Web Application Development for Water Tax Management: A Case Study of Majgoan Village

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ABSTRACT

At the moment the Water Tax Department of the village of Majgoan is dependent upon the manual methods in attempting to compute tax due which is affected by errors and inefficiencies. The normal technique involves carrying out numerous calculations which are well documented in books which makes it a problem for the officials in terms of documentation and preparation of the monthly reports. Most times this will lead to several mistakes, for instance, wrong classification of tax heads, incorrect rate assessment, and so on, which is very difficult for the Treasurer. To combat these problems, this project intends to create an online platform that assists residents in quickly calculating and managing water tax. The application consists of crucial modules such as User Authentication, Tax system Authentication, Paymentsystem Authorization, Automatic Email Notifications, Reporting and Analysis for managing the application.

The system is proposed using descriptive research design and OOAD, system yet to be implemented using contemporary web programming languages and frameworks to make it robust and flexible. The application does not only assist in ensuring that tax computation is done correctly but also handles recording of documents and investigating any reports with ease. There will be future improvements which include an eye-catching landing page that will ensure the users are kept up to date with the most recent changes regarding the procedures and optimally managing the water tax Blake. By changing the way the Treasurer works, this application aims to foster a more organized and transparent approach to water taxadministration in Majgoan Village.

Keywords— Web Application, Water Tax Management, Tax Calculation, User Authentication

I. INTRODUCTION

In contemporary digital age, there's a developing demand for Computer utilization throughout more than one industries, including administrative and financial management inside government businesses. computers are anticipated to beautify effectiveness and efficiency in work, especially the ones concerning information processing. Computerizing this records significantly advantages numerous agencies, which include colleges, hospitals, and government offices. in addition to laptop technology, a complementary device is needed to report, save, and process this facts successfully. As members of society, people and organizations must fulfil their duty of contributing taxes to the government.

Efficient and effective tax management is a crucial component of financial administration at the village office. Now a day's people in the rural areas have to go to panchayat office in their location to pay water tax. It requiresa lot of time and may result in work delay. The data in the office has to be maintained manually. There is no security for the data and faults can be encountered during entering the data mainly which require higher calculations. The village treasurer's responsibilities as a tax collector involve computing taxes on the acquisitionof commodities. However, the manual process of tax calculations and documentation in books can be burdensome and prone to errors. Examples of potential issues include inaccuracies in inputting product prices, variations in tax kinds, and challenges in reporting to the Village Head.

National Water Policy 2002 has graduated from the National Policy on Water 1987 NPW 2002 envisages that water is the part of larger ecosystem, realizing the importance and the scarcity attached to fresh water it has to

be treated as an essential component for the sustenance of life. The policy recognizes that water is a scarce and precious natural resource and needs to be planned. Thus, it emphasizes developing management strategies for the conservation of water.

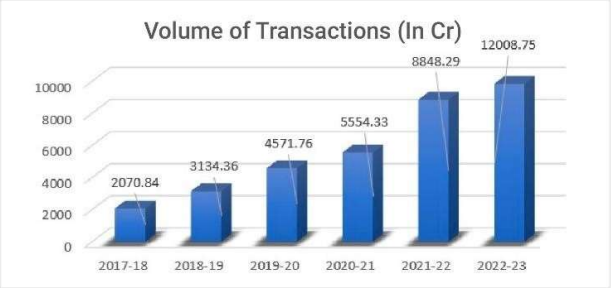
The new rates, after 'due process' of the irrigation department, were imposed through a vide order of the Maharashtra Water Resources Regulatory Authority (MWRRA) dated 29 March 2022. The revised rates fix the bulk water tariff for domestic water use at INR 0.55 per 1,000 litres and INR 2.75 for commercial use. In the rural settings of the state of Maharashtra, water tax charges differ with the existence of a water meter for the household. Villages that do not have meters and utilize a flat-rate system often charge these households a fixed amount per month or year, which may be different between local bodies.

In the case of metered connections, the charges are largely based on the actual water consumption and can also motivate people to use the resource in a more responsible manner. Encouraging villagers to switch to water meters is easy because metered rates are typically lower. Water consumption in the state is monitored and regulated by the Maharashtra Water Resources Regulatory Authority, with new initiatives stressing on water management and equitable distribution even in the remote areas. In order to know the more rates, more standard and detailed rates applicable to Majgoan Village or other rural regions close by, local government or Gram Panchayat sources should be referred to. Integrating technology into the administration and financial management of local offices can provide many benefits. For example, a tax calculator provides a faster and more accurate way to calculate and file taxes. It also has the ability to store information electronically, simplifying the process of searching for and creating information. Most importantly, this program helps the Local Treasurer ensure that all tax requirements are completed quickly and accurately. The program should enhance the accuracy and efficiency of tax administration while enhancing the role of the insurance company as a tax collector. [1] [2]

