Mapping of Tweet Location with Sentiment Analysis (SMTL)

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Abstract: Accumulating public view by exploring social media data has appealed to researchers due to its wide impact. The people behavior or reaction on certain events can be tracked by use of various text mining methods. In this paper, two new approaches for sentiment analysis for twitter data tidyverse and deep learning are proposed. The proposed methods are analyzed for two of Government of India decisions demonetization and removal of Article 370. The tweets are classified as positive, negative and neutral by calibrating scale for sentiment score. The glmnet classifier is used in deep learning approach for training the twitter text data. The proposed methods give promising results of people opinion about these two government decisions. The preprocessing considers TF-IDF features for modeling glmnet classifier. The user location of twitter users is mapped with use of GIS tools which shows overall impact of these events within the country and world. The results of proposed method show improved accuracy in determining positive and negative views of people.

Keywords: tweets, glmnet, deep learning, maps, tidyverse, GIS, sentiment analysis, demonetization, article 370

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1. INTRODUCTION

Sentiment Analysis refers to the use of Natural Language Processing (NLP) to determine the attitude, opinions and emotions of a speaker, writer, or other subject within an online mention. Brain of human being is able to classify text into either positive or negative. A common usage of sentiments comes from social media space to find out how persons feel about certain subjects, for example their tweets or Facebook or Instagram posts. Text mining [2] discovers how they react to events happening around them and analyse their view for ideas or images they view in day today life. Sentiment scores are rarely been used along with ggeospatial technology or spatial analysis.

Twitter user location [1][13] is an example of spatial data which can be correlated with actions or events happening in surroundings. The interrelationship between these factors can determine the socio-economic impact spread over the country and world. The integration of these two technologies is useful for future trends or policy building of the nation.

Two of Government of India declaration of demonetization in year 2016 and removal of Article 370 in 2019 give social media hype. Demonetization of currency means that Reserve Bank of India has withdrawn the old Rs. 500 and Rs. 1000 notes as an official mode of payment. Demonetization [5]is the act of scraping a currency unit. The main reasons for demonetization are,

1. To tackle black money in the economy
2. To lower the cash circulation in the country
3. To eliminate fake currency and dodgy funds which have been used by terror groups to fund terrorism in India.

The people affected mostly by this decision includes daily wage labourers, women, students, small vendors,

shop keepers etc. basically belonging to the lower and middle class families for whom cash is the primary mode of payment for their day to day activities. The remote areas of country, having no bank accounts and no identification proofs are in difficulty. The survey is conducted to assess the level of difficulty people are facing because of demonetization. About 58% persons responded high level of difficulty and rest 42% responded as impact is quiet modest on their daily activities like purchase of eatables, transport, health care, beauty products, entertainment, and shopping.

The Government of India revoked the special status, or limited autonomy, granted under Article 370[6] of the Indian Constitution to Jammu and Kashmir On 5 August 2019.Article 370 of the Indian Constitution is a 'temporary provision' which grants special autonomous status to Jammu & Kashmir. Under Part XXI of the Constitution of India, which deals with "Temporary, Transitional and Special provisions", the state of Jammu & Kashmir has been accorded special status under Article 370. All the provisions of the Constitution which are applicable to other states are not applicable to Jammu & Kashmir. It restricts Parliament's legislative powers in respect of J&K. The citizens of Jammu & Kashmir and relationship between India and Pakistan are major concerns for it. Social media especially twitter is flooded with tweets on these two topics. The location of twitter users is important aspect to judge the impact of these two government decisions.

2. REVIEW OF LITERATURE

Sentiment analysis [8] uses methods, techniques for detecting and extracting subjective information in terms of opinion and attitudes, from language. Traditionally, sentiment analysis has been about opinion polarity [9] that is whether someone has positive, neutral, or negative opinion towards something. In general, the object of sentiment analysis has typically been a product or a service whose review has been made public on the Internet. This might explain why sentiment analysis and opinion mining are often used as synonyms, although, persons think it is more accurate to view sentiments as emotionally loaded opinions.

