Design of UID based Online Census System for Electronic Governance Applications

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ABSTRACT

Census is the citizen socio-economic data collection process for the preparation of the citizen database. e-Governance refers to the delivery of State and Central Government information and services using Information and Communications Technology (ICT) to citizens, businesses and Government departments. In the paper, Unique Identification based e-Census system is proposed. Based on existing census system in India, various modules of the proposed e-Census system are designed such as online data capturing, integrating census system with Aadhar database, census data monitoring and utilization of online census database for various e-Governance applications. Relevant user interfaces are also designed for the system. The proposed system has many advantages including a dynamic updating of birth and death records, utilization of e-Census data for the next census in addition to reducing the manual intervention. It is demonstrated that e-Census data can be utilized more effectively for various decision-making applications such as opening educational institutions and granting unemployment allowance. This is possible as online census data is linked to Government organizations through web services and all the required data is available online. It is concluded that the online census system not only can replace the manual system but also can allow efficient and effective e-Governance.

KEYWORDS

e-Government, e-Census, e-Governance, UIDOCS, UID

I. INTRODUCTION

Census is an integral part of national governance activity. It is the citizen socio-economic data collection process for preparing the citizen database stored in a document called Population Register (PR). It involves several activities like visiting every house for citizen data collection, a compilation of survey forms at the village, tehsil, district and state level and utilization of census records for national socio-economic policy planning. The census survey forms scanned through scanners and hand-written data from the survey forms are converted into digitized data through Intelligent Character Recognition (ICR) software. The dissemination of the results data is available in an electronic media form (i.e. .pdf and excel format) and printed books. These details are shown in Figure 1. The paper based preparation of Population Register faces various barriers like a time-consuming process, high human resources requirement and limited accessibility of the citizen database for e-Governance applications. The Unique Identification Authority of India (UIDAI) provides 12 digit Unique Identification number (UID) to all residents of India. It is used to eliminate duplicate and fake identities of the citizens. There is a need for developing web based census data collection and utilization of census data for policy planning. In this paper design of a Unique Identification Number based Online Census System (UIDOCS)

for addressing the existing barriers. The UIDOCS system includes automation of census data collection and utilization of census database for e-Governance applications.
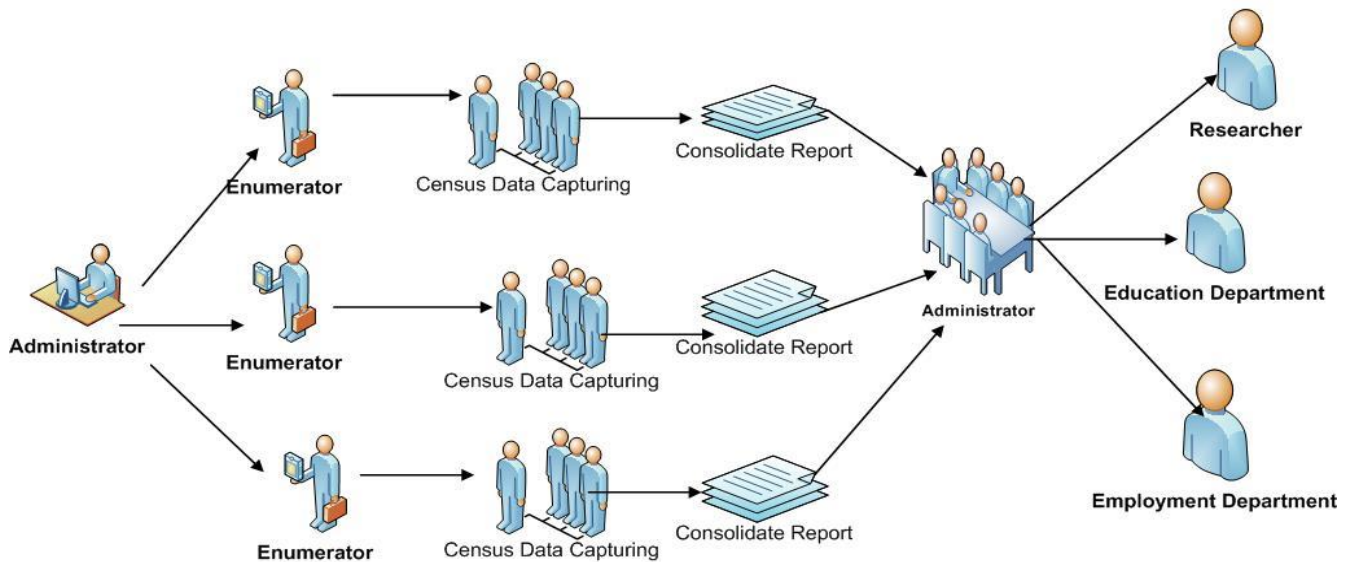

Figure 1: Traditional Census System

The automation of census database includes online census data capturing, citizen existing information fetching from UIDAI database, real time monitoring of census survey and dynamic modification of birth and death records in the census database. The UIDOCS is utilized for decision making applications such as education planning, employment planning, health planning, urban and rural area policy planning etc. In this research, two applications named as unemployment allowance allocation and opening new educational institution requirements analysis have been designed. The online census data analysis techniques, like, roll-up, drill-down and slicing-dicing have been utilized for dimensional modeling of decision making parameters for implementation of job seeker fund allocation and opening new educational institutions requirement analysis.

