

# Everyday Emergencies: Challenges and Designs Involving 9-1-1 Systems

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## ABSTRACT

### Abstract

Since late 1960's, 9-1-1 calls in North America have been answered over audio calls. However, this method of information collection can prove to be challenging as the call-taker relies on the caller and has no visual way of confirming facts. Next Generation 9-1-1 (NG 9-1-1) is a mandated move by the Canadian government to include multimedia features like, video-calling, photo-sharing, and texting in 9-1-1 services. The focus of my thesis work is to understand how user interfaces, desktop and mobile can be designed, so that it helps 9-1-1 call-centres to transition into a future that allows multimedia handling and remote collaboration. My thesis also focuses on designing mobile user interfaces that will allow 9-1-1 callers to use their smartphones and leverage multimedia during a 9-1-1 call.

## CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Human computer interaction (HCI); HCI design and evaluation methods; User studies; Ubiquitous and mobile computing; Ubiquitous and mobile computing design and evaluation methods.

## KEYWORDS

User Interface, User Experience, MobileHCI

### ACM Reference Format:

Punyashlok Dash. 2021. Everyday Emergencies: Challenges and Designs Involving 9-1-1 Systems. In *Adjunct Publication of the 23rd International Conference on Mobile Human-Computer Interaction (MobileHCI '21 Adjunct)*, September 27–October 01, 2021, Toulouse & Virtual, France. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/3447527.3474867>

## 1 INTRODUCTION

Everyday emergencies are those situations where a 9-1-1 caller calls to report about a medical, fire or police related emergency [8]. Traditionally it has been carried out over a phone call where the call-taker and caller exchange information, the call-taker types the information in a Computer Aided Dispatch system and forwards the information to first responders via a dispatcher [6]. However, there are various limitations to this method of data collection, information inaccuracy is prime among them [7]. Callers are often frantic and do

not assess situations well [5]. They may also face language barriers when English is not their first language [1, 2].

NG 9-1-1 which aims at including multimedia capabilities in a call will provide some obvious benefits. Photographs can help a call-taker know about the extent of an injury or a license plate number [3]. A video will help in analyzing the size of a fire or the extent of damage to people and cars in an accident. While multimedia can help improve credibility and accuracy of information, it is still not known how best to design an interface that will enable NG 9-1-1 video call-taking at Public Safety Answering Points (PSAPs). By video-calling I refer to calls like Skype or FaceTime, however the UI is designed with call-takers and 9-1-1 workplace in mind. A challenge that comes with inclusion of potential multimedia in 9-1-1 is to minimize additional mental trauma [4]. Careful considerations for designs must be made to ensure that a call-taker always has the choice to see or skip multimedia.

The overarching research question of my thesis is:

“What are important design factors to consider when designing user interfaces of systems that enable multimedia calling between 9-1-1 callers and call takers?”

To address the research question, I have divided my thesis work into two phases. The first phase deals with designing a UI for 9-1-1 call-taking that enables multimedia facilities.

In the first phase of my research work I made two prototypes (low and medium fidelity) and ran two studies with 9-1-1 call-takers and dispatchers. The findings from this phase contribute towards my second phase of research where I plan to explore how UI can be designed for 9-1-1 callers that will help them shoot videos, take photos and send media to a 9-1-1 call-taker.

## 1.1 Research Contributions

My work will provide the following contributions.

1. A UI design and guidelines for enabling multimedia call-handling facilities at a 9-1-1 PSAP.
2. A UI design for enabling multimedia based 9-1-1 calling facilities from a smartphone.

## 2 PHASE 1: DESIGNING UI FOR SYSTEMS TO ENABLE NG 9-1-1 AT A PSAP

In the first phase of my research work, I designed two prototypes that aimed at testing layouts and components which were best suited to incorporate video calling, photo viewing and texting into existing 9-1-1 practices without majorly affecting other call-taking procedures. I started with a low fidelity prototype to explore my initial design ideas. The low-fidelity prototype is shown in Figure 1 and 2.

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*MobileHCI '21 Adjunct*, September 27–October 01, 2021, Toulouse & Virtual, France

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ACM ISBN 978-1-4503-8329-5/21/09.

