MATERIALS AND METHODS
4.1 THE STUDY AREA

4.1.1 LOCATION AND EXTENT:

The area chosen for our study of “GIS Development in Business, Service planning and Management” is the Hyderabad city. This city has experienced spontaneous growth since a decade. It is developing in all phases of life and especially the growth in the field of information technology is worth mentioning. With the development of IT there has been a marked change in the field of GIS too. The developments and improvements in the basic infrastructure facilities have led to a strong foundation for parallel increase in business service and other related fields. The has led to the improvement of standard of living of the people of this Hitech City.

Hyderabad is the capital of Andhra Pradesh popularly known as city of Pearls and the city of Charminar. It is increasing known in these days of information technology as a Hitech City and Cyberabad. The city is the fifth largest city of India with a population of more than fifty lakhs. Agglomerated area is around 727 Sq.kms.

It is located between 17°E-22°N latitude & 78°-27°E longitudes at an average altitude of 1778 feet above mean sea level. It is surrounded by Rangareddy district on all sides.
Census data for Hyderabad (2001)

<table>
<thead>
<tr>
<th>LOCALITY</th>
<th>AREA (Sq.kms)</th>
<th>RES_HOUSE</th>
<th>HOUSEHOLDS</th>
<th>TOT_POP</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYDERABAD (URBAN AREA)</td>
<td>216.76</td>
<td>524774</td>
<td>533748</td>
<td>3145939</td>
</tr>
<tr>
<td>HYDERABAD (MUNICIPAL CORPORATION)</td>
<td>172.68</td>
<td>491569</td>
<td>499725</td>
<td>2964638</td>
</tr>
<tr>
<td>SECUNDERABAD CONTONMENT</td>
<td>40.17</td>
<td>31897</td>
<td>32675</td>
<td>171148</td>
</tr>
</tbody>
</table>

Table #1
Census data for Hyderabad
Census data of households adjacent to Hyderabad city under Rangareddy District

<table>
<thead>
<tr>
<th>LOCALITY</th>
<th>AREA (Sq.km)</th>
<th>RES HOUSE</th>
<th>HOUSEHOLD</th>
<th>TOT POP</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYDERABAD MCH + OTHER VILLAGES</td>
<td>---</td>
<td>17036</td>
<td>17743</td>
<td>93455</td>
</tr>
<tr>
<td>HYDERABAD (MCH)</td>
<td>---</td>
<td>14785</td>
<td>15492</td>
<td>41134</td>
</tr>
<tr>
<td>KUKATPALLY (MO)</td>
<td>43.96</td>
<td>40533</td>
<td>41221</td>
<td>186963</td>
</tr>
<tr>
<td>MALKAJIGIRI (MO)</td>
<td>17.3</td>
<td>24764</td>
<td>26000</td>
<td>127178</td>
</tr>
<tr>
<td>KAPRA (MO)</td>
<td>43.9</td>
<td>19091</td>
<td>19096</td>
<td>87747</td>
</tr>
</tbody>
</table>

Table #2
Census data for Hyderabad (Ranga Reddy Dist)
4.2 MARKET STUDY OF HYDERABAD:

These are two central business districts (CBD), one each in Hyderabad north and Secunderabad. The CBD of twin cities are neither circular nor semi-circular in shape, but have attained an elongated irregular form. The central business district is the principal thoroughfare. It is the highly specialized business center, which serves areas beyond the municipal limits. The CBD of Hyderabad is more specialized than that of Secunderabad. It is the zone of maximum convergence of traffic arteries. It has a wide range of shops ranging from electrical/electronic goods, jewellery, readymade garments, furniture to leather goods. It has retail show rooms of many major cloth mills like Bombay Dyeing, Raymond’s, Fin lays etc. It is a zone of multistoried commercial complexes, which came into existence by the demolition of palatial villas and bungalows.

Although the CBD continues to have dominant status in the city’s retail activity, a remarkable change has been the growth of secondary shopping centers. Since 1960’s large scale demographic and spatial growth stimulated growth in the transport network in the city. The secondary shopping centers are the large business establishments stringed along the major roads or at the intersection of important traffic arteries with larger vehicular and pedestrian traffic. The catchment area includes the surrounding neighborhood areas. The range of goods is also relatively high. Such shopping centers minimize the longer trip length of the consumers into the CBD. The frontages are large with bold displays. Example, Punjagutta-Ameerpet area, Narayanguda-Chikkadpally area, Malakpet, Koti-Sultan bazaar areas etc. The outlying business district serves the peripheral areas of the city and the sub-urban population. They also have a wide range of goods.
Establishment of such commercial centers eg. Tarnaka, Dilsukhnagar, Balanagar etc. has considerably reduced the congestion in the CBD. As the city grows in size the consumers will be less willing to travel long distances to city centres.

