Applications and Trends of Fact-Checking Technology in Western Journalism (Postprint)

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Date: 2023-10-08T00:00:00+00:00

Abstract

In recent years, the issue of "fake news"—a problem generated by technological development—has attracted considerable attention. Unlike fake news in the print media era, fake news in the internet age is characterized by rapid dissemination, wide-ranging impact, and poor corrective effectiveness. The rise of automated news fact-checking in Europe and America uses algorithms to selectively identify, judge, and distribute results from massive online content, offering a targeted approach to addressi…

Full Text

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In recent years, the issue of "fake news"—a problem generated by technological development—has attracted considerable attention. Unlike fake news in the print media era, fake news in the internet age is characterized by rapid dissemination, wide-ranging impact, and poor corrective effectiveness. The rise of automated news fact-checking in Europe and America uses algorithms to selectively identify, judge, and distribute results from massive online content, offering a targeted approach to addressing fake news. Currently, fact-checking projects are developing rapidly, but their automation process faces multiple obstacles. Addressing fake news requires establishing digital standards or attempting to use blockchain technology to build an online credit system. The potential moral paradox in defining "truth" and concerns about automation are also worth vigilance.

Irish journalist Mark Little founded Storyful to verify the authenticity of social media content. Its information monitoring tool Newswire can monitor user-generated content (UGC) on social media platforms such as Twitter, Facebook,

YouTube, Instagram, and Pinterest in real time, pushing captured hot materials with potential news value—primarily video content—to human editors. These "adopter" human editors rely on long-term journalistic experience to judge and select valuable content.

In addition to specialized verification agencies, social media platforms also regulate content based on management needs. Facebook's Community Standards explicitly prohibit bullying, fraud, hate speech, and other content. In recent years, due to widespread criticism over fake news, Facebook announced it would hire 3,000 additional content reviewers and improve machine learning algorithms to identify suspected fake news content. In China, Tencent has developed the Jiaozhen platform and Rumor Filter to provide users with search services and manual services for verified content.

The 2016 U.S. presidential election brought the fake news issue to a fever pitch, giving rise to a wave of internet technology-based news fact-checking projects, particularly in Europe and America. These include PolitiFact, which rates the veracity of public statements by politicians and other public figures; Storyful, which monitors and verifies social media content; ClaimBuster, which employs machine learning, natural language processing, and database query techniques for automated verification; and FirstDraftNews, which provides professional fact-checking experience and tools for journalists. Currently, these fact-checking projects have not yet achieved complete intelligence and automation, often requiring combination with manual verification, but automated fact-checking technology has established preliminary workflows.

1. Automated Fact-Checking Technology and Process

Automated fact-checking processes can be divided into three steps: identification, verification, and correction, which a 2018 Reuters research report identified as the core elements of automated fact-checking technology.

1.1 Identification and Selection

Identifying verification targets and achieving this technically represents a current practical challenge. This is constrained by technological limitations on one hand, and on the other hand reflects the values of verification organizations, which decisively impacts final verification effectiveness. ClaimBuster, developed by computer scientist Chengkai Li and his team at the University of Texas at Arlington, monitors content from designated broadcast media, Twitter accounts, and websites. In their view, positions and opinions are matters of freedom, while only important factual claims possess the greatest public significance and merit verification. Through natural language processing and continuous machine learning from human judgments on websites, the system classifies massive content into non-factual statements, unimportant factual statements, and important factual statements. The platform also provides end-to-end fact-checking detection services for individual users.

The Duke University Reporters' Lab attempts to provide real-time fact-checking for smartphones, tablets, and television platforms. Its team designed the "pop-up family" initiative, seeking to deliver instant fact-checking through a series of applications called "FactStream," including attempts to directly display verification results on electronic devices—currently still in testing phase. Other verification applications developed include voice-activated assistants that announce verification results through intelligent speech recognition and analysis; Chrome browser extensions that provide real-time pop-up fact-checking during news events such as presidential debates; and the Share the Fact widget that helps search engines locate fact-checking articles.

Some verification organizations still employ manual methods to select content for verification. For instance, PolitiFact, which checks politicians' public statements, has journalists daily selecting transcripts, speeches, news reports, and brochure content from reader emails, television, and social media channels for manual verification and rating, focusing particularly on those in positions of power or who repeatedly make misleading statements. The website won the 2009 Pulitzer Prize for its outstanding performance during the U.S. election.