II. LITERATURE SURVEY

1. Digital Payment Systems for Municipal Services:

The growth of digital ecosystem in India has been driven by a number of factors, including the government's push towards digitalization, an increase in internet and smartphone penetration, and the rise of ecommerce. The Indian government has been actively promoting the use of digital technologies through various initiatives such as Digital India, Make in India, and Startup India. These initiatives aim to increase the use of digital technologies in various sectors. With government's mission to target 2,500 crore digital transactions in 2017-18 Union Budget through UPI, USSD, Aadhar Pay, IMPS and debit cards for promoting digital payment transactions in the country, this has been a significant step towards the government's goal of increasing the use of digital payments and reducing the dependence on cash transactions. Money (BHIM) app, which simplifies the process of making digital transactions. UPI (Unified Payments Interface) has seen significant growth in India since its launch in 2016 by National Payments Corporation of India (NPCI). Here are some highlights of the UPI journey in India with YoY (Year-on-Year) growth statistics till Jan 2023[7]



2. Web-Based Tax Calculation Models:

Resource allocation and revenue generation play significant roles in the management of municipal water taxes. This study explores the shift from traditional modes of tax calculation to modern web-based tax systems, outlining the benefits, algorithms, and relevant case studies.

Traditional vs. Automated Tax Calculation Methods:

This method includes the doing of data entry and calculation manually by municipal staff.

Challenges :

- It is time consuming and susceptible to errors due to the human factor.
- Resident has limited access to information, thus decreasing transparency.
- Tracking data through periods is challenging.
- Excel-Based Systems

This method applies the use of spreadsheets in calculation and record-keeping.Challenges:

- There is the use of manual inputs that will provide wrong information.
- Processing large datasets and complicated calculations will be challenging.
- There are analytical functions and report-generating facilities but limited in use.Automated Web-Based Tax Calculation Methods:

Smart Meter Integration:

Description: This system allows for data collection in an automated manner through smart water metersthat send usage in real time.

Benefits:

- There is accurate and timely billing according to actual consumption.
- Accessibility to data for both the authorities and users is improved.
- Administrative burden is reduced.Tax Calculation Web-Based Systems:

Description: These are centralized websites where the users trace their consumption, calculate taxes to be paid as well as make payments.

Benefits:

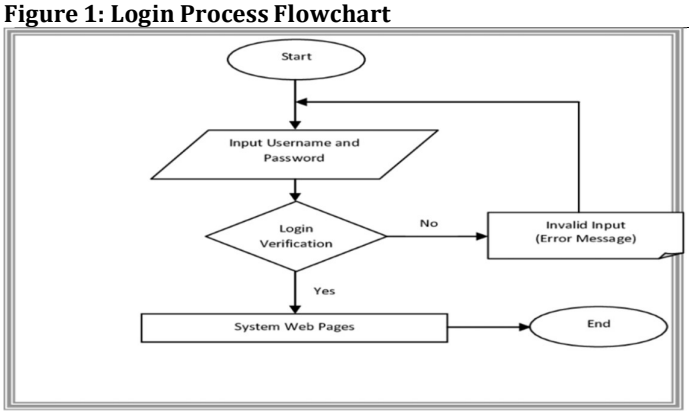
- The interfaces are user friendly. For this reason, they are transparent and accessible.
- It offers real-time data analysis and reporting capabilities.
- Provides Automatic notice of payment and alerts of abnormal consumption patterns.[3]

3. User Authentication and Security in Government Applications:

IT security is an area of research that has received significant interest in the last two decades or so. The main reason for this is the massive growth of the ITsector and the huge role it is increasingly playing in society. Authentication is the assurance that the communicating entity is the one it claims to be. An OTP is one of the most used authentication procedures today. It is randomly generated by secure servers for use by the end user within a specific time slot. If thecode is not used in the specified time slot, then it will expire and become invalid for the user's authentication, which makes the OTP a secure mechanism for verification purposes. Attackers who may want to replicate OTPs will find them useless after a short while (Yeh et al., 2002).