The curiosity on other's opinion is probably almost as old as verbal communication itself. In the past, leaders have been using conspiracy with the opinions of their subordinates to either prepare for opposition or to increase their popularity. Voting as a method to measure public opinion on policy has its roots in the city state of Athens in the 5th century BCE Efforts in capturing public opinion by quantifying and measuring it from questionnaires.The outbreak of modern sentiment analysis happened only in mid-2000's, and it focused on the product reviews available on the Web, since then, the use of sentiment analysis has reached numerous other areas such as the prediction of financial markets and reactions to terrorist attacks. Additionally, research overlapping sentiment analysis and natural language processing has addressed many problems that contribute to the applicability of sentiment analysis such as irony detection and multi-lingual support.

Even if linguistics and natural language processing have a long history very little research had been done about people's opinions and sentiments before the year 2000. Since then, the field has become a very active research area. There are several reasons for this. First, it has a wide arrange of applications, almost in every domain. The industry surrounding sentiment analysis has also flourished due to the proliferation of commercial applications. This provides a strong motivation for research. Second, it offers many challenging research problems, which had never been studied before. Sentiment analysis is now right at the center of the social media research. Hence, research in sentiment analysis not only has an important impact on NLP, but may also have a profound impact on management sciences, political science, economics, and social sciences as they are all affected by people's opinions.

Sentiment analysis in Text mining ranges from document-level classification to the polarity of sentiment words and phrases [14]. Classifying the sentiment of Twitter messages is most similar to sentence-level for up to one sentence limited size and paragraph for more than one sentences. Classification of tweets with polarity method having the sentiment strength scales from +1(least positive) to (+5 most positive) and (-1 least negative) to (- 5 most negative) [8].

The basic contributions for twitter sentiment classification are categorized into four categories:

1. Opinion-based approach [8] (positive and negative, neutral and one more class unsure.
2. Context classes
3. Three classes (Left, Ambiguous and Right)
4. Pros and Anti

Second one is Volume-based approach, prediction based on retweet volume and behaviour of users. Third one is Opinion and Volume (OV)-based approach [9] is combination of both opinion mining and volume based approach. Hu and Liu's opinion lexicon method classifies words as positive and negative and another

dictionary of words is list of AFINN-111 that score the words range from strongly positive as + 5 and strongly negative as -5.Emoji-based approach [10]based on the emoji the categorizes are happy, sad, fear, laughter, and angry.

3. PROPOSED METHOD STAGES

Sentiment analysis model is proposed based on stages as collection of tweets using twitter API. The twitter is API is accessed by user using user credentials such as consumer key and secret. Tweets are saved as text corpus that is collection of text. The location of twitter users is captured by using the attribute screen name. The longitude and latitude are plotted as spatial coordinates using maps. Fig.1 illustrates the stages of proposed model.

The hashtag for capturing tweets related to demonetization is #demonetization and total number of tweets captured (10844 tweets). The hashtag for capturing tweets related to Article 370 is #article370, #RedForKashmir and #kashmir total number of tweets captured (600 tweets).The extracted tweets from twitter are preprocessed by removal of special characters, punctuation, hyperlinks, digits and RT (retweet). The processed tweets corpus is saved as .csv file. In generalized approach for sentiment analysis Sentiment analysis for tweets is carried out in two ways:

