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GEO-SPATIAL SOCIAL MEDIA ANALYTICS FOR COUNTER-TERRORISM

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ABSTRACT. Terrorist groups such as ISIS are continuously disseminating their ideology across the world using social media platforms. Thus, the use of social media is the major problem that needs to be controlled to ensure national and international security. These terrorist groups are the highly active groups on social media platforms such as Facebook, Instagram, YouTube, Twitter, etc. ISIS disseminates its propaganda across the world through social media that is one of the major concerns for international peace and security. In this research paper, the identified problem is emphasized to be resolved by reviewing existing studies. In this paper, the problem is reviewed along with the technological solutions proposed by different scholars. After the comparative literature review, it has been identified that existing studies are limited to conduct geospatial analytics for finding the suspect and their geographic span through analysis of the public posts, comments or other attributes of social media users. A new methodology has been proposed for conducting geo-spatial social media analytics in which combination of NLP and Fuzzy Logic is applied on the public posts and locations of the social media users for finding suspects.

1. INTRODUCTION

Terrorism is the world-wide concern which is deteriorating the mankind, peace, and security of the nations. It has been experienced that terrorists have been trained with emerging technologies to accomplish their mission. The use of

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social media by terrorist organizations such as ISIS become one of the major concerns. It has been reported that such organizations are using social media to recruit, train and communicate with their followers. The social media platforms are the cheaper, effective and efficient means of communication due to which terrorism is using it significantly, [5] (Hossain, 2015). There is a range of studies that have been conducted for counter-terrorism to control the impact of social media presence of terrorism. However, these studies are limited to conduct geospatial counter-terrorism through social media. The existing studies are based on text mining which is used to extract the terrorist communication over social media and insight the future attacks. Text mining based social media analytics is limited to combat terrorism and to ensure a robust security scheme. It can only determine the perception of the terrorists and their supporters, sponsors, and sympathizers, [7] (Kolajo & Daramola, 2017). For the robust security scheme, it is important to integrate the text mining and geospatial based Social Media Analytics. Geo-Spatial Social Media Analytics is the solution that can address this limitation of the existing studies. It is an innovative solution which can ensure the robust security against terrorism threat to the vulnerable places [7] (Kolajo & Daramola, 2017).

2. Research questions

- How to perform Geo-Spatial Social Media Analytics for counter-terrorism in the era of increasing usage of social media by the terrorist groups?
- How to find the suspect involved in the terrorism using public data available over social media?
- How to enhance the specificity, sensitivity, and accuracy to find the suspects as compared to the existing approaches?

3. Ethics and significance of the research

This research would be significant to the intelligence agencies of the different nations to combat terrorism present on social media. The intelligence agencies can follow this study to insight the future attacks and plans to warrant the advance and robust security for the target location. It is an ethical research because there would be no extraction and usage of private data of any social media user. Only public data such as comments, posts, tweets etc. would be considered to

find the suspect over social media. There would be no invasion of privacy of any kind of social media user.

4. Literature review

The comparison of contributions of reviewed studies is shown in Table 1.

5. Literature gap

Although the existing studies are supportive enough to determine the terrorism and illicit activities over social media they are limited to ensure the collaboration of social media analytics and Geo-Spatial Analytics. Social Media Analytics is important to identify the suspected users over social media involved in terrorism. However, Geo-Spatial Analytics is important to identify the geographic network of terrorism to counter them for national and international peace.

6. Methodology and implementation

In the proposed research, a mixed approach (quantitative and qualitative) has been used to find the suspects involved in terrorism over social media, using sentimental analysis with the help of NLP. Along with this, using geo-spatial analytics, the locality of the suspect is also determined (Kaundal & Kaur, 2017, [6]). The designed research methodology has been implemented into NetBeans IDE 8.2. It is a graphical user interface and a java running platform. The end users of this research are enabled to use the controls embedded form for implementation and they would have no need to perform any kind of coding. Following are the details of implementation:

6.1. **Data collection.** Intially, the data has been collected from data.world, an online source. This data is related to a terrorist attack, took place in United States. It is composed of tweets and re-tweets of the Twitter (a social media) users; their location with geographic coordinates over globe; their number of followers; and their name details. Such data is used for finding suspect out of the commentators [14] (V. Lewis, 2017).

TABLE 1. Comparison of contributions of reviewed studies

Peer-reviewed Paper	**Contribution**
(Paul, Monica & Trishanka, 2017) [9]	Social Media Analytics for Data-Driven Decision Making
(Shaikh, Rangrez, Khan & Shaikh, 2017) [10]	Social Media Analytics for opinion mining
(Wamba, Akter, Kang, Bhattacharya & Upal, 2016) [11]	Social Media Analytics using informatics tool for sentimental analysis
(Balan & Rege, 2017) [3]	Social Media Analytics using NLP and computational analysis to identify subjective information from sourced data
(Kolajo & Daramola, 2017) [7]	Social Media Analytics using Apache Spark for opinion mining and sentimental analysis with the real-time data
(Arpinar, Kursuncu & Achilov, 2016) [1]	Social Media Analytics for counter terrorism and to counter extremism by finding suspect using NLP
(Chitrakar, Zhang, Warner & Liao, 2016) [2]	Social Media Analytics for counter terrorism using CNN (Convolution Neural Network) to classify and retrieve the images through probability score
(Tundis & Muhlhauser, 2017) [12]	Social Media Analytics for counter terrorism using Multi-language framework and web translation services
(Das Bhattacharjee, Balantrapu, Tolone & Talukder, 2017) [13]	Social Media Analytics for counter terrorism using Maximum flow algorithm and deep learning
(Cothren, Smith, Roberts & Damphousse, 2008) [4]	Geo-spatial analytics to identify the spatial pattern involved in terrorism activities using deep learning
(Medina & Hepner, 2009) [8]	Geo-spatial analytics for terrorism span
(Kaundal & Kaur, 2017) [6]	Linguistic analysis to find the similarity between the training data set and input data set

6.2. **Data acquisition.** It is the next stage to the data collection in which collected data is buffered into the memory of the machine to be used for the data processing.