II. REVIEW of LITERATURE

The review of literature is performed on the e-Governance applications and online census system. e-Governance review is related to e-Governance projects at national and international level. Census review is based on existing and proposed online census systems. In [1], the survey was done on e-Government development status around the 193 United Nations member countries. The authors described the status of countries on e-Government Development Index (EGDI) and Participation of citizens. The EGDI ranked on the three dimensions of e-governance, namely scope and quality of online services, the status of the development of telecommunication infrastructure and inherent human capital. The top five countries in EGDI ranking are Denmark, Australia, Republic of Korea, United Kingdom and Sweden. India is at 96th rank. e-Participation is defined as the process of engaging citizens through ICTs in policy, decision-making, and service design (UNDESA, 2013). The top five countries in e-Participation ranking are Republic of Korea, Denmark, Finland, Netherlands and Japan. India is at 15th rank. The Government of India had started using computerized decision support system in the departments to facilitate planning process since 1975 [2]. In 1976, The

Government of India established National Informatics Centre (NIC) which through its ICT network, National Informatics Centre Network (NICNET) has linked all the departments of the central government, state governments and around 625 district administrations of the country. Chauhan et al. in [3] discussed about the implementation of UID Number project and its utilizations. They mentioned that the UID number system can help people in many ways. Single UID number can serve in driving license number, voter ID card number, registration number in any organization and bank account number etc. Lavadkar et al. in [4] proposed a model for online cashless payment system which is based on Biometrics in Aadhaar Card. Kumar et al. in [5] proposed the Aadhaar biometric database utilizations for tracking criminal and crime investigation. Waziri et al. in [6] proposed an online integrated census information system for Nigeria. There are two modules: the system administration module and the user module. The administrator is the one who has access to choose registration categories such as personal registration, birth registration, death registration, and foreigner registration. While users have access to view his individual records, or edit his details, or even view his Birth Certificate or Death Certificate of his relatives if access granted. In [7], the author precise calculation of population contributes to various aspects of providing facilities to the public. They described that in civil engineering many structures like water treatment plant, sewage treatment plant and storage tanks etc. are dependent upon the future population of the area for a specific period. Patil and Kulkarni in [8] proposed a service-oriented digital government infrastructure which is focused on efficiently providing customized UIDAI database integration with Passport service. Feuerlicht et al. in [9] presented three levels of interoperability as technical, semantic and organisational. The technical level defines standard protocols and data formats. The semantic level is concerned with the exchange of information in an understandable way between administrations. The organisational level refers to enabling processes to co-operate by re-writing rules for how e-Governance applications work internally.

III. DESIGN of UID BASED ONLINE CENSUS SYSTEM (UIDOCS)

UIDOCS system design includes six components, two databases and four types of users who can interact with the system. The six components are Online Census Data Capturing, Integration of Census Database with UIDAI Database, Online Census Survey Monitoring, Online Modification of Birth and Death data in Census Database, Online Census Data Dissemination for next census survey and Utilization of Census Database for Decision Making Applications. Two databases, Census and UIDAI are created and used for data storage. The details of the high level design are shown in Figure 2. The users of UIDOCS system are administrator, enumerator, organisations, and citizens. The administrator is the government representative who has overall control of the system. He can create enumerator login authentication, create organization login authentication, monitoring of the online census database and insert birth data and delete death data in the census database. The enumerator is the government representative who is responsible for census data collection. Census database can be utilized for various purposes like education, old age pension, employment and health related policy planning. The roles and responsibilities of organisation user are to analyze the last census education and job seeker data for taking three levels of decisions as district level, state level, and national level. The roles and responsibilities of citizens are to fetch the existing information from the census database and perform modifications on personal census information. The interaction of census application and UIDAI database is done via UIDAI web service. Census database is the collection of master and transactional tables. The master table is the table where values cannot be changed frequently and it includes state, district, tehsil, village, age group, and religion information. The transactional table stores citizen information and house related socio-economic information. The simulated census database is a collection of 50 tables and 85 stored procedures.
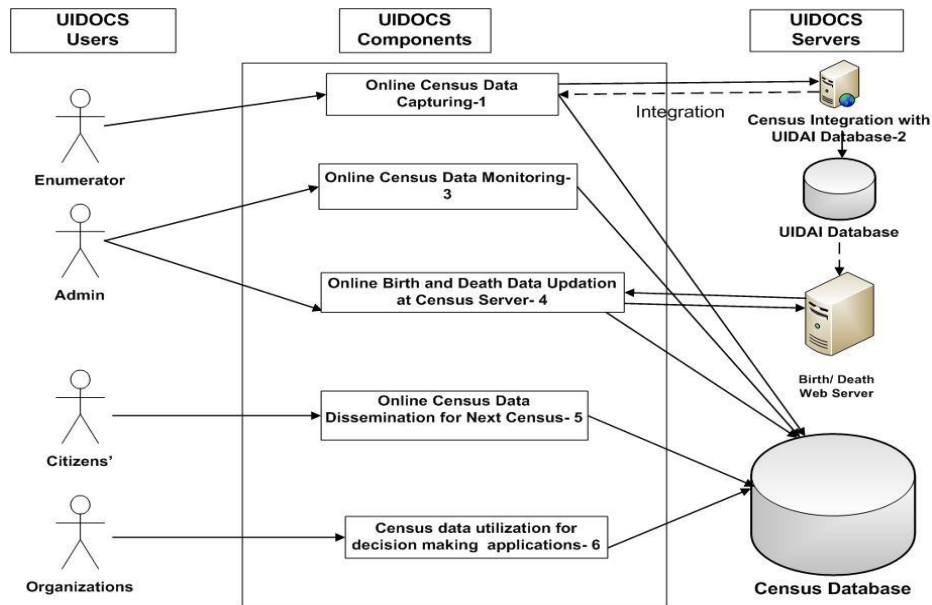
Figure 2: High Level Design of UIDOCS