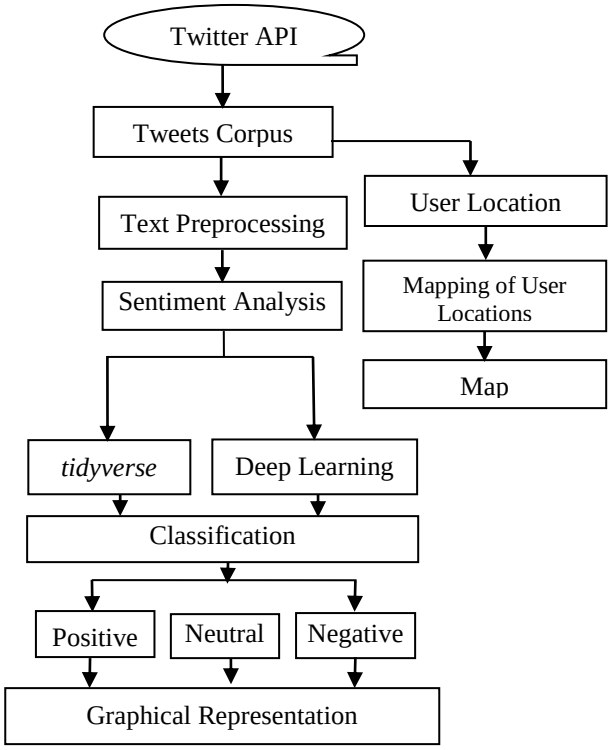

Figure 1: Stages of proposed model

3.1 tidyverse Approach

Data Science has *tidyverse* [7] as an opinionated collection of R packages . The collection of all packages share an underlying design philosophy, grammar, and data structures. The tweets are tokenized with *tidyr* functions. The tokens are stored as unique words and it is associated with unique id. The sentiment score for each word is counted and positive and negative tweets are separated.

Table 1 shows the result of sentiment analysis for Article 370 using *tidyverse* approach. Table 2 shows sample result of text preprocessing stage along with original tweet captured via twitter API. For Article 370 using *tidyverse* approach positive sentiments are more than negative sentiments. Table 3 and 4 shows the Article 370 top five Negative Sentiment sentences and top five positive Sentiment sentences along with sentiment score with *tidyverse* approach.

Table 1: Sentiment Analysis for Article370 using *tidyverse* approach

Sentiment Analysis for Article370		
Negative	**Neutral**	**Positive**
109	391	143

Table 2: Text preprocessing stage for Article370 tweets

Article 370 tweets preprocessing stage		
Original Tweet	**Action**	**Output**
@ANI Horrible, Except of #Kashmiri, Indian are celebrating to revoke on #Article370 , but #Kashmiris are still crying https://t.co/yz	Text preprocessing	Horrible, Except of Kashmiri, Indian are celebrating to revoke on Article370 , but Kashmiris are still crying

Table 3: Article 370 top five negative sentiment sentences along with sentiment score with *tidyverse* approach

Article 370 negative sentiment sentences along with sentiment score		
Sr. no.	**Tweets**	**Score**
1	Indian Government is beleaguered by fanatic fundamental anti Muslim Hindus not allowing Modi resolve Kashmiri issue n others with Pakistan	-1.35
2	Withdraw media curbs in Kashmir' Journalists in Chennai will hold a protest meeting at the Madras Reporters	-1.30
3	In a first such incident after the abrogation of Article terrorists on Monday abducted two members of the Gujjar	-1.25
4	Protest forces Army to lift siege in Kulgam village	-1.20
5	In indian occupied kashmi Crpf .Guilty concious have commited sucidrs raising toll to 228 in last 7 years	-1.10

Table 4: Article 370 positive Sentiment sentences along with sentiment score with tidyverse approach

Article 370 negative sentiment sentences along with sentiment score		
Sr.no.	**Tweets**	**Score**
1	Happy and proud of Governent	2.35
2	Good news after Article370 removal	2.20
3	Good that they have started releasing political detainees.	1.90
4	Had the pleasure to Join a Padyatra celebrating the abrogation of Article370 and 35A in J&K at Banaskantha today.	1.85
5	Factual, crisp, and brilliantly delivered. Dispelling a whole bunch of the fabricated narratives around special statement	1.82

Figure 2 shows the graphical representation of positive and negative sentiment scores for Article370 tweets.

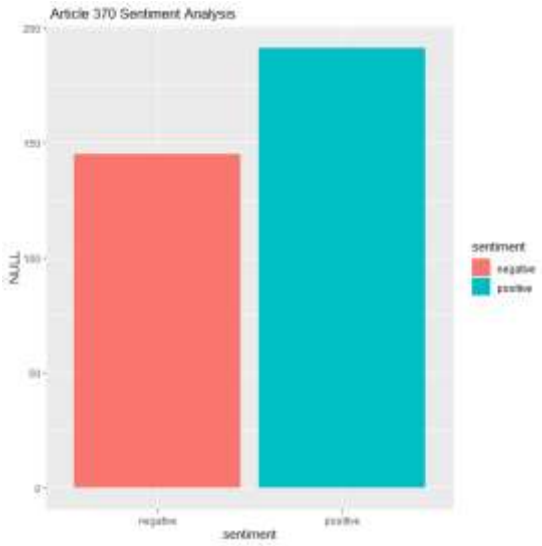

Figure 2: Article 370 sentiment analysis (positive and negative)

Table 5 shows the result of sentiment analysis for Article 370 using *tidyverse* approach. The negative sentiments are more than postive sentiments. Table 6 and 7 shows the Article 370 top five negative sentiment sentences and top five positive Sentiment sentences along with sentiment score with *tidyverse* approach.