Isolated stores or clusters are sprinkled throughout the city occupying the street, frontages of roads, in the by lanes or along the main road. They are providing cheaper convenience goods required in day-to-day life, like kirana and general merchants etc. Their catchments areas are very small.

The study area particularly taken up for study is the Sultan Bazaar area which is one of the busiest shopping centres of Hyderabad City.
4.3 DATABASE

4.3.1 DATA USED:

The data used in this project is divided into different types depending on the source of obtaining the data. The data has been classified into two major types:

1. Field data (Obtained from Field Survey)
2. Map data (Obtained from Map Source)

FIELD DATA:

Field survey conducted for collection of:

(a) Shop details: Name – Address – Telephone Number – Major Commodity Sold.
(b) Commercial establishments: Name – Type of Company / Office / Others – Address – Nature of Business.
(c) Government establishments: Name – Type of Office – Address.

MAP DATA: Locality maps prepared at the scale of 1:1250. (Maps from Municipal Corporation of Hyderabad are taken as reference) selected ground control points have been used for rectification of the MCH Maps. The positional accuracy is estimated to be about 2 metres of this scale. This can further be improved by taking GCPS at a very fine resolution. However the present study does not require positional accuracy of more than 2 metres. As such this aspect is not further considered.

DATA SOURCES AND INTEGRATION WITH GIS

The range of data sources that are available to business is wide, and is highly dynamic. So a system is required to manage such a huge data.
The database management system has been used to pool the required data to a system that allows easy retrieval and easy update.

The range of data required for the improvement of business and service sector include the data ranging from the census data, geodemographic data to the data regarding the marketing and sales of the entire city in particular. This data has been collected from several sources from government and non-government organization. The details of household survey data available with government is obtained and is one of important sources of data used.

Since we are discussing the data sources, it is worth to mention that the collection of data in Indian conditions is not an easy task.

There are several problems underlying the collection of data:

- The census data available for the city is not update.
- The data at the micro level is not available for various parts of the city.
- The geodemographic survey has to be taken up still by the census department.
- The geodemographic data, which is available, poses few questions of reliability and accuracy.

4.3.2 DATA ORGANIZATION

The organization of the data is the second major factor in successful use of a GIS. A database is used to provide this organization. The data base is critical because:
“Data is of no value unless the right data is used in the right place at the right time.”

Over vacation data might be organized by alphabetical filing or by simply putting the maps in one box and the brochures in another. Depending on the quality of data base system, these forms of organization may suffice. In a computer-based GIS, however, the quantity of data is large enough that the form and performance of the database are critical to the overall usefulness of the system.

GEOREFERENCED DATA:
Geographic data are commonly characterized as having two fundamental components:

1. The phenomenon being reported such as a physical dimension or class.
2. The spatial location of the phenomenon.

Examples of a physical dimension might be the height of a forest canopy, the population could be a rock type, a vegetation type, specified with reference to a common coordinates system such as latitude and longitude.

A third fundamental component to geographic information is time. The time component often is not stated explicitly, but it often is crucial. Geographic information describes a phenomenon at a location of different classes of land cover, as they existed at the time of data collection. If the area is changing rapidly, this information may quickly be out-dated. The information may then be unsuitable for decision-making that requires the current status of the land.
Geographic data are inherently a form of spatial data. Geographic data can be represented on a map or in a geographic information system as either point, line or area features. The spatial data that pertains to a location on the earth's surface are often termed as Georeferenced data.

THE NATURE OF GEOGRAPHIC DATA:

The map is perhaps the most familiar form in which geographic data are represented. A map consists of a group of points, lines, and areas that are positioned with reference to a common coordinate system. It is usually represented in two dimensions so that it is easily portrayed on a flat sheet of paper. The map legend links the non-spatial attributes, such as place names, symbols, and colors, to the spatial data i.e. the locations of the map elements.

