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A GPS and GIS based model for an Empirical Study of Village Information System

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Abstract— A study was conducted to prepare a detailed development plan based upon extensive primary survey of the village and its environment by using the techniques of GPS, GIS and managed with the database management programming language. In this study the Village Potheri, is identified as a study area with an aerial extent of 2.86 km^2 in Kancheepuram District, Tamil Nadu, India. Hand-held GPS instruments (1 m level accuracy), the x,y coordinates of points (longitude and latitude) features like houses, water taps, tube wells, street lights and linear features of roads and streets has been collected and converted into shape files and accessed in GIS. The basic essential requirements of land use / land cover (classified from LISS IV), soil, geology, geomorphology and etc., were also prepared thematic maps and non-spatial information also attached with respective thematic layers. The spatial and non-spatial data were connected with VB 6.0 platform (GIS database is considering as a back end and the VB is acted as front end tool) for managing and controlling the data within GIS platform. Through this platform an attempt has been made to generate a GPS and GIS based information model for adding/inserting, deleting and retrieving data from GIS database. For retrieving data different types of queries have been developed viz., query in terms of house number, person's name, street wise information and thematic map wise information with non-spatial data.

Keywords— GIS database, GPS, Visual basic Platform, spatial and non-spatial data, Queries

I. INTRODUCTION

The real India lives in its six hundred thousand villages comprise about 80% of the total population. Necessarily, it is the economic transformation of these villages that can bring a change in India's economic development. In other words, the progress and prosperity of the nation depends entirely on how far it is able to improve the economy and social life of rural masses. In this view the relation of this fact, governments at the center and in the states have been made various attempts through rural development programs to change the face of rural India. Despite this the overall census data reveals that the rural masses are still under developed due to the lack of proper planning of the available resources.

Up-to-date and reliable information is vital for the management of a region's human and natural resources and for dealing with regional development decisions that have a spatial context [5]. A comprehensive information base could reduce uncertainty and enhance decision-making. Managers and policy makers may wish to integrate social, economic and environmental data in order to formulate strategic development plans [4].

In developing countries, however, the data barriers are still obvious due to both institutional and technical reasons. As institutional issues are being recognized and government starts to invest millions of dollars in collecting data, the data management and usage are still far from satisfactory level. Information on various aspects of regional development - social, economic and environmental data - is originally collected for different purposes, at different scales, at different time frames and with different underlying assumptions about the nature of the phenomena. This creates technical difficulties to the integration of social and environmental data, and explains the scarcity of successful empirical researches on regional development analysis in developing countries.

Recent technological advances in geographic information system (GIS) have made it possible to manipulate large amounts of geographic data and construct the topological structure underlying complicated spatial phenomena. Geographical information systems are computer based systems, designed for the collection, storage and analysis of objects and phenomena where geographical location is an important characteristic or critical to the analysis. GIS technology, integrates common database operations such as query and statistical analysis with the unique visualization and geographical analysis benefits offered by maps [1]. It did not only serve as a database for parameter data but the qualitative

and quantitative data could be integrated through spatial relationships rather than through relationships between attributes that might not exist [3].

GPS based geographic information system (GIS), routing and scheduling system is used for tracking the position of the given objects, the platform front-end employ Embedded devices; the background uses high-performance Servers [7]. The system mainly apply to embedded development, GIS, GPS and wireless transmission technology to realize collection, display, query, editing, analysis, path planning, navigation, Points of interest management of the base station information and its surrounding information, so as to achieve fast positioning of the mobile phone location and can response quickly, saving handling time and improving the work efficiency [2]. Road test system apply component-based development, integration management of mass data, comprehensive integration of spatial information technology, and other new technologies, while enabling seamless integration with the Internet [6].

Planning is widely accepted as a way to handle complex problems of resource allocation at regional level. In order to provide a more effective and meaningful direction for better planning and development, necessary support of the information has become essential [8]. Hence the need for a suitable information system is increasingly being felt in all planning and developmental activities in rural areas. It basically reduces the time and cost involved with the creation of data base for the planning. Here an attempt is made wherein GPS data with ARC GIS 9.2 software and Visual Basic 6.0 platform are used to develop an information system which can support the planners to get information through retrieval of data by integrating the spatial and non-spatial data [2].

1.1. *Study Area*

The study area of the project is "Potheri" village, which is situated in Kancheepuram district, Tamilnadu. It is located near NH-45 (GST Road), about 40 km from the Chennai city. The latitude and longitude of the study area is 12º 48' N to 12º 49' N and 80º 02' E to 80º 03' E. The areal extent of the study area is 2.86 Km^2 and the location map of the village is shown in Fig.1. Almost 57% of the village area is occupied by agricultural plantation, fallow land and only 11% of land occupied by settlements.

