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Case Study | Open Access

Application of Geographical Information System in Urban Management and Planning: A Case Study of Kulgaon-Badlapur, Dist-Thane, Maharashtra

Syed Aasif Farooqi and Sohieb Gazali

Department of Environment and Remote Sensing, Srinagar, Jammu & Kashmir, India

Correspondence should be addressed to Syed Aasif Farooqi, s.aasif723@gmail.com

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Abstract The project enclosed, is about GIS application in urban management and planning. The client for this project is KBMC (Kulgaon– Badlapur Municipal Council). Urban Planning is a technical and political process concerned with the control of the use of land and design of the urban environment, including transportation networks, to guide and ensure the orderly development of settlements and communities. Project will provide the new updated and more correct data of the town with the help of GIS. This project will also provide the new improved base maps of the town, which will consist of every feature like footprints of the buildings, the project will definitely help in improving the infrastructure of the city. The project has completed using CAD & GIS software like AutoCAD, Arc GIS and Arc View.

Keywords *KBMC; Development; GIS; Urban Planning; Software's; Municipal Council*

1. Introduction

Geographical Information System (GIS) is defined as computer system that can hold and use different data describing happening on the earth's surface. Its is set of tools for collecting storing, retrieving, transforming and displaying spatial data from the real world for a particular set of purposes. When applied in a municipal context GIS becomes Municipal Information system (MIS) and used as planning tool in urban planning and development control. Applying GIS based municipal information tools can lead to solution of these data management problems. GIS does not work in isolation rather it combines hardware, software and people together to achieve its performance [1] (*Arnof, 1995*).

Geographic Information System (GIS) technology has found its way into many Corporations/Councils across the world. Many local governments now rely on GIS technology as a support tool to design development plans to make important decisions. The nature of GIS and its overwhelming use and reliance on computer technology can run contrary to the data, skills, and training found in many municipalities. In the light of tremendous pressure of rapid development in the urban areas, many

municipal authorities generate large urban dataset of urban information from development planning applications. Irrespective of development control pressure and the fluid nature in which planning applications are submitted at the municipal authorities, data has to be maintained and managed well all the times to allow for an efficient urban development control process [7].

2. Study Area of the Project

The study area of the project is small 12 towns of Kulgaon-Badlapur Municipal Council **(**KBMC) in Thane district near Mumbai city. KBMC in its jurisdiction has the area of about 35.68 sq. Kms [(13.78 sq mile), elevation 44 m (144 ft)], which is split into 34 wards & 13 Operating Zones. This project involves extensive field survey and data collection. Project is done for mapping and calculating legal and illegal properties in the city, for calculating the total tax earn from those properties, planning for development of the transport, now and in the future, management and planning of the town.

Badlapur was a village which turned into a new developed town. It is also known as Kulgaon – Badlapur. It is only 5 kms from the railway station. People from congested areas of nearby cities tends to move toward badlapur town as it provides pleasant environment, beautiful location, affordable real estate price, beautiful landscape and quiet neighborhood along with a proximity to Mumbai by local trains. Now Badlapur city encompasses the old Badlapur village, Kulgaon, Manjarli, Belavali, Katrap and many other small villages.

2.1. Government and Politics

Badlapur name was formed by combination of two name's 'Badla' and 'pur'. Balda in Marathi means 'change' and 'pur' is suffix commonly used to name the village or town. Badlapur name was formed because it was a travel route from Konkan to Gujrat via Surat. The town was famous for its rich horse breeds and Shivaji Maharaj and his warriors used to change their horses at the town in anticipation of the difficult climb through the Konkan area. Badlapur was recognized as a town for the first time in 1971 as a municipal town in the Ulhasnagar Tehsil. Badlapur was surrounded by twelve villages: - Badlapurgaon, Shirgaon, Katrap, Jeweli, Kharvai, Sonivali, Arenjad, Valivali, Manjarli, Mankivali, Kulgaon, and Belavali.

