# AN INTEGRATION OF DRONE IMAGES AND MOBILE APPLICATION FOR WEB BASED GIS MAPPING

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**ABSTRACT:** The Kelani Valley railway line is becoming one of the major railway routes in Sri Lanka. It runs through the major business centers, like Nugegoda and Maharagama, before turning eastwards. Kelani Valley railway is to be rehabilitated under the project of Colombo Suburban Railway Project (CSRP). But due to the over population living alongside of this railway line smooth rehabilitation is problematic at the moment. To this end, Mapping of building by the side of the railway line with the citizen information is vital factor for a better planning of the project. This paper presents a method for generating web-based cartographic maps using Drone images and Mobile information.

Drone images acquired by a UAV system which is the latest geo-spatial data acquisition technique are used in this project for mapping building features. This reduces the project cost and time substantially. Geo clipping video output of the drone are stored in a database and these data can be viewed together with the Google 2D map of the captured areas. Generated frames from the captured video which contain XY coordinates for individual frame are used to convert those raster into vector maps. Developed vector maps are stored in both ArcGIS server and specific map engine. Each individual building is stored with a unique ID.

A newly developed mobile application is used to send citizen information of individual buildings, using unique ID of the building, directly to the shape file stored in ArcGIS server. This in-house developed Android mobile application is capable for sending data directly to the ArcGIS server which was earlier limited to ArcGIS cloud. Map engine allows users to generate buffers according to the given distance over the railway line which is a mandatory requirement of the project for the demarcations. KML of the building layer is available for users in map engine. Moreover, users can overlay KMLs of DSD, GND, and District for better understanding. Experiments done in pilot study shows that the method is highly suitable for designing the rehabilitation purposes of highly crowded areas.

## 1.INTRODUCTION

Railway is the largest public undertaking in the country. Their charges are always maintaining in a minimum level which can be bear by most of the people in the society. Also it reduces the pollution and the traffic conjunction. The Kelani Valley railway line is one of the major railway lines in Sri Lanka which runs southeast from Colombo Maradana Station, through much of the city of Colombo. It runs through major business centers, like Nugegoda and Maharagama, before turning eastwards. It crosses the Southern Expressway near Homagama and continues east towards Avissawella, the current terminus of the line. The Kelani Valley Line is entirely single track, as train frequency increases, it is becoming increasingly challenging to operate trains running both direction on the single-line track. Currently the line serves an increasingly urbanizing population leading up to Avissawella. Even though the line was broad-gauged to improve the services in capacity and speed, the objectives have not been achieved due to sharp curves (a leftover of the narrow gauge system) and the illegal constructions on either sides of the track from Colombo up to Maharagama.

This railway line is to be rehabilitated under the project of Colombo Suburban Railway Project (CSRP) and illegal constructions to be demolished. As per the guidelines of the Sri Lankan Railway Department (SLRD) 50 meters from the railway line will be marked as illegal constructions and immediate actions to be taken to demolish any constructions. Several attempts was taken to conduct ground surveys to demarcate the illegal construction beside the railway line but never been success due to protest against demolishing illegal constructions. SLRD requested Center for Research and Development (CRD) – Ministry of Defence to demarcate the area, create illegal building map and to develop landuse map along the Kelani Valley railway line.

