rigorously verified before publication, and thus more reliable, and present a rich context that completes the semantic picture about an event, news articles may report breaking news slower than social media.

[05] Finally, extracting event information from more than one media type, such as from both social media and news articles, is challenging due to their difference in text length and reporting style.

[06] Thus, a need exists for systems and methods to perform event extraction on multiple different types of media, in a manner to both correctly extract event information from these sources, and overcome the potential limitations of any given one of these types of media.

SUMMARY OF INVENTION

[06a] According to a first aspect of the present invention, there is provided a method of providing cross-media event linking, the method comprising: receiving, at a first input of an event coreferencing system, a stream of social media postings, and at a second input of the event coreferencing system, a stream of news articles; generating, by the event coreferencing system, a first set of event representations representing events referenced by the social media postings, and a second set of event representations representing events referenced by the news articles; determining, by the event coreferencing system, that at least one of the social media postings references a same event referenced by at least one of the news articles, the determining including determining at least one similarity using data of at least one of the first set of event representations corresponding to the at least one of the social media postings and data of at least one of the second set of event representations corresponding to the at least one of the news articles; and transmitting, by an output of the event resolution system to a user system, an alert including at least one coreferenced event representation representing the event referenced by the at least one of the social media postings and the at least one of the news articles.

[06b] According to a second aspect of the present invention, there is provided a system for providing cross-media event linking, the system comprising: at least one non-transitory machine readable storage medium storing program instructions; and at least one processor configured to execute the program instructions to perform a method of providing cross-media event linking, the method including: receiving, at a first input of an event coreferencing system, a stream of social media postings, and at a second input of the event coreferencing system, a stream of news articles; generating, by the event coreferencing system, a first set of event representations representing events referenced by the social

media postings, and a second set of event representations representing events referenced by the news articles; determining, by the event coreferencing system, that at least one of the social media postings references a same event referenced by at least one of the news articles, the determining including determining at least one similarity using data of at least one of the first set of event representations corresponding to the at least one of the social media postings and data of at least one of the second set of event representations corresponding to the at least one of the news articles; and transmitting, by an output of the event resolution system to a user system, an alert including at least one coreferenced event representation representing the event referenced by the at least one of the social media postings and the at least one of the news articles.

[06c] According to a third aspect of the present invention, there is provided at least one non-transitory machine readable storage medium having program instructions, which when executed by at least one processor perform a method of providing cross-media event linking, the method including: receiving, at a first input of an event coreferencing system, a stream of social media postings, and at a second input of the event coreferencing system, a stream of news articles; generating, by the event coreferencing system, a first set of event representations representing events referenced by the social media postings, and a second set of event representations representing events referenced by the news articles; determining, by the event coreferencing system, that at least one of the social media postings references a same event referenced by at least one of the news articles, the determining including determining at least one similarity using data of at least one of the first set of event representations corresponding to the at least one of the social media postings and data of at least one of the second set of event representations corresponding to the at least one of the news articles; and transmitting, by an output of the event resolution system to the user system, an alert including at least one coreferenced event representation representing the event referenced by the at least one of the social media postings and the at least one of the news articles.

BRIEF DESCRIPTION OF THE DRAWINGS

[07] So that the features of the present invention can be understood, a number of drawings are described below. However, the appended drawings illustrate only particular embodiments of the invention and are therefore not to be considered limiting of its scope, for the invention may encompass other equally effective embodiments.

[08] FIG. 1 is an exemplary architectural diagram of the system.

[09] FIG. 2 is an exemplary event processing server.

[10] FIG. 3a is an exemplary flow chart of one implementation of the disclosure.

[11] FIG. 3b is an exemplary flow chart of another implementation of the disclosure.

[12] FIG. 4a illustrates exemplary elements in a veracity calculation.

[13] FIG. 4b illustrates exemplary elements in an alternative verification calculation.

[14] FIG. 5a illustrates an exemplary processing of an item of social media data.

[15] FIG. 5b illustrates an example table representation of mapping key concepts to the respective social media data.

[16] FIG. 5c illustrates an example database representation in relation to the exemplary social media data of Fig. 5a.

[17] FIG. 5d illustrates an example unit cluster.

[18] FIG. 5e illustrates an exemplary ingested data.

[19] FIGS. 5f-5k is an exemplary metadata of ingested data in Fig. 5e.

[20] FIGS. 5l-5n is an exemplary metadata of an event detected cluster with ingested data of Fig. 5e as one of the related unit data.

