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Lessons learned from deploying crowdsourced technology for disaster relief during Kerala floods

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Abstract

Crowdsourced technology has been proven as effective communication mechanism in various disaster relief efforts worldwide. It often results in generating actionable and timely information regarding disaster situation, shelters, requirement for and availability of essential supplies such as food, clothing etc. But crowdsourcing has its downsides such as providing potentially inaccurate, incomplete and unverifiable information. We have developed and deployed a crowdsourced disaster relief mobile and web platform during 2018 and 2019 Kerala floods and provided relief to victims in the areas of rescue, medical help, supplies and services. During the deployment we experienced firsthand, both the positive and the negative aspects of crowdsourced approach. In this paper we detail our experiences and analysis and highlight some potential measures to mitigate the challenges in deploying crowdsourced technology.

Keywords: Crowdsourced technology, Disaster relief, 2018-2019 Kerala floods, Mobile application

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1. Introduction

Crowdsourced technologies have been used successfully during disaster relief for almost a decade. Crowdsourcing has been used for real-time mapping of the disaster situation such as flood levels, status of buildings, roads and bridges, shelters, and medical camps. Crowdsourced technologies have also been used for sharing information about missing persons, safety status, riots and mobs etc. In some cases, crowdsourced approach has been used to request for food, medicine and clothing and to offer these essential items.

A quick analysis into the usage of crowdsourced technologies for disaster relief would reveal the following benefits of this method. Crowdsourced approach enables quick information flow. Victims, volunteers and NGOs can contribute information related to victims needs and volunteer offerings can be shared to anyone with an internet connection. This encourages more relief contributions from across the world in cash, materials and medicines. The availability of such information greatly helps and enables the government to act quickly and efficiently towards disaster relief. Since the victims and on ground volunteers can contribute to the disaster information, it becomes comprehensive, realistic and trustworthy. Often information about landslides, flood levels, damaged roads, bridges and buildings etc., can't be gathered by the government until it is much later. Crowdsourcing approach fills this gap by enabling the government to mobilize the relief equipment and personnel to the concerned location much more precisely at war footing. Crowdsourced approach gives the opportunity to the victims to express their needs and concerns to the world directly without any intermediary aggregating and generalizing it. This helps to reduce the trauma and bring hope to the victims with the sense that they can tell the world about their needs. Similarly, the crowdsourcing platform enables the individual volunteer to contribute to the disaster relief, through information, cash & kind, food, services such as driving vehicles, cleanup, helping the elderly and disabled, rescue efforts, etc. Since quick, fine-grained, on-ground information becomes publicly available in crowdsourced approach, it motivates the local volunteers, NGOs and government, other citizens, and international patrons to contribute to the relief efforts at the earliest. Availability of detailed victim level information also ensures that everyone gets what they need, without much wastage of resources.

While the crowdsourced approach had many advantages in the disaster relief, the current technologies used to implement it have a lot of limitations. In the following section we enumerate a few of these downsides which were observed through our own study of 2015 Chennai flood relief activities. During Chennai floods a publicly available Google spreadsheet was used to record the rescue, shelter, food and supplies needs of the people along with the volunteers' offerings of shelter, food and supplies. Apart from that, Facebook, Twitter and WhatsApp were extensively used to share the helpline numbers, details of shelters, food and items, supply center details, etc.

Fig. 1. Image of the shared Google spreadsheet. Image Source [1]

The messages shared through social media such as Facebook, Twitter, and WhatsApp do not adhere to any specific format. The Google spreadsheet (Fig. 1) provides better formatting in terms of the columns but does not restrict the people to adhere to certain standards while entering the relief information. For example, the Area column may include multiple areas instead of single area, or the area name could be misspelled. The Original source link column has details about the relief. The contact info column contains the relief information etc. The non-standardized information is certainly useful for human consumption, but extremely difficult for computers to process, aggregate and filter. This hinders the governments and NGOs from deploying relief efforts at a larger scale as they can't get higher level summaries to answer questions such as how many people need shelter by area, how many people need blankets or medical attention by area, etc. In many cases, people do not provide complete postal address of the victim to be rescued. They may give descriptive address, sometimes they may omit the locality and street information, and in some cases, they may provide the name of the school, hospital or other public place as their address. Also, in most cases, they do not provide the geolocation details such as latitude & longitude, which means that the various relief needs cannot be plotted on the map interface. This lack of proper address prevents the area wise summarization of disaster relief information. Another major disadvantage with social media based crowdsourced approaches is that there is no mechanism to incorporate status updates of the various relief requests and offers. For example, if someone requests blankets and medicines and then gets them, there is no easy mechanism for them to update the status in their Facebook or WhatsApp post, tweet or google spreadsheet, in such a way that others become easily aware. Also, if someone is offering food, there is no way to say that they have run out of food. This prevents others from trusting the information's validity, especially when its ages by a few hours or days. Even though the Google spreadsheet was created, many people were still requesting help through social media, SMS and call centers. This required volunteers to manually enter the information from the social media etc. into the systematic google spreadsheet. Volunteers were also manually removing outdated and fulfilled requests from the spreadsheets. Since there is no systematic way to identify the users who are requesting and offering through social media and Google spreadsheets, there is no way to prevent multiple postings of the same request across multiple channels. Also, there is no way to identify who is entering the data in the publicly shared spreadsheet. Since the users can't be identified positively, there is no way to contact them to verify the validity of the information and there is no way to block such users from further activity on the spreadsheet.

