SSTA-HADR Competition Submission by: Team Kestrel

After a disaster, the most common, portable and user-friendly device is a phone. The aim of our project is to create a mobile application that can be used by all relief workers as well as survivors regardless of technical literacy. The app is designed with a simple, yet intuitive and functional design in mind. This is to allow for clear communication, easy use, and fast actions that are required in a disaster scenario where every second counts.

The main features of the app include:

1. Logistics Backbone to coordinate and support relief efforts.

Relief workers are able to request for additional supplies or manpower through the app. All requests are categorized under “Pending”, “In Process” and “Complete” to clearly indicate resource and manpower allocations required for each task. This ensures no double deliveries or unnecessary worker allocations are made, ensuring quick and efficient delegation and preventing wastage of manpower and material.

2. Drone Fleet Management System

Relief workers are able to request for telemedicine drones to land at their locations to aid in the disaster relief effort. When telemedicine drones are first sent to the disaster zone, they stay within holding areas until called upon by relief workers. In order to remain effective, drones will have to be sent back either for maintenance or restocking of material. The app will reflect this Return-To-Base timing of each individual drone.

Relief workers are able to designate a drone’s landing zone by searching for a location and selecting it. This allows users to use landmarks at common locations that can be easily seen by others as landing zones to more easily coordinate relief efforts.

Relief workers are also able to create a new landing zone by marking it on the phone’s map. This will allow drones to deploy more flexibly and land in the exact GPS location the user marks. This is useful for when terrain changes cause previously viable locations to be inaccessible or hazardous.

3. Multiple Map Options

Local terrain may change drastically after disasters, however, workers and civilians may be more comfortable giving directions with reference to previously standing buildings or landmarks that are now indistinguishable. The app includes multiple map options for easy discernment of a user's location, allowing them to select between 'Before' and 'After' versions of satellite imagery and indicates changed regions under separate map options. In certain situations, terrain features may be hidden by cloud or fog cover and the normal map (a familiar "Google Maps"-esque simple digitised map) may be more suitable than satellite imagery. The app computes the changes in the before and after images with OpenCV, a computer vision API.

4. C2 Broadcast Information System

The C2 Broadcast information system allows the C2 centre to quickly and efficiently broadcast updates to relief workers and civilians, such as hazardous weather warnings and updates on new drone fleet arrivals.

5. SOS Call Relay

The app uses a mesh network to relay SOS calls made by trapped civilians to relief workers in the disaster zone. As the majority of infrastructure is assumed to be destroyed, Wi-Fi and cellular services for trapped civilians may be unreliable or unavailable in the disaster zone. Our app installed in a civilian's phone will search for nearby devices installed with the same app, attempting to establish a connection through the mesh network utilising the phone's pre-existing radios such as Wi-Fi and Bluetooth. Once a connection is established, the civilian is able to send their SOS message to the nearest worker.

This mesh network established by our app helps to significantly extend the range of communications in comparison to conventional star network topologies. The mobile app detects civilian SOS signals and alerts relief workers through a bar in the bottom of the app home screen, including their GPS coordinates for quick rescue.

6. Zephyr Pseudo-Satellite Interoperability

The Zephyr High Altitude Pseudo-Satellite plays a critical part in the project infrastructure by providing both line-of-sight and beyond-line-of-sight communication, high-resolution optical imagery for mapping purposes under all weather conditions, and additional key data metrics from space or airborne sensors. Such data metrics can be used to update the map or warn relief workers of incoming changes of the weather through the C2 broadcast information system.

Appendix A: Application parameters, setup, and caveats

This section contains information about the application's technical parameters

IMPORTANT: The login credentials for the test worker is username: tester1, PIN: 123456

1. APIs used (major):

- OpenCV Android SDK ⇨ Computes change in the before and after satellite images
- Nearby Connections ⇨ Google's Nearby API allows for the creation of a mesh network
- Firebase ⇨ Database in the cloud
- Google Maps and Places ⇨ Mapping and location picking

2. Caveats

This app can only be considered a "functional mockup", not a "semi-functional" application. A "functional mockup" typically lacks data flow at certain points of the application. Given the time constraints, we have made the best use of what we were given to implement as many functional components in the application to properly demonstrate it to the judging panel.

- UAV view is not synchronised with a cloud database
- Lack of multiuser support, only one worker and one civilian
- Supports Android 5.0 and above, but only tested with real devices down to Android 6.0
- Mesh network functionality is still in testing phase and may not fully function
- Mesh network functionality requires a device that supports Bluetooth Low Energy (Bluetooth 4.0 and above)
- Display of satellite imagery may crash older devices due to the large RAM usage