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Crowd sourcing (Authoritative) of Geographic Information on Public Assets and Amenities

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Abstract — The utilization of geospatial data and services for a wide range of uses has seen a steady growth in recent decade. This has led the administrators and planners to seek and adopt various data capturing devices to collate quality spatial data at micro level. Availability of spatial data at finer resolution is crucial for planning and decision-making at micro level. Based on the felt need, the Council took up a study to assess the capability of crowd sourcing concepts to capture Geospatial Information by authorities on public assets and community resources, to enrich and augment the spatial content of the data. Crowd sourcing through authorized sources enable authoritative data availability at micro level in a short span of time at nominal cost. Mobile application developed on android platform was assessed on two local governments to check spatial accuracy and data capture format. The results are within the acceptable limits.

***Keywords*—Crowd sourcing, Android apps, GPS (Global Positioning System).**

I. INTRODUCTION

Capturing of geographic information (GI) based on crowd sourcing concepts is a participative activity in which generally citizens voluntarily involve in capturing GI sought by crowd sourcer. The Council under the project funded by Karnataka Knowledge Commission, Government of Karnataka planned to initially capture crowd sourced GI on public assets and community resources by training department officials and local youths. Crowd sourcing of GI in the proposed context is contributed by authoritative sources i.e., officials from government departments. This is to encourage availability of authoritative data at micro level in a short span of time. Recent developments in web mapping applications also provide a venue for citizens to become active contributors to geo databases and could be looked into once the proof of concept is established. These capabilities will allow everyone from authoritative source to citizens to contribute content to the spatial database. The crowd sourced data is expected to enrich the spatial content and provide access to new types of data to use, manage, interpret, and incorporate in planning apart from significantly augmenting authoritative datasets. Crowd sourcing also gives ordinary citizens the opportunity to provide feedback directly to the government. The GIS organisations in the state are expected to use this finer resolution data in a GIS workflow or to turn this crowd sourced data into readily available useful geographic knowledge to concerned departments.

II. STUDY AREA

A. Kadaganchi Gram Panchayath, Aland Taluk of Gulbarga District

Kadaganchi is a Village in Aland Taluk of Gulbarga District. Gulbarga district of Karnataka lies between Northern latitudes $16^0$41' 8.2" and $17^0$46' 36.0" and between Eastern longitudes $76^0$3'10.4" and $77^0$42' 13.3" covering 8.49% of the geographic area and 5.9 present of population of the state [1] as shown in Figure 1. Kadaganchi is 17 km from its Taluk Main Town Aland, 22 km from its District Main City Gulbarga and located along SH10 highway with frequent service of buses, trucks and other transports [2]. Kadaganchi is 507 km from capital city of Karnataka State i.e., Bangalore. Kadaganchi Gram Panchayath has 1 revenue village and 3 habitations. According to census 2001, Kadaganchi Gram Panchayath has a population of 6,899, out of which male and female population is 3,538 and 3,361 respectively and total number of households is 1,148. Scheduled Caste Population is 1,334 out of which male and female are 688 and 646 respectively. Average literacy rate of Doddabelavangala as per census 2001 is 43.02%. The population density is 44.58 Sq.kms.

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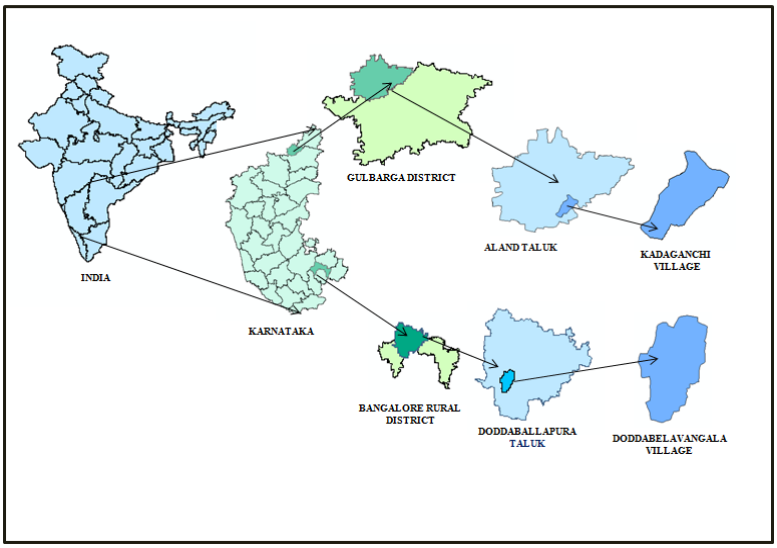