Table 5: Sentiment analysis for demonetization with *tidyverse* approach

Sentiment Analysis for Demonetization tidyverse approach		
Negative	**Neutral**	**Positive**
4678	2148	4018

Table 6: Demonetization top five Negative Sentiment sentences along with sentiment score with *tidyverse* approach

Demonetization negative sentiment sentences along with sentiment score		
Sr.no.	**Tweets**	**Score**
1	I am no fan of demonetization but to give d devil its due it clearly brought outfact Magnitude of corruption is that of Ebola virus	-4.25
2	Ministry of Finance Government of India is launching ad campaigns on Demonetization	-3.60
3	Decision of demonetization infest to lead in upcoming elections cause NDA chance comes to Up seats	-2.75
4	why does one need to pay a convenience fee for forced cashlessness demonetization	-2.60
5	So lottery and laddoos have been offered as perks of demonetization Theres another L word missing here"	-2.55

Table 7: Demonetization top five positive Sentiment sentences along with sentiment score with t*idyverse* approach

Demonetization positive sentiment sentences along with sentiment score		
Sr.no.	***Tweets***	***Score***
1	Demonetization does not deserve Demonization. It will take time to mature like all sweet fruits. When Demonetization Matures, all benefit.	3.60
2	3 Weeks After #Demonetization, Five Practical, Rational, Effective Steps That Need To Be Taken To Curb Black	3.30
3	Go with a safe and convenient payment option to ease cash crunch	2.90
4	Govt. is trying to give democratic power to honest, hardworking and compassionate citizens compassionate citizens through #demonetization. They must respond boldly.	2.80
5	RT @udaytharar: Post #demonetization & #Trump election victory, till date INR has been pretty resilient. In fact better than #EmergingMarke…	2.75

Figure 3 shows the graphical representation of positive and negative sentiment scores for demonetization tweets. The sentiments of tweets are classified as 10 emotions as anger, anticipation, disgust, fear, joy, ssadness, surprise, trust, negative and positive. Figure 4 and Figure 5 shows the graphical representation of these emotions for Article 370 and demonetization tweets.

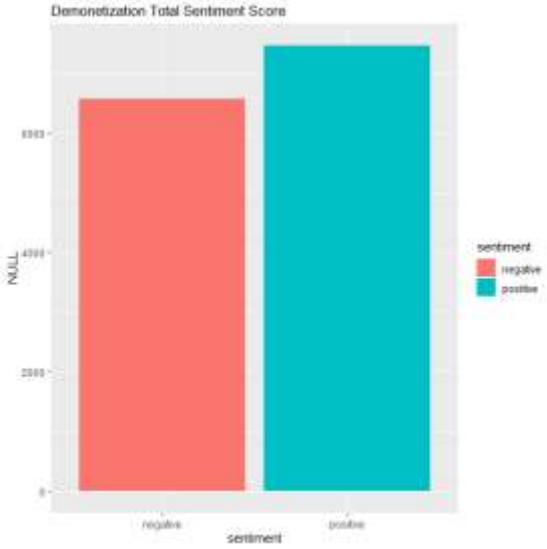

Figure 3 : Demonetization sentiment analysis (positive and negative)