- **Online Census Data Capturing**

Online census data capturing component is a process of data collection from citizens and stored in the specific database. Census Data modelling is the process of documenting a manual system designed to a diagram. The two census forms namely *houselisting* and *household* with 46 and 53 attributes, respectively in the manual process are converted to four files namely *common data, houselisting, household* and *family member information* with 35, 12, 41 and 41 attributes respectively in the Online Census System. The issues like data redundancy, normalization and integrity are addressed in converting manual census forms to online census forms. Data validation is the inspection of all collected data for completeness, fairness and the elimination of invalid values. After validation of data, it can be transferred to a database for storing values. Two new fields are proposed in online census systems which are UID number and mobile number. UID number is used as a unique key parameter for individual identification in the census database. The design of online census data capturing are shown in Figure 3.
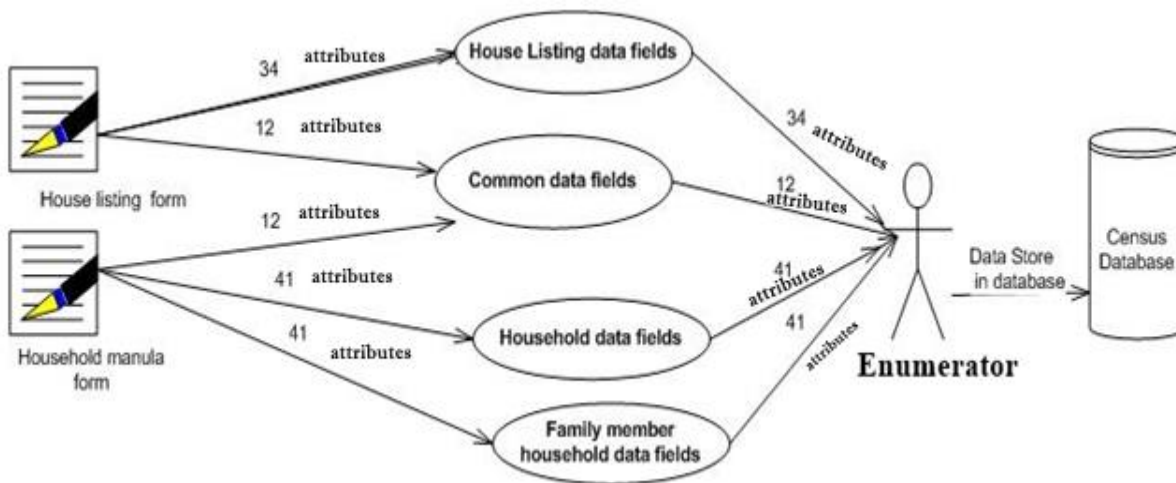