Fig 1. Study area

B. Doddabelavangala Gram Panchayath, Doddaballapur Taluk of Bangalore Rural District

Doddabelavangala Gram Panchayath is located in Dodballapur Taluk of Bangalore Rural District. Bangalore Rural district in Karnataka lies between Northern latitudes 12^0 51'9.69"and 13^0 30' 26.3"and between Eastern longitudes 77^0 9' 46.5"and 77^0 58' 43.8" as shown in figure 1. Bangalore Rural district has 2 divisions, 4 Taluks, 35 Hoblis, 1,713 inhabited and 177 uninhabited villages, 9 towns and 229 Gram Panchayaths [3]. Doddabelavangala is 12 km from its nearest town i.e., Dodballapur and 50 km from its capital city Bangalore. It is located along NH 207 Highway. Doddabelavangala Gram Panchayath has 8 revenue villages and 2 habitations as per census 2001[4]. Doddabelavangala Gram Panchayath has a population of 6,876 of which male and female population constitutes around 3,469 and 3,407 respectively with a total number of households standing at 1,444. Average literacy rate of Doddabelavangala in 2001 was 66.71%. The population density is 22.02 Sq.kms.

III. METHODOLOGY

The crowd sourcing application developed under this project is built on a free and open source android platform to capture GI. The apps also captures attribute data crucial to planning along with time stamped geo-tagged images. Providing this inherent spatial information in a spatial context can connect Government with citizens and optimize the use of resources. The crowd sourcing application is tried in few Gram Panchayaths to demonstrate its feasibility and proof of technology. It is planned in future to develop software applications which shall work on several mobile operating system to cater to the heterogeneous mobile devices available in the market, once the proof of technology is realised. The following Gram Panchayaths were identified for implementing this project in Karnataka state, India.

1. Gulbarga District - Kadaganchi Gram Panchayath, Aland Taluk.
2. Bangalore Rural District – Doddabelavangala Gram Panchayath, Doddaballapur Taluk.

The project also ascertained the spatial accuracy of content sourced from remote locations, taking into consideration the type of network and devices used to understand the quality of spatial information contributed. The crowd sourced information in future could be either from authorized source i.e., government departments or volunteered information from citizens. In Karnataka, several departments are already involved in capturing GI and such information in future could be integrated with spatial layers for managing resources and infrastructure. The GI sourced from mobile devices is expected to produce actionable information.

The mobile application to capture GI of public assets and infrastructure on android based mobile operating system christened as GeoInfo. Generally android phones and android tablets, use a 2.x release. The app was developed on Android version 4.0. Android releases are nicknamed after sweets or dessert items like Cupcake (1.5), Frozen Yogurt (2.2), Honeycomb (3.0) and Ice Cream Sandwich (4.0). Android app allows user to capture feature/assets along with attributes. Samsung Galaxy tab and Handheld Garmin GPS were used concurrently to capture the

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information of all the features and the results of android app were compared with Handheld Garmin GPS to ascertain quality and accuracy of the coordinates. In the study area about 160 and 178 features were identified for capturing information by both the devices. The process of capturing features is given below. Graphs are plotted against the latitude and longitude values captured by Samsung Galaxy Tab and Handheld Garmin GPS.

Process involved in operating mobile apps.

1. Enable the GPS and Mobile data in a mobile phone based on android OS.
2. Click on the GeoInfo mobile Apps to activate (this application supports only Android OS) GeoInfo
3. Data Entry format is displayed as shown in Fig 2.
4. Enter all the credentials starting from Department/Institution name to Asset Status as per the format.
5. Once completed, click start camera (shown in Fig. 3). (All credential should be entered for camera to operate).
6. Wait for three minutes to capture the required image (feature/asset). Minimum three minutes waiting period is necessary to get better accuracy.
7. After capturing the image, the screen will appear as displayed in Fig 4.