<https://doi.org/10.1145/3447527.3474867>

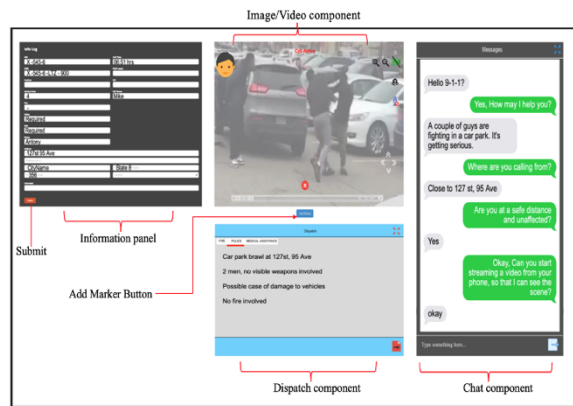


Figure 1: Main Screen – NG 9-1-1 components



Figure 2: Map Screen – Timeline Based Interaction

I conducted semi-structured interviews after the first study with nine participants (five call-takers and four dispatchers), and I share the results of the study below:

#### a. Video and Picture Viewing

Call-takers and dispatchers were introduced to the idea of using multi-media in a 9-1-1 call. Both live and recorded video for sharing the context of a scene was considered important. It was also found that the ability to switch off video and just use audio for part of a call was still important. This would help prevent call-takers/dispatchers from seeing traumatic events and would also reduce information overload. Call-takers and dispatchers also wanted to be able to control the camerawork of callers by being able to provide some sort of visual instruction in the form of on-screen markers. Call-takers also wanted the ability to take snapshots from streamed videos and not completely rely on callers for sending photographs of incidents.

#### b. Call-Taking and Camera Instructions

In order to guide callers and perform camera work at a scene, it was important that call-takers knew what they wanted to see in a scene. A catalogue for suggesting necessary camerawork, like pan, zoom and tilt based on the nature of a scene was considered



Figure 3: Medium-Fidelity Prototype, Main UI Screen

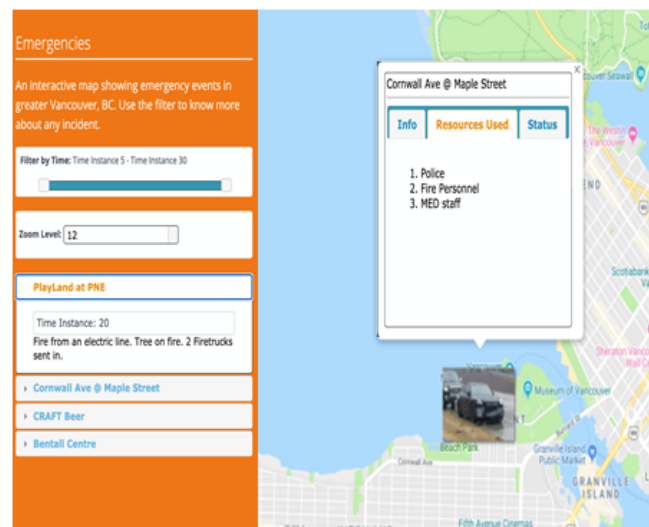


Figure 4: Map Screen with timeline interaction and filters

important. This catalogue would appear on a screen and could be glanced by a call-taker real-time during a call.

Based on the results, I created a digital prototype of the main screen and map after my first study. The prototype ran on a browser. I incorporated some of the findings from my first study into the medium fidelity prototype and conducted another study with eight participants to evaluate my initial design. Figures 3 and 4 show the medium fidelity prototype version of the main and map screen.

I conducted another semi-structured interview after the second study with eight participants. Five of them were call-takers and three were dispatchers. Both the studies were conducted at a PASP in Vancouver, Canada. I share the results of the second study below.

#### a. History and Mapping

Call-takers and dispatchers liked additional filters and a time-based interaction feature. However, an important design consideration that comes out was not to use incident thumbnails on maps as it could force call-takers to view unpleasant or trauma inducing pictures. Generic icons were preferred over image thumbnails.