Badlapur Municipal Council was a separate gram panchayat before 1983 and became a Municipal Corporation on 2nd October 1983 as part of Kalyan-Dombivali-Ambernath and Badlapur Municipal Corporation. It was found that the formation of the corporation was geographically improper and many questions were raised by public personalities and objected its formation as Municipal Corporation. Thus, in 1992 Badlapur and Ambernath Municipal Councils were formed. Badlapur Municipal Council was rewarded by "Presidential Silver Medal of India" for its commendable efforts and achievements. Badlapur Municipal Council was declared as B-class municipal council based on the population which was approximately 52,000 as per 1991 census [2].

2.2. Collaborative-Strategic-Goal-Oriented-Programming (CoSGOP)

CoSGOP has been developed as a logical framework to help develop the community based approach for tackling urban distress and to support large-scale regeneration. It has been applied in European cross-border policy programming, as well as in local and regional development programs with good results. It offers a decision-making process which is inclusive, competitive and sustainable. As such it promotes collaboration between stakeholders and their integration into a strategy which is cross-cutting and allows partners to develop consensus on the scope and distribution of urban distress and program of area-based regeneration. In addition to this, it draws particular attention to the goals of the program and participation required between stakeholders to agree them. The scope and distribution of urban distress and goals of the area-based regeneration program, CoSGOP provides a way of

logically framing the improvement process and a means of communicating the aims and objectives between stakeholders.

The generic goals of this program are to represent the main outcomes expected from the community-based approach to tackling urban distress and area-based regeneration. CoSGOP is a process model on the contrary than a planning method. It provides a framework for communication and joint decision-making in a structured process characterized by feed-back loops. In this sense, it facilitates a joint learning process of all the stakeholders involved [4].