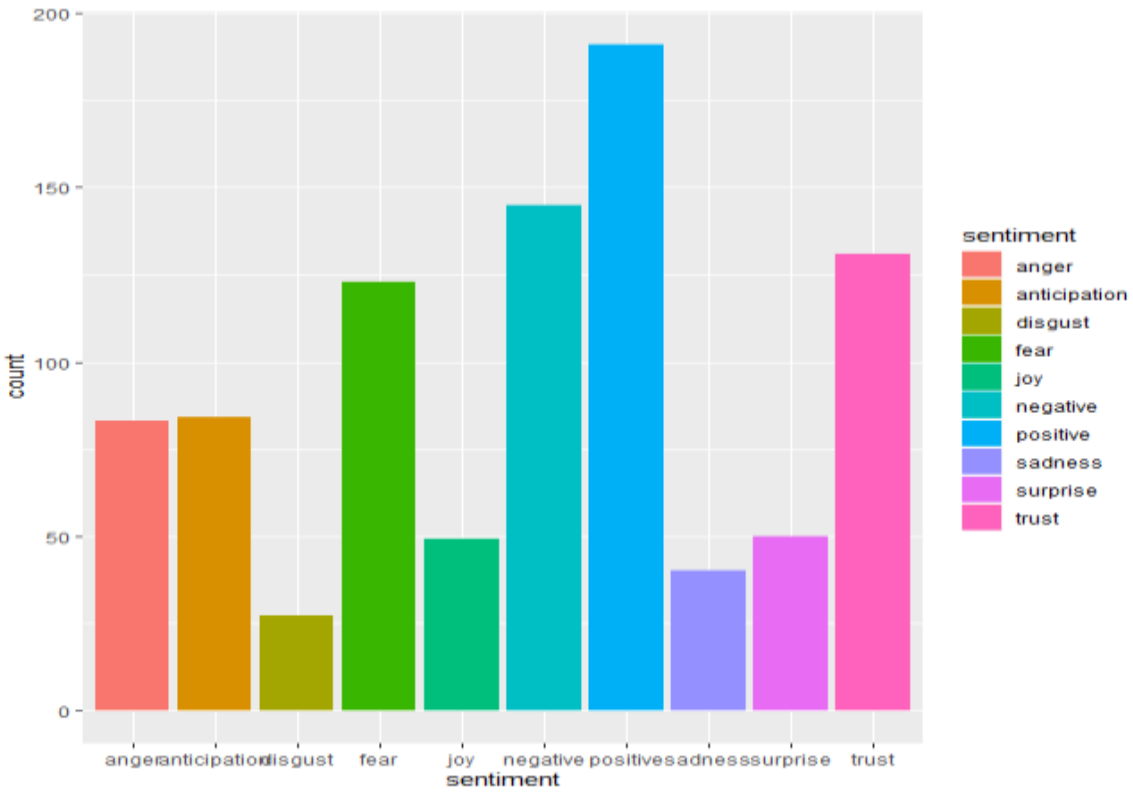

Figure 4 : Emotion classification for Article 370 using tidyverse approach

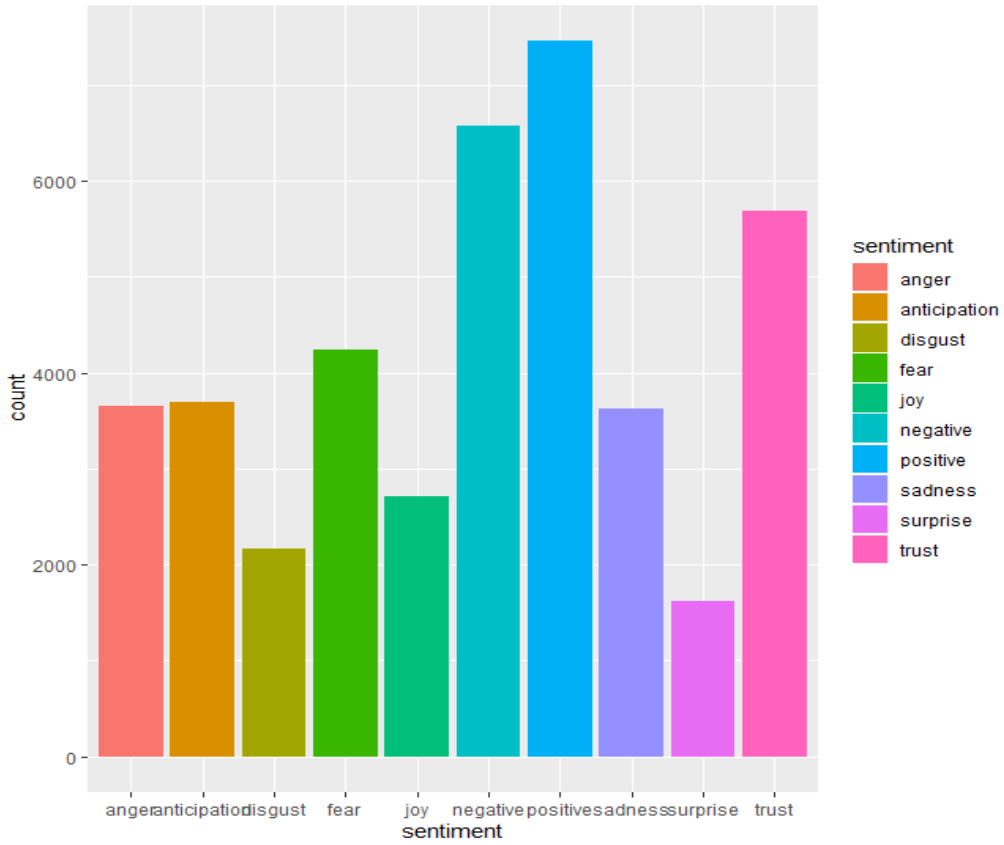

Figure 5 : Emotion classification for demonetization using tidyverse approach

3.2 Deep learning Approach

Deep learning algorithm text to vector draws meaning from sentences. This is one of best ways of sentiment classification. The use of this algorithm is for movie reviews, feedbacks and sales forecasting. The results are excellent for tweets because it includes lots of spelling mistakes.

Set of 1.6 million classified tweets are used for training a model. The classifier algorithm is *glmnet* [12] giving accuracy up to 87%. The range of sentiment score is 0 for negative and 1 for positive, if score >= 0.35 and <= 0.65 are neutral. The text preprocessing method is TF-IDF .Model is trained and validated for use. Table 8 shows top five negative sentiment sentences along with sentiment score and Table 9 shows top five positive Sentiment sentences along with sentiment score with deep learning approach for demonetization.

Table 8: Demonetization top five negative sentiment sentences along with sentiment score deep learning approach

Demonetization negative sentiment sentences along with sentiment score		
Sr.no.	**Tweets**	**Score**
1	It happens only in India. People dying...Badly executed. Amounts to murder!!	0.000
2	Support ur every step so did with demonetization but seems like it won't work,can't bring black money ever as I feel,,chaoseverywhere	0.000
3	nobody disagrees with poor implementation. But Demonetization is out on a killing spree is just plain ridiculous.	0.000
4	why does one need to pay a convenience fee for forced cashlessness demonetization	0.001
5	What is worse than #DeMonetization failure? Making RBI lie about the data! #Shame	0.001

Table 9: Demonetization top five positive Sentiment sentences along with sentiment score deep learning approach

