A lucrative model for harnesssing the power of Social Media in Disaster Management

Shubham Deshpande[1]
shubhamdeshpande123@gmail.com

Revati Ganorkar[1]
revatisganorkar@gmail.com

Mayur Giri[1]
mgiri6612@gmail.com

Gaurang Suki[1]
gaurang210498@gmail.com

Araddhana Deskhmukh[2]
aadeshmukh@sinhgad.edu

[1]Student, Department of Computer Science, S.K.N.C.O.E, Pune
[2]Ass. Professor, Department of Computer Science, S.K.N.C.O.E, Pune

Abstract -

In today's world, online social media has established itself as one of the most significant information carriers, and that spread over the field of disaster management as well. However extracting noteworthy information from online social media like YouTube, Twitter and Facebook is challenging. Due to this disaster management authorities and citizens in disaster prone areas face problem. To reduce this problem, we propose a platform that collects information from these media and encapsulates them to give relevant information which would be more precise and accurate. In addition to this, a SMS will be sent to all the mobile phones, in case of emergent situations. Thus the practice of textual message services will be extremely beneficial as it can directly inform people during emergencies. As the information interpreted by this platform would be a collection from various social media, misinformation and spam messages can be reduced up to a great extent. Hence, to enhance the capabilities of social media in disaster management we have proposed a model which combines different characteristics of social networking sites.

Keywords – Facebook, Twitter, YouTube, Social media, Disaster Management

I. INTRODUCTION

In recent years, social media has proved to be a prominent, real-time communication channel to share information especially during the times of calamities and natural disasters. Social networking sites such as Facebook, Twitter and YouTube plays a crucial part in emergency preparedness and disaster management. During natural disaster, such as earthquakes, tsunamis or hurricanes, dissemination of information is much important, as it helps in mitigating the stress, providing social support to victims which are directly or indirectly affected by such disasters, and also provide important information which can be valuable to cope up with the these disasters. The information obtained through the social networking sites is proved to be beneficial. Replacing the traditional communication means such as Telephones, Newspapers and News channels with social media, has significantly increased the rate of information exchange over the world and most importantly between the disasters affected communities and emergency responders.

As we cannot depend on the physical hardwired connection during any natural calamity, social networking sites become the prominent tool for information sharing. They provide a platform for the users to share or post their views, information during disasters. Facebook and Twitter are two of the most popular social media, used for social networking. They are proved to be the best tackles for connecting people across world. YouTube provides a platform for uploading, sharing videos and music among friends and families. Disaster management authorities are using social platforms to increase public awareness, to give prior warnings, to alert the public in emergencies, and fast recovery processes.

The increase in usage of social media have resulted in an increase in data, known as “Social Media Big Data”. Social media platforms allows sharing of information in various format such as textual, images and videos.

II. LITERATURE SURVEY

A. Previous Work

Social media might be a boon to the community but extracting information indicating disaster is quite a challenge.

In [3] J. Rexiline Ragini, P. M. Rubesh Anand, focus was on building an automatic text classification system which isolates the tweets according to the various needs of public at the time of disaster. They proposed a framework which consists of three phase viz. Labeling phase, Feature selection phase, Machine learning phase.In these three phases' tweets are categorized, filtered and classified using various algorithms like Support Vector Machine and Naïve Bayes algorithms.

In [4], a case study of Nepal earthquake was studied to analyze the problem. Twitter data related to earthquake was filtered and analyzed using crisis-Tracker (An open source web platform used for harvesting tweets during disasters).The control on what topic to collect is done in back-end through MySQL.

In [9] Doan S., Vo BK.H., Collier N, Tohoku earthquake was the disastrous earthquake which struck Japan in 2011.It caused tsunami and nuclear accidents. The information about emergencies was tracked using both English and Japanese tweets. The Japanese tweets were in excess compared to English tweets. To analyze tweets simple parser in Python was used to parse the text and use relevant keywords for filtering. As a result, twitter tweet data can be useful in prior warnings as well as a tool for analyzing situations and conditions during times of disasters.