2.3. Information Data Flow

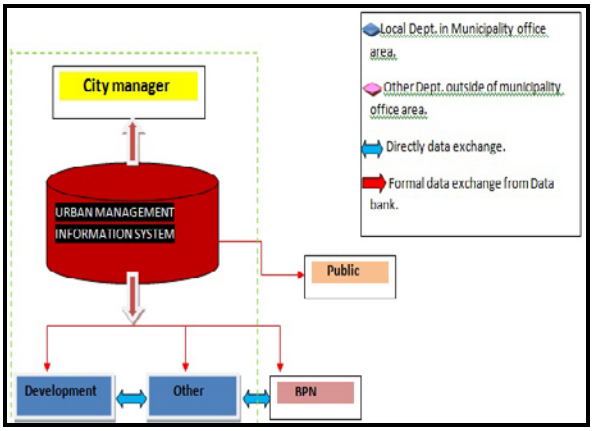


Figure 1: *The Existing Condition*

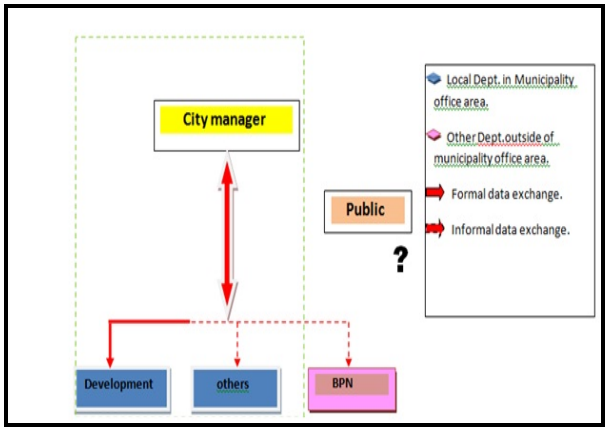
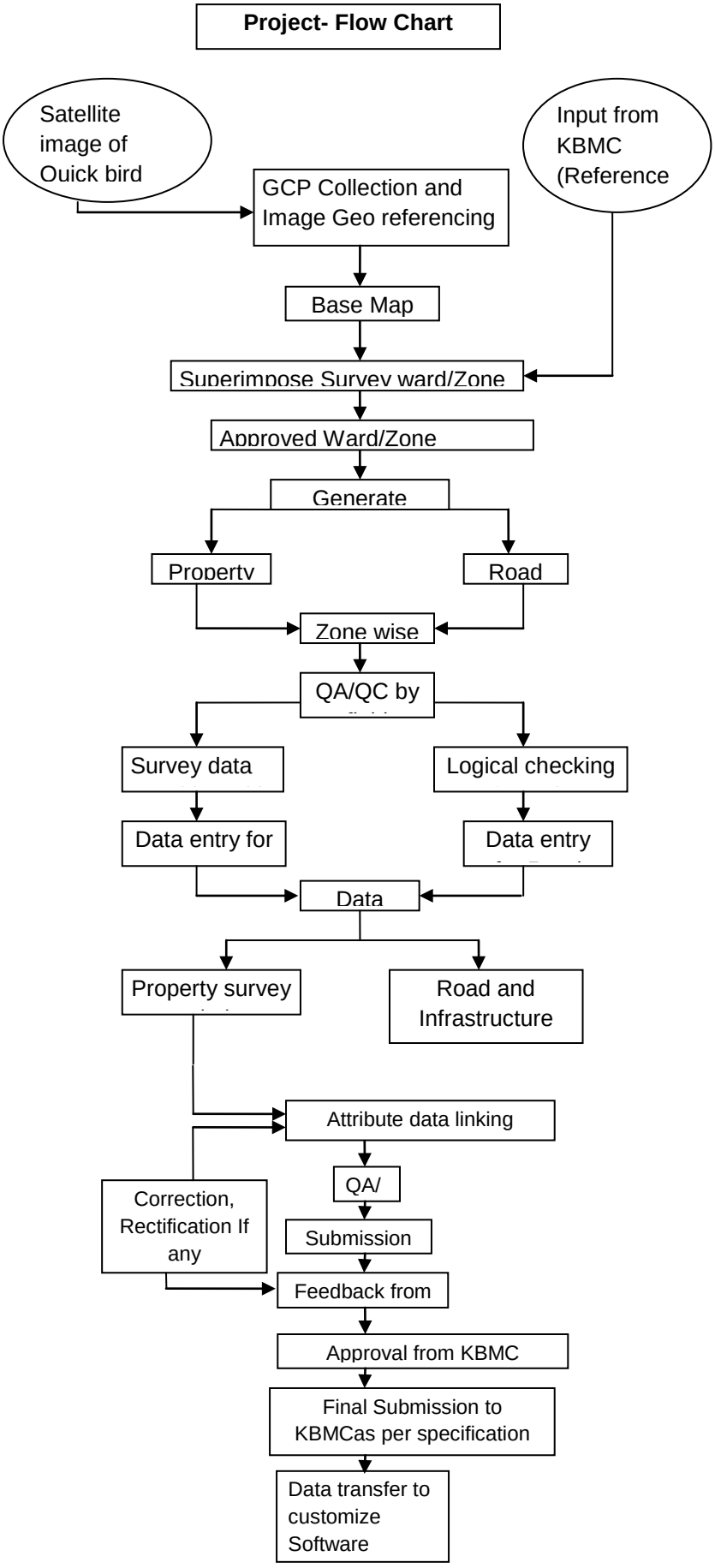


Figure 2: *The Ideal Condition*

3. Objectives

The objectives that are expected to achieve through the course of this study are, to integrate remote sensing, GIS and non-spatial data and to bring them on a common plat-forum viz e-GIS, to share the resources generated from the study using a common plat-forum for better planning and optimization of the resources and at same time to quantify the shortcoming of spatial data integration.


Project- Flow Chart
Satellite image of Quick bird
Input from KBMC (Reference
GCP Collection and Image Geo referencing
Base Map
Superimpose Survey ward/Zone
Approved Ward/Zone
Generate
Property
Road
Zone wise
QA/QC by
Survey data
Logical checking
Data entry for
Data entry
Data
Property survey
Road and Infrastructure
Attribute data linking
QA/
Correction, Rectification If any
Submission
Feedback from
Approval from KBMC
Final Submission to KBMCas per specification
Data transfer to customize Software

4. Methodology

Research methodology involves means and methods of conducting the research. It includes the procedure used in data collection and analysis.