Figure 3: Logical design of online census forms

- **Integration of Online Census Application with UIDAI Database**

The Online Census System is integrated with the UIDAI database for fetching citizen existing information. The Simple Object Access Protocol (SOAP) based *GetUserDetails* web service is used for developing heterogeneous distributed applications that can perform cross-platform and cross-language communications. The integration of the UIDAI database with census web server is shown using the sequence diagram in Figure 4. The UIDAI web server is the web service provider and Census web server is the service consumer. The objective of this incorporation is to retrieve the citizens existing information like name, mobile number, age, gender and postal address from the UIDAI database [3].
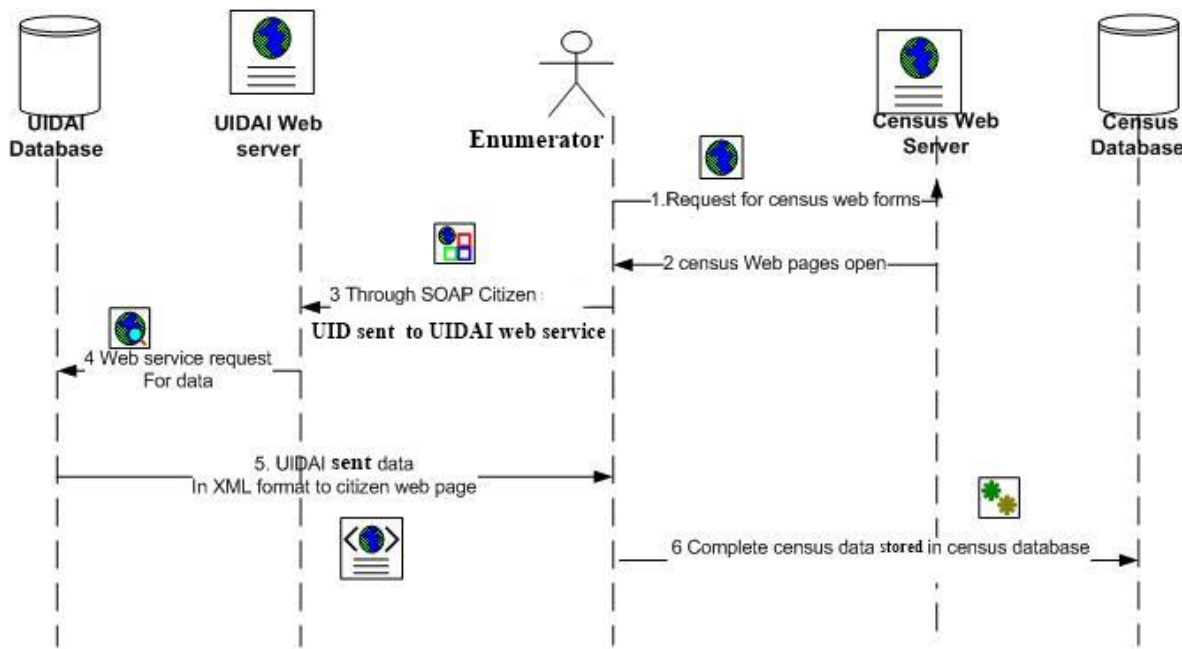

Figure 4: Sequence diagram for integration of UIDAI database with online census system

- **Online Census Survey Monitoring**

The online census survey monitoring is a process to track its progress towards reaching its objectives. The user interface is designed to track the census survey progress from the national level to tehsil level. In this process, administrator is interconnected with online census database server as shown in Figure 5. There are three input variables namely state, district, and tehsil. The data monitoring results are provided in the form of high level to low level for example nation to tehsil level.
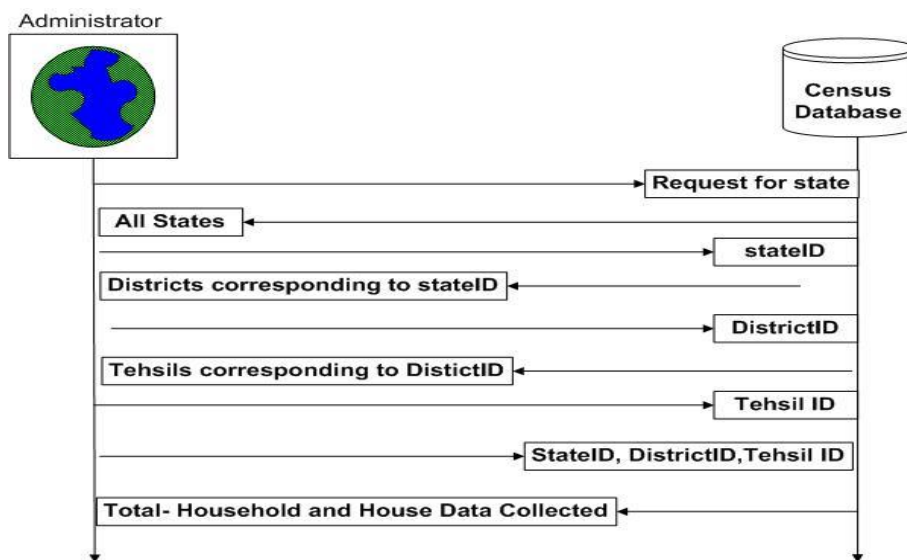
Figure 5: Census Data Monitoring Flow