6.3. **Pre-processing.** In this stage, the nominal conversion has been performed for converting string data into the real values in order to enhance the accuracy and efficiency.

6.4. **Data classification.** In this stage, regression mechanism is used for the data classification for finding and describing data classes and concepts. For predicting higher accuracy, it is integrated with the cross validation. Equation for data structure formation:

$$\sigma y = nb + m\sigma x,$$

$$\sigma y^2 = b\sigma x + m\sigma x^2.$$

Formation of matrix for cross validation:

$$\sigma y = n\sigma x,$$

$$\sigma y^2 = \sigma x\sigma x^2.$$

6.5. **Data analysis.** It analyzed the data structures those are classified in the previous stage. It is intended to check the utilized data format. The combination of NLP and Fuzzy logic is used in this to identify the suspect and to conduct the geo-spatial analytics over the classified data structure (Tundis & Muhlhauser, 2017, [12]).

6.6. **Data Visualization.** It is used to depict overall results of research in the terms of sensitivity, specificity, and accuracy.

7. Results and discussion

After complete data processing, the results have been identified in the favor of formulated research questions. Using above approach suspects have been identified along with their meridian location, with the help of social media data. Furthermore accuracy, specificity, and sensitivity have also been improved.

* Accuracy is the first parameter to express the research results. It is expressed in the form of true positive, false positive, true negative, and false negative.

  Equation:

$$\text{Classification}_{\text{Accuracy}} = N\frac{TP + TN}{TP + TN + FP + FN}.$$

* Sensitivity is the second parameter used to find the research results. It can be determined with the ratio of number of correct positive predictions to the number of positives.

  Equation:

$$\text{Senstivity} = \frac{TP}{P}.$$

* Specificity is the third parameter used to find the research results. It can be determined with the ratio of total negative predicted to the total number of negative.

  Equation:

$$\text{Specificity} = \frac{TN}{N}.$$

The comparison between accuracy, specificity and sensitivity of existing system (regression) and proposed system (regression with nominal conversion) is shown in Figure 7.

After analysis, the accuracy, specificity, and sensitivity of the proposed methodology has been identified as improved as compared to the existing methodology. In this research, regression classifier with the nominal conversion is utilized for counter terrorism. It is proved as better approach for finding the suspect on the basis of their comments and locations as compared to the simple regression.

8. Conclusion and future scope

For terrorism counter agencies it is highly important to have the geographic network of the terrorist groups. Thus, along with the opinion mining of the suspected users over social media, it is highly important to perform geospatial analysis. Opinion Mining can help to identify the suspected social media users who are involved in the illicit and terrorist activities to threaten national and international security. However, Geo-spatial analysis can help to identify the geographic network of the suspected users so that they can be encountered by

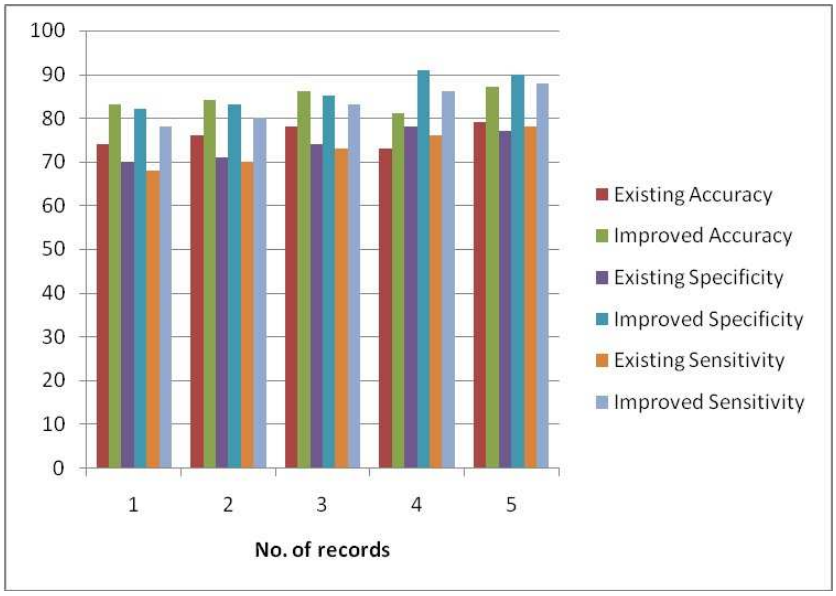

FIGURE 1. Comparison between accuracy, specificity and sensitivity of existing system (regression) and proposed system (regression with nominal conversion)

the defense forces. Thus, it is highly important to have hybrid solution i.e. integration of NLP for opinion mining and geo-spatial analysis to have a practical solution for counter-terrorism. It would help the combating agencies of the strengthen the security in advance for the targeted areas. In the future, the research can be modified by following the proposed mechanism for live data to be accessible using fog computing or edge computing for highly accessible (real-time) counter and detection.

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