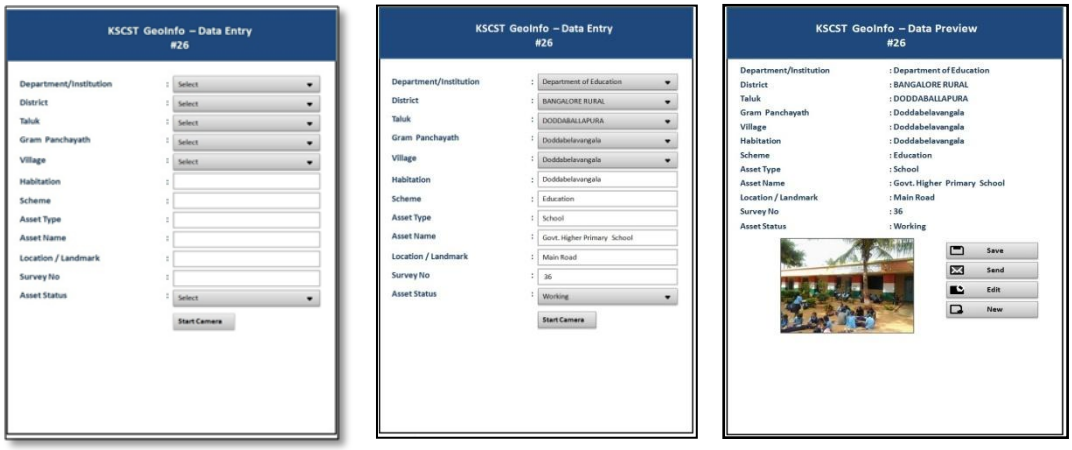

Fig 2, 3& 4: Geo info data entry form, Filled asset information data entry form and Data preview of Geo info application

1. Fig 4 represents the data preview section and provides the asset information and the options for further processes such as Save, Send, Edit and New.
    a. Save – Option to save the information
    b. Send – This option assist users to send the information with image to any authenticated e–mail id. (need GPRS or Wi-Fi connection)
    c. Edit – Edit option is used to edit all the credentials except the image.
    d. New – This option showcases a new data entry form.
2. The saved excel sheet contains all the credentials available in GeoInfo – Data Entry sheet with Time stamp, IMEI number, Latitude and Longitude.

IV. RESULTS AND DISCUSSION

The primary aim of the project is to capture GI of public assets through authoritative sources and to involve citizens later in managing public assets and infrastructure through crowd sourcing concepts. Another key objective is to check the mobile device accuracy and the possibility of utilizing it in remote locations. The features are captured by both the devices for comparison. ArcGIS version 9.3 was used to process the GPS points from both the devices. The first survey was carried out in Kadaganchi Gram Panchayath, Aland taluk of Gulbarga District and the second survey was carried out in Doddabelavangala Gram Panchayath belonging to Doddaballapur taluk. About 160 assets information in the 1st survey and 178 assets information in the 2nd survey collected and processed for comparison. The resource and infrastructure facilities such as water facilities (hand pump, cistern, overhead tank, mini water supply, pump house, open well and bore well), Education (anganwadi, higher and lower primary school, high school, colleges etc), Government buildings (Gram panchayath office, library, police station, bus stand, Milk dairy, primary health centre, etc), Power supply, Towers, Banks, provision

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stores, petrol bunks are mapped during the survey.