After careful analysis of the advantages and drawbacks of crowdsourced approaches to disaster relief, we have designed and implemented Amrita Kripa, a crowdsourced disaster relief mobile and web app platform, which maximizes the advantages and compensates for the drawbacks. We deployed Amrita Kripa during 2018 and 2019 Kerala floods and provided rescue and relief for thousands of victims. While Amrita Kripa proved much more effective compared to the general-purpose social media platforms, the deployment experience helped us to uncover some more challenges of crowdsourcing approach in disaster relief. This paper is our attempt to catalogue these experiences and potential changes required to be implemented in Amrita Kripa to address these challenges.

In the rest of paper, we present the related work in terms of specific usages of social media applications during earlier disasters, following that, we present the high-level details of Amrita Kripa application, how it addresses the drawbacks of existing social media applications, the deployment and usage details during Kerala floods. In the subsequent section we present the challenges faced during the deployment and potential solutions to be implemented in Amrita Kripa to address these challenges and finally we end with conclusions.

2. Related Work

During the Haiti earthquake in 2010, which claimed more than 230,000 lives and affected more than 3 million people, Ushahidi application was used for setting up the crisis map to capture, organize and verify information regarding shelters, missing and trapped persons, medical and other essential supplies requirements. All the information was gathered from various social media channels such as Twitter, Facebook and from a special SMS number setup for this purpose. A team of volunteers translated the data from these sources and entered into the Ushahidi system. This data was instantly visible to everyone with an internet connection and the on-ground volunteers were able to use this information to effectively direct the resources for relief work [2]. During the 2011 Japan earthquake and tsunami, people resorted to Twitter and Facebook for sharing information regarding missing person, relief for disabled, fund-raising, NGO activities, and requirement and availability of shelters and essential supplies [3]. Twitter promoted its usage by setting up special instruction pages in Japanese language and setup hashtags to be used in every situation and they also made available a special webpage to display all the earthquake-related pages. Facebook promoted awareness of the disaster around the world, which helped in bringing large amounts of donations from all over the world for the relief efforts. During the 2012 Beijing flash floods which killed 70 people, destroyed 8000 homes, and affected 1.5 million people, Google maps were used for mapping real-time flood status and impact. Google maps were setup for this purpose within 2 hours and people started contributing information using the maps. This was circulated widely through social media. These maps were far more accurate and were delivered a day earlier than the government's information [4]. During the 2012 Philippine floods which affected around 800,000 people volunteers setup a non-editable, public Google spreadsheet containing the rescue, shelter and supplies requirements of victims. The data was input into the spreadsheet using a Google form. Google's crisis response team setup a person finder and a shelter map [5]. Volunteers also set up a crowdsourced OpenStreetMap-based live flood level indicator [6], which turned out to be very critical for planning and delivering relief. During the 2015 Nepal earthquake which left 9000 dead, 22000 injured and 3.5 million people homeless [7], OpenStreetMap set up a crowdsourced map which was populated by various experts around the world based on the inputs from on-the-ground sources. It turned out to be a difficult job as the earthquake and resulting avalanches altered the terrain and several roadways. Maps were created by using UAVs, satellites and the contributions from the local organizations. The maps included the damaged buildings, roads and other infrastructure, shelters, medical requirements etc. [8] [9]. 2015 Chennai floods killed 5000 people and affected 1.8 million people [10] and the floods lasted for more than a month. In the wake of this disaster, Chennai experienced an unprecedented relief effort from volunteers and NGOs. Technologies like Google spreadsheets, Google crisis map, Facebook Safety indicator and Twitter were used extensively for sharing information about people needing to be rescued, requests and offers about food, shelter, and essentials like blankets, clothing, sanitary items etc., [11] [12] [13].