- **Integration of Census Database with Birth and Death Data Server**

The correct population information of a specific location is very important for policy planning. It requires dynamic modification of census database with birth and death records. The UIDOCS system is designed for automatic modification of birth and death records in the online census database. The birth and death records are also available in the UIDAI database. The new birth records are automatically inserted and death data is marked for deletion data in the census database as shown in Figure 6. In the first phase, User Interface is designed at UIDAI webserver for incorporating birth data and death data at the UIDAI database. In the second phase, the census web server sends a request to UIDAI web server for fetching birth data and death data. The communication between UIDAI and Census system is performed via web service. In the third phase, UIDAI Web Service sends a request to the UIDAI database for fetching new birth data. In fourth, the census web server user interface is designed that inserts birth data and deletes marked death data from the online census database.
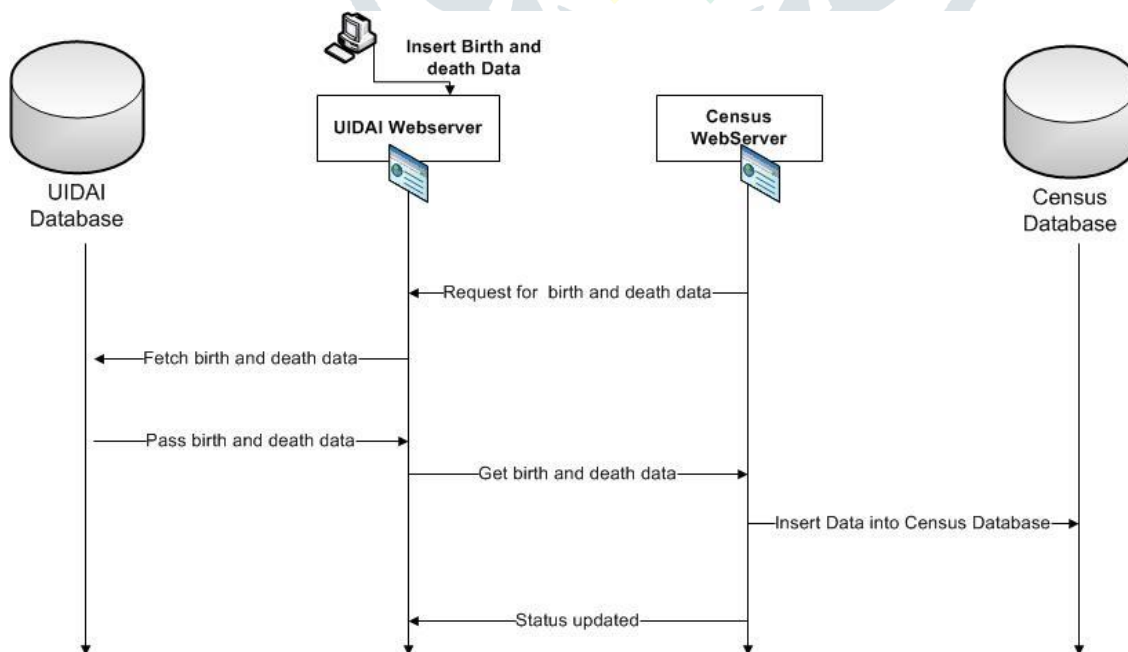

Figure 6: Birth and Death data updation using web services

- **Census Information Acquisition and Dissemination for Next Census**

Once UID based citizen census database is prepared, thereafter in next census, there is no need to enter citizen data again from scratch, only modification of existing data in the database is required. To modify credentials, a citizen has to go through the verification process. One Time Password (OTP) is used by UIDOCS for authentication of users. An OTP is generated using pseudo random number generator, which is then used to generate a unique PIN for each transaction. OTP number is valid for only one login transaction. To authenticate for the census information updation, citizen needs to have an UID number and a mobile number registered with census database.

IV. UTILIZATION of ONLINE CENSUS DATA

The utilization of census database for e-Governance applications are described in detail in this section. It includes citizen census data sharing with e-Governance applications, budget planning **for** unemployment allowance allocation and opening new educational institutions requirement analysis.

- **Unemployment Allowance Allocation Application Development**

To address the issue of poverty, the government plans a basic income scheme or allowance for those who seek an employment. The allowance can vary on the basis of education, gender, age, and location. The planning of job seeker allowance budget is a major decision for the national, state and district level governments. It requires information about a number of job seekers with respect to gender, location, age group, and education. The UIDOCS system provides answers to various queries for unemployment allowance budget planning like number of job seekers, number of literate or illiterate job seekers, number of male or female job seekers and number of young or aged job seekers with respect to state and district.

The detailed design of the unemployment allowance allocation application is described in this section. It takes four input attributes for finding unemployed population correlated with multiple fields such as gender, age group, geographical area, and educational qualification. The online analytical processing of input attributes is presented through dimensional modeling. A data cube named as a job seeker is designed that allows census data to be modeled and viewed in multiple dimensions. The job seeker data cube is a collection of the four dimensional model and fact tables. At the national level, complete data is compiled. At the next level, aggregate data distribution is limited to the state level, next state to the district level, district to tehsil level and last at the village level. The summarized collection of data attributes makes information retrieval more efficient.