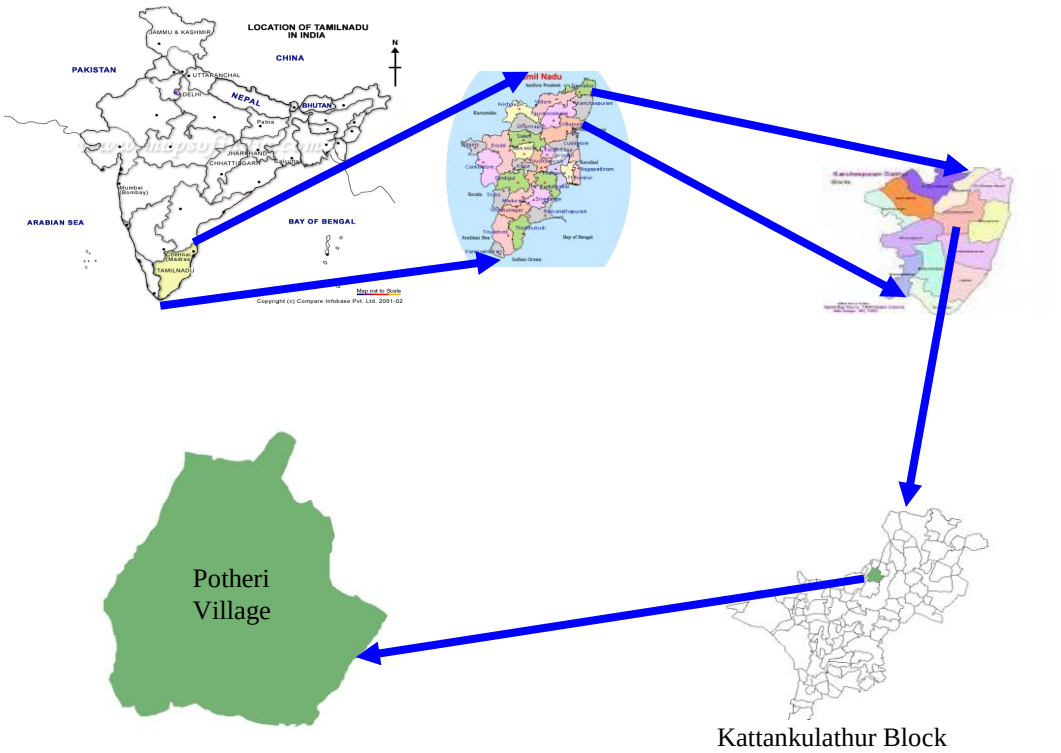

Fig.1. Location of Potheri village

II. MATERIALS AND METHODS

2.1. Materials

2.1.1. Spatial Data

The spatial data of Village Boundary Map includes roads, streets and collection of GPS data (Trimble Company – unoSB with 1m accuracy) from field survey were considered.

2.1.2. Non Spatial Data

The non-spatial data includes meteorological data, census data, water supply data, community halls, temples, schools and household information of Potheri village were considered.

2.1.3. Softwares

The softwares used for the studies are ArcGIS 9.2, Erdas Imagine 9.1, Arc Pad 7.0, and Visual Basic 6.0.

2.2. Methodology

GPS instrument at 1m level accuracy were used as a source for collecting individual point feature (houses, water taps, electric posts, wells & etc.,) on the village and linear features of roads and streets. These points are downloaded and converted in Arc GIS software files (.shp file). The collected GPS points are processed and developed as a information system. The flow chart for GPS, GIS based information is shown in Fig. 2.