WHAT IS CLAIMED IS:

1. A method of providing cross-media event linking, the method comprising:

receiving, at a first input of an event coreferencing system, a stream of social media postings, and at a second input of the event coreferencing system, a stream of news articles;

generating, by the event coreferencing system, a first set of event representations representing events referenced by the social media postings, and a second set of event representations representing events referenced by the news articles;

determining, by the event coreferencing system, that at least one of the social media postings references a same event referenced by at least one of the news articles, the determining including determining at least one similarity using data of at least one of the first set of event representations corresponding to the at least one of the social media postings and data of at least one of the second set of event representations corresponding to the at least one of the news articles; and

transmitting, by an output of the event resolution system to a user system, an alert including at least one coreferenced event representation representing the event referenced by the at least one of the social media postings and the at least one of the news articles.

2. The method of claim 1, the determining including performing a classification of whether at least one of the social media postings references a same event referenced by at least one of the news articles based on the at least one similarity.

3. The method of claim 1, wherein the coreferenced event representation includes at least one of: links to the at least one of the social media postings and at least one of the news articles, or the at least one of the social media postings and the at least one of the news articles.

4. The method of claim 1, wherein transmitting the alert includes at least one of: transmitting an email including the alert to the user system, transmitting a text message including the alert to the user system, or transmitting a feed including the alert to the user system.

5. The method of claim 1, wherein transmitting the alert includes transmitting the alert by an application programming interface (API) of the event coreferencing system.

6. The method of claim 5, wherein the API transmits the alert in response to a request by the user system.

7. The method of claim 1, further comprising controlling by the user system at least one component of the user system based on the alert.

8. The method of claim 7, wherein the controlling includes at least one of:

operating a supply chain scheduling controller to schedule a supply chain delivery based on the alert;

operating a financial trading controller to execute a trade of a financial commodity based on the alert; or

operating a manufacturing system controller to power down a manufacturing system component based on the alert.

9. The method of claim 1, wherein each event representation includes a plurality of attributes representing the corresponding event.

10. The method of claim 9, wherein each event representation includes a location of the event, a time of the event, and an impact of the event.

11. The method of claim 1, wherein the determining the at least one similarity includes determining at least one of:

a temporal similarity between at least one time extracted from the at least one social media posting and at least one time extracted from the at least one news article;

a spatial similarity between at least one location extracted from the at least one social media posting and at least one location extracted from the at least one news article;

a person entity similarity between at least one person entity extracted from the at least one social media posting and at least one person entity extracted from the at least one news article;

an organization entity similarity between at least one organization entity extracted from the at least one social media posting and at least one organization entity extracted from the at least one news article; or

a text similarity between a text of the at least one social media posting and a text of the at least one news article.

12. The method of claim 1, wherein the determining the at least one similarity includes determining a temporal similarity between the at least one social media posting and the at least one news article, a spatial similarity between the at least one social media posting and the at least one news article, an entity similarity between the at least one social media

posting and the at least one news article, and a text similarity between the at least one social media posting and the at least one news article.

13. The method of claim 1, wherein the determining the at least one similarity includes determining a spatial similarity between the at least one social media posting and the at least one news article by:

determining feature vectors for the social media cluster and the news article based on locations extracted from the social media posting and news article;

calculating similarities between each pair of such locations of the news article and the social media cluster using the feature vectors; and

determining the spatial similarity as function of the determined candidate location similarities.

14. The method of claim 1, wherein the determining the at least one similarity includes determining a temporal similarity between the social media posting and the news article by:

determining feature vectors for temporal expressions extracted from the social media posting and the news article; and

determining the temporal similarity as a minimum time difference between temporal expressions in the feature vectors for the social media posting and the news article.

15. The method of claim 1, wherein the determining the at least one similarity includes determining a person entity similarity between the social media posting and the news article by:

determining sets of person entities extracted from social media posting and the news article; and

determining a similarity between the sets of extracted persons for the social media posting and the news article.

16. The method of claim 1, wherein the determining the at least one similarity includes determining an organization entity similarity between the social media posting and the news article, including by:

determining sets of organization entities extracted from social media posting and the news article; and

determining a similarity between the sets of extracted organization entities for the social media posting and the news article.

17. The method of claim 1, wherein the determining the at least one similarity includes determining a text similarity between the social media posting and the news article, including generating vectors for tokenized text of the social media posting and the news article based on word embeddings, and determining a similarity between the determined vectors.