Reference [14] presents the study of crowdsourced geographical information technologies (GeoWeb) in the context of disaster mapping during various fire, flood and earthquake disaster around the globe. They observe that crowdsourced platform must be able to rapidly identity inaccurate information so that the information is actionable. They identified that GeoWeb can address the challenge of real-time information dissemination to the people affected and the challenge of providing timely location-based information on the disaster situation to the decision makers. Reference [15] focused on the importance of coordination among various disaster relief agencies, NGOs and public for effective disaster management, along with crowdsourcing. They observed that many crowdsourcing applications can provide accurate and timely information about the crisis but fall short when it comes to providing mechanisms for collaboration and coordination, crowdsourced information is often inaccurate and inadequate to provide the relief and finally many crowdsourced applications do not have adequate security features for relief operations. Reference [16] provides exhaustive analytical study of fake news in social media during 2018 Kerala floods, they concluded that most of the people share or forward the information they received from social media channels such as Whatsapp, Facebook and Twitter without verifying the facts.

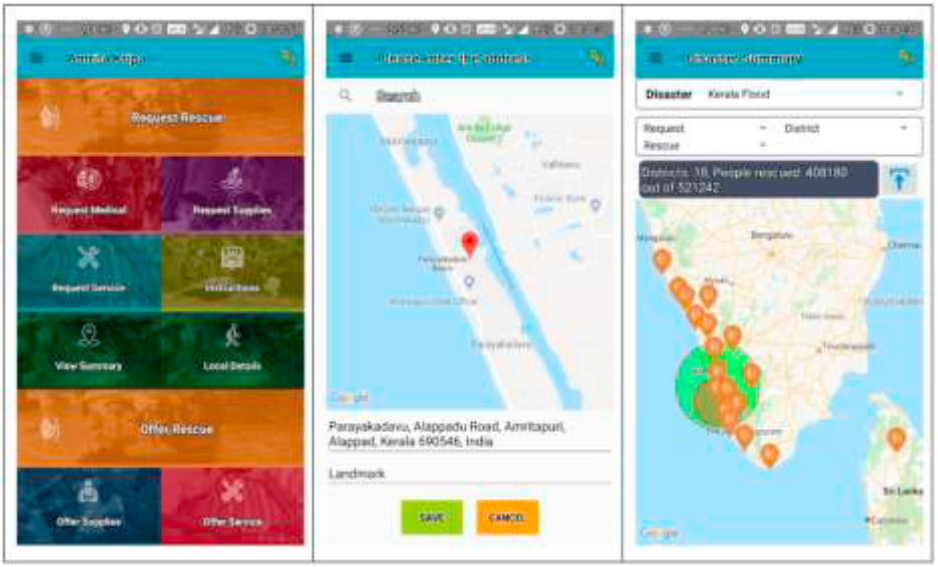

Fig. 2. Amrita Kripa App screens. Various features, Address configuration and Summary View

3. Amrita Kripa & Kerala Floods 2018 & 2019

We have developed an application called ‘Amrita Kripa’, as part of an Indo-German collaborative project called FloodEvac [17] [18]. Amrita Kripa supports a crowdsourced disaster relief model. It enables the victims to request for rescue, medical attention, supplies such as food, clothing, essential sanitary items, etc., and services such as cleaning, moving, plumbing, electrical, etc. It enables the volunteers to offer rescue, supplies and services. All the requests and offers are presented over an interactive map interface, which supports summary views, drill downs and various filters. All the requests and offers are updated in the map interface in real-time. ‘Amrita Kripa’ comes with both mobile and web applications. The web application is especially suitable for the governments and NGOs as it has administrative screens enabling viewing detailed reports of the entire disaster relief efforts (Fig. 2).

3.1. *How ‘Amrita Kripa’ addresses the downside of Crowdsourced Approach*

In this section we present an analysis of how Amrita Kripa app minimizes the above-mentioned downsides of crowdsourced approach (Table 1)