#### b. Layouts

Call-takers and dispatchers wanted to visualize every UI component as re-sizable and movable. They wanted to be able to flip components along the Y-axis (180 degree) to reveal other components. This would help save space and hide away components that may not be required during an active call. This was something akin to a camera flip button where flipping would switch between cameras.

### 3 PHASE 2: DESIGNING A NEXT GENERATION SYSTEM FOR 9-1-1 CALLERS

In the final phase of my research work I aim to design a multimedia enabled 9-1-1 calling application for callers to use on their mobile phones. This will be a medium-fidelity prototype that will allow users to capture video streams, shoot photos and receive instructions from a 9-1-1 call-taker. The prototype will have the following features:

**a. Camera work:** The camera interface within the prototype application will show appropriate overlays to guide callers to perform necessary tasks. Some of the supported tasks will be as follows: (1) **Sharing pictures and video:** Any photos or videos shot by the caller while using the camera feature within the application will appear as temporary thumbnail. Clicking the thumbnail will show a preview of the files and provide an option to send all the captured media to the 9-1-1 centre. (2) **Panning and Zooming:** The interface will show arrow marks in the required direction where the user will have to pan their phone. The overlays will suggest zoom through a pinch-to-zoom gesture or via a written text. The interface will suggest taking photos of a scene by highlighting the app border in a specific color or show a word like ‘snap’. (3) **Multiple camera angles:** The camera app will provide an option to stream simultaneous views from both the front and rear cameras. The front camera will provide a view of the caller’s face which will help 9-1-1 authorities in quicker identification of the caller. Depending on the level of camera access provided by APIs on different mobile devices, the camera application will also provide an option to stream multiple views from multiple rear cameras. For example, a wide-angle view and a tele-photo (zoomed) view of a scene. (4) **Toggling between audio and video modes:** The camera application will provide the caller an option to toggle between audio and video modes. The decision to switch on/off the camera must be provided by the call-taker. This can help save bandwidth as the entire duration of the phone call does not need to live stream a video and some calls may not even require a video to be streamed at all.

**b. Instructions:** Once the call-taker understands the situation of a caller, they may send out instructions to the caller to deal with the situation. The nature of instructions can vary greatly depending on the case. For a lost/stolen item like a credit card, a caller will need a list of steps to follow and that may exist as a document. In this case the application will provide the ability to open and read

the document on fly, once it is downloaded by the caller. For cases where the call-taker may need to type steps, the steps can appear as cards or text bubbles within the call interface.

If a caller needs to perform CPR, the call-taker may send a demo video. The prototype will have options to play the demo video within the application and may provide a picture-in-picture functionality as well, which will depend on OS level support for various mobile platforms. These instructions will accompany standard call-taking procedures and will be treated as supplementary material.

### 4 FUTURE WORK – PROTOTYPING AND EVALUATION

I will refer to previous literature [5] as a starting point. I will first sketch my ideas and then build the medium fidelity prototype to have features that are mentioned above. The features will be developed on a mobile platform using technologies like React Native to make the prototype functional on both iOS and Android.

To evaluate the design, I will recruit around 20 participants through ads on social media platforms and on the university website. Preference will be given to those who might have called 9-1-1 in the past, but it may not be the sole criterion of selection. I will design a series of scenarios that can represent different types of 9-1-1 emergency situations that occur on a day-to-day basis like, fire in a household, break-in and enter, medical emergency or a road accident to name a few. The scenarios will guide the user to use the software to either text, stream a video, send photos using the phone or read instructions. I will ground the user in the scenario by showing them videos of various incidents that are either available on the internet or may be pre-enacted. I will conduct the study in a lab environment to observe the participants face to face and conduct semi-structured interviews with them after the session.

### 5 BENEFITS OF PARTICIPATING IN MOBILE HCI DC

I believe I will greatly benefit from participating in the MobileHCI DC for these reasons.

a. I am inspired by the work of others in the MobileHCI community. I think it would be beneficial for me to learn more about how others conduct research, particularly within domain-specific contexts, and to understand the different perspectives that other researchers come from along with the ways they put those perspectives into practice.

b. Participating in the DC would allow me to interact with other researchers. This is important for me professionally, as these will be my peers, from whom I will be able to seek advice from or collaborate with, in the context of MobileHCI.

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