–36. 2017. https://doi.org/10.1145/3137597.3137600.

[4] UNESCO "Journalism, fake news & disinformation". 2018. https://en.unesco.org/sites/default/files/journalism_fake_news_disinformation_print_friendly_0.pdf

[5] Allcot, H., Gentzkow, M., & Yu, C.. "Trends in the Diffusion of Misinformation on Social Media". 2018. http://web.stanford.edu/~gentzkow/research/fake-news-trends.pdf?utm_campaign=The%20Interface&utm_medium=email&utm_source=Revue%20newsletter

[6] Beech, H., Meikhtila, B., & Pattani, T. "The face of buddhish terror". Time Magazine, 182 (1). 2013.

[7] Allcott, H., & Gentzkow, M. "Social Media and Fake News in the 2016 Election". Journal of Economic Perspectives 31 (2): 211–236. 2017

[8] Macquarie Dictionary World of the Year 2018 https://www.macquariedictionary.com.au/resources/view/word/of/the/year/

[9] Macquarie Dictionary World of the Year 2016 https://www.abc.net.au/news/2017-01-25/fake-news-named-2016-word-of-the-year/8211056

[10] Oxford Dictionaries Fake News 2016 https://www.theguardian.com/books/2016/nov/15/post-truth-named-word-of-the-year-by-oxford-dictionaries

[11] Yang Yang, et. al. "TI-CNN: Convolutional Neural Networks for Fake News Detection" 2018, https://arxiv.org/pdf/1806.00749.pdf

[12] Hunt Allcott and Matthew Gentzkow. "Social media and fake news in the 2016 election". Technical report, National Bureau of Economic Research, 2017

[13] Niall J Conroy, Victoria L Rubin, and Yimin Chen. "Automatic deception detection: methods for finding fake news". Proceedings of the Association for Information Science and Technology, 52(1):1–4, 2015.

[14] Justus Thies , et. al. "Face2Face: Real-time Face Capture and Reenactment of RGB Videos", 2016 https://web.stanford.edu/~zollhoef/papers/CVPR2016_Face2Face/paper.pdf