18. The method of claim 1, wherein the generating the second set of event representations representing events referenced by the news articles includes:

filtering out non-event related news articles;

classifying a type of event referenced by the news articles using a feature vector based on word embeddings for the news articles;

determining candidate attributes of the event representation using natural language processing;

determining a location attribute of the event representation, including classifying candidate locations using feature vectors based on the candidate attributes;

determining a time attribute of the event representation, including determining temporal expressions in the news article and applying a rule based model to select one of the temporal expressions as the time attribute; and

determining an impact attribute of the event representation, including classifying pairs of numeric references of the candidate attributes and adjacent word sequences.

19. The method of claim 1, wherein the generating the second set of event representations representing events referenced by the news articles includes determining an impact attribute by:

determining sentences of the news article with tokens with a cardinal number part-of-speech tag representing numeric values;

generating word sequences in the vicinity of the cardinal token in the text by constructing n-grams from each side of the cardinal token within the sentence;

generating a feature vector for each sequence based on one or more of: word embeddings for the sequence, a length of the sequence, a pre or post offset of the cardinal number token relative to the sequence, a part-of-speech for words in the sequence, entity types of the word sequence, dependency tree relations of the word sequence; and

classifying each generated pairs of numeric value and word sequence feature vector as either indicating a human impact or not.

20. The method of claim 1, wherein the generating the second set of event representations representing events referenced by the social media postings includes:

filtering out noise postings representing spam and chit chat;

detecting and clustering postings referencing an event;

classifying the type of event referenced by the cluster of postings;

removing clusters of postings related to events older than a predetermined current time period;

determining a summary for the cluster of postings;

determining a location attribute for the cluster of postings;

determining a time attribute for the cluster of postings; and

determining an impact attribute for the cluster of postings.

21. A system for providing cross-media event linking, the system comprising:

at least one non-transitory machine readable storage medium storing program instructions; and

at least one processor configured to execute the program instructions to perform a method of providing cross-media event linking, the method including:

receiving, at a first input of an event coreferencing system, a stream of social media postings, and at a second input of the event coreferencing system, a stream of news articles;

generating, by the event coreferencing system, a first set of event representations representing events referenced by the social media postings, and a second set of event representations representing events referenced by the news articles;

determining, by the event coreferencing system, that at least one of the social media postings references a same event referenced by at least one of the news articles, the determining including determining at least one similarity using data of at least one of the first set of event representations corresponding to the at least one of the social media postings and data of at least one of the second set of event representations corresponding to the at least one of the news articles; and

transmitting, by an output of the event resolution system to a user system, an alert including at least one coreferenced event representation representing the event referenced by the at least one of the social media postings and the at least one of the news articles.

22. The system of claim 21, wherein the determining includes performing a classification of whether at least one of the social media postings references a same event referenced by at least one of the news articles based on the at least one similarity.

23. The system of claim 21, wherein transmitting the alert includes at least one of: transmitting an email including the alert to the user system, transmitting a text message including the alert to the user system, or transmitting a feed including the alert to the user system.

24. The system of claim 21, wherein transmitting the alert includes transmitting the alert by an application programming interface (API) to the user system, wherein the API transmits the alert in response to a request by the user system.

25. The system of claim 21, the method further comprising controlling by the user system at least one component of the user system based on the alert.

26. The system of claim 21, wherein each event representation includes a plurality of attributes representing the corresponding event, including a location of the event, a time of the event, and an impact of the event.

27. The system of claim 21, wherein the determining the at least one similarity includes determining at least one of: a temporal similarity between the at least one social media posting and the at least one news article, a spatial similarity between the at least one social media posting and the at least one news article, an entity similarity between the at least one social media posting and the at least one news article, and a text similarity between the at least one social media posting and the at least one news article.

28. At least one non-transitory machine readable storage medium having program instructions, which when executed by at least one processor perform a method of providing cross-media event linking, the method including:

receiving, at a first input of an event coreferencing system, a stream of social media postings, and at a second input of the event coreferencing system, a stream of news articles;

generating, by the event coreferencing system, a first set of event representations representing events referenced by the social media postings, and a second set of event representations representing events referenced by the news articles;

determining, by the event coreferencing system, that at least one of the social media postings references a same event referenced by at least one of the news articles, the determining including determining at least one similarity using data of at least one of the first set of event representations corresponding to the at least one of the social media postings and data of at least one of the second set of event representations corresponding to the at least one of the news articles; and

transmitting, by an output of the event resolution system to the user system, an alert including at least one coreferenced event representation representing the event referenced by the at least one of the social media postings and the at least one of the news articles.