In [11] a sentiment classification was done of user tweets as positive, negative and neutral in Twitter during the Hurricane Sandy and visualizes these sentiments on a map. The authors demonstrated the change in user's sentiments according to user's locations and the distance from the disaster. The research consisted of three parts extracting, grouping raw data and visualizing useful information and integrating both the information and its visual display according to responders needs. The sentiments during disaster helps people to develop superior situational awareness about the disaster zone.SentiStrength algorithm was used to classify tweets which give two scores a positive score from 1 to 5 and negative from -5 to -1 .Neutral is from +1 to -1.They integrated the sentiment of tweets with their geo-locations. SVM (Support Vector Machine) algorithm used to label remaining tweets as positive and negative. Projections of all tweets were plotted on Map .It was inferred that positive and negative tweets were clustered a point of Sandy's maximum impact.

In [13] Dennis Thom, Robert Krügerand Thomas Ertl, a real-time Twitter analysis during crisis related to the operational crisis management: This assay was performed with the help of an information extraction tool to nearly 97,000 tweets. When the storm hit the festival, Twitter tweets increased exponentially upto 576/minute. The extraction tool empowered analyzing tweets through predefined methods such as (geo) graphical displays, message content filters (damage, casualties) and filters like twitter. Twitcident is a system based on web. It automatically sorts, find and analyzes tweets related to various events. Graphical display is used to displays the number of tweets that are recognize by the search query/min. Graphical display can be used to display sudden rise in tweets which clearly indicates that something has attracted people's attention that might be worth monitoring. A way of analyzing twitter messages by presenting key relevant methods like Burst detection, Tweet filtering, Evaluation, Online clustering and geo-tagging which facilitate to enhance the awareness of time critical situation. Further evaluation can be done by Accuracy matrix and Time split Evaluation. After the classification of tweets validation of tweet is done. There are various algorithms like 10-fold cross validation, Border-split cross validation, Time split validation, Time border split validation, and Neighbor split validation.

B. Data Storage and Algorithms used

Data Storage during disaster is crucial task. Data stored in database must be retrieved efficiently in order to be used in disaster management.

Twitter: New tweets are stored in internal system named as T-bird which used Gizzard as base.T-Flock is used for storing secondary indexes. UIDs are assigned for each tweet by snowflake.FlockDB stores relationships between IDs and and is used for ID to ID mapping. Gizzard is distributed data storage framework used by twitter. Along with MySQL, Cassandra, Hadoop and Vertica are used [20].
Old Tweets from same data range are stored together on same shard. Tweets are stored on machines one after another. [20]

Facebook: Facebook uses data storage system called Presto which is built on the top of Haddop. It also uses community version of MySQL which Facebook has optimized for its own use.Memcached is used to minimize access time. Haystack is used for photo storage. Cassandra is used for inbox search. [19]

YouTube: MySQL database with sharding.Videos are stored in Content Delivery Network.

Social networking sites uses different algorithms for efficient data retrieval and real time data updation.

1. **EdgeRank:-**This algorithm was utilized by Facebook to decide which posts to be viewed in user's news feed. It determines which stories will be shown in each user's newsfeed depending on the content that user is interested in.This algorithm was used till 2011. [18]

2. **ML based algorithm:-**

Facebook now uses machine learning based algorithm which determines past behavior to predict action probabilities for most engaging stories for users and put them on top. There are numerous factors such as number of likes, comments, media types, and author of the post and interactivity of post from which algorithm makes decision on which article is to be shown in the beginning. [19]

C. Use of Social media in Disaster Management

Social Media is mostly used to make connections with friends, family, customers and clients but its value as an information source cannot be neglected. Social Networking Sites are increasingly being used not only to build and maintain social networks, but also as a tool which can reach millions with in a second, helps both before and after disaster has occurred. Following table shows how social media was used during disaster management in recent years.