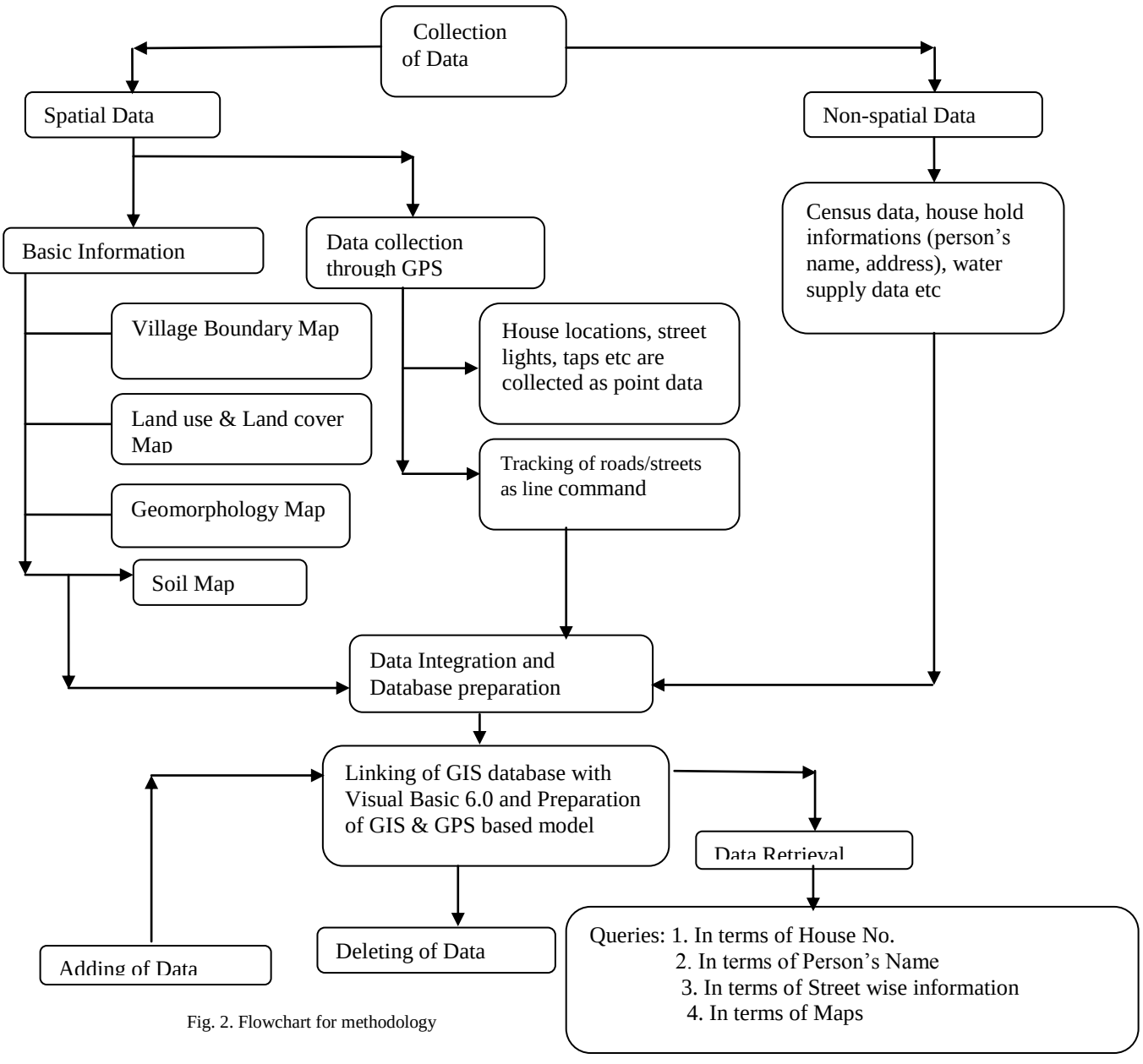

Fig. 2. Flowchart for methodology

2.2.1. Basic Information of the village

First the basic information about the village is generated such as land use and land cover details, geomorphology details, soil details, climatic details, census data, water supply data etc. The land use and land cover map for the village is prepared from the Kattankulathur land use and land cover map which was prepared from the LISS III (1997) image. The climatic data of the village is collected for period of 8 months and from that the climatic influence of the village is determined. The census data of 2001 for the village is collected along with the respective number of houses.

2.2.2. Collection of GPS points

Using GPS instrument (1m accuracy level) the house locations, roads, street lights, water taps, tube wells, etc are collected as a point data. The collected GPS points are saved in instrument as a shape file (.shp) accessed by Arc GIS software. The new personal Geodatabase has been created and the collected coordinates are digitized and edited in Arc GIS 9.2. From the shape files which are edited in Arc GIS 9.2, the thematic layers for the village are prepared separately.

2.2.3. Database Preparation

The collected non-spatial data was attached with spatial data which generated through GPS data.

2.2.4. Linking of GIS database with Visual Basic 6.0 and development of model

The GIS database is linked with Visual Basic 6.0 and developed as an information system. The various types of queries were generated and also checked the modification (insert, delete and update) of data through VB language. Also inserting and deleting of data through this model can be done easily.

III. RESULTS AND DISCUSSIONS

3.1 Basic Information of the Study Area

The basic essential information required for village are land use and land cover map, geology and geomorphology map, soil map for the village were prepared. These thematic maps provide a basic idea about the village were shown in Fig.3 to Fig.6.

3.1.1. Land use and Land cover details

The land use and land cover map is prepared from LISS IV image (2007). Land use/land cover map of the study area is analyzed with the help of ArcGIS 9.2 to get the present land variations of the study area. The major land cover is Agricultural area as 57.61%, water bodies covers 19.31%, 11.51% is built-up land, 9.79% covers Barren rocky/stony waste land and 1.88% is upland with and without scrub as shown in Fig.3.