Infrastructure, utilities and the newly constructed building features are digitized from satellite imagery. The photos are also attached for additional supporting information and to verify the work. The non-spatial data such as land information, building information and utility services information are collected during the field survey. All The available data are linked together in Arc View and Arc Map platform. Research methodologies are described in relevant headings:

4.1. Digitization

In this process Digitization of the polygon features like buildings, line features like Roads and Railways, Engineering or point features like street lights, manholes, shoulder drains etc was carried out. When digitization of these buildings was carried out, at the same time plot boundaries are also marked. All this digitization was carried out using AutoCAD. This is also called as feature extraction. Side by side plot boundary is also digitized. Because it is necessary to take the plot boundaries.

This feature extraction is important for verification and marking of the features on the actual site.

4.2. Creation of the Base Maps

From those digitized drawings base maps of the buildings were created. These maps were used for site verification. Parcel and house data maps were produced from the digitization of the satellite imagery, at the scale of 1: 500. The map sheet was digitized in AutoCAD using the sheet corner to control the digitization and facilitates joining adjacent map sheets together. The updating of buildings, parcels were made from “Quick Bird“ satellite imagery.

The other spatial data map of road network was also prepared from the image, and supported with recent field verification [6].

4.3. Verification of the Base Maps

Base maps of the buildings were then sending to the site for verification. On those maps all the updating according to the conditions on the site were made. At the same time, survey team also marked Ward boundary and Zone boundary on those maps, because for taking final output it is necessary to digitize Ward and Zone boundary. Plot boundaries which are digitized initially on the satellite image are also checked and if necessary those are corrected.

4.4. Data Collection (Non-Spatial Data)

The non – spatial data collected are land data records. The land data are used to guide for the revenue collection of parcel by parcel information of owners, building permit data that has building information, addressed data that has a house numbers and road names information and utilities data which has information for payment calculation of utilities services. Data collection is the main work in the project. It is the most tedious work of the project [6].

4.5. Data Integration (Spatial and Non – Spatial Integration)

The user – interface data integration developed in Arc View, interfaces parcels, building, infrastructure, utilities and satellite image, photos of buildings and owners and associated non – spatial data. Data

Integration consists of the work of removing error from the work they entered data. Integration means entering newly updated data and removing errors from the old data or removing incorrect data. It also consists of editing and merging all the data. The application has helped to make a spatial query for parcel, building, utilities services of owners.

Data integration is very important since it is the first step for output data. If data entered at the time of data integration is correct then there will be no need to enter data again after verification by revenue inspector [6, 8].

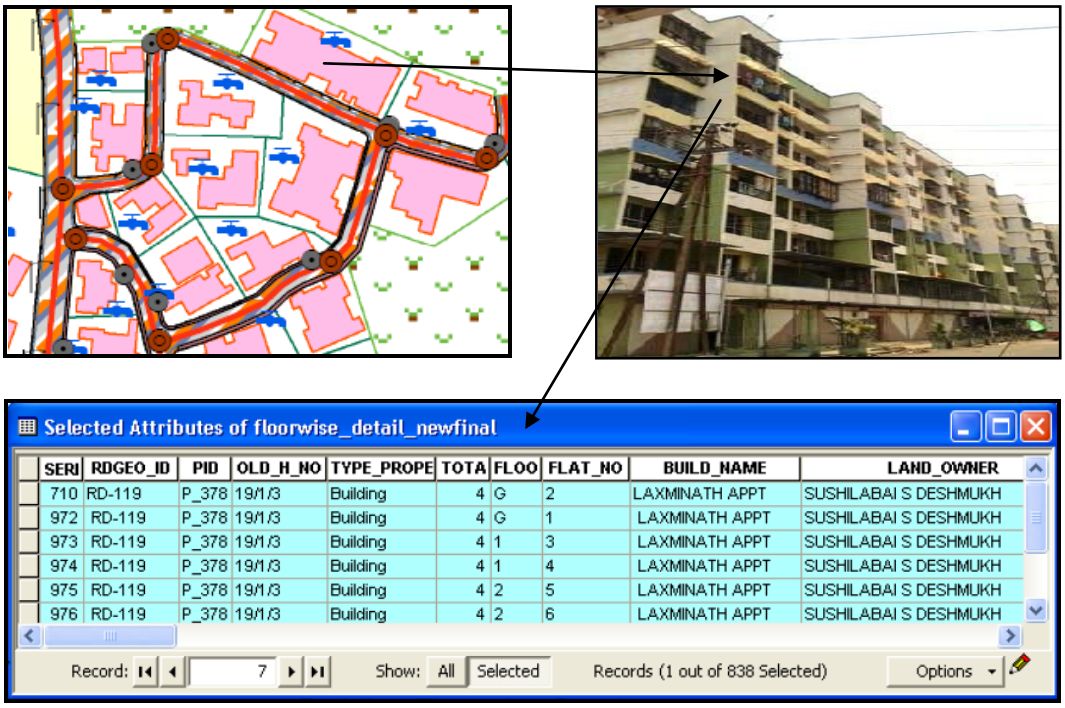
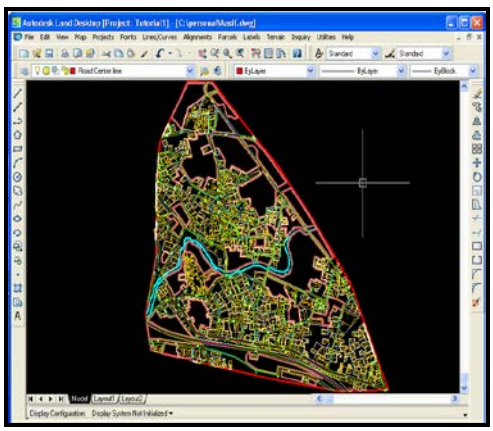