The map itself serves to both store the data and to present the data to the user. It is a relatively inexpensive means of storing a considerable amount of spatial information. However, its dual service as a medium of storage and presentation has a number of limitations. For the map to be legible, the amount of data represented in the map must be limited. Similarly, the form of presentation the map provides is constrained by the need to carry considerable information. The map is relatively expensive to draft manually, and so a map is commonly designed to serve many different uses. This may require that compromises be made in the scale, level of information detail, and other design considerations. It has also become difficult to analyse the information available in several maps.
In a GIS, the storage and presentation of geographic data are separate. The data may be stored at a level of detail and then plotted at a more general level and a different scale. In a GIS, the plotted map becomes one of many forms of presenting the data. It becomes, in effect, a view of a geographic database. The same data may be viewed as many different types of the maps. Each can be customized for a specific use because it is relatively inexpensive to plot a map by computer. In addition to maps, the data may be represented in the form of tables, or even as text descriptions.

The geographic data is represented in GIS as points, lines, and areas as with maps. However, for efficient implementation, these elements are organized somewhat differently than the organization of a paper map. It has a set of characteristics that make the features distinctly different from the more familiar lists and tables of data used in the information systems developed for business applications.

The information for a geographic feature has four major components: its geographic position, its attributes, its spatial relationships, and time. More simply, the four components are: where it is, what it is, what is its relationship to other spatial features, and when did the conditions or features exist.

**GEOGRAPHIC POSITION:**

Geographic data are fundamentally a form of spatial data. Each feature has a location that must be specified in a unique way. The locational definitions can be quite complex patterns, such as a sinuous shoreline or a web of transportation routes.
For geographic data, locations are recorded in terms of a coordinate system like the Latitude/Longitude, UTM (Universal Transverse Mercator), or State plane coordinate systems. In some cases the coordinates of one system can be mathematically transformed into coordinates of the other. But in many cases this is not possible. For example, property boundaries were at one time described with reference to local features like fences or trees. The type of reference system cannot be mathematically transformed into geographic coordinate system. Similarly, a geographic coordinate cannot be calculated from a street address.

A GIS requires that a common coordinate system be used for all the databases that will be used together. For a study area the coordinate system can be any convenient grid. For larger coverage areas, one of the nationally or internationally accepted coordinate systems is generally used. The UTM coordinate system is convenient one for scales of 1:500000 or larger.

Geographic data may be stored at different levels of positional accuracy. To some extent the locational data are always imprecise at some level of details. Some data may be accurate to within a few centimeters, while other data may be only be accurate to 10 m.

**ATTRIBUTES:**

The second characteristic of geographic data are their attributes, i.e. "what is it". For example, the feature might be a forestland. Its attribute might include the species composition, average tree height, the crown closure, and the date it was last logged. These attributes are often termed non-spatial attributes in that they do not in themselves...
represent locational information. There is a level of inaccuracy inherent in non-spatial attribute data as there is for spatial data. A commercial district may not be 100% commercial and a stand of pine trees is generally not 100% pine. Often GIS users do not address this type of inaccuracy, but for many types of analyses it is important to recognized and take into account this imprecision.

SPATIAL RELATIONSHIP:

The third characteristic of geographic data are the spatial relationships among the geographic features. These relationships are generally very numerous, may be complex, but are important.

TIME:

Geographic information is referenced to a point in time or a period of time. Knowing the time when geographic data were collected can be critical to using those data appropriately. An area may be covered by trees one year and have been clear-cut the next. An urban area may be zoned residential for twenty years and then be re-zoned commercial. Agricultural crops are grown in certain seasons. In some regions of the world, different crops are grown in the same area at different times of year. So, it would be important to know the time of year when the crop area data were collected.

Historical information may also be a valuable component of the GIS database. Knowing the previous condition of a geographic location may be very useful. For example, knowing the forest that previously grew on a clear-cut site that has been harvested can be useful in deciding how best to replant an area. Knowing that a site was once a waste dump will restrict its future use.
The representation of time in a GIS is an added level of complexity that is difficult to handle. As a result, the time factor has generally not been addressed in a sophisticated manner. Taken together the four characteristics, geographic position, attributes, spatial relationship, and time, make geographic data uniquely difficult to handle. It is too complex to record all the information for geographic entities. As with other database systems, a data model is used to represent the information considered to be most relevant to the applications at hand. If the model is appropriately designed, the GIS will mimic the behavior of the real world accurately enough to provide useful information. The database system of a GIS provides the means to organize the spatial and non-spatial attribute data for efficient storage, retrieval and analysis.

4.3.3 DATABASE CREATION FOR OUR PRESENT STUDY:

Based on the availability of the data and survey taken up the database was built with the demographic data which was divided into several tables. The main table being 'CADASTRE INFORMATION'. It contains several database files such as Cadastre database, House information database, Land use database, Environmental database, Medical facility database, Educational facility and Tax file database. In this project, depending on the study taken up we will be dealing mainly with cadastre, house information, and land use and tax file database only. Other types of databases are not of much relevance to our present study.

