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Paper 4: Twitter, disasters and cultural heritage: A case study of the 2015 Nepal earthquake

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Abstract

The purpose of this paper was to understand how Twitter users responded to the cultural heritage damaged during the 2015 Nepal earthquake. This paper utilizes 201,457 tweets (including retweets) from three different data sets. The analysis shows that approximately 4% of tweets were regarding cultural heritage. Moreover, asymmetrical information was available on Twitter regarding cultural heritage during the Nepal earthquake, that is not every site received equal attention from the public. Damaged sites received more attention than unaffected sites. The content of tweets can be divided into five categories: information, sentiment, memory, action and noise. Most people (89.1%) used Twitter during the disaster to disseminate information regarding damaged cultural heritage sites.

KEYWORDS

2015 Nepal earthquake, cultural heritage, disasters, social media, Twitter

1 | INTRODUCTION

Social media is an umbrella term generally applied to Web-based services that facilitate some form of social interaction or networking (Zappavigna, 2012). They have been noted for their ability to rapidly and continuously be updated by numerous users. In the present-day context, there are more than 200 social networking sites globally, each dedicated to a specific function such as friend connections, professional connections, photo sharing, video sharing, blogging and chatting. A user's choice of social media may depend on the popularity of the media, its purpose and expected dissemination. Twitter, a microblogging platform is a popular choice for instantaneous dissemination of information due to several reasons such as openness, searchable contents, dissemination and ability to share any media. Originally envisioned to facilitate circulation of a "short burst of *inconsequential* information" (Johnson, 2013), it has grown into a globally significant outlet for instantaneous information and news dissemination, particularly during disasters (Shaw et al., 2013).

With over 320 million active users (Statista, 2019), Twitter increases awareness of the situation, facilitates coordinated response and reduces the time lag between crisis and action. It has functioned as a channel for mediating exchange of information during disasters. It has also empowered new actors to participate in the disaster management process. As a result, Twitter has received tremendous attention from researchers in disaster management regarding how information is created, distributed, collected, processed and utilized. However, the role of Twitter in the context of cultural heritage during such events has received less attention. Addressing the gap in research, this paper is the first step towards understanding the response on Twitter by addressing the following research question:

> How did the users respond on Twitter to the cultural heritage damaged during the 2015 Nepal earthquake?

This paper aimed to understand what kind of data was posted regarding cultural heritage during the earthquake and whether

these data can be used to analyse the situation on the ground. The 2015 Nepal earthquake is an appropriate case study as the earthquake damaged many important cultural heritage sites of the country. A report of the Department of Archaeology estimated that out of 743 affected buildings in 20 districts of Nepal, 133 collapsed, 95 partially collapsed and 515 suffered part damage (Department of Archaeology, 2015). The post-disaster needs assessment report of the Government of Nepal estimated that the total value of cultural heritage effects (damages and losses) caused by the earthquakes is US$ 171 million (National Planning Commission Nepal, 2015).

The sites included in UNESCO World Heritage property "Kathmandu Valley" suffered to a different degree. The property includes seven groups of monuments and buildings including Durbar Squares of Hanuman Dhoka (Kathmandu), Patan and Bhaktapur, the Buddhist stupas of Swayambhu and Bauddhanath and the Hindu temples of Pashupatinath and Changu Narayan. Several temples in Darbar Square in Kathmandu, Patan and Bhaktapur and Changu Narayan had collapsed. The Buddhist stupas of Swayambhunath were also affected, whereas the Buddhist stupas of Bauddhanath and Pashupatinath temple had minor damages. On the other hand, UNESCO World Heritage property "Lumbini, the Birthplace of the Lord Buddha" did not suffer any damage. Dharahara Tower was completely collapsed. Other heritage sites such as Janaki Mandir in Janakpur, a monastery in Ghiling village, Upper Mustang, National Museum in Kathmandu and Living Traditions Museum at Changu also suffered damages (ICORP & ICCROM, 2015).

To address the user response on Twitter, this paper is structured in six additional parts. Section 2 conceptually frames this research, particularly linking it to other works on the use of Twitter during disasters and the 2015 Nepal earthquake. Section 3 describes the data collection and methodology adopted for this research. Section 4 describes the results. Section 5 discusses the implications of this research. Lastly, Section 6 concludes the paper with possibilities for future work.

2 | RELATED WORKS

2.1 | Twitter, disasters and cultural heritage

In recent years, Twitter has been used extensively during disasters due to its instantaneous nature, widespread dissemination and openly available information. As a result, the role of Twitter in disaster management has gained tremendous attention amongst researchers. Researchers have studied several aspects of Twitter during disasters such as crisis communication (Bruns & Burgess, 2014; Gunawong et al., 2019; Wang & Zhuang, 2017), situation awareness (Karami et al., 2020; Vieweg et al., 2010) and information credibility (Gupta & Kumaraguru, 2012; Mendoza et al., 2010; Setiawan et al., 2020) by focusing on case studies from different parts of the world.

Murthy and Longwell (2013) use the case of 2010 Pakistan floods to understand the patterns of tweeting behaviour of the public based on their location. Their study concluded that the Western users preferred traditional media whereas the Pakistani users linked to data posted on social media. Acar and Muraki (2011) analysed tweets from directly and indirectly hit areas from the Great Tohoku earthquake. Their analysis concluded that the contents of tweet posted during disasters were related to the user's location. Users in affected areas tweeted regarding their uncertain situation, whereas users in remote areas tweeted regarding their safety.