## 2. METHODOLOGY

It is learnt that ground survey is difficult due to protesters and is a time consuming task. Understanding those difficulties and limitations of ground survey CRD decided to conduct a drone based mapping along the railway line which is the latest geo-spatial data acquisition technique. In-house developed quad copter used to capture the videos of the area which then been undergo through the geo-clipping process to get X and Y coordinates for each frame of the video. Those geo clipped images can be overlay with the Google 2D maps to get a better idea about the landuse. Raster feature extraction techniques of the ERDAS been used to extract the landuse from the individual raster images. Using individual X and Y coordinates, raster images converted to vector layers. Those generated vector maps used to digitize buildings using ArcGIS. Each digitized buildings are containing a unique ID for easy reference. Household details and the other nesseary details of those digitized illegal buildings is a vital factor for the demolishing activities, thus completeness and the correctness of the data must be ensure. Traditional paper based data collection methods always leads inaccurate and incomplete data which also having great possibility of losing the data. Considering impotency of these sensitive data CRD decided to develop Android application to collect data. This in-house developed mobile application is capable of sending data directly to the ArcGIS server which was previously limited for the ArcGIS cloud. Mobile application is use unique ID of the building to store data. To visualize and to store data apart from the ArcGIS server CRD developed own map engine which assure the availability and integrity of the data. Figure 3.1 shows the methodology chart of this project.
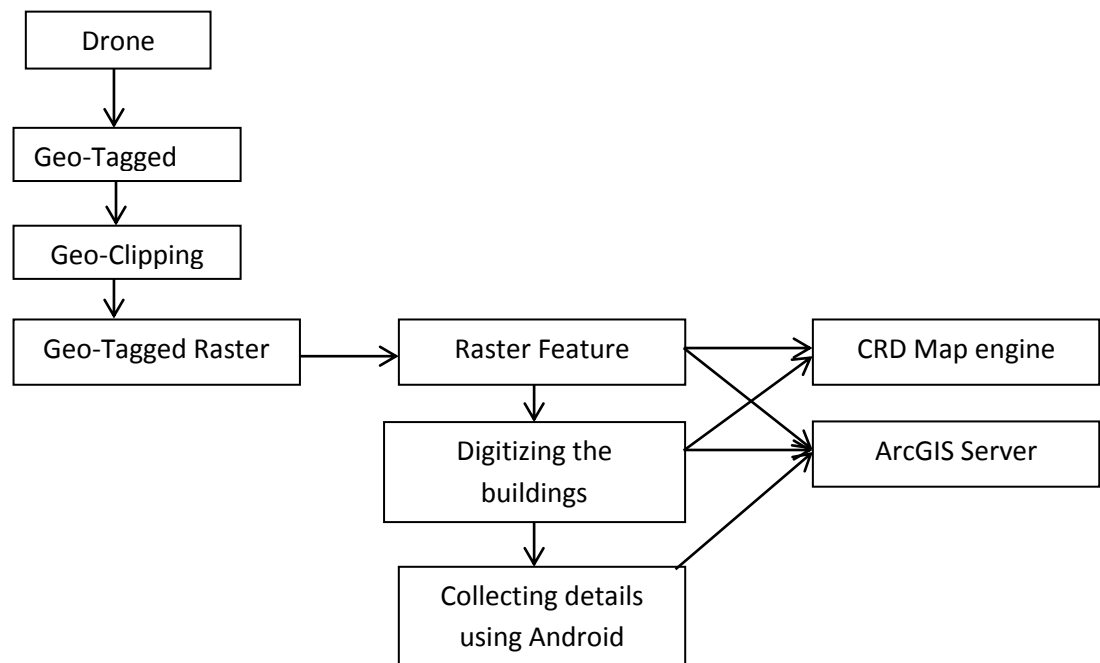


Figure 2.1 - Methodology Diagram

## 3. MOBILE APPLICATION

Android technology was incorporated over the development of mobile application. The System has given avenues to users to insert building information and citizen information. Mobile devices are registered with the system using IMEI numbers since it is unique to each mobile device.

GPS technology is adopted to the system to get the spatial reference of the present location achieving higher level of user satisfaction. Further system has given a more user friendly interface with a verification mechanism to the users to provide other required information to the system.

After an extensive research work discovered a unique approach to relate spatial and non-spatial data which are in different platforms. Unique ids will be generated for buildings in spatial platform by the system to relate with the non-spatial database. Therefore users are allowed to insert building features and citizen information using their android application then the system relate them with the spatial data.

Next challenge was to come up the solution with offline mode. Therefore the solution was diverted to offline mode without making any damage to online solution. When there is a failure of network connectivity data will be recorded in the client side itself and once the connectivity restored to the normal data will be pushed into the server with the concern of reliability and security.