The model provides a count to cross classification of dimensions like location, age group, gender, and education status in various dimensions. Dimensions like 0-Dimension (0-D), 1-Dimension (1-D), 2-Dimension (2-D) and 3-Dimension (3-D) are represented in Figure 5.4. The aggregated information of facts can be viewed as the 0-D level which is the top most hierarchical level. The same information can be viewed at a 1-D level in the context of location or age group or gender distribution or literacy level. In 2-D representation, the job seekers are shown with respect to the location (organized as a state, district, tehsil, and village) and gender (organized as male and female) etc. In 3-D representation, the job seekers are shown with respect to the location (organized as a state, district, tehsil, and village), gender (organized as male and female) and age group etc. In 4-D representation, the job seekers are shown with respect to the location (organized as a state, district, tehsil, and village), gender (organized as male and female), age group and education etc. The cuboid that holds the lowest level of summarization is called the base cuboid. The 4-D cuboid in Figure 7 is the base cuboid for the given location, gender, education and age group dimension.
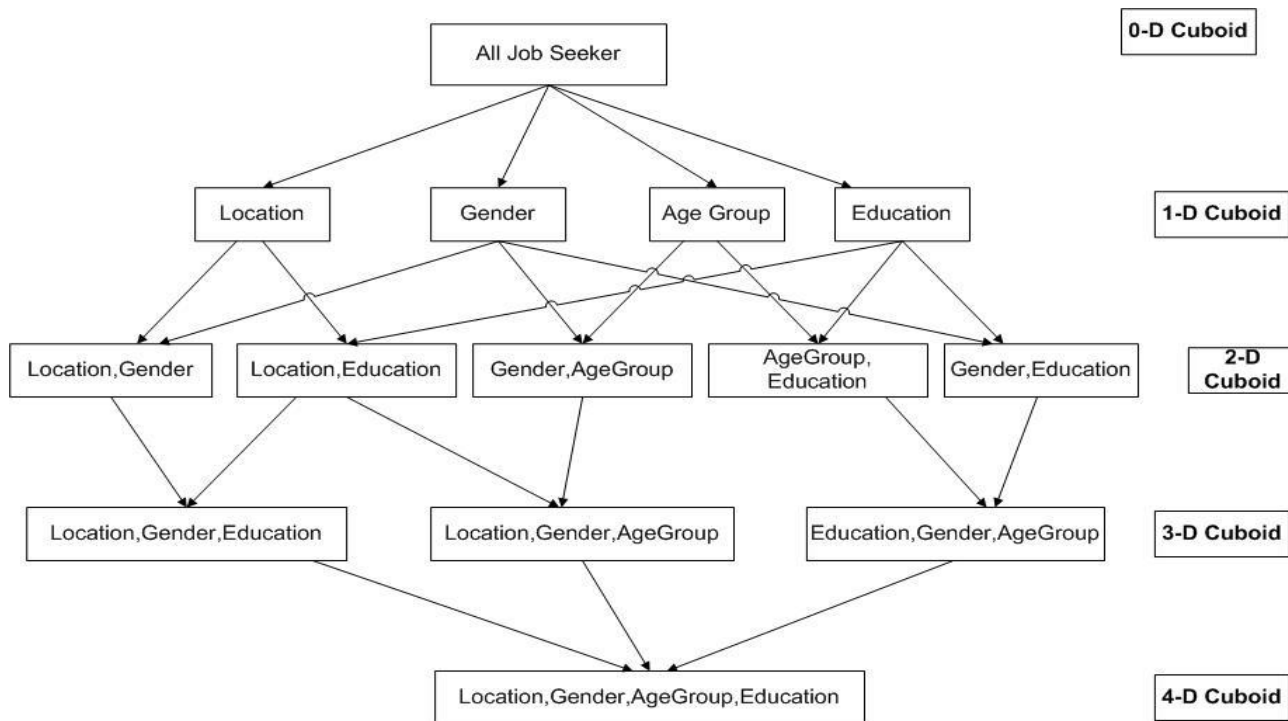
Figure 7: Types of Dimensional Views in the Cube

- **Educational Institution Requirements Analysis**

The opening of the new educational institution requires proper information on the needs of people such as a number of students seeking education at a specific location. A new institution can be opened at a nation level or state level. Analysis based on the census data answers various queries like number of primary passed, number of higher secondary passed, number of graduates, number of above graduates and number of technical diploma holders of a specific location. Further, the need of institutions can be categorized on the basis of the gender data like co-educational college, Boys College and Girls College.