[15] Deep fake https://www.youtube.com/watch?v=dMF2i3A9Lzw

[16] Deep fake https://www.youtube.com/watch?v=8LhI-e2B8Lg
[17] Deep fake https://www.nytimes.com/2018/10/17/opinion/deep-fake-technology-democracy.html
[18] Tensorflow from Google, https://www.tensorflow.org/
[19] CAROLINE CHAN, et. al. "Everybody Dance Now", 2018 https://arxiv.org/pdf/1808.07371.pdf
[20] Well-known Deep fake https://en.wikipedia.org/wiki/Video_portal
[21] Mauricio deep fake https://en.wikipedia.org/wiki/Mauricio_Macri
[22] Hitler deep fake https://en.wikipedia.org/wiki/Adolf_Hitler
[23] Introducing deepfakes, https://www.visgraf.impa.br/mediascopium/introducing-deepfakes/
[24] Romano, Aja . "Jordan Peele's simulated Obama PSA is a double-edged warning against fake news". *Vox*. 2018.
[25] Pew Research Center survey, 2018, http://www.journalism.org/2018/09/10/news-use-across-social-media-platforms-2018/
[26] Eliza Strickland, "AI-Human partnership tacking fake news", IEEE Spectrum, 2018, https://spectrum.ieee.org/computing/software/aihuman-partnerships-tackle-fake-news,
[27] Tessa Lyons , "Hard questions: How is Facebook Fact Checking Program Working", Facebook Newsroom, 2018, https://newsroom.fb.com/news/2018/06/hard-questions-fact-checking/
[28] Karen Hao, "Even the best AI for spotting fake news is still terrible" , MIT Technology Review, 2018 https://www.technologyreview.com/s/612236/even-the-best-ai-for-spotting-fake-news-is-still-terrible/
[29] Don McLaughlin, 2017 https://wvutoday.wvu.edu/stories/2017/03/27/wvu-students-experiment-with-artificial-intelligence-to-detect-fake-news
[30] "Google News will now label articles that include fact checking", GoTo5Google, 2016, https://9to5google.com/2016/10/13/google-news-fact-check/
[31] Duke University Bass Connection project, 2018, https://bassconnections.duke.edu/project-teams/data-and-technology-fact-checking-2018-2019
[32] Duke Today, 2018, https://today.duke.edu/2018/10/real-time-fact-checking-theres-almost-app
[33] Fake News Challenges, http://www.fakenewschallenge.org/
[34] Civil Corporation, https://civil.co/
[35] Alex Champandard, https://www.fipp.com/news/features/fighting-fakes
[36] Nir Grinberg, Kenneth Joseph, Lisa Friedland1, Briony Swire-Thompson, David Lazer, "Fake news on Twitter during the 2016 U.S. presidential election", *Science* 25 Jan 2019: Vol. 363, Issue 6425, pp. 374-378 http://science.sciencemag.org/content/sci/363/6425/374.full.pdf
[37] David Lazer, et. at., "Combating Fake News: An Agenda for Research and Action", Shorenstein Center, Harvard University, February 17–18, 2017. https://shorensteincenter.org/combating-fake-news-agenda-for-research/
[38] Craig Silverman, "Here Are 50 Of The Biggest Fake News Hits On Facebook From 2016", https://www.buzzfeednews.com/article/craigsilverman/top-fake-news-of-2016
[39] Media Cloud, Berkman Klein Center at Harvard University, Civic Media at MIT, https://cyber.harvard.edu/research/mediacloud
[40] Volunteer Science, Northeastern University, https://web.northeastern.edu/nulab/volunteer-science-project/
[41] OpenSources, Merrimack College, http://www.opensources.co/
[42] Newsguard, https://www.newsguardtech.com/
[43] Satoshi Nakamoto , "Bitcoin: A Peer-to-Peer Electronic Cash System", https://bitcoin.org/bitcoin.pdf
[44] Vitalik Buterin, "Ethereum Whitepaper" https://cdn.relayto.com/media/files/QFTNsr6YSYCE9zyamwis_EthereumWhitePaper.pdf
[45] "Hyperledger white paper", https://docs.google.com/document/d/1Z4M_qwILLRehPbVRUsJ3OF8Iir-gqS-ZYe7W-LE9gnE/edit#heading=h.m6iml6hqrnm2
[46] Enterprise Ethereum Alliance, https://en.wikipedia.org/wiki/Ethereum
[47] Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Mill er, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press in 2016
[48] Croman, Kyle; Eyal, Ittay, "On Scaling Decentralized Blockchains", International Conference on Financial Cryptography and Data Security, FC 2016
[49] Joseph Poon, Thaddeus Dryja, "The Bitcoin Lightning Network: Scalable Off-Chain Instant Payments", https://lightning.network/lightning-network-paper.pdf
[50] Mustafa Al-Bassam, etc., "Chainspace: A Sharded Smart Contracts Platform", https://arxiv.org/pdf/1708.03778.pdf
[51] David Cerezo Sánchez, "Raziel: Private and Verifiable Smart Contracts on Blockchains", https://eprint.iacr.org/2017/878.pdf
[52] Fan Zhang, Ethan Cecchetti, Kyle Croman, "Town Crier: An Authenticated Data Feed for Smart Contracts", ACM CCS'16, https://eprint.iacr.org/2016/168.pdf
[53] Yan Zhuang, Lincoln Sheets, Zonyin Shae, Jeffrey J. P. Tsai, Chi-Ren Shyu, "Applying Blockchain Technology for Health Information Exchange and Persistent Monitoring for Clinical Trials." AMIA 2018
[54] Zonyin Shae, Jeffrey J.P. Tsai, "Transform Blockchain into Distributed Parallel Computing Architecture for Precision Medicine", ICDCS 2018
[55] Yan Zhuang, Andrea Atkins, Chi-Ren Shyu, Zonyin Shae, Jeffrey J.P. Tsai, Chung Hsu, "A Hybrid Blockchain Design for Patient Recruitments and Persistent Monitoring for Clinical Trials". IEEE Standards Association: Blockchain for clinical trials. 2018, https://blockchain.ieee.org/images/files/images/clinicaltrialsforum-2018/U-of-Missouri_Informatics-Institute_Synopsis.pdf
[56] Zonyin Shae, Jeffrey J.P. Tsai. "On the Design of a Blockchain Platform for Clinical Trial and Precision Medicine", ICDCS 2017.
[57] Hsing-Chung Chen, Bambang Irawan, Zon-Yin Shae: "A Cooperative Evaluation Approach Based on Blockchain Technology for IoT Application", IMIS 2018
[58] Conover, M., et.al., "Political polarization on twitter". International AAAI conference on weblogs and social media" (ICWSM), 2011
[59] Conover, M., Gonçalves, B., Flammini, A., & Menczer, F. "Partisan asymmetries in online political activity". EPJ Data Science 1:6, 2012
[60] Ferrara, E., Varol, O., Davis, C.A., Menczer, F., & Flammini. A. "The rise of social bots". Comm ACM, 59(7):96-104. 2016
[61] Flynn, D. J., Nyhan, B., & Reifler, J. "The Nature and Origins of Misperceptions: Understanding False and Unsupported Beliefs about Politics". *Advances in Pol. 2016"*
[62] Metzger, M. J., Flanagin, A. J., Medders, R. B. "Social and Heuristic Approaches to Credibility Evaluation Online". *Journal of Communication, 60(3), 413-439, 2010*
[63] Nyhan, B., & Reifler, J. "When corrections fail: The persistence of political misperceptions". *Political Behavior, 32(2), 303-330, 2010*
[64] Sunstein, C. R., Bobadilla-Suarez, S., Lazzaro, S. C., & Sharot, T. "How People Update Beliefs about Climate Change: Good News and Bad News", (SSRN Scholarly Paper No. ID 2821919). Rochester, NY: Social Science Research Network, 2016
[65] Xiaoyan Qiu1, Diego F. M. Oliveira, Alireza Sahami Shirazi, Alessandro Flammini, Filippo Menczer, "Limited individual attention and online virality of low-quality information", 2019. https://arxiv.org/pdf/1701.02694.pdf