3.1.2. Geomorphology details

The geomorphology map for the present study area is contain deep buried pediments covers 65% of the village area, 25% of the area is covered by shallow buried pediments, each 5% of area is covered lineament and pediment inselberg complex (Fig.4)

3.1.3 Soil details

The hydrological soil group 'B' with moderate runoff potential available in 78% of the village area and the remaining 22% of the area is covered by the soil group 'C' with slow infiltration rate and moderate runoff potential were depicted in Fig.5

3.1.4. Climatic details

In the study region the minimum and maximum temperature is 25 ^{0}C and 33 ^{0}C. The average wind speed and RH were found to be 1.25 m/s and 75%.

3.1.5. Census details

According to 2001 census data, the total population of Potheri village is 2576. Out of this, 1329 male and female is 1247. The category wise population distribution is shown in Fig.6.

3.2. Collection of GPS Data and Preparation of Separate Thematic Layers

Using GPS instrument (with 1m accuracy) the house locations, roads, street lights, water taps and tube wells etc were collected as point data. These GPS points are extracted from GPS instruments and downloaded to Arc Pad software. The new personal Geodatabase is created and the collected coordinates are digitized and edited in Arc GIS 9.2. The edited GPS data has been linked with relevant non-spatial data (collected from municipal office) and segregated as a separate shape file. The individual GPS points were collected for different features/objects on the village viz., 889 Nos individual houses, 138 No. of water taps 24 Nos of tube wells, 256 Nos of street lights and 28 Nos of streets. From these shape file each feature is prepared as separate thematic layer with their respective attributes. The layout of Potheri village using GPS points and the map of SRM University were shown in Fig. 7 and Fig. 8.