Contrary to traditional forms of authentication that only required a user to access a system using a username and a password, this system can be beneficial if used correctly (IETF, 2005). An OTP can be generated by two methods. The first method involves the use an OTP algorithm, using hash functions and pseudorandom number generators to ensure high-level encryption and also ensure that the guessing of password predictions is extremely difficult, if not impossible. The second method involves using time synchronized systems algorithms, which represents the most popular methods for generating OTPs. In this method, the OTP is created by making use of current timestamps and using the previous password or secret keys (Nag et al., 2014). The most common algorithm, the Time-based OTP (TOTP), makes use of both the current timestamp and a shared secret (often user information such as an ID number or address). A cryptographic hash function is then used to determine. The use of OTPs is essential in the implementation of multi-factor authentication systems. In e-government services, it has been used over the last two decades. However, the most popular means of getting this generated OTP to the user is through use of SMSs. Since most people have access to mobile phones, the use of these phones as a way to access the generated password makes sense.[9]

Figure 1: Login Process Flowchart



III. METHODOLOGY

System Overview :

The developed system consists of three core modules: the Lessee Information Module, the Business Information Module, and the SMS Notification Module. The Lessee Information Module stores lessees' personal details, the Business Information Module manages business-related rent information, and the SMS Notification Module handles SMS notifications. Figure 4 displays the decomposition data flow diagram of the system.

Research Methodology :

To design and implement the water tax management system for Majgoan Village's Water Tax Department, a descriptive research methodology was used. This approach facilitated the gathering of necessary information, which included:

Stakeholder Identification:

Engaging key stakeholders to understand the existing manual tax collection processes.

Data Collection Methods:

- Interviews: Water Tax Department officers and village treasurers were interviewed to gatherinsights on tax calculation, payment collection, and reporting mechanisms.
- Observation: Daily activities of the treasurers were observed to identify issues, such as computation inaccuracies and reporting delays, which informed system requirements.
- Documentation Review: Existing tax records, invoices, and transaction logs were reviewed to guide the database design.

System Development Approach :

An Object-Oriented Analysis and Design (OOAD) methodology was chosen to manage system complexity effectively. OOAD helped break down system requirements into modular components, ensuring maintainability and scalability.

Key Steps in System Development :

- Use Case Identification: Use cases for tax calculation, payment processing, reporting, and user management were defined and mapped to classes (e.g., Tax Calculator, Payment Gateway, User, Admin).
- Class and Sequence Diagrams: Diagrams were developed to illustrate object relationships and information flow.
- Prototyping: An initial prototype with basic user interfaces was developed to validate system

functionality with stakeholders.

- System Architecture
- The system utilizes a Model-View-Controller (MVC) architecture with CodeIgniter as the backend framework. CodeIgniter's lightweight nature, ease of use, and performance capabilities made it a suitable choice for the project.

Back-End Development :

- Programming Language: PHP, leveraging CodeIgniter's MVC framework to maintain a separationbetween application logic (Model), user interface (View), and request handling (Controller).
- Database:
  MySQL database was designed to manage:
  a) User information (authentication details)
  b) Water meter readings
  c) Tax data (rates and consumption details)
  d) Payment histories
  e) Administrative reports

API Integrations:

Integrated with payment gateways for secure online payments.

Front-End Development :

The front end was built with HTML5, CSS3, and JavaScript, focusing on usability and responsive design tosupport various devices.

Ease of Use: Simplified navigation with intuitive layouts for meter readings, tax review, and payments.Responsiveness: Optimized for mobile, tablet, and desktop use, ensuring accessibility.

Development Tools :

- IDE: Visual Studio Code for its PHP and JavaScript support, debugging tools, and Git integration.
- Version Control: Git and GitHub for managing code changes, collaboration, and project versions.
- Testing Framework: PHPUnit for unit testing, ensuring the functionality of tax calculation and payment modules. Integration tests verified system component interactions.
- Deployment: The system was deployed on a LAMP stack (Linux, Apache, MySQL, PHP) for stabilityand scalability.

Database Design :

The MySQL database was structured to support the following entities:

- Users: Details of residents and administrators, including authentication information.
- Water Meter Readings: Monthly consumption data for each household or entity.
- Tax Records: Information on tax rates, calculations, and obligations.
- Transaction History: Records of payments, statuses, and receipts.
- Reports: Automated tax collection and payment reports for administrators.

Security and User Authentication :

To secure user data, the system includes:

- Role-Based Access Control (RBAC): Differentiated access levels for Admin, User, and Treasurerroles.
- Encryption: Sensitive information like passwords is cryptographically secured.
- Secure Payment Processing: Integrated with secure gateways to encrypt transactions, protectingsensitive information.

System Testing :

Multiple testing stages were conducted:

- Unit Testing: Each module was individually tested to ensure functionality.
- System Testing: End-to-end tests ensured smooth module interaction.
- User Acceptance Testing (UAT): Village officials tested the system to confirm usability and functionality alignment with their needs

- **Outcome :**

The final web application automates tax calculation and payment for the Water Tax Department, reducingerrors in tax computation, streamlining reporting, and providing real-time data to administrators while enhancing usability for residents.