Reference	Disaster Name	Platform used	Media used	Advantages	Disadvantages
[5]	Ya'an Earthquake	Twitter	Tweets	tweets related to eq,aftershock,landslide,collapse buildings,food,relief,shelter is etc were circulated through social media	No disadvantages as social Media was used efficiently in spreading information.
[6]	Thai Floods	Twitter ,Facebook	Tweets,Posts, Facebook	Situational Awareness, requests for assistance, announcements for support, requests for information was possible through social media	social media was used for political issue during disaster.
[7]	Haitian Earthquake	Twitter	Text	Disaster survivors used social media to tell their story,Twitter, however, primarily was not used to obtain news about the disaster.	Accuracy of information needs to be constantly checked and validated. This is difficult because of huge amount of data.
[7]	Huricane katrina	Websites, location specific apps	Text,Images,Tweets	Disaster survivors used the Internet to activate other social networks.	During this disaster social media was not emerged fully.Therefore it was difficult to utilise it fully.
[8]	Calgary flood	Facebook,Twitter, Instagram	Text,Video clips	The Canadian Red Cross (CRC) used social media for fundraising, information sharing, reputation management, and responding to questions from people affected by the floods	Misinformation about the disaster situation and rumours were the major disadvantages
[17]	New Zealand earthquake	Twiiter,Facebook	Images ,Videos	Information relating to earthquake was circulated quickly through social media .Various posts incuded how to protect and be safe during an earthquake	Data management and its efficient retrieval was a real challenge
[8]	Christchurch earthquake	Facebook,Twitter	Text,images	The affected community was able to not only communicate with the emergency management officials directly, but also self-organize to assist in recovery efforts, as evidenced by the 10,000 Student Volunteer Army organized via Facebook which assisted with clean-up, manned call-centers and distributed supplies	Social media was used systematically for spreading information about the earthquake so no major disadvatages.
[10]	Joplin Tornado	Facebook	Text,Images,Videos	All posts were verified beforehand, accuracy was key , Rumor control,quick response, volunteer enquiry	Verification and validation of posts and messages to control rumours and misinformation was a tough job because of large data set
[11]	Hurricane Sandy	Twitter	Tweets,texts	The tweets were classified as positive,negative and neutral and then visualized on map and found out that sentiments varied as we go away from the epicenter of earthquake	Internet Connectivity was a major problem
[8]	UK riot	Facebook,Twitter, Blackberry Messenger	Text,Images,videos	Situation got even worse because of rumours and misinformation	There are no disadvantages since there was a efficent use of social media for spreading information.
[16]	Typhoon Morakot	Twitter	Text,Images,Videos	During Typhoon Morakot, The Association of Digital Culture Taiwan established an unofficial Morakot Online Disaster Report Center. They then asked people in the areas affected by the typhoon to monitor Twitter and other SocialMedia sites andpost information on damage and people in need of assistance to the Online Disaster Report Center. The day after this report center was established itwas integrated into the Taiwanese government's official communication systems	Lack of preparedness as well as a lack of internet access insome parts ofthe country. The government hadn't yet adopted astandardized method of using Social Media.This caused the Taiwanese people to look to the websites of non-government organizations for information on the disaster
[13]	Chennai Floods	Twitter,Facebook	Tweets,Posts	Created awareness about the flooded regions and the regions to avoid and various NGO's helped during floods.Rehabilation is possible through social media.	Rumuors was the major problem faced
[15]	Japan Earthquake	Twitter,Facebook, YouTube,Mixi	Images, Videos	Use of facebook for information sharing.Simple online searching information using email.Experts can interact directly with commoners.	Mass amounts of information can be difficult to sort. Some messages needs response immediately.Tone of message cannot be determine.Short messages may leave out important information.Inaccurate info
[9]	Tohoku earthquake	Twitter	Tweets,posts	Japanese and English tweets were compared and it was conclude that native language tweets played an import role during disasters	Social media revealed that foriegn people came to know about earthquake a little later than Japanese people
[14]	Hurricane Sandy	MySpace,Twitter , Facebook,Youtube	Text,Images,Videos	Government agencies turned to mobile and online technologies. Before, during and after Sandy made landfall, government agencies throughout the Northeast used social media to communicate with the public and response partners, share information, maintain awareness of community actions and needs, and more.	Throughout the course of the storm, misinformation and doctored photographs circulated on the Internet, made it difficult to find and verify accurate information.
[10]	Boston bombings	Twitter	Text,Images	Police communicated using social media, less rumours	Problems - validatiom of info, release of correct information
[4]	German Floods	Twitter,Facebook	Tweets,Posts	There was vital info on net but no means of accessing it .scatterblog was used	Through scatterblogs on;y numerically comparable values can be plotted
[3]	Nepal Earthquake	Twitter	Tweets,texts	People helped from all around the world .Many people volunteered for helping the victims through social media.International relief agencies, such as Doctors without Borders and the Red Cross were able to start the evacuation of victims by helicopter.	False rumors that another earthquake is confirmed was circulated.Other Rumours included that Being Human foundation from India donated money for victims .Also well know football player Ronalo donated a huge sum of money was circulated through social media.