1.2 Verification and Analysis

The second step in automated fact-checking involves verifying selected content. Current methods and approaches involve matching and comparing content against previously verified statements or authoritative sources. Technically, this requires machines to possess capabilities in understanding text and cross-analyzing multiple sources on one hand, and on the other hand necessitates databases with verified and sourced information.

Currently, ClaimBuster demonstrates relatively high automation in verification. Its matching tool can collect verified content from other databases and websites. The verification tool compares statements awaiting verification against this content, analyzing both symbolic and semantic similarity, and generates detailed verification reports. The platform has also developed an end-to-end verification portal where users can search expressions themselves, and ClaimBuster will match similar expressions and provide verification results.

NewsCracker, developed by three students including Justin Berman from Williams College, measures media reporting bias through algorithms, rating media credibility based on a composite score of headline strength, neutrality, and accuracy. Algorithmic measurement criteria include preliminary ratings for specific websites, the number of reports on the same news story, the quantity and sources of quotations, the number of biased terms, and sentence length and structure—considered by the team as "the five most important factual claims."

However, in practice, the most common approach remains classifying content awaiting verification and breaking it down into smaller tasks, using website tools to provide information for human judgment. Reuters research reports indicate that while current natural language recognition algorithms can effectively

capture similar variations of statements, subsequent analysis often sacrifices verification accuracy. Moreover, in studies and interviews with fact-checkers and computer scientists, they found that current automated fact-checking technology lacks contextual judgment capability and the sensitivity required of professional fact-checkers.

1.3 Correction and Distribution

Based on different philosophies, platforms adopt different result distribution methods. Organizations focused on providing tool services often choose to rate or label verified content, while some platforms publish verification reports. PolitiFact publishes rating results on its website and allows netizens to submit objections, which staff will consider. Storyful, known as a social media news agency, provides verified and copyrighted social media content to news media partners. ClaimBuster offers end-to-end verification, presenting results instantly on web pages. Full Fact develops personalized verification tools that engage in direct dialogue with users through artificial intelligence verification.

2. Characteristics and Limitations of European and American News Fact-Checking

2.1 Rapid Development with Multiple Automation Barriers

Fact-checking organizations primarily operate under two models: newsrooms and NGOs. In recent years, the number of fact-checking organizations has continuously grown. According to statistics from the Duke Reporters' Lab, from 2014 to January 2018, the number of fact-checking organizations worldwide increased from 44 to 149, with 41 operating for more than five years, accounting for 29% of the total.

However, automated fact-checking still faces many challenges. On one hand, automated fact-checking technology struggles to understand complex text, particularly when contextual analysis is required, and cannot achieve the capability and sensitivity of professional fact-checkers. On the other hand, the fixed procedures of algorithms are difficult to perfect and fail to achieve expected results. When NewsCracker verified a BuzzFeed report, it identified an originally objective report as biased because user tweets cited in the article were detected as "many statements cannot be verified," affecting the credibility rating of the entire website.

Additionally, many organizations attempt to generate real-time scores for live news but find machines cannot accurately identify corresponding figures; professional political terminology in non-English countries cannot be accurately translated by machines; and access rights to some official databases are difficult to obtain, among numerous other issues.

In fact, current European news fact-checking still relies on manual supervision and participation. Storyful's social media monitoring tool Newswire, after mon-

itoring and capturing social media UGC, still requires human teams to judge whether it has news value, and verification often requires manual contact with sources. Some image analysis tools cannot accurately obtain important digital information such as capture time and location, some geographic location judgments require visual comparison by checkers, and some verification websites even depend on user participation to provide more information.

2.2 Multi-Platform Collaboration with Emphasis on Information Integration

Bill Adair, co-director of the Duke Reporters' Lab, proposes that "automated verification relies more on people's cooperation than on technical complexity." In the internet era, using fact-checking to combat fake news is a continuous systematic project. From current practice, verification organizations often need to unite multiple stakeholders including news media and social platforms to complete multi-dimensional verification steps.

The biggest difference between automated and manual fact-checking is that humans can excavate facts from real society, while machine verification can only be based on databases containing true information. This places high demands on algorithms that aggregate information and once again highlights the importance of obtaining information access channels—that is, cooperation.

Currently, global verification organizations are attempting to establish common standards. In September 2016, the Poynter Institute for Media Studies launched the International Fact-Checking Network, with 35 organizations and individuals from 27 countries participating in signing five international principles including non-profit status, uniting verification organizations including Factcheck.org, Full Fact, PolitiFact, Snopes, as well as professional checkers from the Washington Post, Agence France-Presse, and other news organizations.