Demonetization positive sentiment sentences along with sentiment score		
Sr.no.	**Tweets**	**Score**
1	demonetization has done something wonderful...great report	0.992
2	Inspiration DeMonetization Cashless and worry-free in AP	0.976
3	Benefits of Cashless It's pleasure to for it.in	0.967
4	Great ,Ab toh demonetization is a super duper whopper success !	0.966
5	people are very happy with currencyban n demonetization.	0.965

Table 10 shows total number of positive ,neural and negative tweets for demonetization with deep learning approach if rounding up to two digits after decimal points is considered (assume 0 as completely negative and 1 as completely negative), total number of negative sentiments are more than positive sentiments ,prediction is matching with tidyverse approach .

Table 10: Total sentiment analysis score for demonetization deep learning approach

Sentiment Analysis for Demonetization Deep Learning Approach		
Negative	**Neutral**	**Positive**
6528	1524	2792

Table 11 shows top five negative sentiment sentences along with sentiment score and Table 12 shows top five positive Sentiment sentences along with sentiment score with deep learning approach for article370.

Table 11: Article 370 top five Negative Sentiment sentences along with sentiment score deep learning approach

Article 370 Negative Sentiment sentences along with sentiment score		
Sr.no.	**Tweets**	**Score**
1	In Kashmir, a Race Against Death, With No Way to Call a Doctor	0.000
2	Because Abrogation of Article370 was out of syllabus. Never prepared for it. & now it has gone out of hands.	0.000
3	I don't..please count me as exception and many like minded Indians are against abrogation	0.000
4	I will continue to be an activist and raise my voice against injustice	0.001
5	After India's historical scrapping of Article370, the entire world has snubbed Pakistan	0.001

Table 12: Article 370 top five positive sentiment sentences along with sentiment score deep learning approach