Figure 1: Table, shows which and how social media was used in Disaster management and advantages and disadvantages in using it.

In the above Figure 1, different platforms, types of media used and its advantages and disadvantages during disaster management is mentioned. From 2009, there have been a rapid growth in the use of social media. It can be inferred from the above table that social media was used during disasters in many ways like using the safety check feature, geo-tagging and spreading awareness through social sites. Information can be disseminated during disasters mainly in the form of text and posts which includes people asking for help, disaster prone areas and rescue operations. Social media was advantageous in many ways like people used social Media for communication, disaster survivors used social media to tell their stories, people used it for fundraising, relief groups etc. But there were some disadvantages of social media like spreading of misinformation and rumours, spam messages, connectivity problems and many more.

Considering the disadvantages we have proposed the following model in which we have tried to overcome the drawbacks of social media and to maximize its disaster management capabilities.

D. Limitation

Social networking sites are vital medium of communication during crises situation. It is more powerful than the traditional communication means.Despite of its desirable characteristics and features, social media has some major disadvantages when it is used during emergencies:

- Incompetent use of the social media by the organization's personnel.
- Unauthentic information.
- Inaccurate data
- Non-use of social media
- Internet required
- Electricity required
- Fake alerts.

E. Gap Analysis

Today's social media can be utilized as a tackle for disaster management. But there are certain optimizations which can be done to improve the efficiency and resource management in the period of disaster. If people who are trapped in the disaster zone were to write a post for help then other side (Rescue force) should be active on the same site to take appropriate action. But this may not true in most of the cases. The rescuing party may not be active at the moment. In case of twitter, there is no section for disaster management. But if such section is included then desired situations can be handled more efficiently .This section is open for anyone but if tweet is related to rescue or disaster then only that tweet will be posted here.Also, rescuing party will be continuously monitoring this section.So, whenever tweet is posted for help rescue force can be deployed very efficiently. Emergency situation can arise at different location simultaneously but there may not be enough rescue team to mitigate the emergency at the desired location. Even though Facebook and Twitter plays a vital role in emergency management, many times it is difficult to predict sarcastic and ironic post/tweets which may result in false dissemination of information. False information, rumors in emergency cause challenges in release process. Validity and trustworthiness of information is very much essential in order to achieve efficient system in emergency management. Major Gap between current systems and desired systems is connectivity.In order to use social media in disaster it is necessary to have connectivity (Internet).

III. PROPOSED MODEL

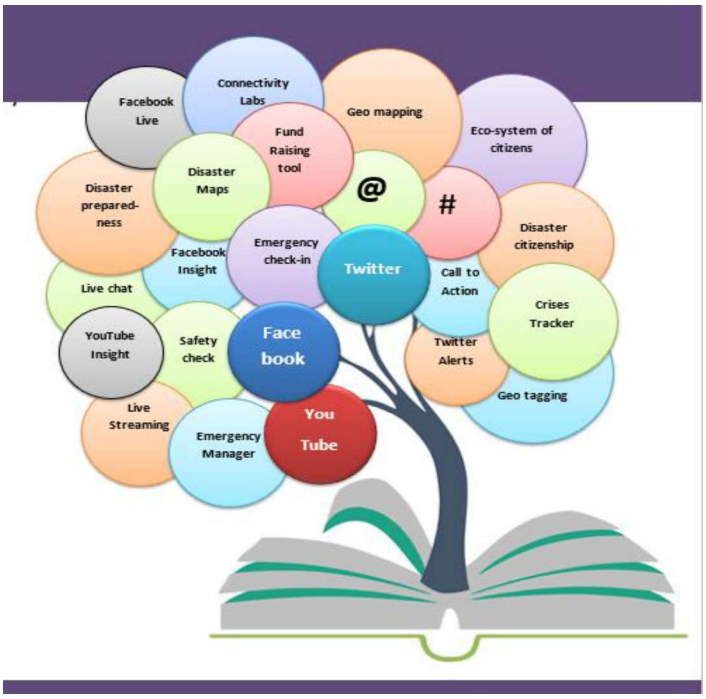

Figure 2: shows how our platform will combine the features of different social sites.