CADASTRE DATABASE:

This database contains information regarding parcel number (Primary Key) and other types of municipal details such as municipal circle
number, municipal ward number, municipal house number, type of land ownership, type of land use and type of structure.

EXPLANATION OF VARIABLES:

Parcel Number: This gives the house number of each and every polygon. Some public properties such as parks and temples are not provided with house numbers. Care is taken to keep this variable as unique in the entire database since it is used as primary key in the database. This is taken as a character item.

Municipal Circle Number: The entire municipality of Hyderabad is divided into several circles and each Circle is given a number. This parameter lists the number of the Circle we are dealing with.

Municipal Ward Number: Each Circle is again divided into small wards and each ward is the lowest level of unit for administration in a municipality. This parameter will give the ward number of the area under study.

Type Of Land Ownership: Each parcel is classified into two types depending on the type of land ownership. This item can have the values of either Government land or Private Land. This item is a character item.

Type of structure: This parameter distinguishes the given parcel as either independent or multiple depending on the type of structure.

Type of land use: Land use is another type of classification, by which each parcel is divided into different types based on its land use. The
different types of land use taken into consideration are residential, commercial, industrial, residential cum commercial, medical, recreational and offices etc.

**Locality**: This gives the name of the locality of the study area. The value is common in this study. Its value is 'Sultan Bazaar' for the entire project.

**City**: This gives the name of the city of the study area. The value is common in this study. Hyderabad is the value for the city item in this database.

**Pin code**: This shows the zip code for the area under consideration.
CADASTRE DATABASE (CADASTRE.DBF)

HOUSE INFORMATION DATABASE (HOUSE INFO.DBF)

LANDUSE DATABASE (LANDUSE.DBF)

ENVIRONMENTAL DATABASE (ENVIRONMENT.DBF)

SHOP INFORMATION DATABASE (SHOP INFO.DBF)

ELECTRICITY DATABASE (ELE.DBF)

MEDICAL FACILITY DATABASE (MEDICAL.DBF)

EDUCATIONAL FACILITY DATABASE (EDUCATION.DBF)

COMMERCIAL TAX FILE DATABASE (COMM.DBF)

DFD #4
CADASTRIC INFORMATION
DOFD #5
Cadastral DBF
HOUSE INFO.DBF:

This database file contains information about each and every house in the study area. This table contains household information such as Parcel number (primary key), name of the head, Number of male occupants, Number of Female Occupants, Number of children, occupation, income form all sources, caste and Power service number.

This table will provide complete information regarding each household in the study area. This will provide an idea of economic level of people residing in the area with their annual income and their religion and caste details.

The data in the table will be helpful to analyze the number of people belonging to a particular age group. For example, a particular business may have the customers belonging to a particular age group. Such as ladies beauty parlour may require lady customers from the age group of 15 to 40 years, the gym may be visited by the youth, a videogames parlour is generally visited by children only and internet café is generally visited by youth. The schools and tuitions points require student community.

The data are also useful for estimating the population of different sex groups where this data may be used for analyzing need for a particular business mostly visited by particular sex. For example a Bar is mostly visited by males and female customers mostly visit cloth-matching centers.
The social status parameter gives an idea of distribution of people with different income levels. This will help immensely in focusing the market strategy.

This data will help to understand the lifestyle of the people and their taste and preferences, thereby going for the stores, which suit their preferences. Any business analysis starts with the identification of the customers' income range. The data obtained from the store surveys or from the credit card bill of the customers may give idea of the income levels of the progressive or good and regular customers. So if the businessman focuses his further marketing strategy on identifying the customers from their annual income levels of the tables created, he can minimize his marketing costs to the particular section of the society. In the same way this data can be useful in commodity selection based on the demographic data of that area. For example, if the shop is located in an area where the predominant social status is lower middle and middle class the opening a showroom with branded commodities may not attract much business. Instead understanding the lifestyle of the people help the shopkeeper to go for the commodities, which suit the tastes and preference of the people of that locality.