Moreover, researchers have also constructed different categories of tweets posted during disasters (Kongthon et al., 2014) using supervised and unsupervised classification methods (Castillo, 2016). For instance, Qu et al. (2011) used the case of the 2010 Yushu earthquake to understand the type of messages posted and reposted on Sina Weibo, a Chinese microblogging system. Their study identified four main categories of microblogging: information, opinion, emotion and action. Shaw et al. (2013) also developed typologies of tweets 2010–2011 Queensland floods in Australia as information, media sharing, help and fundraising, experience, discussion and reaction. David et al. (2016) analysed tweets posted during 2013 Typhoon Haiyan and developed the following categories: information, expressions of support, emotion, disaster relief and aid, and political expressions. The overlapping categories in researcher's works hint at the common practices adopted by the Twitter users during disasters regardless of their geographical location. Further, using the case of 2017 Hurricane Irma, Xu et al. (2019) explored public opinion in different stages of disasters. Their analysis shows that public opinions differ and concerns change in different stages.

In contrast, research on the use of Twitter regarding cultural heritage damaged during disasters is limited. In the cultural heritage domain, Twitter is mainly used for dissemination of initiatives. For instance, during the 2015 Nepal earthquake heritage professionals disseminated the "Kathmandu Cultural Emergency Crowdmap" (Tandon, 2017) using two dedicated hashtags #heritagedamagenepal, #culturedamagenepal. As evident from the 83 tweets using these hashtags, the professionals requested to use the dedicated hashtags and submit data (reports and images) about damaged cultural heritage. Moreover, they also shared news from the mainstream media. A similar effort was initiated by Wikipedia after the fire in the National Museum of Brazil in 2018. Wikipedia also used Twitter to disseminate its crowdsourcing initiative to preserve the memory of objects damaged by the fire. In contrast, this paper analyses the tweets posted regarding cultural heritage during the Nepal earthquake.

2.2 | The 2015 Nepal earthquake

The participative technological applications used during the 2015 Nepal earthquake have been studied from many perspectives. Researchers have focused on Twitter, mobile applications and crowdsourced mapping both during the disaster response and recovery phase. Thapa (2016) analysed location-based tweets posted during the 2015 Nepal earthquake to understand the spatial and temporal characteristics of the tweets. The study concluded that a relatively small number (22%) of people used hashtags related to the event, whereas most of the tweets were without any hashtag.

TABLE 1 Details of data sets including the period of collection, number of tweets and keywords used for data collection

Data set 1	
Period	25.04.2015–28.09.2016
Number of tweets	449
Keywords	#Nepalearthquake, Heritage
Data set 2	
Period	25.04.2015–25.04.2015
Number of tweets	150,940
Keywords	Basantapur, Patan, Anamnagar, Bhaktapur, Durbar Square, Nuwakot, Dharahara Tower, Gorkha, Lamjung, Khudi, Kathmandu, Sankhu, Sunsari, Solu district, Okhaldhunga, Nepal, nepal earthquake, ktmearthquake, IndiaWithNepal, NepalQuake, NepalQuakeRelief, NepalEarthquake, KathmanduQuake, KathmanduQuakeRelief, KathmanduEarthauqke, QuakeNepal, EarthquakeNepal, QuakeKathmandu, EarthquakeKathmandu, PrayForNepal
Data set 3	
Period	25.04.2015–10.05.2015
Number of tweets	50,068
Keywords	Nepal earthquake, Nepal quake

Moreover, amongst the people using hashtags, more than 25% of tweets posted were not related to the earthquake. The study also found a hike in the number of tweets upon an earthquake of high intensity and concluded that English was a preferred language amongst Twitter users. Priya et al. (2018) developed a framework for retrieving tweets providing information about infrastructure damage during earthquakes. Moreover, the framework also determines the damage score of affected locations. Using the case of the 2015 Nepal earthquake, the authors demonstrated that their approach can efficiently measure the extent of infrastructure damage in the region. Further, using the case of the 2015 Nepal Earthquake, Verma et al. (2019) established that tweets and newswire articles provide complementary point of view, which could provide holistic view of the event. On the other hand, Subba and Bui (2017) focus on the use of Twitter by the National Police Headquarters in Nepal to communicate with the citizens. The study concluded that Twitter was an effective communication and collaboration platform between the emergency managers (i.e. the police) and the citizens, which also lead the police to reconsider its planning activities. Poiani et al. (2016) focused on the use of OpenStreetMap, a collaborative mapping platform during the 2015 Nepal earthquake in which a large number of off-site users had contributed to the platform. On the other hand, Bossu et al. (2015) studied the adoption of LastQuake smartphone application by the on-site users.

In comparison, the participatory applications in the context of cultural heritage during the 2015 Nepal earthquake were limited. "Kathmandu Cultural Emergency Crowdmap" (Tandon, 2017) utilized the Ushahidi Platform to rapidly assess damage to cultural heritage after the earthquake. However, cultural heritage damaged during the 2015 Nepal earthquake has received the attention of researchers from different perspectives. Researchers have studied the causes of damage to heritage sites (Bhagat et al., 2018; Gautam, 2017; Shrestha et al., 2017), its impact on tourism (Kunwar & Chand, 2016) and coverage in the media reports (Hutt, 2018). Bhagat et al. discussed the reasons behind the collapse of cultural heritage buildings. They concluded that the main reasons behind the extent of damage were the magnitude of the earthquake, lack of maintenance of the buildings and deterioration of the construction materials. Further, KC et al. (2017) concluded that structures that were seismically retrofitted were least damaged during the earthquake. Kunwar and Chand (2016) assess the impact of the earthquake on tourism in Bhaktapur[2] highlighting the importance of heritage in the tourism industry. Hutt concluded that Dharahara Tower received more attention than the country's World Heritage properties in the media to the extent that it became a point for the revival of Nation's identity (Hutt, 2018). To date, it appears that no prior study deals with the study of tweets posted regarding cultural heritage during the 2015 Nepal earthquake.