From Figure 2, a platform can be specifically designed for disaster management which monitors all the social networking sites and decides whether the disaster has really occurred.This way there would be spam protection against fake messages.The data would be collected from more than one platform and if there is confirmation from all the platforms then only it will be declared that disaster has really occurred.The information collected would be more accurate.This platform depends on other social networking sites and cannot be designed as standalone system.Tasks performed by this platform are:

1. Real time disaster tracking
2. Protection from spam posts
3. Organized deployment of rescue force
4. Public awareness about the disaster
5. Disaster alert
6. Real time response to 'Help requests'
7. All required information from social media in one place

As any other networking media this platform will provide all its features. For eg. Emergency Check-in and Safety Check at the time of any disaster.Moreover the platform would be an excellent guide for disaster preparedness and emergency management.

In addition to this, whenever there is confirmation of a disaster in any particular area, Security Alert message will be sent on the mobile devices of citizens residing in the that area.This will be of great help to the citizens who are not the

part of any of the social media and also to those who do not have internet connectivity.This platform minimizes some major drawbacks of social media used in disaster management.Main aim of this platform is to reduce dependability of using single social media during emergency. This will result in efficient management before and after disaster/emergency has occurred. Our platform will also contain fundraising tools which will allow the users to raise money for the victims of disasters, as money is one of the most important things whenever a disaster strikes for immediate rehabilitation of victim.

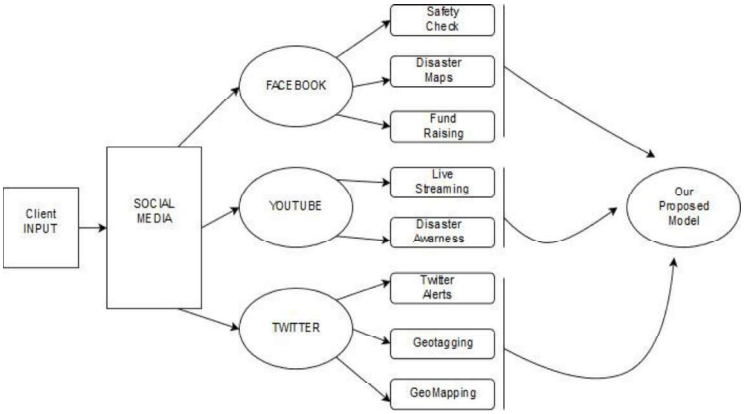

Figure 3: Proposed System which uses different feature of social media.

How this platform will overcome the Drawbacks of existing system:

1. Spam Detection:-

Spams are major drawbacks of social media .Spams are nothing but unsolicited bulk messages or posts uploaded on social media by people.Spam messages attempts to get user's attention by sending messages which appears to beneficial for the users.Different ways to spam can be Bulk messaging, spreading malicious links Fraudulent reviews, sharing undesired or excessive contents, clickbait and likejacking.

To overcome spams our platform will restrict messages with similar contents to be posted more than once .The users who repeatedly posts spams will be flagged and their posts will not be shown.The platform will extract only the information related to disasters and redundant and irrelevant information will be discarded.Thus the spam messages can be easily detected.

2. Logins, Signups:-

As,this platform depends on other social media platforms (YouTube,Facebook,Twitter) no login/signup system is required.Whenever,user posts his/her first message, he/she will be automatically registered by retrieving appropriate credentials from the platform he/she posted that message. People do not require any logins. Sign ups to view the information on the platform.

3. Misinformation Detection:-

Many times wrong information is circulated on social networking sites which lead to anxiety among the public.To avoid dissemination of wrong information,our platform will check the authenticity of information on different social media and different news websites and after confirming the genuineness of information it will be shown on the platform.This will reduce rumours during disaster situations.

4. Simplicity(all on single platform):-

The information from all dependent platforms is collectively analysed and only disaster related content will be posted on the platform.Hence there is no need to switch to different platform for updates regarding the specific disaster.

5. Validity and Credibility of information:-

As stated earlier the information offered on our platform will be authenticated from different sources and only valid information will be shown.Even then the posts and messages will be regularly examined to provide reliable and up to date information.

6. Faster response/ mitigation:-

The information on our platform will be updated in quick time whenever any information related to disaster will be detected on social sites. Up to date and valid information will be a great asset to the users as they can quickly access the situation and inform their loved ones about the disaster prone areas and this in turn will help people to be away from vulnerable areas.