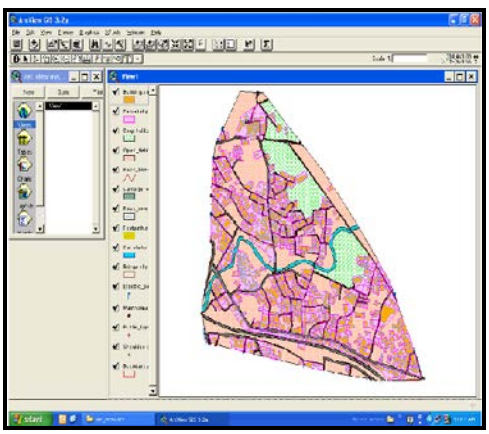
Figure 3: *Property Survey*

4.5.1. Integration of Data with GIS System

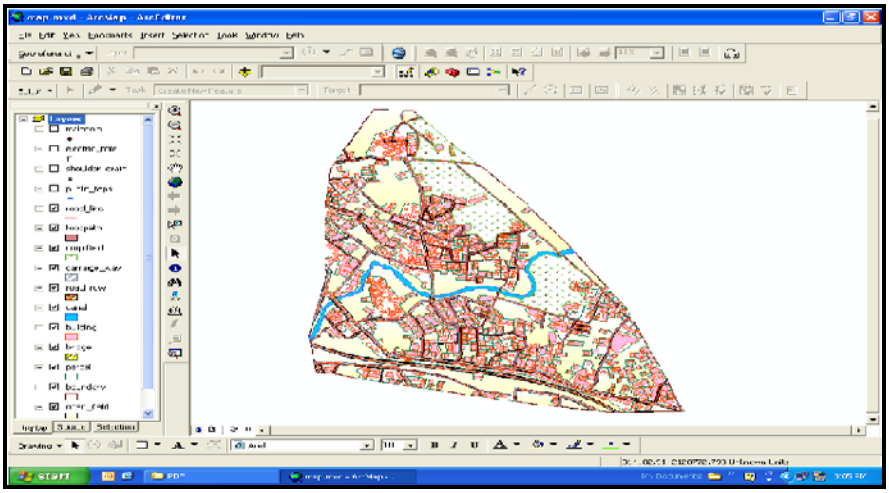
The finalized data after getting all the approvals from KBMC and the external agency are integrated into the GIS system developed for KBMC. As we have done all the process in the software of Autodesk map, it is compatible with all the leading GIS formats. Hence data can be provided in the format as desired by KBMC [8].