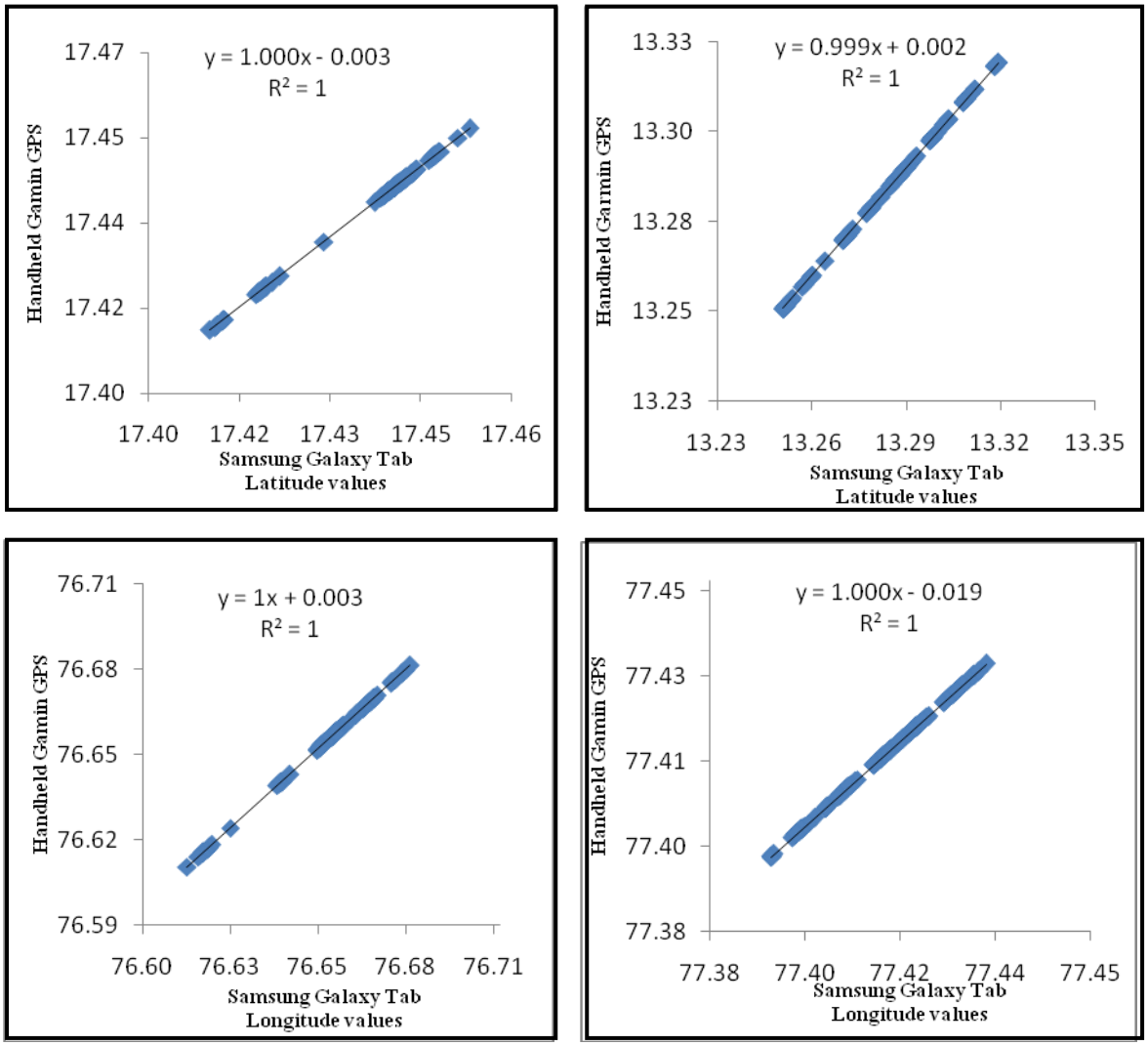

Fig 5. Latitude values between Samsung Galaxy Tab v/s Handheld Garmin GPS of Kadaganchi Gram Panchayath.
Fig 6. Latitude values between Samsung Galaxy Tab v/s Handheld Garmin GPS of Doddabelavangala Gram Panchayath.
Fig 7. Longitude values between Samsung Galaxy Tab v/s Handheld Garmin GPS of Kadaganchi Gram Panchayath.
Fig 8. Longitude values between Samsung Galaxy Tab v/s Handheld Garmin GPS of Doddabelavangala Gram panchayath.