3 | DATA COLLECTION AND METHODOLOGY

In this section, I will discuss about the data collected for this study and the methodology adopted for analysis.

3.1 | Data collection

This study utilizes 201,457 English tweets (including retweets or RTs) from three different data sets. Table 1 provides details of the data sets. The data are of two kinds: (a) manually collected heritage-specific data (data set 1) and (b) data collected on Nepal earthquake through APIs (data sets 2 and 3). The date of collection of the data sets corresponds to the event, that is the collection of data started on 25 April 2015. However, the period of collection is different, as evident from Table 1. Data set 1 contains 449 tweets posted

TABLE 2 Examples of language usage

Type	Tweet
Typographical Error	#Kathmandu's Darbar Square, A UNESCO World Heritage Site!!:(:(#EarthquakeinNepal #PreyforNepal #Earthquake
Abbreviations	#PrayForNepal We lost our 19th century Dharahara Tower; life of so many ppls in Capital Kathmandu R.I.P. to all of them
Abbreviations	It's v hard to see #Kathmandu devastated by d #earthquake. Most of d historical places r gone including #Dharahara d landmark of Kathmandu.
Emphasize by Capitalization	Very SAD. #Kathmandu 's Darbar Square, a UNESCO World Heritage site, in ruins after today's #Nepalquake

between 25 April 2015 and 28 September 2016. Twitter search "#Nepalearthquake heritage" was used to collect tweets in this data set. Data set 2 contains 150,940 tweets collected using AIDR (Imran et al., 2014) on 25 April 2015. Data set 3 contains 50, 068 tweets collected between 25 April 2015 and 10 May 2015 (Moens et al., 2018).

3.2 | Methodology

This paper aimed to analyse tweets relevant to cultural heritage sites affected during the 2015 Nepal earthquake. This paper uses a methodology for retrieving data regarding a niche subject (i.e. cultural heritage sites) from the big data sets. As evident from Table 1, the big data sets were not curated for heritage purposes. Nevertheless, the data sets contain information regarding cultural heritage sites damaged due to the disaster. The method consists of the following steps:

1. Baseline Construction
   a. Building a preliminary set of query keywords manually from data set 1
   b. Manual content analysis of tweets to build preliminary categories
2. Examining tweets from data sets 2 and 3 with the help of the baseline
   a. Retrieving the relevant tweets from data set 2 and data set 3
   b. Expanding query keywords with the help of the word tree of query keywords
   c. Retrieving more relevant tweets from data set 2 and data set 3
   d. Manual content analysis of tweets to build categories

Manual generation of query keywords and content analysis was selected for three reasons. Firstly, significant expertise was required at each step mentioned above. Secondly, to my knowledge, no prior studies have examined the content of tweets posted regarding cultural heritage sites affected during disasters. Therefore, in the absence of any previous study which could serve as a reference, I decided to manually analyse the data. Lastly, the language used in Twitter tends to be informal and often contain typographical errors. Therefore, manual methods for analysis were considered suitable for this research.

3.2.1 | Baseline construction using data set 1

Twitter data from the 2015 Nepal earthquake was used to construct a baseline for this research to build an initial, yet flexible understanding of the nature of data posted during the disaster. Since data set 1 is a small data set containing heritage-specific tweets; therefore, this data set was the most appropriate for constructing a baseline for examining data sets 2 and 3. The data set was used to (a) construct a set of query keywords and (b) construct preliminary categories of tweets.

Constructing a set of query keywords

The 449 heritage-specific tweets were analysed to build a preliminary set of query keywords using NVivo, a qualitative data analysis software. Firstly, the data were cleaned for the main attributes using NVivo. The stop words were removed, and data were normalized and lemmatized (Silver & Matthews, 2017). The resultant frequently occurring words were summarized and sorted by the frequency.

Out of the most frequent words, I selected the words occurring at least five times. Thus, 152 unique keywords were defined as the initial query keywords. Similar words were then grouped manually under the following categories: action words, descriptive words, generic words, organization's name, sentiment, site type, site name and situational word. The manual grouping of frequently occurring words was done to evaluate the utility of each category for query keywords in data sets 2 and 3. Table 3 illustrates the categories with a few examples.

Constructing preliminary categories of tweets

The 449 tweets were coded in NVivo to understand the underlining patterns of communication. Manual content analysis was used to identify preliminary common themes and constructing underlying meanings in tweets. As Krippendorff (2018) and Weber (1984) suggest, the content analysis can include beyond the message itself. This paper briefly focuses on the number of retweets, the type of users, to understand the context and impact of the tweets.

It is important to acknowledge the language of the Internet is ever-evolving. However, the language is based on a set of established principles (Crystal, 2006) the tweets can be brief, informal and often contain slangs, typographical errors, abbreviations and incorrect grammar (Han et al., 2013). Therefore, each tweet was read and re-read in order to understand the usage of words, possible errors and correct tone of the tweet. Table 2 provides some examples of the language usage found in the tweets.

3.2.2 | Examining data sets 2 and 3

With the results from the analysis of data set 1 in hand, rest 201,008 tweets in data sets 2 and 3 were approached with flexibility if more keywords and categories were to be found.