Category of classification:

<table>
<thead>
<tr>
<th>Annual income (Rs.)</th>
<th>Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 24,000</td>
<td>Poor</td>
</tr>
<tr>
<td>24,000 - 60,000</td>
<td>Lower middle</td>
</tr>
<tr>
<td>60,000 - 1,20,000</td>
<td>Middle</td>
</tr>
<tr>
<td>1,20,000 - 1,80,000</td>
<td>Upper-middle</td>
</tr>
<tr>
<td>1,80,000 - 3,00,000</td>
<td>Upper class</td>
</tr>
<tr>
<td>more than 3,00,000</td>
<td>Affluent</td>
</tr>
</tbody>
</table>
Ration card item gives the details of the families possessing the civil supplies ration cards. The households have been classified into different ration cards such as pink and white card. Possessing white card signifies low-income status and pink card show better income status. This has been considered as a part of analyzing the GIS applications in service sector. The data is used for developing reports which require income and economic status as a parameter. Even a civil supplies store location can be analyzed and its distribution area can be studied and results can be used to examine the need for a new store in the area. If the number of people residing in the area is above the capacity of the stores to serve them the civil supplies department may think of starting one more new store in the area to cater to the needs of the people. Thus, new locations for business can be identified by using the available demographic data.

Explanation of Variables:

Parcel Number : This gives the house number of each and every polygon. Some public properties such as parks and temples are not provided with house numbers. Care is taken to keep this variable as unique in the entire database since it is used as primary key in the data base. This is taken as a character item.

Name of the Head : This gives the name of the head of the household. He is the active earning member of the household. This is a character item.

Family members : This gives information about total family members in the household. This includes the number of male occupants, number of female occupants and number of children in the house. This is generally a numeric value. This value also includes the head of the household. This has been taken as a numeric item.
Males : This gives the total member of males living in the household. This includes even male children. This has been taken as a numeric item.

Females : This gives the total member of females living in the household. This includes even female children. This has been taken as a numeric item.

Children below the age of 15 years : This gives information of total number of children below the age of 15 years of age.

Caste category : This gives information regarding different type and category of the caste of the households living in the area. This is taken as character item.

Occupation : This shows what is the occupation of the head of the household. The main source of income for a family is taken as the prime occupation of the household. This is taken as character item.

Income : This calculates the sum of all the salary earned by different persons in the house. The salary can be from various sources such as incomes from the land, rents, salary for the employees, interests from the existing properties etc. This is taken as the numerical item.

Social Status : This item will distribute the family into different social classes based on their income.

Ration card : This item refers to the type of ration card the family holds. It gives the value of either White ration card or pink ration card or No ration card.
LAND USE.DBF:

Land use is another type of classification, by which each parcel is divided into different types based on its land use. The different types of land use taken into consideration are residential, commercial, industrial, residential cum commercial, medical, recreational and offices etc.

Explanation of Variables:

Residential: All the parcels falling under House.Dbf will be categorized as residential land use type.

Commercial: All the parcels other than residential and which are commercial establishments like small business houses to big bazaars fall into this category. The parcels falling into this category can again be classified into different types as shown in the figure.

Industrial: The parcels which are identified as industrial locations fall under this category. All the small scale, medium scale to large scale industries are grouped into this parcel.

Residential cum commercial: There are some parcels which are used for dual purposes i.e., the road side portion is used for commercial purposes and the back side or the upper floors are used for residential purposes. Such parcels are classified into this type of category.

Medical: This includes all the parcels involved in providing medical facilities such as hospitals, clinics, pharmacists and diagnostic centres.
**Educational institutions**: All the parcels classified as Schools, Colleges and Universities are grouped into this group called educational institutions.

**Recreation**: Clubs, Stadia, sports centres and parks meant for recreational purposes are grouped into this category.

**Utility**: All the parcels classified as Post Offices, Police Stations, Fire Station, Electricity Offices, Railway Stations, Bus Depots, Water Service Boards etc., are included in the Utility parameter.

**Offices**: All the Central Government Offices, State Government Offices and Private Offices are classified into this Group.
LAND USE.DBF

RESIDENTIAL
COMMERCIAL
INDUSTRIAL
RESIDENTIAL & COMMERCIAL
MEDICAL
EDUCATIONAL INSTITUTIONS
RECREATION
UTILITY
OFFICES

DFD #7
LAND USE
RESIDENTIAL.DBF

PARCEL NUMBER

STREET NAME

LOCALITY NAME

NO. OF OCCUPANTS

CITY

DFD #8
RESIDENTIAL.DBF
SHOP INFORMATION DATABASE:

Shop information database table reflects the market data containing name, commodity sold, pedestrian population and the locational address of the shop.

This data forms the backbone for market analysis. The data will address the following queries:

1. What are the shops located in this area?
2. What is the major commodity that is sold in that area?
3. What are the commodities that are not available in that area?
4. What is the ideal business that can be taken up in this area?
5. Which commodity stores can be set up for successful business?
6. Where are the possible store locations that are available for setting up of new stores?