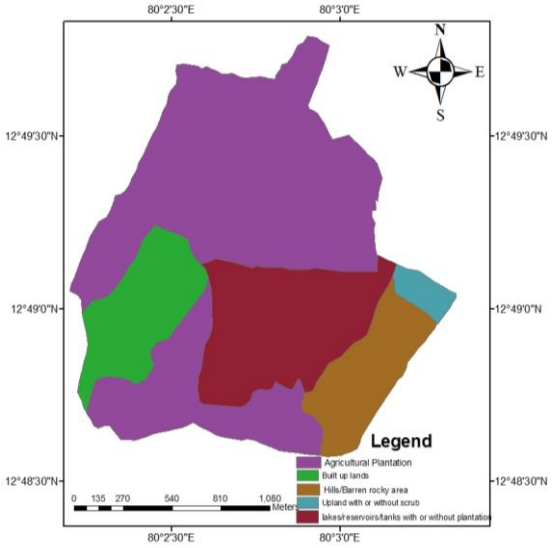

Fig.3. Landuse Map of Potheri village

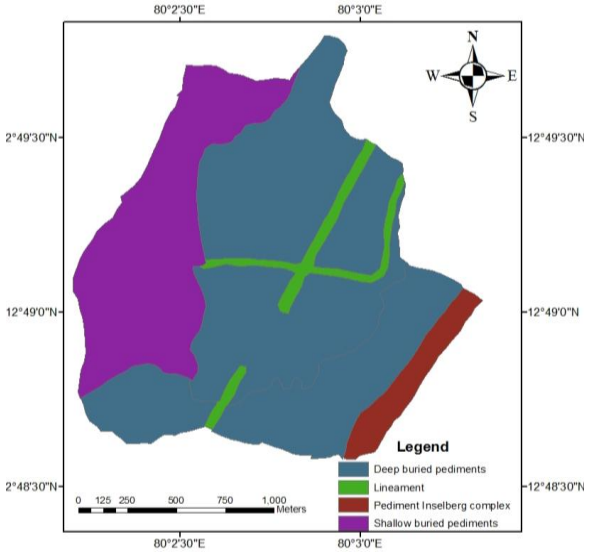

Fig.4.Geomorphology Map of Potheri village

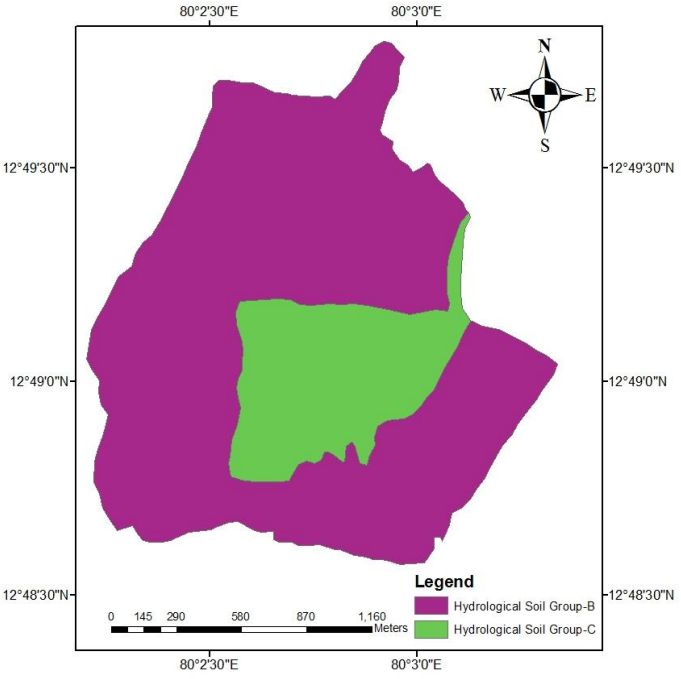

Fig.5. Soil Map of Potheri village

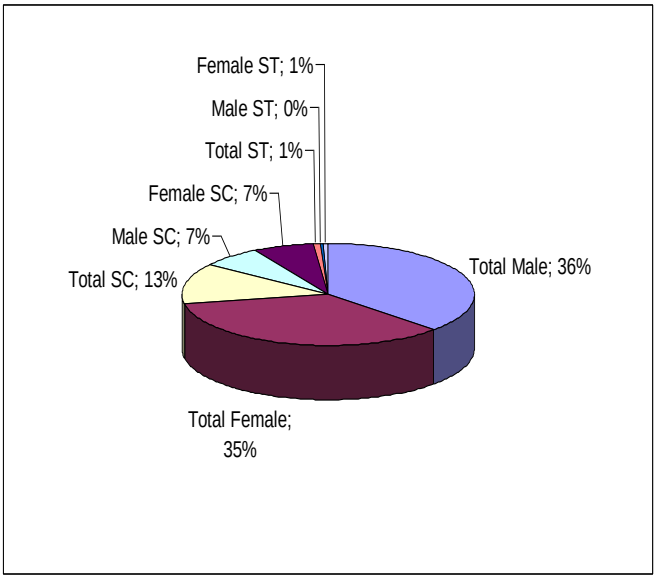

Fig.6. Pie chart for Population

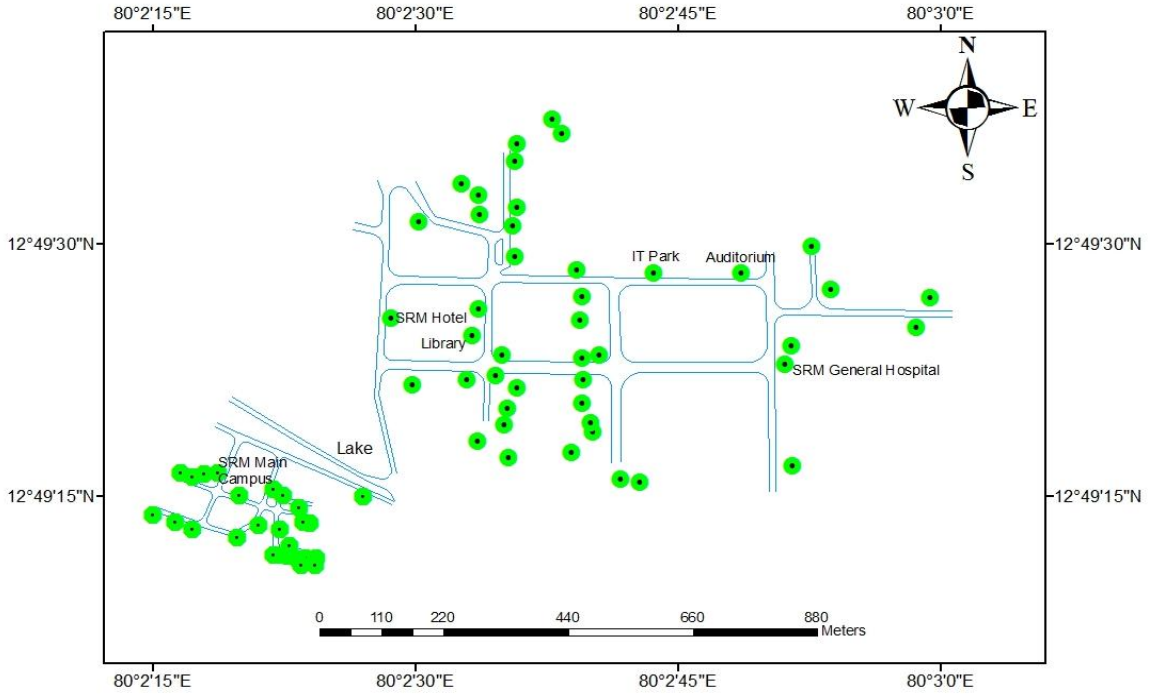

Fig.7. Map of SRM University

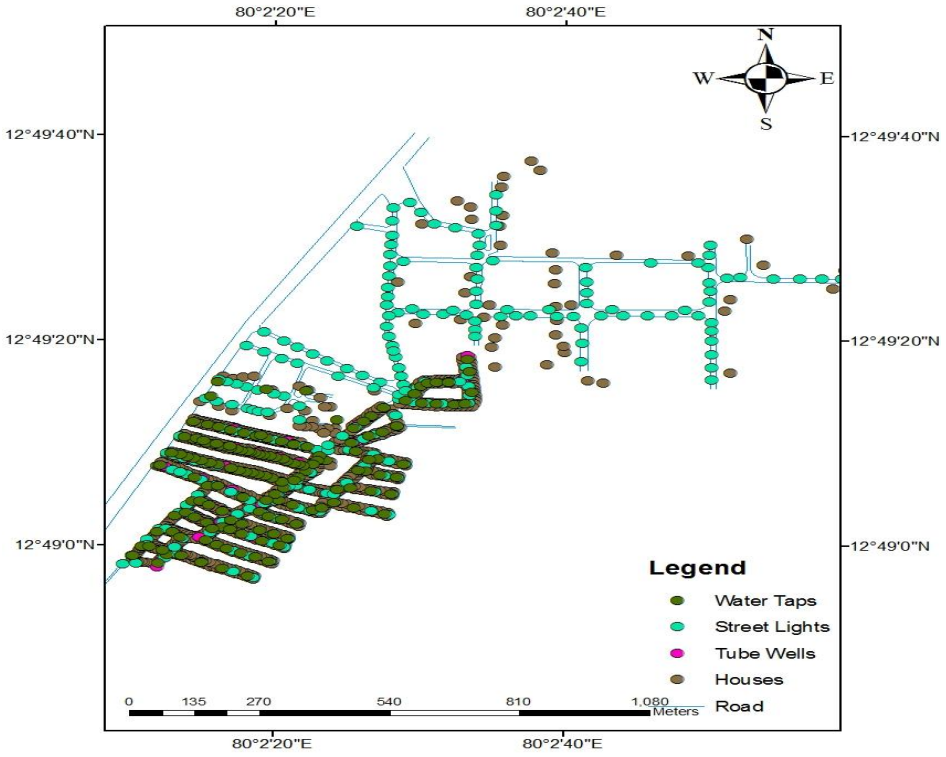

Fig. 8. Layout of Potheri village

3.3. *Database Preparation and Linking of GIS Database with Visual Basic*

The additional information of each feature has been collected separately from different sources and attached with existing GPS data through ArcGIS software. The personal Geodatabase is converted into shape file by using the conversion tool in Arc GIS. The shape file having .shp, .shx, .dbf files. The dbf file is linked with Visual Basic 6.0, so that the attribute table which is created in ArcGIS is fully controlled and managed by Visual Basic software

3.4. Development of GPS and GIS Based Model

In this model the GPS & GIS based data were connected with Visual Basic platform, the Arc GIS is considered as back end tool and Visual Basic is acting as front end information tool. The whole setup like GPS, GIS and Visual Basic are considered as a single pack and called as GPS and GIS based Information system. Any type of database query as well as modification (updating, inserting and deleting of data) can be easily done through this model. The inserting data structure of the model is shown in Fig. 9.

3.5. Queries

The spatial and non-spatial types of queries are generated from the database by using this model as shown in Fig.10 and Fig.11. The queries in terms of house number, person's name, street information and in terms of map are generated by this model. The spatial query will be identified from map using "i-tool" which gives non-spatial data of spatial location / feature. When the non-spatial is applied query from attributes, the spatial location will shown on the map.