Retrieving the relevant tweets from data set 2 and data set 3

Data sets 2 and 3 were imported in NVivo, and the 152 query keywords were used to find relevant data in the data sets. The 152 query keywords were tested, regardless of the frequency of the keyword. In other words, the less frequently occurring words such as landmark or old (see Table 6) were also used to find relevant data. It should be noted that not all 152 query keywords were useful. Some query keywords resulted only in irrelevant data. Certain categories of keywords were found to be better suited to find relevant data. For instance, the words falling under site name, site type and descriptive words in Table 6 resulted in most tweets related to cultural heritage. The resultant relevant tweets using the query keywords were coded under the node "heritage" in NVivo. Nevertheless, some unrelated tweets were also found with the relevant data. Such tweets often contained information regarding the cultural heritage sites of other countries. The unrelated tweets were coded under the same node "heritage," to understand noise generated from the search terms.

Expanding query keywords and retrieving more relevant tweets

To ensure that I find all the tweets related to cultural heritage, I used the word tree of each query keyword to understand the usage of words in context. Figure 1 shows the example of a world tree for the term heritage. Word trees were particularly important to understand the nuances of language usage in the tweets. For instance, different spellings were used for the cultural heritage sites' name. Moreover, certain words in the local language were also used to refer to a site. Consequently, the query keywords were expanded and used to retrieve more relevant tweets.

Manual content analysis of tweets to build categories

Content analysis of tweets coded under the node "heritage" was done to understand the underlining patterns of communication. With the preliminary categories in hand from data set 1, the analysis was carried out to understand the categories in bigger data sets. The tweets were approached with flexibility if new categories were to be found or certain categories from the preliminary analysis were absent in the bigger data sets. The coding scheme is explained in Table 3. Furthermore, quantitative analysis was done to understand the patterns in overall data, dominant category and sub-categories.

Verification of coding scheme

To verify the reliability of the coding scheme, two coders coded a sample of 131 relevant tweets. Cohen's kappa (Cohen, 1960) was calculated to identify intercoder reliability per category. Table 4 shows the kappa (k), percentage of agreement and agreement level for each category. The intercoder reliability of "action" was rated as moderate, "information" and "memory" as substantial, and "sentiment" and "noise" as almost perfect. Moreover, the percentage of agreement indicate good agreement for each of the category. Therefore, it was decided to retain the coding scheme.

3.2.3 | Ethical aspects of this research

As this research draws its data from the Internet and deals with personal information, it is important to address the issue of ethics and take a position regarding ethical decision-making. McKee and Porter (2009) acknowledge the challenges of ethical decision-making in Internet research due to several factors, such as the global reach of the Internet, the diversity of research sites and online communities, and the diversity of research methodologies. The data posted on Twitter are usually open and searchable; therefore, removing personal details (e.g., @username or phone number published in tweets)

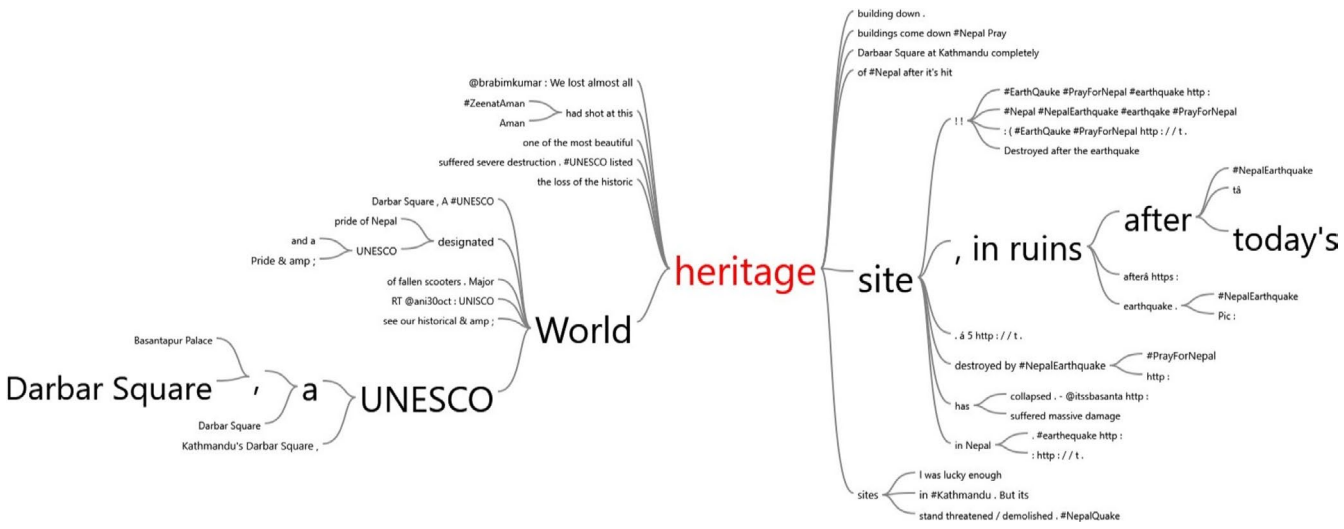

FIGURE 1 Word trees were used to explore the query keywords in context

TABLE 3 Coding scheme

Category	Details
Information	The tweets which had information regarding the situation of heritage sites were coded under this category. These tweets describe the extent and type of damage to heritage sites, or scale of the impact.
Sentiment	Tweets which had an expression of emotion were coded under sentiments.
Memory	Any kind of recollection of events or facts in the context of cultural heritage was coded under memory.
Action	The tweets which had the information regarding ongoing efforts to rescue heritage or future steps towards restoration were coded under this category.
Noise	The tweets which did not information about the cultural heritage of Nepal were coded under this category.

may not always be sufficient in publishing tweets. This poses risks to marginalized populations particularly those whose views may not be congruent with the rest of the population. Therefore, in case of such conflicting views, the tweets were slightly modified. The slight modification of tweet content made the tweet unsearchable, and hence, the privacy of individuals has been protected.