These queries will help a businessman to analyze market at micro level before starting a new stores or expanding his existing business. The results can be obtained in terms of a suitability classes for establishment of a shop. The results will be given in a table format whether the location selected for the set up of new stores will be falling under 'zone of suitability' or falling under zone of 'non-suitable'. Analysis can be performed such as what type of stores can be suggested for better business. A list of different shops are suggested as a result based on priority and suitability to the area and its demographics.
Explanation of Variables:

House number: This gives the house number of each and every polygon. Some public properties such as parks and temples are not provided with house numbers. Care is taken to keep this variable as unique in the entire database since it is used as primary key in the database. This is taken as a character item.

Shop name: This item has the name of each and every shop in the study area. The item is of character.

Commodity sold: This provides the data of the major commodities sold from a particular shop. This is of character type.

Pedestrian population: This is the measure of number of people moving in front of the shop daily. This is taken into account because it is assumed that most businesses are successful whenever there is flow of people in front of it and most of the pedestrian population turn into potential customers.

Locality: This stores the locality name of the particular household. It is a character item.

City: This stores the name of the city in the polygon under consideration. This is a character item. Its value is same all along the database i.e Hyderabad.

Zip code: This stores the zip/pin code value. This is of numeric type.
ELECTRICITY DATABASE:

Electricity Database Table shows the municipal house number and electricity service connection details.

Power sector is one of the most important sectors without which modern world would come to a standstill. At the same time, the sector is facing with number of problems like power thefts, grid failures, distribution loses, frequent power cuts and failures. The electricity database can address problems of power thefts, restoration of power failures in a reasonable time.

The table provides data regarding the electric meter numbers of each hold and its consumption. The data also helps in comparison with demographic data such as the income levels of the households and their lifestyles, the power consumption levels of the household and detect any possibility of power pilferages, for example, in the collection of data, we have located certain houses without electricity meters but enjoying power supply. Such instances can be curbed by using GIS tools in service and utility sectors like electricity.

Power is a service sector, which is facing the problems of electricity theft and losses. This can be very well monitored and the persons responsible for the illegal act can be located using the demographic data available in the table. This table provides data regarding the possession of electric meter or not. Not only the existence of the meter but also provides the details regarding proper working of the metre. Having this data we can identify the house with no electric meter and by comparing with the other demographic data such as his profession
and his annual income we can come to some conclusions that whether the house really doesn't have the meter or they are having any illegal connection. For example in the data we have located some houses with no electric meter but when comparing the annual income of the head of the household, it gives an impression that the house is having an illegal connection. Such possibilities can be found out. The data regarding the working condition of the meter will enhance the identification of the house where service is needed and it can increase the revenue through payments of the bills.

Explanation of Variables:

Parcel Number: This gives the house number of each and every polygon. Some public properties such as parks and temples are not provided with house numbers. Care is taken to keep this variable as unique in the entire database since it is used as primary key in the database. This is taken as a character item.

Name of the head: This gives the name of the head of the household. He is the active earning member of the household. This is a character item.

Electric connection number: This gives the electric meter number. The parcels like house or a commercial establishment will have an electric meter with a unique number respectively.

Condition of electric meter: This gives information regarding the condition of electric meter in their house or shop. It states whether the meter is working properly. The item is of character type.
**Connection type**: This describes the type of connection. It can be either residential or commercial.

**Electric pole number**: Every parcel having an electric connection will be getting the power supply from a particular electric pole whose number is given by this item of the database.

**Transformer number**: Every electric pole is connected to a particular transformer which converts the high voltage into low voltage that is supplied to different consumers. This item will give the number provided by the electricity officials for identification.

**Substation number**: Every locality will be having a power station either 33kv or 66kv. From this power station the distribution of the power is done. This item will provide the number for the substation from which the entire locality is getting the power supply.
ELECTRICITY DATABASE

PARCEL NUMBER

CONNECTION TYPE

CONDITION OF THE METER

ELE. METER NUMBER

ELE. POLE NUMBER

TRANSFORMER NO.

SUB STATION NO.

KEY

RESIDENTIAL

COMMERCIAL

DFD # 17
ELECTRICITY . DBF
COMMERCIAL TAXES FILE DATABASE:

Commercial taxes file database gives information about all the business establishments of the area along with their nature of business, commodities sold, taxes paid etc. This database is included in our study to suggest measures to improve the existing system of tax collection by applying GIS tools for better management and planning of the government department. Spatial data of the business places can be used for plugging tax leakages by enforcement and tax authorities.