IV. PROPOSED METHODOLOGY

This research project aims to develop a web-based application for the Water Tax Department of Majgoan Village, focusing on automating the processes related to tax calculation, payment, and reporting. The proposed methodology consists of the following phases:

Requirements Gathering and Analysis Objective:

Understand the needs of the Water Tax Department and the end-users (residents of the village).Approach:

Conduct interviews with key stakeholders such as the village authorities and tax administrators to gather functional and non-functional requirements.

Analyze existing manual processes for tax calculation, payment, and record-keeping to identify pain pointsand inefficiencies.

Gather requirements for the user interface, security features, and data reporting mechanisms.

Outcome: A clear set of system requirements and user stories that will drive the design and development ofthe application.

System Design Objective:

Develop a blueprint of the system, including architectural design and database schema.Approach:

Use UML diagrams (use case, class, and sequence diagrams) to represent system functionality and interactions between different components.

Design a relational database to store user data, tax records, payment transactions, and meter readings. MySQL will be used as the database management system.

Create a secure user authentication mechanism, ensuring that both users (residents) and administrators have appropriate access to the system.

Outcome: System architecture and database design, with detailed technical specifications.

Technology Stack Selection Objective:

Choose appropriate technologies to implement the proposed system.

Approach:

Frontend: Angular for the dynamic and responsive user interface.

Backend: Java Spring Boot for server-side logic, handling tax calculations, user management, and emailnotifications.

Database: MySQL for structured data storage.

Payment Gateway Integration: Use APIs to integrate a secure payment gateway.

Automated Emails: Use JavaMail API for sending payment confirmations and reminders.

Outcome: A fully defined technology stack that supports the development of the application.

Development and Implementation Objective:

Develop the web application based on the system design and requirements.

Approach:

Module 1: User Authentication—Implement user registration and login, with secure password storage using hashing.

Module 2: Tax Calculation—Develop algorithms to calculate water tax based on usage, rates, and penaltiesfor late payments.

Module 3: Payment System—Integrate payment gateways to allow users to pay taxes online.

Module 4: Email Notifications—Automatically send email confirmations and reminders for upcoming or missed payments.

Module 5: Reporting for Admin—Create a dashboard with analytical tools to monitor tax collections, overdue payments, and meter readings.

Outcome: A working prototype of the web application with all essential features to be implemented.

Testing and Validation Objective:

Ensure that the system functions correctly and meets user expectations.

Approach:

Unit Testing: Test individual components such as the tax calculation algorithm and payment processing.

Integration Testing: Verify the interaction between modules, including authentication, tax calculation, and payment systems.

User Acceptance Testing (UAT): Have stakeholders (village authorities and select users) test the applicationand provide feedback on usability and functionality.

Outcome: A thoroughly tested application, free of major bugs and meeting the functional and non-functional requirements.

Deployment and Maintenance Objective:

Deploy the system for use by the Water Tax Department and ensure its ongoing maintenance.Approach:

Deploy the application on a cloud server (e.g., AWS or Heroku) for scalability and remote access.

Set up a regular maintenance and update schedule to ensure the system continues to function smoothly and adapts to new requirements.

Outcome: A live web application used by the Water Tax Department of Majgoan Village.

Documentation and Reporting Objective:

Document the development process, system features, and user manuals.Approach:

Create detailed user manuals for administrators and residents, explaining how to use the system.

Prepare technical documentation for future developers, outlining the system architecture, database schema, and key code components.

Outcome: Comprehensive documentation for end-users and developers. [5]

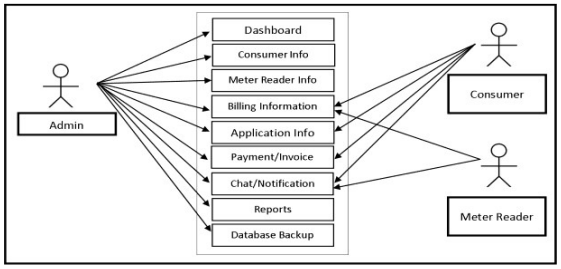


Figure 2: Use Case Diagram for Water Tax Management System

V. CONCLUSION

In conclusion, the development of the web application for the Water Tax Department of Majgoan Village will be a significant step towards streamlining tax management processes, improving transparency, and enhancing user experience. The project will address the needs of all stakeholders, including the Admin, Authority, and Citizens, by providing specific functionalities and tools tailored to their roles and requirements.

The web application will include features such as data entry, tax calculation, expense management, and reporting, which will simplify the tasks of the Admin and Authority, enabling them to efficiently manage tax-related activities and ensure accountability. For citizens, the user-friendly interface and convenient registration and payment processes will empower them to access and understand their tax information, make payments through the app, and view detailed reports with ease.

Once implemented successfully, the web application is expected to bring numerous benefits to the Water Tax Department and the community. It will improve the accuracy and efficiency of tax management processes, reduce paperwork, and enhance data security, thereby making the overall system more reliable and user-centric.

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