4 | RESULTS

The results are divided into three main parts. Section 4.1 describes the generic results of data analysis. It provides an overall view of the data analysis. Section 4.2 describes the results of keyword analysis. Section 4.3 answers the primary research question in this paper.

4.1 | General observation

The analysis shows that only a small number of tweets were posted regarding cultural heritage during the 2015 Nepal earthquake. A total of 7,989 (approximately 4%) relevant tweets were extracted from data sets 2 and 3.

TABLE 4 Intercoder reliability per category (kappa and percentage of agreement)

	k	Percentage of agreement	Agreement level
Information	0.794	92.4	Substantial
Sentiment	0.831	92.4	Almost perfect
Memory	0.711	89.3	Substantial
Action	0.554	91.6	Moderate
Noise	0.917	97.7	Almost perfect

Asymmetrical information was available on Twitter regarding cultural heritage during the Nepal earthquake, that is not every site received equal attention from the public. Sites which were damaged received more attention than the unaffected sites. The tweets contain a combination of user-generated and mainstream media tweets (see Table 5). The mainstream media tweets include tweets from professional journalists and media outlets.

The tweets from the mainstream media outlets were found to be factual, formal and informative. On the other hand, some professional journalists' also tweeted emotional contents (see Table 5). The goal of the mainstream media tweets was to provide as much information on the current situation in as little words as possible. Often the information about heritage sites was coupled with humanitarian information, that is how many people were affected by the damage to the site. The user-generated tweets were found to be mainly emotional, personal and informative. However, some user-generated tweets were also formal and factual (see Table 5). These tweets often contain contextual information such as the meaning of the name of the site, information about its construction (date and people), its role in the society and the users' relationship with it. Overall, the tweets from mainstream media were retweeted more than the user-generated tweets. Table 5 provides examples of most retweeted tweets from mainstream media and users.

4.2 | Building and expanding query keywords

As explained in Section 3.2, the query keywords were first built from 449 heritage-related tweets. Later, the keywords were expanded with the help of the word tree of initial query keywords. Table 6 exemplifies the initial manually categorized query keywords.

While expanding the query keywords, one of the important findings was different names and spellings of sites. For example, the Dharahara Tower was also referred to as Bhimsen Tower, Dharara Tower, Kathmandu Tower, Gharahara Tower, 19th century Tower, Famous Tower, Historic Tower, Tower and so on. Similarly, Darbar Square was often referred to as Durbar Square. Moreover, it was found that many terms in the local language were also used instead of English terms. For instance, many tweets referred to a temple as a mandir.

4.3 | Categories

Three categories of tweets were established from the analysis of data set 1: information, action and sentiment. Two additional categories emerged from the analysis of data sets 2 and 3: memory and noise. However, none of the categories had to be removed from the original classification. Table 7 provides an example of each category and its distribution. As evident from the table, Twitter was used mainly for circulating information (89.1%), followed by expressing sentiment (25.4%), sharing and recalling memory (5%), and organizing and suggesting action (3.8%). It should be noted that the four

TABLE 5 The tweets are a combination of user-generated contents and from mainstream media

Type	Tweet	Number of retweets	Number of comments	Number of favourites
User-generated content	Darbar Square, #Nepal's Pride & UNESCO designated World Heritage Site destroyed by #NepalEarthquake #PrayForNepal	877	13	121
	Pictures of Patan Durbar Hall, a UNESCO world heritage site, in #Kathmandu one hour apart before & after #earthquake	135	4	34
	Dharara Tower, built in 1832, collapses in #Kathmandu during earthquake, Plz Guru ji please help them victims ppl #MSGHelp	102	0	0
Mainstream media	Truly awful sight. Kathmandu's Darbar Square, a UNESCO World Heritage site, in ruins after today's earthquake.	2,084	54	376
	RT @BBCWorld: Before and after: Kathmandu's historic Dharahara Tower flattened by #earthquake	2,012	55	534
	RT @nytimes: Photos of Nepal's landmarks, before and after the earthquake	1,509	65	417

categories are not mutually exclusive. Most of the tweets are hybrid, that is they follow at least two of the above-mentioned categories. Table 8 provides examples of hybrid tweets.

4.3.1 | Information

The analysis shows that Twitter was used mainly for disseminating information. Approximately 89.1% of the relevant tweets (see Table 7) provide some information regarding the situation of sites. Tables 5 and 9 provide examples of tweets which disseminated information during the earthquake. Tweets also illustrate how the sites were used after the earthquake. For instance, people continued praying in the damaged temples and took selfies in damaged sites (see Table 9). Attempts of information seeking were also evident, particularly for the sites which were not extensively covered in the mainstream media reports. Overall, some tweets are more useful in assessing damage to the heritage sites and understanding the situation on the ground. Such tweets include the name of the site, information about its condition and the number of humans affected by its damage. Table 4 shows that the most popular tweets disseminated information regarding the situation of the sites. Table 9 exemplifies tweets that mention how the sites were used after the earthquake (i.e. practice) were also reposted extensively.

