

DESIGN AND DEVELOPMENT OF AN ONLINE SYSTEM FOR ISSUANCE OF CASTE AND OTHER CERTIFICATES BY REVENUE DEPARTMENT

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Abstract: Certificates such as caste, income and domicile certificates issued by the Revenue Department are required by citizens to access reservation, scholarships, employment reservation and other welfare schemes. In many parts of India, however, the process of obtaining these certificates is still largely manual, requiring repeated visits to government offices and giving the applicant little information about the status of an application. This paper presents the design and development of an online system for the issuance of caste and other certificates by the Revenue Department. The proposed system supports role-based access for four types of users, namely the applicant, the clerk, the revenue officer and the administrator, and it automates the complete life cycle of a certificate application, from submission and document upload through multi-level verification and approval to the generation of a verifiable PDF certificate. The system records every change of status together with the reason and the responsible official, sends an email notification to the applicant at each stage, and allows any person to verify an issued certificate using its certificate number. The system was developed using Java, Spring Boot and MySQL and was evaluated through functional testing and a small user study conducted with sample data. The results indicate that the proposed workflow reduces the number of steps required from the applicant and makes the status of an application visible at every stage, addressing the delay, lack of transparency and repeated office visits reported in the existing literature on caste certification in India.

Keywords: E-Governance, Caste Certificate, Online Certificate Issuance, Revenue Department, Role-based Workflow, Application Tracking.

I. INTRODUCTION

E-governance refers to the use of information and communication technology by government agencies to deliver services to citizens, improve administrative efficiency and increase transparency [3], [4]. In India, this effort took a formal shape with the National e-Governance Plan of 2006 and the Digital India programme of 2015, which together cover mission-mode projects such as e-District, delivering services including birth, death and caste certificates through digital channels [4]. Certificates issued by the Revenue Department, in particular caste, income and domicile certificates, occupy a central place in this system because they are the documentary proof of eligibility for reservation in education and employment, scholarships and other welfare schemes [8].

Despite these initiatives, the process of obtaining a caste certificate remains difficult for a large section of applicants. Ashwinjit Singh [8] describes how an applicant must submit an application together with several supporting documents, such as a ration card, a school leaving certificate and the parents' community certificates, to the Taluk office, where it is scrutinised by caseworkers and forwarded to a revenue official before the certificate is issued. Many of these documents are hard to obtain, and delays at the verification stage have in some cases required intervention by the courts. Related studies of government certificate systems also report repeated visits to offices, missing documents and the absence of any facility for the applicant to check the status of a pending application [5], [7].

Reusing existing citizen data and automating the verification workflow have both been proposed as ways of reducing this burden. Dutta et al. [1], for instance, showed that census data linked to a unique identification number can be reused across e-Governance applications, including the issue of caste and rural area certificates, to avoid repeated data entry. The present work builds on this general direction and focuses specifically on the workflow of caste and other certificate issuance by the Revenue Department, which is described further in the next section.

II. RESEARCH PROBLEM

Although several systems related to certificate issuance have been reported in the literature, none of them fully addresses the problem of caste certification by the Revenue Department in a tested form. Albar and Perdana [2] developed a system that generates a digital certificate and a verification QR code, but it does not include any approval workflow, so it cannot represent the multi-level scrutiny that a caste certificate requires. Nalwade et al. [7] proposed a general government document portal with an agent-based verification step, but the system was reported as incomplete, and no test results were given. Bari et al. [5] and Anupama et al. [6] are closer to the present problem, since both propose role-based certificate issuance workflows for the Revenue Department, but the evaluation of [5] is limited to a simulated load test and fifty sample applications, and [6] reports no measured results at all. At the same time, Ashwinjit Singh [8] gives a detailed account of the real difficulties applicants face, such as hard-to-obtain documents and delay at the scrutiny stage, but this work analyses policy and does not propose or build a system. This gap between the description of the problem and a complete, tested solution is the problem addressed by the present study.

The objective of this study is therefore fourfold. First, to study the existing manual process of issuing caste and other certificates together with the related systems reported in the literature. Second, to design a role-based online workflow with distinct stages for application, verification, approval and certificate issue. Third, to develop the system with facilities for real-time status tracking, email notification and public certificate verification. Fourth, to test the developed system through a set of functional test cases and to evaluate it with a small group of users.

The scope of the present work is limited to the online application, verification, approval and issue of a certificate using sample data. Integration with Aadhaar, DigiLocker or the state government's own certificate portal, the separate caste validity process conducted by a Scrutiny Committee, and deployment in an actual Revenue Department office are outside the scope of this study and are identified as directions for future work in the concluding section.

III. REVIEW OF LITERATURE

Dutta et al., in (ACM ICEGOV 2017) [1], discussed the difficulties of the paper-based census process in India, including the heavy requirement of manpower, long processing time and the limited availability of citizen data for e-Governance services. They proposed a UID based Online Census System with three modules for the administrator, the enumerator and the citizen, and used One Time Password based authentication for citizens. They presented a Service Oriented Architecture built on SOAP web services, in which a service provider, a service broker and service consumers share citizen data, and implemented a prototype in ASP.NET Core with C# and SQL Server Express. The system was piloted with caste certificate and rural area certificate windows, where the citizen's name, age, category and address were fetched automatically using only the twelve-digit UID number. The authors concluded that reusing census data in this way avoids data redundancy and saves processing time across departments.

Albar and Perdana, in (IOP Conference Series 2021) [2], developed a website-based digital certificate issuance information system using the Laravel framework. They described a three-step workflow consisting of uploading a certificate template, importing a dataset and generating a PDF certificate together with a QR code for verifying its authenticity, and they measured the system's performance using Google Lighthouse, obtaining an average score above seventy. They stated that the system is more efficient than manual certificate creation and reduces paper usage, but they also noted that the work covers only certificate generation and QR-based verification, and recommended studying blockchain technology for stronger security in future work.