Once user completed the forms user can simply send data using send button. Once user clicked on the submit button the application checks the availability of the data network. If it's available the application sends data in the same time but if it's not available the application stores all the data in the application database. Application has capacity of storing any number of data until it get network facility when device gets the internet facility it synchronized all the data to the server

## 4. QUAD COPTER

Centre for Research and development developed a military type quad copter. Furthermore it is embedded with following capabilities, Video streaming, geo tag image capturing, it can travel speed of 20ms-1. With the existing batteries it has more than a 15 minutes flight time. During that period it can fly around 2.5Km. Quad copter is connected with GPS, Electronic compos and air pressure sensor for its navigation use. Camera is fitted with gyro stable gimbal to obtain undisturbed photos. It can operate manually and autonomously. Quad copter frame and other hardware is made out of light weight carbon fibre and it has the capability of carrying around 1Kg pay load.



Figure 4.1- Quad Copter

### 4.1 Flight plan

The flight plan (flight and data acquisition) is planned before the aerial survey using CRD flight plan software which developed by customizing the open source flight plan software, starting from the area of interest (AOI),the required ground sample distance (GSD) or footprint, The take-off and landing operations can be controlled by the ground pilot or can be assign into flight plan. Using the customized software quad copter can be monitor during the fly which shows real-time flight data such as position, speed, attitude and distances, battery life, rotor speed, etc.
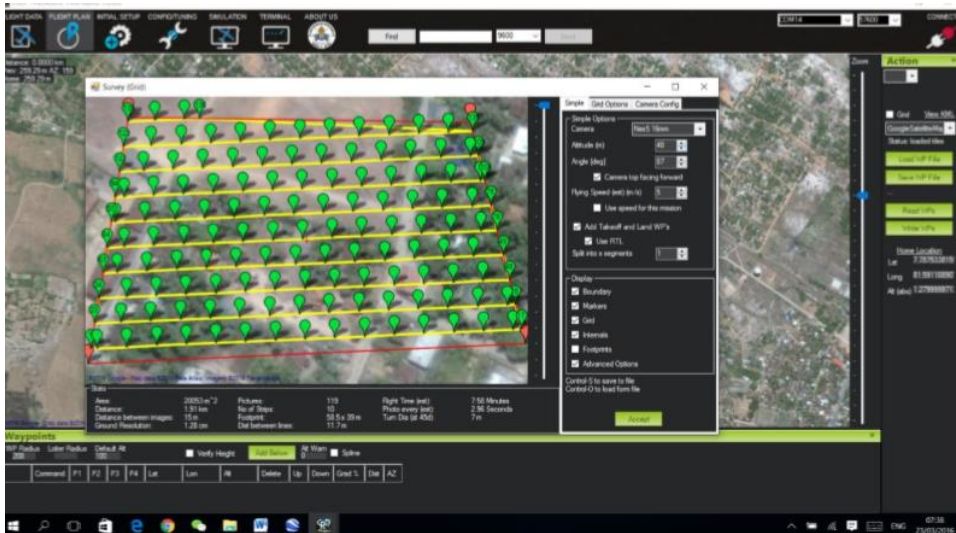


Figure 4.2- Flight Plan

## 5. CRD WEB MAP ENGINE

CRD has developed separate map engine for this project to visualize, analyses, store and display the spatial data. each captured data and the geo clipped data are stored before they been processed. For the better understanding of those geo-clipped images can be overplayed on the Google 2d map and possible to simulate the individual frame using XY coordinates. Figure 6.1 shows the simulation of the frames. This map engine facilitated users to measure the distance of the two locations and also possible to generate buffers with the given values. Figure 6.2 shows the generated buffers from the map engine. All the processed maps are available within map engine and the ArcGIS server which ensure the availability of the data. This map engine facilitates overlay analysis for users.

## 6.CONCLUSION

Drone based mapping never been used before in Sri Lankan history for railway expansion projects. This project will be an eye opener for the Sri Lankan government to utilize latest technologies for the development of the country. Data collection process was highly success with the minimum errors hence it is highly recommended to use similar applications for data collection process and the capability of directly send data to the ArcGIS server always add advantages for the similar projects. Automated raster extractions techniques must be used for the future projects in-order to speedup digitizing process. CRD in the process of developing fixed wing UAV which can carry higher payload and to improve the flying hours. GPS filtering techniques will be used for the future enchantments of those UAV's.

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