Article 370 positive sentiment sentences along with sentiment score		
Sr.no.	**Tweets**	**Score**
1	demonetization has done something wonderful...great report	0.992
2	Inspiration DeMonetization Cashless and worry-free in AP	0.976
3	Benefits of Cashless It's pleasure to for it.in	0.967
4	Great . Ab toh demonetization is a super duper whopper success !	0.966
5	people are very happy with currencyban n demonetization.	0.965

Table 13 gives total number of positive ,neural and negative tweets for Article 370 with deep learning approach if rounding up to two digits after decimal points is considered (assume 0 as completely negative and 1 as completely negative), total number of positive sentiments are more than negative sentiments ,prediction is matching with *tidyverse* approach .

Table 13: Total sentiment analysis score for Article370 with deep learning approach

Sentiment Analysis for Article370		
Negative	**Neutral**	**Positive**
153	195	345

After comparison of values in Table 10 , Table 5 and Table 13, Table 1 for Deep learning approach and tidyverse approach respectively the total number of sentiment score is more accurate for deep learning approach as number of neutral tweets are reduced they are either classified as positive and negative sentiments. Deep learning approach gives more accurate results as compared to *tidy verse* approach.

In general approach for Sentiment analysis consists of classification techniques such as machine learning approach, lexicon based approach and hybrid approach. The *Machine Learning Approach* (*ML*) (subclasses are supervised and unsupervised learning) applies the famous ML algorithms and uses linguistic features. The *Lexicon-based Approach* (subclasses are dictionary based and corpus based) relies on a sentiment lexicon, a collection of known and precompiled sentiment terms, uses statistical or semantic methods to find sentiment polarity. The *hybrid Approach* combines both approaches and is very common with sentiment lexicons playing a key role in the majority of methods .These methods are implemented using Python, C++, JavaScript, Java, C#, Julia, Shell, R, TypeScript, and Scala programming languages.

3.3 GIS Mapping

A geographic information system (GIS) [11] is a structure for collecting, managing, and evaluating data. Using basic science of geography, it integrates many types of technologies along with data. Spatial location coordinates information is visualized using maps and 3D scenes.

GIS discloses deeper perceptions into data in the form of patterns, relationships, and situations which helps users for making decisions. Maps can be useful in understanding the variety of social structures. They can reveal the structures of the crowd and highlight strategic locations or roles in these webs of connection.

By mapping social media user spaces researchers and practitioners can learn about the most common and best uses for these communication services. The location information for twitter users is stored in the separate column user location. Location of users is found using screen name of twitter user. The coordinates are obtained by matching the cities and states in the column with the exact coordinates through Google Map API. OpenStreetMap[3] is used

for plotting of maps of India and World using spatial coordinates for cities giving topmost user counts.

The unique cities count for demonetization tweets is obtained. The cities are further separated as cities in India and world. Table 14 gives top 7 cities in India reacting for demonetization.

The overall impact of users reaction about demonetization shows that Mumbai that is also called as money capital of India, it has highest numbers of users reacting over this topic as well as the foreign countries especially nonresident Indians which are spread all over the world are tweeting on the topic .The red dots size in map in figures below shows the number of users strongly reacting on this topic.

Table 14: Twitter user count in India for Top 7 cities for demonetization

Twitter User Count in India		
Sr.no.	**City**	**Twitter User Count**
1	Chennai	28
2	Ahmedabad	29
3	hyderabad	35
4	Pune	41
5	Bangalore	73
6	New Delhi	100
7	Mumbai	132

Table 15 gives top 10 cities in world tweeting about demonetization. The maps visualization of users for twitter adds extra functionality to research. Mapping social media networks can enable a better understanding of the variety of ways individuals form groups and organize online. Maps of Twitter users have illustrated connection around different kinds of topics.

The capital of India, New Delhi also has second highest number of users. The capitals of all states are in the list. The urban people are most active users on twitter than rural background, it reflects in the count of users who tweeted on this topic. They are educated and react mostly on social media.

Table 15: Twitter user count in India for Top 7 cities for demonetization

Twitter User Count in World		
Sr.no.	**City**	**Twitter User Count**
1	Sydeny	10
2	London	14
3	Dubai	6
4	New York	6
5	Singapore	6
6	Washington DC	6
7	San Francisco	5

The visual impact by use of maps is more powerful than theoretical one. Figure 6 shows Map of India for Twitter users for #demonetization for top 7 cities and Figure 7 is world map of Twitter users for #demonetization for top 7 cities.