Table 1. Downsides to Crowdsourced approach Vs Amrita Kripa

Downside	Amrita Kripa Feature	Explanation
Unorganized information	Requests and Offers Types and Subtypes	Amrita Kripa offers separate request types for Rescue, Medical, Supplies and Services and separate offer types for Supplies and Services. Each of the requests and offers have separate screens with individual fields to capture the number of people affected, contact details, medical problem type, service type, supplies type, supplies subtype, and additional attributes. Each of these types are presented as selectable drop-down boxes to prevent nonstandard entries. This design ensures that data can be summarized and filtered easily to support NGOs, governments, and individual volunteers as well.
Incomplete address and No geolocation	Address screen	A flexible address screen with map interface accepts address with either a click on the map, search box, or a plain free-style text. In any case, the address is converted into a marker on the map, so that user can move the marker to accurate location. The landmark field is provided to give additional details such as 3rd floor, etc.
No status updates	Request and Offer statuses	Amrita Kripa supports 5 request statues (Submitted, In Progress, Partially Fulfilled, Fulfilled and Taken Back) and 2 offer statuses (Available and Unavailable). It also provides a field to enter the currently filled quantity and currently available quantities.
Manual efforts	Mobile and Web interfaces	With mobile and web interfaces the users can directly request and offer help, so no intermediate volunteers are required.
Unknown users & Fake information	User registration	Each user must register to use Amrita Kripa. They need to provide their mobile number and email address during registration

3.2. *Kerala floods 2018 - 2019 and Amrita Kripa launch*

In August 2018, Kerala experienced the worst floods in the past century due to unusual heavy monsoon rains combined with opening of dam gates in quick succession. The floods and landslides killed more than 483 people and affected more than 1 million people [19]. Similar floods but on a much smaller scale occurred in Aug 2019 killing 121 people in floods and landslides and affecting over 0.2 million people [20]. We had deployed Amrita Kripa during the 2018 floods [21] and made several improvements to the functionality and usability based on the user's feedback. We deployed it again during the 2019 floods [22]. In both instances the Amrita University set up and operated a 24-hour call center manned by 100s of staff and students.

The Amrita Kripa mobile app was used by the victims directly and by the call center volunteers. The web app was used by the call center personnel to enter the caller data, their request and location details in the Amrita Kripa system. Fig. 3 shows the operational flow adopted during Kerala floods. Victims either called the call center or directly entered the requests into the app. Upon receiving the calls from the Victims, the call center personnel collected the critical data such as location, type of request, number of affected people and the contact details and entered the information into the app. The call center also setup verification teams, one team per request and offer type. Upon receiving a rescue request the rescue team would call the local police station or Army helpline and give them the coordinates of rescue, alternatively the Army or police can see the latest rescue requests from the App itself. Upon receiving the other types of requests or offers, the medical, supplies and services teams would call the victim or volunteer back and confirm their request or offer, confirming the number of people, medical problem type, supplies type and subtype, service type accordingly. Once it is verified as genuine request the respective on-ground agencies were contacted to provide relief. Overall the call center had helped 100,000 victims by handling over 25,000 phone calls [23]. Fig. 4 shows high level statistics of Amrita Kripa app usage during the Kerala floods. The app recorded more than 5117 rescue requests, 4928 supplies requests by type, 24 service requests and 16 medical requests. The app also recorded 74 service offerings and 1682 supplies offerings by type.

Fig. 3. Amrita Kripa Call center relief process

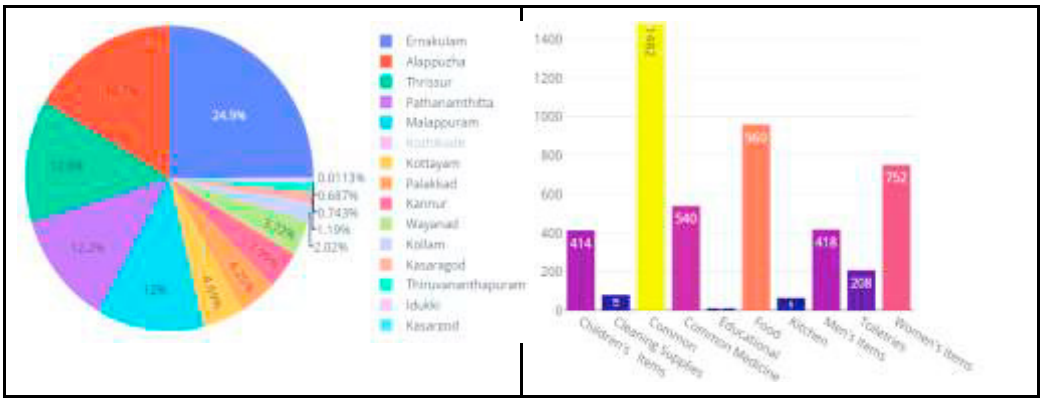

Fig. 4. Amrita Kripa usage during 2018 &2019 Kerala floods.
Percent of requests by District (Left) and Number of Supplies requests by Type (Right)

4. Lessons learned

Even though we had incorporated many features in Amrita Kripa app to handle the many downsides to crowdsourcing approach, we had faced many other downsides of the crowdsourced system. We have observed that different relief phases are being more active as time progresses after the disaster (Fig. 5). Immediately after the disaster strikes, the Rescue phase becomes more prominent with the greatest number of victims needing rescue. Depending on the victims' condition they may either need medical attention, shelters and/or supplies such as food, clothing etc. After the disaster subsides, as the victims start to go back to their homes, as their lives go back to normal, they may request several services such as electrical, telephone, plumbing, cleanup, etc.