Auto CAD Map 2008



Arc View 3.2



ArcMap 9.2

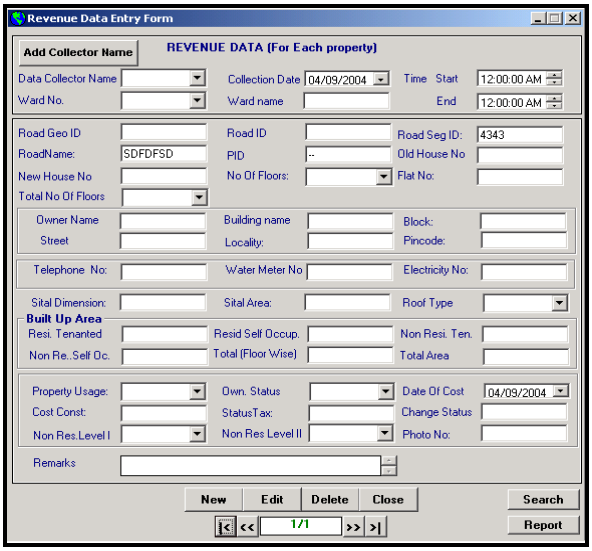
5. Software Development

Software development for various purposes in the project is carried out by the software department. The computer language used for the software development is VB (Visual Basic).

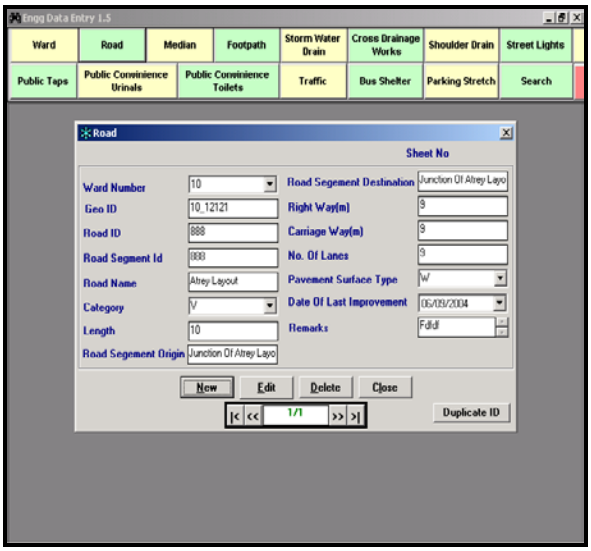
Various small software's like data entry software for various features and one software for e-Taxpaying is prepared. These software's act as the front end of the database where as MS-Access act as a back end.