2.3 Funding Shortages and Sustainability Challenges

According to Reuters research reports, most non-profit fact-checking organizations are currently affiliated with news media or NGOs. Their funding sources fall into two main categories: one is to absorb diversified funding, the other is to rely solely on media or charitable organization support. For example, the Duke Reporters' Lab's Tech & Check project received a total of $1.2 million in funding from the Knight Foundation, Facebook Journalism Project, and Craig Newmark Foundation. Although some fact-checking organizations have created relatively low-cost and independent AFC tools, developing and advancing large-scale AFC systems still requires continuous support from foundations, schools, and platform companies. In 2016, Reportedly, which verified eyewitness media content, ceased updates after losing funding from its parent company.

Notably, Storyful, which has established a relatively successful business model, attempts to find content in UGC that can be used for commercial promotion in addition to developing social media resources.

3. Reflections on the Development of Automated Fact-Checking

3.1 Fake News Exploits Human Nature Online, Requiring Digital Norms

"When truth is still putting on its shoes, rumors have already run halfway around the world." In the post-truth era, personal emotions are amplified, and content that caters to psychological needs receives more clicks and views. A March 2018 study published in *Science* analyzed the dissemination of 126,000 news items on Twitter over the past 12 years and found that fake news travels faster, deeper, and more broadly than real news. Moreover, fake news shared by people has one obvious characteristic: novelty.

The yellow journalism craze of the 1880s receded due to resistance from all sectors of society, and people's thirst for fresh information needs to be restrained by reasonable norms. In the West, the spread of false information, especially political content, is considered a serious matter. The impact of Facebook fake news on the U.S. election has prompted European and American governments to actively take measures to address fake news. On January 1, 2018, Germany's Social Media Management Act was implemented, imposing stricter regulatory requirements on social network platforms such as Facebook and Twitter providing content services within Germany, with combating online fake news being one of the law's primary functions. The EU's General Data Protection Regulation also took effect on May 25, 2018. In recent years, American society's calls for legislating against misleading information in political propaganda and governing fake news have grown increasingly strong.

3.2 Using Blockchain to Establish Online Credit Systems

Identifying source information represents one of the current difficulties in automated fact-checking. The replicability of online content allows debunked messages, images, and videos to be continuously redisseminated, with many images and videos being processed or even distorted before being re-uploaded to confuse the public. Some researchers propose that blockchain technology can solve the fake news problem from an information distribution perspective. Blockchain technology can generate digital certificates for content with permanent preservation and immutability characteristics. Bundling content with individuals makes all content traceable, thereby solving the problem of difficult information tracing. On the other hand, just as social credit systems produce invisible constraints on individual behavior, if original information is treated as personal assets and users need to take responsibility for published information, this would have some effect on curbing fake news dissemination.

In fact, the concept of using blockchain to address fake news has been initially practiced. For example, in early 2018, Matters, co-founded by Zhang Jieping (editor-in-chief of Initium Media) and Fang Kecheng, among others, attempts to use blockchain's digital currency incentive mechanisms, content "on-chain,"

and decentralized characteristics to reshape public discussion. The platform is currently in internal testing phase.

3.3 The Paradox of Defining "Truth" and the Limits of Automation

Automated fact-checking selects factual statements for verification, seemingly avoiding interference from subjective positions. However, even for factual statements, binary true/false judgment is inadequate. When verifying factual statements, the degree of textual ambiguity and the dynamic presentation of facts affect "truthfulness," and simple labels may lead to simpler thinking. "Facts are no longer the presentation of the world itself, but the expression of consensus about the world." Some argue that in the post-truth era, fact-checking journalism faces a transformation from "verifying objective facts" to "assisting understanding of reality." Therefore, many verification organizations attempt to provide unstructured data to help users think from multiple perspectives, but practical effects remain unclear.

Neurological research finds that humans' ability to estimate situations and make rapid judgments comes from tacit knowledge. This knowledge often originates from neural activity beyond the scope of human conscious control and cannot yet be decomposed into precisely describable written instructions. Harvard scholar Nicholas Carr proposes in his work *The Glass Cage: Automation and Us* that over-reliance on automation reduces individual skills: during automated system operation, insufficient information load leads to burnout psychology, creating risky work environments and ultimately increasing workload. This is termed the "automation paradox" in his book, representing problems brought by highly developed automation. Regarding the current state of fact-checking technology development, its automation has not yet reached this degree.

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Note: Figure translations are in progress. See original paper for figures.