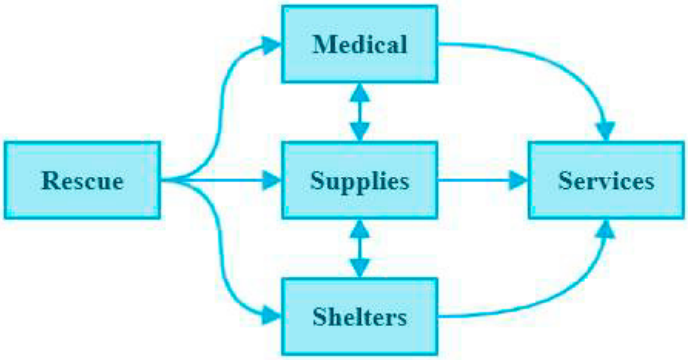

Fig. 5. Typical relief cycle during disasters

We tend to get mostly genuine requests during the Rescue, Medical, Shelter and Service phase, but when it comes to Supplies phase, there is a raise in percentage of not-so-reasonable requests. This is so because the non-perishable supplies are the only type of relief help, which can be accumulated and stored for later use. Table 2 lists all the types of misuses of crowd sourced system with respect to Supplies phase of the relief cycle.

Table 2. Lessons learned for further improvement of Supplies crowdsource phase

Lesson	Description/Experience	Possible solutions to the App/Crowdsourced process
Duplicate requests	We often got duplicate requirements related food and clothing needs from the same house or shelter. Sometimes they were requesting unknowingly, in some cases they were requesting again if they have not got any help	Duplicates should be identified based on the geo location and time of the request with proximity thresholds to identify and confirm with users automatically.
Exaggerated requests & Hoarding	In some cases, we got requests for large number of non-perishable items such as clothes, sanitary items, cleaning items, etc. For small household. In some cases of shelters, we got requests for 1000 clothes, 1000 sanitary pads etc., even though the shelter capacity may not be more than 50 or 100 people. In many cases people take a lot more items than they need in reasonable cases to hoard and resell to others.	For an individual household the app should allow a pre-configured maximum items per person. So that they may not request more than that. In case of shelters, the app should ensure that they follow stricter registration and verification process. The shelter feature should also accept the number of occupants and their details, and maximum number of items must be decided based on those details.
Rebranding and Redistributing	Some unscrupulous organizations were observed to accept lot of items from the collection centers and rebrand them as though they are being distributed by them.	Only shelters and individuals should be allowed to request supplies and the above-mentioned procedure and item limits should be enforced. If any observation of rebranding occurs, then that organization/center should be black listed and reported to authorities
Pranks	Many people play pranks by registering for spurious requests and offers	Users should be explicitly warned not to indulge in pranks. Users should be advised to respond to verification calls. Otherwise their account should be blacklisted, and their mobile and email addresses should be prevented from using the Amrita Kripa system in future.
Privacy management	Since the crowdsourced system is publicly available, there is a chance of misusing the	Amrita Kripa needs to be improved such that the visibility of contact information should be

	victims and volunteers contact information	controlled by the respective users. Initially the interested party should contact the victim or volunteer through live messaging and the victim and volunteer should use their discretion to make their contact information visible to the specific user.
Opportunistic vendors	The summary maps can be misused by the vendors. They may be able to find out area-wise supplies requirements and setup their shops in that area and sell the goods at a premium	Amrita Kripa needs to be improved such that summary maps are visible only to trusted users and regular citizens may see only detailed requests and offers
Lack of enthusiasm	We noticed that some potential volunteers may not participate in the relief efforts due to lack of enthusiasm	Amrita Kripa needs to be enhanced such that every user who contributes the relief process gets some type of digital rewards which they can share in their social media channels

5. Conclusions and Future work

In this paper we have analyzed the almost decade-long track record of crowdsourced efforts during various disasters around the world, presented the advantages and potential downsides of the crowdsourced approach, we also highlighted how Amrita Kripa was designed to offset some of these downsides. We also shared our deployment experience during the 2018 and 2019 Kerala floods and finally we ended with sharing the insights about the common misuses of the crowdsourced system during Supplies phase of the relief cycle and possible countermeasures to be taken in future to tackle these misuses.

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