Explanation of the Variables:

Parcel number : This gives the house number of each and every polygon. Some public properties such as parks and temples are not provided with house numbers. Care is taken to keep this variable as unique in the entire database since it is used as primary key in the database. This is taken as a character item.

Sales Tax Number : This the unique number given to each and every registered dealer of the commercial taxes department. The commercial tax officials identify the dealer with this number. All the transactions of tax payments are carried out with this number only.

Circle : Each and every registered dealer based on his annual turnover is under the jurisdiction of either a Commercial Tax Officer (CTO) or Deputy Commercial Tax Officer (DCTO) of Assistant Commercial Tax Officer (ACTO). This item in the database will classify every dealer into any of the above officer's jurisdictions.
Gross turnover at the beginning of the month of the year: This item will give the value of Gross turnover at the beginning of the month of the financial year, i.e., April month of the year, when the financial year begins for every businessman. Gross turnover means total turnover of the dealer.

Gross turnover at the ending month of the year: This item will give the value of Gross turnover at the ending month of the year, i.e., March month of the year, when the financial year ends for every businessman.

Net turnover at the beginning month of the year: This item will give the value of Net turnover at the beginning month of the year, i.e., April month of the year, when the financial year begins for every businessman. Net turnover means the turnover on which tax is payable.

Net turnover at the ending month of the year: This item will give the value of Net turnover at the ending month of the year, i.e., March month of the year, when the financial year ends for every businessman.

Tax due at the beginning month of the year: This item will give the value of tax to be paid at the beginning month of the year, i.e., April month of the year, when the financial year begins for every businessman.

Tax due at the ending month of the year: This item will give the value of tax to be paid at the ending month of the year, i.e., March month of the year, when the financial year ends for every businessman.
Tax paid at the beginning month of the year: This item will give the value of tax paid at the beginning month of the year, i.e., April month of the year, when the financial year begins for every businessman.

Tax paid at the ending month of the year: This item will give the value of tax paid at the ending month of the year, i.e., March month of the year, when the financial year ends for every businessman.
COMMERCIAL TAX FILE DATABASE

PARCEL NUMBER
SALES TAX NUMBER
CIRCLE
GROSS TURNOVER_B
GROSS TURNOVER_E
NET TURNOVER_B
NET TURNOVER_E
TAX DUE_B
TAX DUE_E
TAX PAID_B
TAX PAID_E

KEY

CTO
DCTO
ACTO

DFD # 18
COMMERCIAL TAX.DBF
4.4 SOFTWARE USED:

1. ARC/INFO 8.0.2
2. ARC VIEW 3.2a
3. AUTO CAD 2000
4. VISUAL BASIC 6.0
5. MAP OBJECTS 2.0
6. ORACLE 8.0

Arc/INFO is used for performing activities such as editing of maps, integration of database and performing overlay analysis.

ARC VIEW's extension, SPATIAL ANALYST is used to perform analysis of the data and display the results in a user defined way.

AUTO CAD is used for digitization purpose i.e., for preparation of digital vector maps from the raster maps.

VISUAL BASIC is used for preparing the GUI (Graphical User Interface). This is used for customization of the GIS into an application independent of the software.

MAP OBJECTS is a programming language that can perform all the functions of the GIS software (ESRI Products) which works on the Visual Basic platform. So that we can implement all the GIS software functions into our application.

ORACLE is the Database Management System that is used in the project.

SQL queries can be performed on the data in the final application accessing the data from the Maps.
User Interface made using Visual Basic

Plate # 2 User interface created using Visual Basic
4.5 PREPARATION OF VECTOR MAPS:

The basic input for any GIS study is the ‘MAP’. The Maps are the spatial representation of the features of all the features that exist on the earth.

A Base map is a reference map showing details of all the other layers of information such as roads, buildings (Residential houses or commercial complexes), prepared from the municipal locality maps of the MCH Hyderabad at the scale of 1:12000.

The locality maps were procured from the Municipal Corporation of Hyderabad. The locality map was scanned to get a raster image. Using this raster image the base map (vector map) was prepared for the locality under study area using AutoCAD software (version 2000). From this base map each and every layer was extracted and stored separately for performing analysis under GIS environment. The maps thus prepared were updated using GPS as a tool. Finally the updated maps were used for analysis.

4.5.1 NEED FOR UPDATION OF LOCALITY MAPS:

The maps procured from the municipal corporation were found to be less accurate. A cross check was performed to verify the features lying in the maps with the original feature on the ground. It was found that, few features like roads and other settlements were missing in the map. So there was a need to update the map with the roads and other newly constructed houses.