Coefficient of determination (R^2) indicates the strength of the linear relationship between two variables, is used to evaluate the performance of Samsung Galaxy tab in comparison with the Handheld Garmin GPS device. Statistical analysis such as standard deviation, mean, mode, standard error and sample variance etc., are determined for latitude and longitude values of both the devices. Figure 5 and 6 represents the Coefficient of determination (R^2) between the latitude values of Samsung Galaxy Tab and Handheld Garmin GPS. R^2 near 1.0 indicates that a regression line fits the data well, while R^2 closer to 0 indicates that a regression line does not fit the data very well. Similarly Coefficient of determination (R^2) for the Figure 7 and 8 are 1 for longitude values between the Samsung Galaxy Tab and Handheld Garmin GPS, indicating a perfect fit between the readings. Table 1 provides a statistical result of the distance between latitude and longitude values of Samsung Galaxy Tab and Handheld Garmin GPS. GPS readings of about 160 in Kadaganchi Gram Panchayath and 178 in Doddabelavangala Gram Panchayath were used for the analysis. The standard deviation is 2.05 for Kadaganchi

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Gram Panchayath and 2.83 for Doddabelavangala Gram Panchayath. The minimum and maximum distance varies from 0.16 to 9.36 and 0.28 to 14.68 meters respectively for each Gram Panchayaths as shown in Table 1. The average value is 3.51m for Kadaganchi Gram Panchayath and 3.74m for Doddabelavangala Gram Panchayath.

Table 1. Statistical results of distance between latitude and longitude values from Samsung Galaxy Tab and Handheld Garmin GPS of Kadaganchi and Doddabelavangala Gram Panchayaths.

STATISTICAL RESULTS		
GRAM PANCHAYATHS	**KADAGANCHI**	**DODDABELAVANGALA**
Mean	3.511	3.746
Standard Error	0.162	0.212
Median	3.142	2.926
Mode	4.956	2.921
Standard Deviation	2.058	2.833
Sample Variance	4.239	8.027
Kurtosis	0.018	2.421
Skewness	0.652	1.513
Range	9.198	14.399
Minimum	0.164	0.285
Maximum	9.363	14.684
Sum	561.871	666.716
Count	160	178

V. CONCLUSION

The spatial accuracy of the content sourced from remote locations, taking into consideration the type of mobile network/devices when compared to Garmin GPS is well within the acceptable limits for this specific purpose and application. The state can source information of public assets in future by using smart phones by the authorized officials of urban and rural local bodies. The mobile application demonstrated in this project needs to be extended to other mobile operating platforms as well to become vendor neutral and to allow all the OEM's to participate in the authoritative crowd sourcing process. The mobile application also needs to be fine tuned to capture attribute information of all the line departments at village and ward level. The capturing of GI of public assets by the government machinery is simple, economical and less time consuming. The capturing of GI by authorities also leads to ownership and accountability. The GI sourced through this process when overlaid with other spatial layers available within the state up to cadastral level produces actionable information enabling planners and decision-makers to practice geospatial governance. This method is proposed for adoption on a wider scale to cover large number of such micro administrative units.

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His main areas of interest include beach and near shore sediment dynamics of South-Central Kerala and the Lakshadweep Islands. He served in the Department of Space as a Scientist at Regional Remote Sensing Service Centre at Kharagpur and developed several in-house research projects related to satellite applications for geomorphologic and coastal zone mapping and monitoring, participated in the National Missions of ISRO viz. the Integrated Mission for Sustainable Development (IMSD) and Natural Resource Information System (NRIS) programmes. At DST he evolved sub-programs on Coastal Zone Management and Conservation, Ground water modelling and Promotion of SAR Interferometry. In Earth System Sciences Program he nurtured- application of remote sensing in resource evaluation, Water Resources Management, Quaternary paleo-climate reconstruction, Geo-Archeology, Glaciology etc. He is also instrumental in the establishment of several major national facilities for supporting research in earth sciences as well as organizing several Contact Programmes/ Field workshops/ Trainings aiming at scientific manpower development. During Tsunami hit in the coast of India, he helped the administration to take scientifically backed decisions and also to understand the effects/ recovery of the eco-system. He actively participation in the implementation of a UNDP project and prepared the mission document on 'National Mission on Sustaining Himalayan Ecosystem' - one of the eight national missions identified by the Government of India in the context of Climate Change mitigation initiatives.

Dr. M. Prithviraj has to his credit several national and international publications and has participated in several symposia both in India and abroad and presented papers. He is on several committees at the national level. He has participated in research cruises in the Central Indian Ocean Basin and off Kerala and Lakshadweep

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