The input attributes are taken for finding literacy correlations among multiple fields like gender, age group of the population, geographical area, literacy status, and educational qualification. In this process, organization is interconnected with online census database server as shown in Figure 8. There are five input variables namely state, district, tehsil, age range, and gender. The education data analysis results are provided in the form of high level to low level for example nation to tehsil level. The Online Analytical Processing (OLAP) is a technique used for answering multidimensional queries very fast. It enables the processing of the voluminous data count in real time.
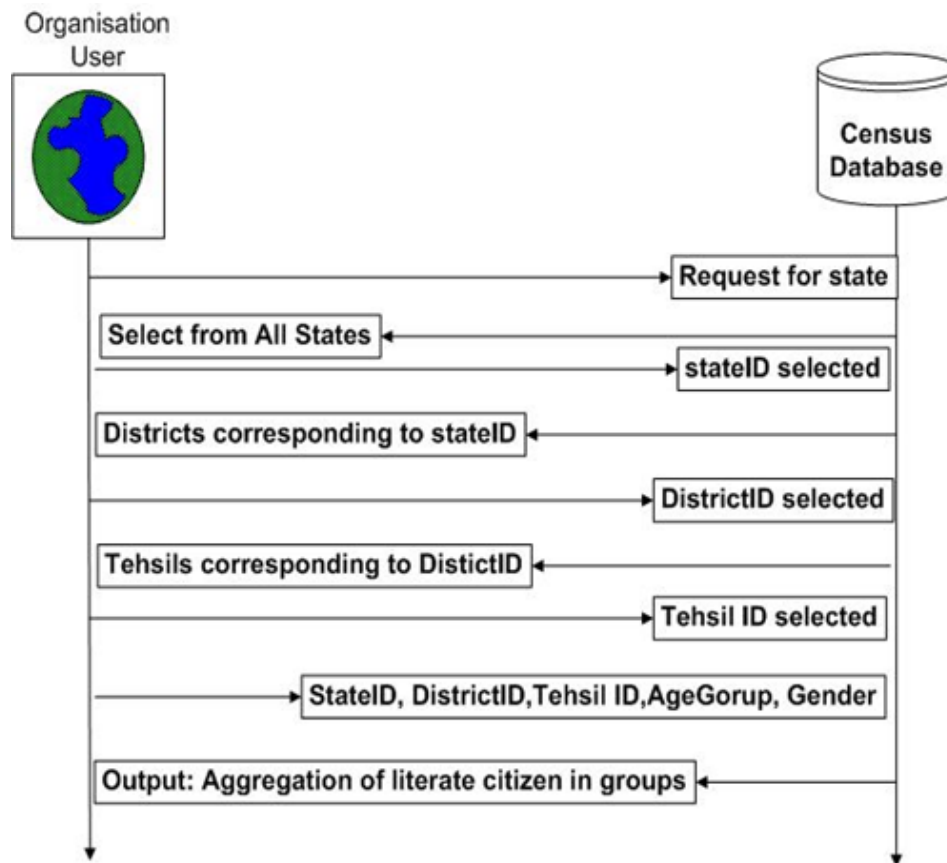
Figure 8: Activity diagram for literacy data analysis

V. IMPLEMENTATION and TESTING

The UIDOCS application and web services are implemented in Visual Studio development platform. Microsoft SQL Server is used as a backend tool for database management. The implementation of UIDOCS system is divided into four parts *DBAWEB, DBABAL, DBADAL* and *DBADataEntities*. It is shown in Figure 9. The *DBAWEB* is a presentation layer, *DBABAL* is a business logic layer. *DBADAL* is a data access layer and *DBADataEntities* is a collection of variables and their data types. Tools used for implementation of these layers are shown in Table 1. The programming of UIDOCS components is done using C# programming language. The integration between the online census system and UIDAI database are designed using web service. The web service is implemented using various protocols such as eXtensible Markup Language (XML) , Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL) and Universal Description, Discovery, and Integration (UDDI). The web interface is implemented in Active Server Pages (ASP) using Hypertext Markup Language (HTML) 5, Cascading Style Sheets (CSS), Java Script and Jquery. Bootstrap is an open source front end library for designing web applications. It contains HTML 5, Java Script and CSS based design templates for forms, buttons, navigation and other interface components design. The UIDOCS system used bootstrap features for implementation of components. HTML5 is a markup language used for structuring and presenting content on the World Wide Web (WWW). The UIDOCS uses CSS style feature to design the separation of document content from document presentation including aspects such as colors, layout, fonts, and style. CSS file reduces complexity isnd repetition in the formatting. A JavaScript (JS) file is used to run client side JavaScript code on a webpage. The JS file named as *ASPSnippets_Pager.min.js* is written as an external file.
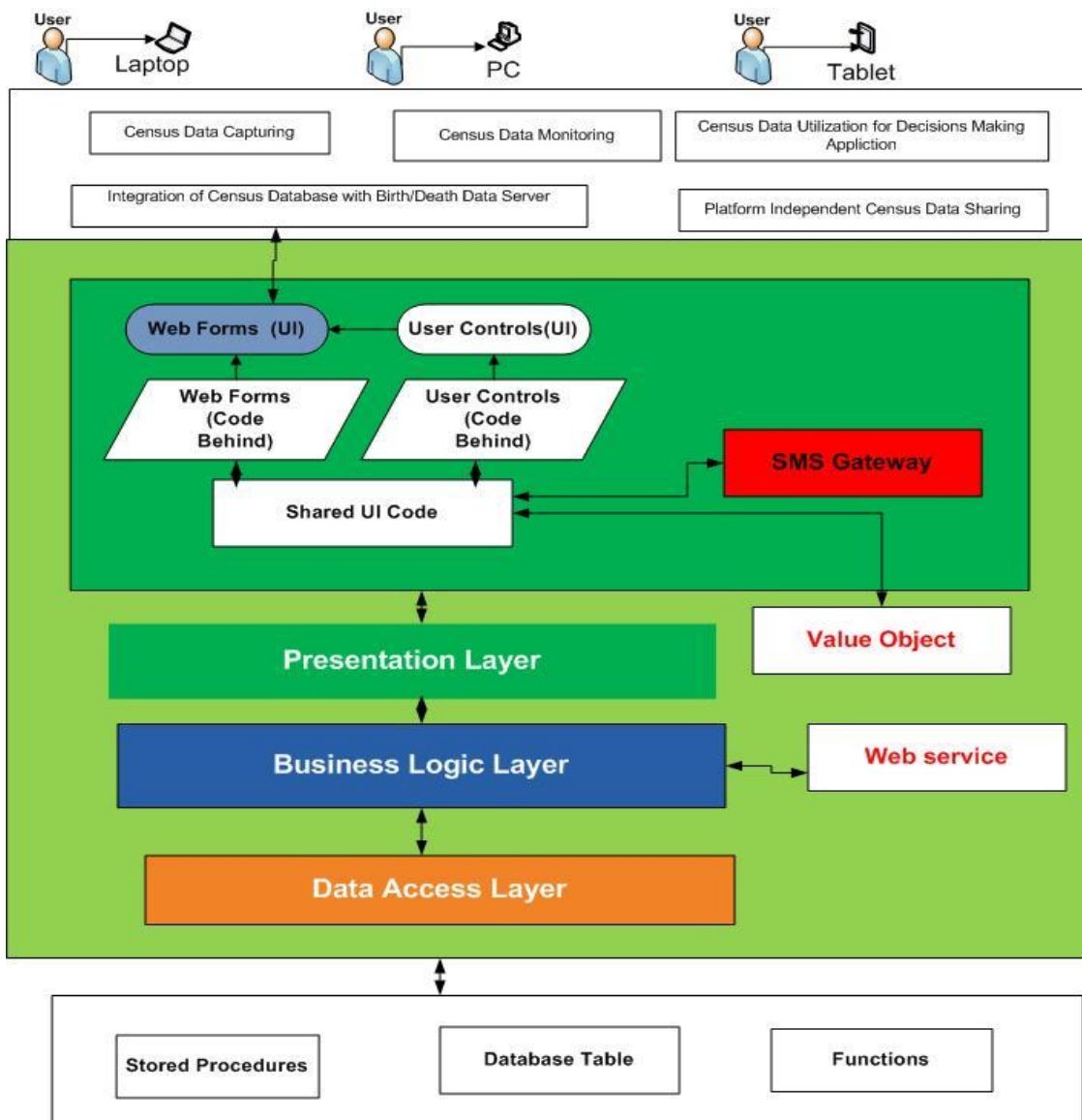
Figure 9: Three Layer Architecture for UIDOCS