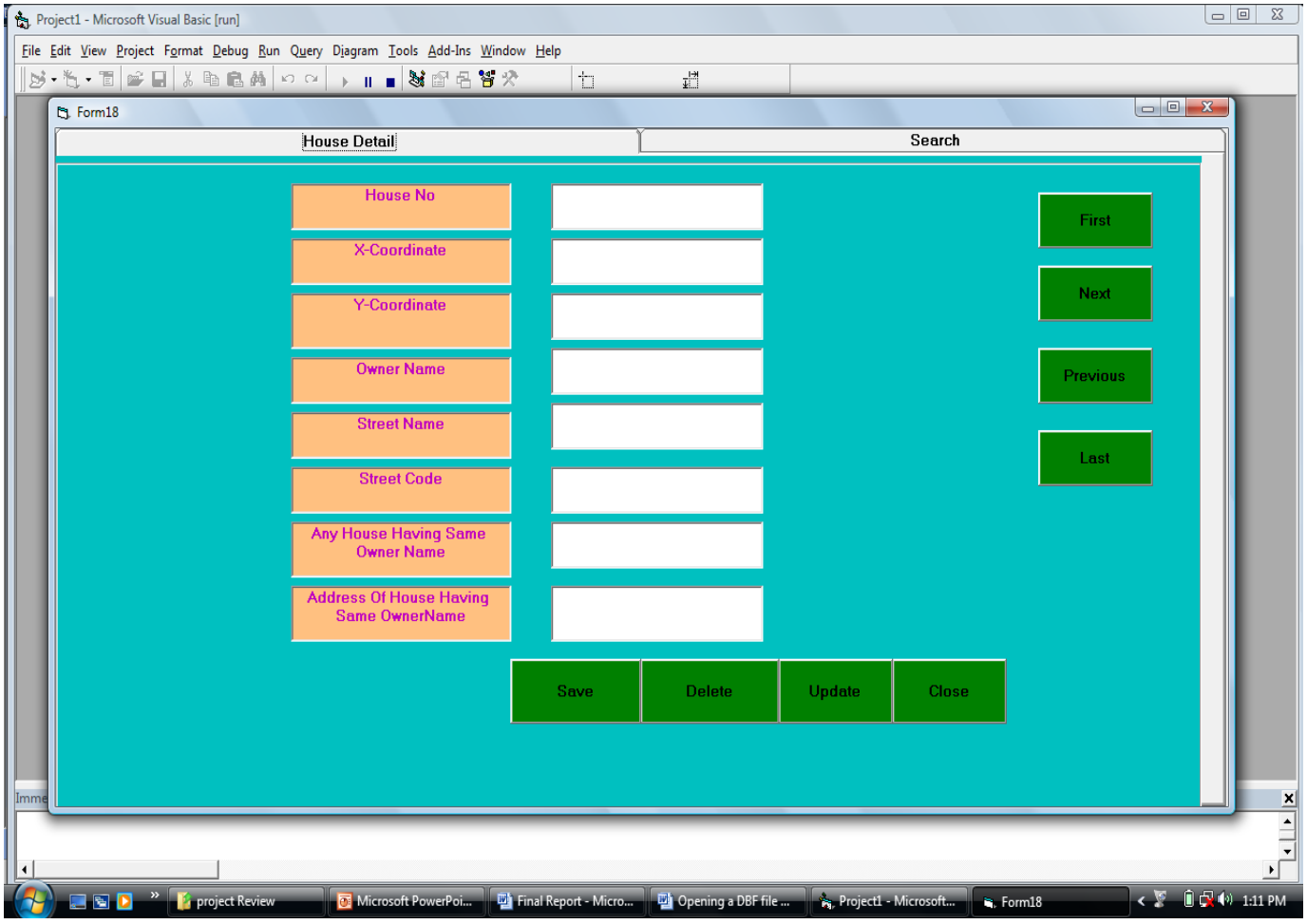

Fig.9. Inserting data structure of the model

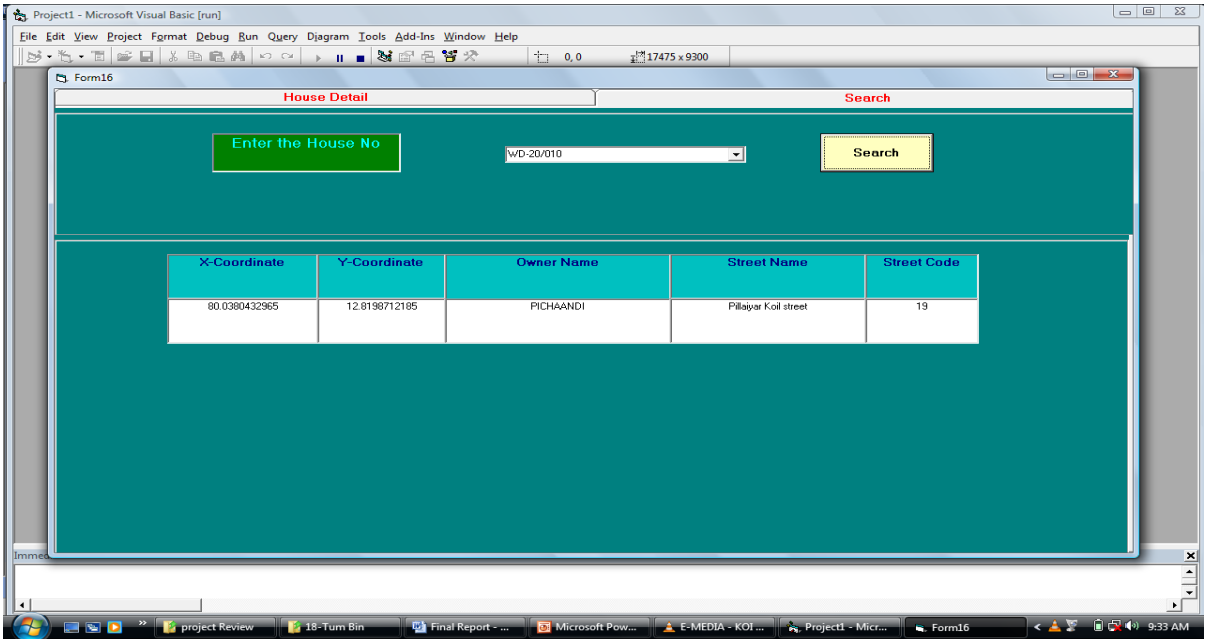

Fig.10. Query in terms of House number

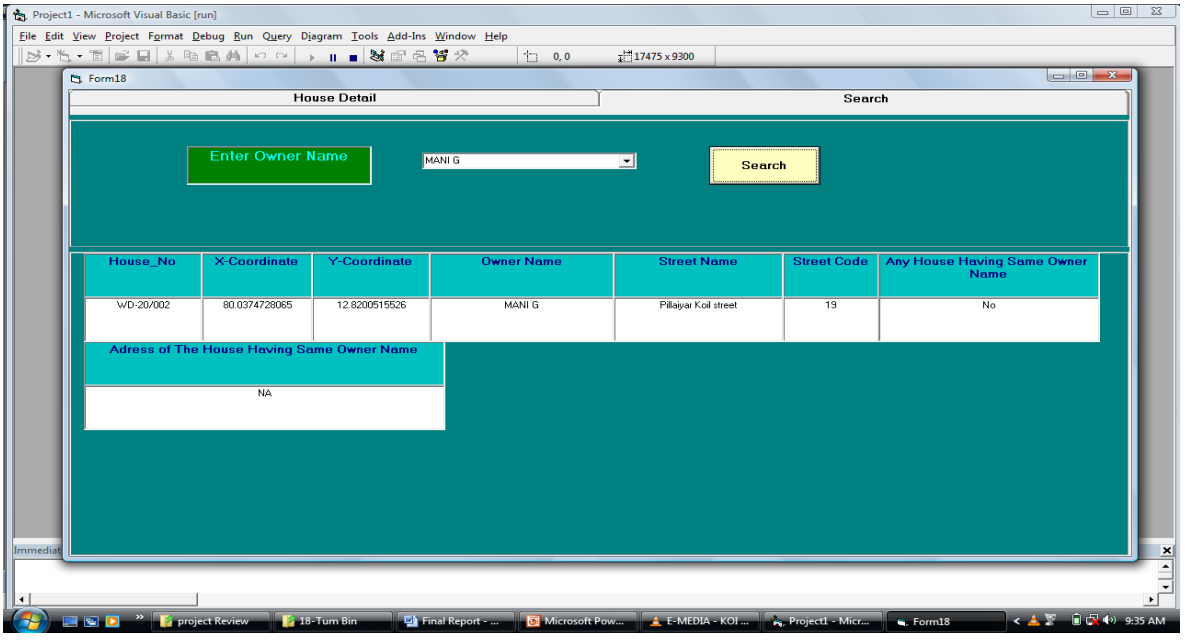

Fig.11. Query in terms of Person's name

IV. CONCLUSIONS

A flexible and user friendly information system is developed to assist the planners for village level planning with reference to managing the resources of Potheri village, Kancheepuram district, Tamil Nadu, India. The Information system is created in terms of house number, owner name, latitude, longitude, address etc. So by the help of this system, the modification like updating and deleting of data can be easily done. Using this model the queries also developed in terms of house number, person's name, street name and locations from maps. This information system will be very much helpful for the local authority like municipality, post-office and electricity board. Also this model can be considered as model and it will be very much essential for each village for its developmental activities. Planners and decision makers at micro level have to be depends upton spatial and non-spatial data for optimal interpretation. Hence, the planners can utilize above such information system for sophisticated data management systems to handle such spatially correlated data. The system proves to be a user friendly interface for spatial and aspatial information retrieval which supports users with minimal computer knowledge for access of spatial information.

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