Additional useful features which will be supported by the platform are:-

1. The **Security alert** will work as following:-

a) If number of posts related to some topic exceeds pre-specified threshold then these posts will be sent for analysis.
b) Analyser will check if posts contain any disaster related information.
c) If disaster related information is detected then notifications will be sent to the users who are living in the disaster prone zone, friends of the user who posted the message regarding disaster.Notification will be sent to users through email or messaging service.

2. The **Rescue force deployment** will work as following:-

a) The platform will continuously analyse the posts for hot words such as 'Help', 'Save', 'Rescue' etc.
b) Only the posts containing hotwords like 'Help', 'Save', 'Trapped' will be geo-tagged and rescue team will be alerted for immediate rescue operation.
c) Rescue force will be continuously monitoring for such posts.
d) As these posts are enabled with geo-tagging, the location from which the message was posted can be easily retrieved and responses can be given in real time.

A. Mathematical Model –

Consider,

	Social Media	Capabilities
1	Facebook	A
2	Twitter	B
3	YouTube	C

*Capabilities are features provided by Social Media

Table1: Following table shows social media and its capabilities in Disaster Management

Let S_1 be feature set of Facebook
Let S_2 be feature set of YouTube
Let S_3 be feature set of Twitter
Then

S_1= {S_{11}, S_{12}, S_{13}, …….S_{1n} }
S_2= {S_{21}, S_{22}, S_{23}, …….S_{2n} }
S_3= {S_{31}, S_{32}, S_{33}, …….S_{3n} }

Where,
Feature S_{m1} falls into same category and m -> 1 to 3
Feature S_{m2} falls into same category and m -> 1 to 3
Feature S_{m3} falls into same category and m -> 1 to 3

Let A, B, C be the current points which are given to Facebook, Twitter, YouTube respectively such that A>B>C,

Equation can be modelled as
$T_1=x_1 \sum_{i=1}^{n} S_{1n}$ (1)
$T_2=x_2 \sum_{i=1}^{n} S_{2n}$ (2)
$T_3=x_3 \sum_{i=1}^{n} S_{3n}$ (3)

Where
x_1, x_2, x_3 are multipliers which will enhance the existing features of social media.
T_1, T_2, T_3 are enhanced feature of social media

Then proposed system can be represented as

$E=T_1+T_2+T_3$

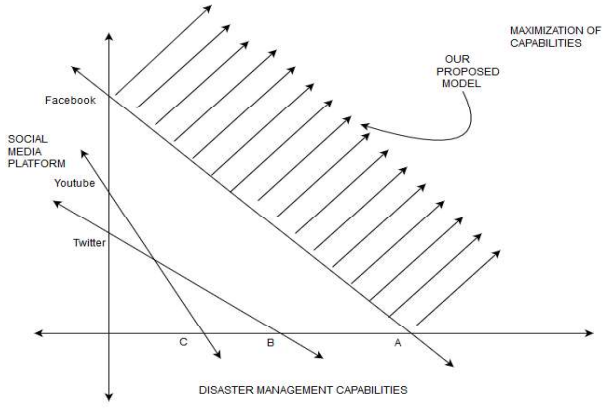

Figure 4 - Maximization of capabilities of social media.

In figure 3, we maximize the capabilities of different social media.Based on this we proposed a model which include enhanced and efficent features of all. This will be easy to use platform with faster response having maximum capabilities.

IV. CONCLUSION

In this paper we proposed a platform which keeps a track of social media and extract all the disaster related information. When information from social sites will be confirmed as valid then only this credulous information will be added on the platform .The main advantage of this platform is users don't need to login or sign up, they will be automatically registered and the users who are living in disaster prone areas will be sent SMS so the drawback of network connection is eliminated .Other major drawbacks of social media like spam messages, misinformation will also be removed as platform will constantly validate information and redundant posts will be discarded.Also all the tools from different social media such as safety check, geo-tagging, twitter alerts and other will be available on single platform. Rescue force deployment is an important aspect which will constantly check for rescue related posts and deploy the rescue team for efficient and rapid mitigation process.Hence the platform maximizes the disaster management capabilities of different social media. The data related to disaster from different media will be presented in an useful and efficient way. Hence by harnessing the power of different social networking site the platform maximize the use of social media in disaster management.

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