TABLE 6 Categorization of preliminary query keywords

Category	Word	Similar words	Count
Action	Rebuilding	Rebuild	16
Action	Reconstruction	Reconstruct, reconstructing	15
Descriptive	Heritage	–	479
Descriptive	Culture	Cultural	74
Generic	Architecture	Architectural	11
Generic	Landmarks	Landmark	5
Organization	Unesco	–	122
Sentiment	Heartbreaking	heartbreak	7
Sentiment	Tragic	–	6
Site Type	Temples	Temple	29
Site Type	Monuments	Monument	13
Site Name	Durbar	–	29
Site Name	Dharahara	–	15
Situation	Destroys	Destroyed, destroying	64
Situation	Damages	Damaged, damage	53

TABLE 7 Examples of tweets in different categories

Type	Number	Per cent	Tweet
Information	7,119	89.1%	Historic Dharara Tower collapses in Kathmandu after 7.9 earthquake
Sentiment	2,034	25.4%	The sadness is sinking in. We have lost our temples, our history, the places we grew up. #NepalEarthquake
Memory	406	5%	Apparently this is what Durbar Square used to look like.
Action	306	3.8%	@NepalPoliceHQ Protect the heritage sites! Our own people are looting #Nepalearthquake
Noise	306	3.8%	Earthquake in #Nepal Golden Temple send 1 lac and Delhi Gurdwaras send 25k meals daily. Those who share sardar jokes, please share this too

TABLE 8 Examples of hybrid tweets

Type	Tweet
Information + Sentiment	Awful sight. Kathmandu's Darbar Square, a UNESCO World Heritage site, in ruins after today's earthquake.
Information + Action	Nepal Quake: search for survivors, with 50 people missing in Dharahara Tower collapse
Information + Memory	Historical Dharahara tower (1832) was built by the Prime Minister BHIMSEN THAPA. Just collapsed due to #earthquake
Sentiment + Action	—
Sentiment + Memory	Never knew last time I visited #Kathmandu and roamed around #Basantapur was the last time I saw those ancient temples.:(rip to history
Action + Memory	Durbar Square damaged in 1934 earthquake & again today. We need to learn and not let this keep happening #NepalQuake
Information + Sentiment + Action	Oh, MY! GOD!! The Durbar Square is GONE!!! 7.9 Magnitude #earthquake HELP IS NEEDED Immediately! @UNDP #RedCross
Information + Sentiment + Memory	One hour before Nepal earthquake. Small temple behind me completely collapsed. Absolutely surreal. #NepalQuake
Information + Action + Memory	—
Information + Sentiment + Memory + Action	I visited #Nepal in 2009. Devastated to see Durbar Square in ruins. My thoughts go to all victims; I urge immediate #humanitarian response

4.3.2 | Sentiment

Approximately 25.4% of the relevant tweets expressed sentiments using emoticons, words, hashtags and phrases. The sentiments can be divided into two polar categories: sympathy and indifference towards heritage. Tweets showing sympathy are the ones which express sadness and disappointment over the loss of heritage, whereas the indifference tweets display antipathy towards heritage. Table 10 shows some examples of both categories. The sympathetic tweets exceed in number than the indifferent tweets. Only about 5% of users expressing emotions showed indifference to heritage. People who posted antipathy thought that humans should be the first concern during this disaster rather than the heritage. However, people who showed sympathy towards heritage also showed sympathy for the loss of life. Interestingly, the Nepali users posted only sympathetic tweets, as evident from Table 10. Moreover, on average the sympathy tweets had more engagement than the indifferent tweets. On the other hand, users who posted indifferent tweets were located outside Nepal.

4.3.3 | Memory

The analysis shows that 5% of the relevant tweets shared memories that were historically relevant or personally meaningful. This includes users' visit to the heritage site, other's experience of disaster in the context of cultural heritage. Heritage as a context in movies was also remembered. People also remembered the impact of the 1934 earthquake and compared the 2015 earthquake with the 1934 earthquake. Twitter was used to post regarding memorials constructed for the damaged heritage sites. Lastly, the dissemination of memorial events was also done via Twitter. Table 11 provides examples of tweets coded under this theme. As evident from the Table, these tweets were not reposted extensively and had minimal engagement.

4.3.4 | Action

The analysis shows that approximately 3.8% of the relevant tweets are action-related. There are two types of action: immediate action

TABLE 9 Tweets that shared information disseminated the on-site situation and practice around the sites. Attempts of information seeking were also evident

Type	Tweet	Number of retweets	Number of comments	Number of favourites
Situation	Ancient monuments are no more than a debris in NEPAL AFTER 7.9 RICHTER EARTHQUAKE!!!	0	0	0
	Nepal's historic Kasthamandap temple wiped off in earthquake http://t.co/H8KG7koWNc	0	0	0
Practice	A woman bows her head in prayer in Patan Darbar Square on the morning after the #earthquake	40	1	18
	Nepal's famous Dharahara Tower becomes site for selfies after devastating Earthquake	95	8	42
Information Seeking	Anyone in Nepal can tell us if the Pashupatinath temple is alright? #earthquake	6	1	1

and future action. Table 12 provides examples of immediate action and future action. Immediate action includes tweets where users demand action and informed about ongoing action. In the context of cultural heritage, the user demand for immediate action was found to be extremely crucial. These tweets represent a call for action and coordination from public on-site. They show the urgency of action required to address a specific issue urgent in order to prevent more damage to cultural heritage. However, as evident from Table 12, these tweets had very little engagement.