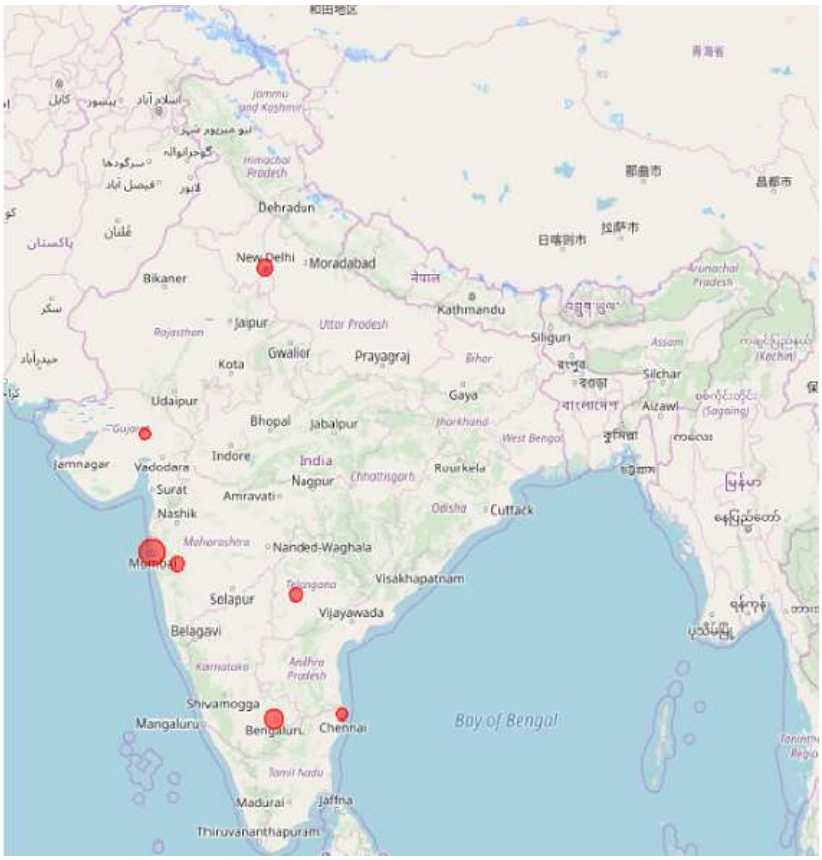

Figure 6: Map of India for Twitter users for #demonetization for top 7 cities

Figure. 7: Map of World for Twitter users for #demonetization for top 7 cities

4. CONCLUSIONS

Sentiment analysis on twitter is effective in predicting people attitude on social economic topics. Two new approaches for computing the sentiment score of users is proposed in this paper. After comparison of number of positive ,negative and neutral sentiment scores, deep learning approach is more accurate for analysis of user sentiments. The *tidyverse* approach counts user sentiments in terms of words sentiment score, the tweets are classified as emotions: anger,anticipation,disgust,fear, joy,sadness , surprise,trust, negative, positive. Sentences are tokenized for count of sentiment score.

In deep learning approach, classified tweets are used for training a model. The *glmnet* classifier is used form a model. The range of sentiment score is fixed for positive, negative and neural sentiment. The preprocessing of text also includes TF-IDF. The pperformance of this approach shows some excellent results. The user location for twitter users is plotted with help of GIS methods.

5. FUTURE WORK

As the research considers only Twitter data, future work can include other social media data such as Facebook and WhatsApp. Proposed approach uses small sample, a more global and efficient model is to be designed for larger volume of data. Twitter sentiment analysis using NLP techniques observes language barriers this has also been identified in terms of future scope. Information from micro-blogs, blogs and forums as well as news source, is widely used in sentiment analysis recently. Using social network sites and micro-blogging sites as a source of data still needs deeper analysis. In many applications, it is important to consider the context of the text and the user preferences therefore there is need to make more research on context-based sentiment analysis. Using language processing tools to reinforce the sentiment analysis process is considered in future as it still needs some enhancements.

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