The database is implemented in MS SQL Server 2014 express version. The SqlClient drivers are used for connecting application components with database components. Window IIS 7.0 Server is used for deploying UIDOCS system. The development operating system is Windows 10 (64 bit). The hardware configuration of the development platform is Intel Core i3 processor with 4 GB RAM.

Table 1: Tools used for developing the proposed system

Tools	Purpose
Microsoft Visual Studio framework	System Development
Microsoft SQL Server	Database Management
C#	Programming Language
Java Script	Data Validation
Internet Information System (IIS)	Web Server
Windows 10	Operating System
Microsoft Visio	System Modeling

| Browser (Any) | User Interface |
| Cascading Style Sheets (CSS) | Designing Interface |

Testing of UIDOCS system is done to verify the functionalities implemented for the users such as administrator, enumerators, citizens, and organisations. The verification of administrator functioning includes login authentication, create enumerator account, birth/death data modifications and census data monitoring functionality. The verification of enumerator user functioning includes login authentication of the enumerator, census data capturing and integration of census application with UIDAI database for fetching citizen existing information. The verification of organisation users includes testing of education institutions requirement application analysis and job seeker allowance budget planning application analysis. The verification of citizen user functionalities includes One Time Password (OTP) based authentication and dynamic updation of census information.

The verification of UIDOCS user functionalities is tested by collecting last census data from census website and simulating census database. The simulated census database is a collection of 1500 records. The verification of online census data capturing, integration of census database with UIDAI database, online census data monitoring, dynamic modification of birth and death data at census database, platform independent data sharing for e-Governance applications and utilization of census data by organisations for decision making modules have been tested with simulated online census database. The verification of the national, state and district levels literacy and employment data is tested with historical census data.

VI. CONCLUSIONS and SCOPE for FUTURE WORK

The UIDOCS includes automation of census data collection and utilization of census database for e-Governance applications. The proposed system helps is efficient and effective. It can reduce process time in data collection and analysis. It is cost effective as far as storage, retrieval, and handling of paper records are concerned. The digital census record management provides better support for disaster recovery. The proposed system can be operated at any place without any special software installation and with zero client maintenance as long as there is a computer connected to the Internet. There are a lot of benefits of new technologies, but cybercrime overcomes the benefits of digital governance. The proposed system verification through the security rules of Open Web Application Security Project (OWASP) is required to be performed.

Census database decision making functionality can be enhanced by incorporating new decision-making techniques like cluster analysis and regression analysis. The online census system

can be integrated with other departments like health, food supply, and youth welfare etc. census information can be linked with citizen social and economic information like bank account, vehicles, and property etc. This will enable to access citizen socio-economic information in an integrated way. The UIDOCS administrator functionality can be enhanced by designing Enumerator Management system. It can help the administrator to monitor the performance of enumerators.

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