The tweets referring to future action are comparatively less. These tweets discuss the need to rebuild or reconstruct these monuments. They often look up to the government for this. People also directly urge the political leaders by mentioning them (using @) on the tweet to help in the process.

4.3.5 | Noise

This category includes tweets which included one of the query keywords, however, were not relevant to the cultural heritage of Nepal. The analysis shows that approximately 3.8% of tweets were irrelevant. Table 13 provides examples of such tweets and their impact.

5 | DISCUSSION

Approximately 4% of the total tweets were about cultural heritage. However, this is not surprising. Firstly, this study used data sets that were not curated for heritage purposes. Secondly, during disasters, an enormous amount of irrelevant, redundant and repetitive content is posted on Twitter (Castillo, 2016; Nguyen et al., 2017). Lastly, cultural heritage formed only a small section of the elements affected by the earthquake. Therefore, the small quantity of relevant data is not necessarily a limitation. On the contrary, the small quantity of relevant information posted on social media during disasters can give accurate information about the situation on the ground. The combination of sources (user-generated contents and mainstream media) represents the real influence of social networking sites, where everyone has the power to share information. Hence, the dissemination pattern is not a strict top-down controlled environment rather a network of free-flowing information curated by the mainstream media and people simultaneously. However, messages from mainstream media tend to be circulated more. The findings of this paper support the findings of previous studies that mainstream media is extremely important in the present times (Ali, 2013; Joye, 2018; Miller & Goidel, 2009). Moreover, unlike Verma et al.'s (2011) findings, some tweets that provided information on the situation of heritage sites also expressed emotions.

The analysis shows that people mainly posted information regarding the situation of heritage sites. This research supports the findings of previous studies which recognize microblogging sites as a source for situation update (Qu et al., 2011; Vieweg et al., 2010). Information from Twitter can reduce uncertainties and can be used for rapid damage analysis particularly after a disaster, a phase often characterized by the lack and need of information to prioritize action (Huang et al., 2010; Zook et al., 2010). However, asymmetrical information poses a challenge in the evaluation of the overall situation. The asymmetrical attention to heritage sites was not only prevalent in Twitter but also prevalent in media report. Hutt's (2018) analysis concluded that the Dharahara Tower received more attention than the country's World Heritage properties in the media. It could be due to several factors such as popularity as a tourist destination and amount of damage to the site. Heritage professionals seeking information from Twitter during disasters may need to request the on-site users, in case such asymmetrical patterns are evident. Despite the limitations, information from Twitter is irreplaceable, as suggested by Castillo (2016).

Action-related tweets illustrate the importance of social media during disasters. Although the action-related tweets were small in number (3.8% of the relevant tweets), they show the direct action taken by the on-site users during the earthquake. The on-site users can be sensors/respondents and may help in protecting the heritage from any further damage. The action-related tweets also illustrate that during disasters Twitter can function as a collaborative infrastructure.

TABLE 10 Tweets coded in sentiment category showed both sympathy and indifference towards heritage

Sentiment type	Tweet	Number of retweets	Number of comments	Number of favourites
Sympathy	When not only u feel 4 ur luvd ones but also 4 ur country & ur ppl & even ur heritage is cald patriotism. A lesson hard learned.#NepalEarthquake	0	0	0
	it's v hard to see #Kathmandu devastated by d #earthquake. Most of d historical places r gone including #Dharahara d landmark of Kathmandu.	1	0	0
	A tragic scene in my country Nepal. Historic buildings and monuments, all destroyed. #NepalEarthquake #PrayForNepal	46	1	8
Indifference	If I hear one more Westerner complaining about the loss of heritage instead of human lives in #NepalEarthquake I will SCREAM.	0	0	0
	Rs 2 is trending. it is price of your brain if u r worried about unesco world heritage sites in #Kathmandu instead of human lives. #NepalEarthquake	3	1	3
	Some tweeters are worried about old Mosques/Temples/ UNESCO heritage sites, please grow up and save humans 1st. #NepalEarthquake	5	2	12

The analysis of sentiments highlights an ideological divide amongst the users regarding what should be important during disasters. These concerns, though not too common, as seen in Section 4.3.2, need addressing in this research. Indeed, life should be the prime importance during disasters and this research does not intend to undermine the importance of humanitarian response. Culture (or heritage) may not be an immediate need or priority in disaster struck societies (Graham & Spennemann, 2006; Tandon, 2017). However, it is indeed an integral part of a society, as evident from the findings of this paper. Firstly, the action-related tweets in number prove that the Nepalese people care about their heritage. They worked collaboratively to protect their heritage during the earthquake. Secondly, sentiment-related tweets show people's attachment to their monuments. Lastly, people continuing prayers in the damaged heritage sites exemplify the relationship people share with their heritage and the role of heritage in distressful situations. The

TABLE 11 Types of memory

Type	Tweet	Number of retweets	Number of comments	Number of favourites
Other's Experience	People on my flight had injuries from the earthquake-- scrape on head/ broken leg. One person saw the big tower collapse #Nepal.	5	0	0
Past visit	I visited #Nepal in 2009. Devastated to see Durbar Square in ruins	1	0	0
	I went there about 20 years ago (travelled through India and Nepal) so sad to see the temples turned in piles of rubble.	0	0	0
	I always make a point to visit the Patan museum + Durbar Sq when I'm in Nepal. It saddens me now to think that it would never be the same now	0	0	0
Heritage as context	#DarbarSquare in rubble, @SrBachchan and #ZeenatAman had shot at this heritage site in Nepal. #earthequake	1	0	0
Past disaster	#earthquake in #Kathmandu in 1934 and now 2015. #Durbar, #Patan. A comparison.	10	1	4
Comparison	Imagine a fire ripped through the #Louvre. That's what #Kathmandu is suffering today. Ancient treasures now dust. #WorldHeritage rubble.	9	0	4
Memorial	New York City Museum Celebrates the Culture of Earthquake-Ravaged Nepal	5	0	2
	Rubin Museum Highlights Nepalese Culture in Wake of Earthquake	0	0	0