The process of updating was performed using Handheld Global Positioning System (Garmin 12 channel GPS). The latest coordinates
of the feature missing, was recorded and then they were used in construction of those features in the vector map. The roads, which were not to the exact shape, were also corrected. Finally a map that is almost error free was prepared and this map was used in the project.

4.5.2 SPATIAL CLASSIFICATION OF THE MUNICIPALITY MAP:

The main purpose of this project is to carry out feasibility studies of various applications of GIS in Business, Service Sector Planning and Management. The study is aimed at improving the existing systems in above-mentioned areas by introducing the municipal applications of GIS. So municipal Information is to be prepared, using all the possible application of GIS to make a study of various sectors.

To perform this we need to classify the municipality map (vector Map prepared). The classification output will aim at differentiating the features such as roads, residential, commercial, Residential-cum-Commercial, Industrial, Hospitals, Medical, recreational. Offices, Police stations etc., all this classification can be carried out based on the database used. Later each type of land use is to be stored in different database files for further analysis.
Map showing description of each parcel

Plate # 3 Landuse Map describing nature of each parcel
4.6 GROUND TRUTH COLLECTION:

The Ground truth was collected basically for two purposes:

- One for the updating of the vector base map.
- Second for the classification of different parcels into different land use types.

A survey was conducted keeping in view of the above requirements. For the first requirement a global Positioning system was used to get the coordinates of the missing and ambiguous features. Later all the coordinates were used to generate the same feature on the map.

For the second purpose, a field survey was conducted to collect data for each and every parcel. The information for the type of land use was collected i.e., all the parcels in the maps were classified into different land use types such as residential, commercial, residential-cum-commercial, medical, office, recreation, educational institutions, and utility.

- For every residential parcel encountered it was found whether it is an independent or multiple house.

- For every commercial establishment the data collected include: name of the commercial establishment, major commodity sold.

- All the pharmacists, hospital, diagnostic centers etc., are grouped into the medical group.

- For every office traced, it was recorded whether it is a government office or a private office.
All the parks, clubs and stadiums were included in the category of the recreation.

All the post offices, police stations, water service departments, fire stations were included into the category of utility.

All the schools, colleges and universities were included under educational institutes category.

All the small-scale industries, medium scale and large-scale industries can be grouped into industries category.
Residential Areas of Sultan Bazar

Plate #4 Residential Areas
The main aim of this Project is to use the Municipal Information System and to test the feasibility of the GIS applications in improving the business in an area and to help even small business people to improve upon their business processes by making use of GIS technology. All the business locations are identified in survey conducted for Ground truth collection. All the existing business locations and also the vacant locations where business can be started and flourished are identified. This data is used to focus on the business locations, which are having high business potential and also those which are having potential to develop if given special treatment. This work has been carried out by performing several analysis using GIS. The major types of analysis carried out are proximity analysis, demographic analysis, and commodity sales analysis and site location analysis.
Shops in Sultan Bazar area

Plate # 5 Commercial Establishments
Map showing the most potential and populated business areas in a locality.

Plate #6 Potential Business Areas
4.8 Delineation of the Registered and Unregistered Dealers of the Commercial Taxes

All the dealers that are registered and unregistered with the commercial tax are identified and delineated. This was done by comparing the ground truth collected with the data of registered dealers with the commercial tax department. The ground truth is collected for each and every business shop. The database obtained from the commercial tax department consists of the details of those dealers who are registered with the department. So by simple comparison we can delineate the registered and unregistered dealers. Our main aim is to identify the unregistered dealers and suggest strategies to make them register with the department to plug leakages of revenues to the state.
MAP SHOWING REGISTERED DEALERS

Polygons Showing in Yellow are the Registered Dealers

Plate # 7 Map Showing Registered Dealers
MAP SHOWING UNREGISTERED DEALERS

Polygons Showing in Yellow are Unregistered Dealers

Plate #8 Map Showing Unregistered Dealers
4.9 PREPARATION OF ELECTRIC POLE NETWORK

The third aspect of this project is to test the feasibility analysis of GIS in utility sector. As a part of this, a study is taken up to improve the fuse call management service for the electricity department. For this the data required was assumed for much of the area. The electric service connection number (meter number) was assumed and this data was attached to the map using GIS software. Each Parcel will receive its power supply through a electric pole and the electric pole gets the low voltage electricity from the transformer which converts high voltage electric current into household usable voltage. Every transformer is in turn connected to the sub station. So all the electric poles, transformers and the sub station are assumed to be present in one part of the locality. These features were represented on the map and a network and flow of the electric current was made.