➢ Screens for Data Entry for Various Features

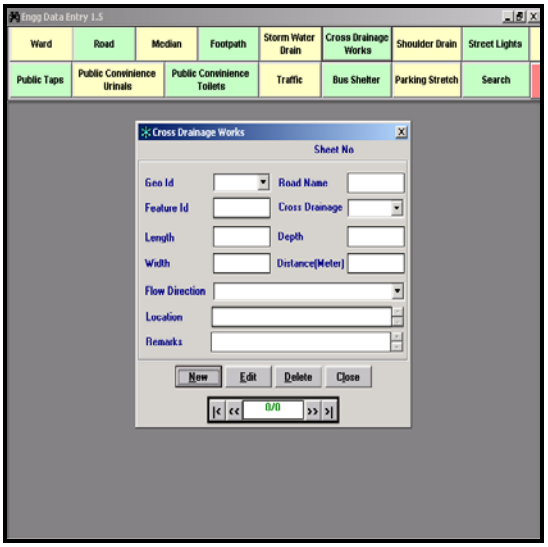
Entry Screen for Property Data



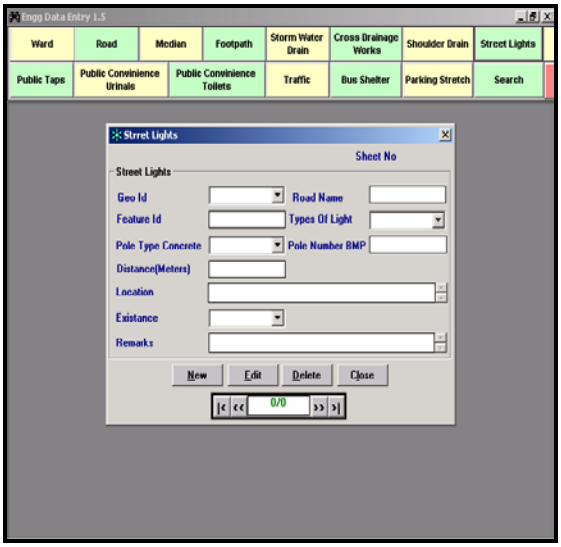
Data Entry Screen for Cross Drainage



Data Entry Screen for Road



Data Entry Screen for Street Lights



6. Software & Data

6.1. Software Used

AutoCAD Autodesk 2004, Arc View 3.2, Arc Map 9.2, Data Entry Software, MS- Access.

6.2. Data Used

Quickbird satellite was successfully launched in 2001. Quickbird, having high spatial resolution space borne sensor is capable of panchromatic imaging at 0.61 cm. The sensor also has 4 multispectral bands with resolutions of 2.44 m at nadir. Among all the VHR (Very High Resolution) satellites having an extended archive, Quick Bird possesses the one with the best resolution. The imagery can sufficiently distinguish man-made features on the landscape and serve as an excellent base map for GIS applications.

- Launch date: 18th October 2001
- Orbit: 97,2°, sun synchronous
- Orbital altitude: 450 km
- Viewing angle: Max +/- 30° off-nadir
- Equator crossing time: 10.30 am solar time
- Revisit time: 2,4 to 5,9 days depending on latitude
- Swath width: 16,5 km at nadir
- Minimum order size: 25 km² (archive) and 1800 USD (new acquisition) for Standard and Ortho-rectified product
- Resolution

Resolution
0,61 m (panchromatic) at nadir
2,44 m (multispectral) at nadir
0,72 m (panchromatic) at 25° off-nadir
2,88 m (multispectral) at 25° off-nadir
23 m CE90% for Basic and Standard products
12,7 m CE90% for Ortho-rectified products

- Geo-vocational accuracy (without GCP)
- Spectral range

Spectral Range
0,45 – 0,90 µm (panchromatic)
0,45 – 0,52 µm (band 1 – blue)
0,52 – 0,60 µm (band 2 – green)
0,63 – 0,69 µm (band 3 –red)
0,76 – 0,90 µm (band 4 – near infrared)

- Standard acquisition window new imagery: 90 days
- Tasking: Standard, Priority and Rush tasking possible
- Radiometric resolution: 11 bits per pixel
- Product types: Basic, Standard, Ortho-rectified, Stereo are available
- Price: Pricing per km²
- Area of Interest: Irregular polygon (max 999 vertices and minimum width of 3 km)

7. Results

It will become easy to acquire information about any property [5].

Infrastructure development will become more powerful.

(i). Project will provide facility of online taxation.
(ii). As it will provide the facility to find optimum path, in case of emergency services, facilities can be provided faster.
(iii). For PWD department, it will become easy to maintain roads line and to monitor road life.
(iv). In case of Slums, facilities can be improved. Provision for new facilities can be done.
(v). Drainage system can be monitor and improve.
(vi). Marking of green belt area, can give the information about vegetated area in the town.
(vii). Town also has a river. So, there is always a danger of flood. With the help of this project, flood prone can be marked, as well as buffer zone around the river can also be marked.
(viii). In case of any disaster, estimation about loss of property as well as human life will become easy.
(ix). Documentation about any purpose related to urban management become easier.

8. Conclusions and Recommendations

Bringing the information together for planning and management activities certainly provide broader vision. Through this study the main aim was to develop a preliminary e-GIS plat forum that will showcase the ability of e-geographical information system for optimization of resources in a most excellent form. The e-GIS plat-forum will become a conceptual model for achieving better planning, good urban governance and management to the whole areas of city which may require further working. Once the application become functional, it is necessary a training part for daily operational activity. Security offices and other stakeholders could be more useful these integrated application as well as the introduction of e-geographical information system in governmental system is surely going to benefit the people in variety of ways [3, 5].

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