TABLE 12 Types of action

Action type	Tweet	Number of retweets	Number of comments	Number of favourites
Immediate action	Some Volunteers are required to sort out the debris and recover save heritage artifacts at Basantpur, Contact… #NepalEarthquake	3	0	1
	@NepalPoliceHQ Protect the heritage sites! Our own people are looting	2	0	0
	Thieves & smugglers are active, keeping an eye open on our heritage leveled to ground. Our priceless jwels also need rescue #Nepalearthquake.	1	0	0
Future action	The Historic Pillar Dharahara is now gone. Govt. should take actions to reconstruct it. #PrayForNepal #Dharahara.	0	0	1
	Dear @narendramodi Ji, let India take pledge to rebuild all historic Nepal temples destroyed in the #earthquake after Rescue & Relief is done.	Not available	Not available	Not available

findings of this research confirm Kunwar and Chand's (2016:32) argument that "heritage in Nepal is deeply connected to the nation's pride, the people's souls, belief and identity," making the heritage in Nepal exceptional examples of living heritage (Weise, 2015).

The indifferent tweets clearly illustrate that social media affords visibility to voices marginalized in the mainstream. These tweets can be useful in raising awareness, initiating debates and generating interest in the event.

Lastly, Twitter was also used as a space for the recollection of personal experiences and past events. Many memories illustrated in Table 10 may be a part of the people's daily lives; however, such discussions surface on Twitter only when a disaster strikes. The category "memory" may be unique to cultural heritage during disasters, as it has not appeared earlier in other studies of tweet classification during disasters (Castillo, 2016). It clearly illustrates that people who visited the cultural heritage sites, regardless of how much time has passed after their visit, remember the sites. Moreover, a visit to a heritage site may not be necessary for people to remember it. Users also remembered heritage sites from movies. Heritage of a country may be remembered and celebrated in other countries after a disaster. This clearly shows that often heritage is valuable to the people outside the national boundaries. Lastly, memories of a historically significant disaster were also shared during the 2015 earthquake. These memories are important for "socially distributed curation" (Liu, 2012) to preserve the memory of events for future generations. Moreover, these memories can also be used to inform the possible vulnerabilities of heritage sites and, thus, help in disaster risk reduction.

Tweets coded in the category "noise" clearly illustrate the complexity of the task. The language usage in Twitter poses a challenge in data collection and analysis. Firstly, query keywords can have different meanings. Secondly, the use of different spellings can make data collection even more challenging. Lastly, often people use words in regional language to refer to heritage sites. All the above-mentioned factors illustrate the complexity of the process.

Finally, the findings also highlight the importance of participatory technologies in empowering the users to enhance the disaster

TABLE 13 Examples of noise

Tweet	Number of retweets	Number of comments	Number of favourites
Historic #earthquake in #Nepal; much lost, many to mourn, as much to rebuild. Hopefully worst is over. Stay alert, safe	692	36	225
Nepal Earthquake. Golden Temple to send 1 lac & Delhi Gurdwaras to send 25 k meals daily. Those who share sardar jokes, please share this too.	5	0	2
When Sonia was disallowed her entry in Pashupati Nath Temple in 80, on limited Darshan by Rajeev in 80s, Nepal started decaging?	0	0	0
Biggest Earthquake ever in the history of Nepal!! #PrayForNepal	0	0	0
Hats off to our army and government for providing aid to Nepal… This is our culture…#Earthquake	0	0	0

management process, thereby also broadening our understanding of events. During disasters, participatory technologies such as Twitter functions as an infrastructure to support communication and collaboration (Leong et al., 2015). Therefore, they can also help strengthen our response to the disasters.

6 | CONCLUSION

This paper set out to understand the response to cultural heritage damaged during Nepal earthquake by utilizing 201,457 tweets (including RTs) from three different sources, collected at different time spans using different keywords. The analysis shows that only a small number of tweets (approximately 4%) were posted regarding cultural heritage. These tweets can be divided into 5 categories: information, sentiment, memory, action and noise. It should be noted that most of the tweets are hybrid, that is they followed at least two of the above-mentioned categories. The analysis shows that people use Twitter during disasters mainly for information dissemination regarding damage to the sites. Such dissemination is in the form of sharing mainstream media reports and also retweeting people on-site. Overall, some tweets are more useful than the other in assessing damage to the heritage sites and understanding the situation on the ground. Such tweets include the name of the site, information about its condition, the number of humans affected by its damage and information about rescue operations. The analysis also shows the importance of Twitter as a channel for mediating exchange of information, support communication and collaboration during disasters.

The paper has a few limitations. Firstly, it utilizes only Twitter as a source. The results of this research may not apply to other social networking sites such as Facebook and Instagram. Secondly, it focuses only on the 2015 Nepal earthquake. Whether the results of this research are applicable during other disasters is a matter of future work. Future work can also include analysis of posts on other social networking sites.

DATA AVAILABILITY STATEMENT

Data supporting the results of this paper cannot be provided by the author. If you are interested in the dataset, please contact the researchers who provided data for this research.

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