Aman Singh, in (Vidya – A Journal of Gujarat University 2023) [3], presented a qualitative study of e-governance covering its concept, significance, prerequisites, initiatives and challenges, and reviewed Indian initiatives such as Digital India, e-District, DigiLocker, UMANG, MyGov and Direct Benefit Transfer using data from the United Nations E-Government Survey of 2022. The author stated that e-governance reduces paperwork, corruption and the number of visits citizens must make to government offices, and identified challenges such as a shortage of skilled staff, weak interoperability between departments, data security and privacy risks, resistance from the bureaucracy, and the digital divide. He suggested awareness campaigns conducted in local languages, staff training and citizen-centric process re-engineering as ways of addressing these challenges.

Khan and Haider, in (IJRTI 2025) [4], presented a conceptual overview of e-governance in India, tracing its growth from the National Informatics Centre of 1976 and the E-Governance Action Plan of 1999 through the National e-Governance Plan of 2006 to the Digital India programme of 2015. They explained the Government-to-Citizen, Government-to-Business, Government-to-Government and Government-to-Employee models and discussed three case

studies, namely Aadhaar, e-District and M-Governance. They stated that the e-District project delivers certificates such as caste, birth and death certificates online, and identified the digital divide, cybersecurity, infrastructure and resistance to change as the main obstacles, concluding that artificial intelligence, blockchain and the Internet of Things will shape the future of e-governance while data protection and social inclusion remain priorities.

Bari et al., in (IJERT 2025) [5], developed a web application for the online issuance of caste, income, domicile and other certificates by the Revenue Department, built using React.js and Tailwind CSS on the front end, Node.js with Express.js on the back end, and MongoDB for storage. They implemented role-based access control for four actors, namely the applicant, the clerk, the staff and the sub-divisional officer, together with a first-in-first-out queue for applications and SHA-256 hash-based certificate verification, and integrated email and SMS notifications using SendGrid and Twilio. They reported that the turnaround time fell from fifteen to twenty-one days in the manual process to two to five days in the digital workflow, based on a simulated load test and a user acceptance test conducted with fifty sample applications, and observed that many existing solutions depend on a centralised database and remain vulnerable to data manipulation.

Anupama et al., in (JSETMS 2026) [6], proposed a multi-authority e-governance framework for automated certificate issuance and verification built using Django, MySQL and SMTP-based email services. The framework supports four roles, namely the user, the hospital official, the revenue officer and the administrator, and routes birth and death certificates to hospital officials and income and community certificates to revenue officers. The system prevents duplicate applications, lets users track the status of their application, and allows certificate download only after One Time Password validation sent to the user's registered email, while keeping audit trails of approvals and uploads. The authors concluded that the model improves transparency, efficiency and accessibility compared with manual processes, although they did not report quantitative performance results.

Nalwade et al., in (IJASRET 2020) [7], developed a government document processing system, a web portal covering services such as the PAN card, Udyog Aadhaar and driving licence. They designed four roles, namely the administrator, who creates departments and services, the service department, which creates agents, the agent, who verifies documents, changes the application status and uploads the final document, and the end user, who applies for and downloads the document. The system was built using PHP, MySQL and Bootstrap, and the authors stated that it reduces paperwork and saves the applicant's time, while noting that the remaining modules and the test cases for the system were still to be completed at the time of writing.

Ashwinjit Singh, in (IJSSER 2018) [8], presented an analysis of the efficacy of caste certification in India and the obstacles present in the process. The author described how an applicant submits an application with details such as name, father's or husband's name, address, ration card number, school leaving certificate and the parents' community certificates to the Taluk office, where it is scrutinised by caseworkers and forwarded to a revenue official before the certificate is issued. He stated that these documents are often difficult for applicants to obtain, that several states, including Tamil Nadu, Kerala and Maharashtra, have started to facilitate the process online, though this still assumes access to technology, and that delays at the scrutiny stage have in some cases required the intervention of the courts. He recommended easing the certification process so that the reservation policy reaches the applicants who need it most.

Table 1: Comparison of the reviewed studies

Ref.	Focus	Technology	Limitation
[1]	UID-based online census and data sharing; pilot with caste and rural area certificate windows	SOAP web services, ASP.NET Core, SQL Server	Focus on data sharing; no certificate approval workflow
[2]	Digital certificate generation with QR code verification	Laravel	No approval workflow; only generation and QR verification
[3]	Concept, initiatives and challenges of e-governance	Conceptual study	No working system presented
[4]	Overview of e-governance in India, including Aadhaar and e-District	Conceptual study	No working system presented

Ref.	Focus	Technology	Limitation
[5]	Certificate issuance by the Revenue Department with roles, queue and hash verification	React.js, Node.js, Express.js, MongoDB	Results from a simulated load test and fifty sample applications only
[6]	Multi-authority framework with OTP-protected download	Django, MySQL, SMTP	No measured results reported
[7]	General government document portal with four roles	PHP, MySQL, Bootstrap	Reported as incomplete; no test cases given
[8]	Analysis of the caste certification process and its obstacles	Policy study	Analyses the problem but does not build a system

The above review of the state of the art describes several methodologies proposed by existing researchers for the online issuance of certificates. Most of the systems reviewed use a role-based workflow with a database back end, and a few use a hash code or a QR code for verification. Even so, a few gaps remain in these systems. General e-governance studies [3], [4] do not present a working system, certificate generation tools [2] omit the approval workflow, a general document portal [7] is not specific to caste certification and was left untested, and the two systems closest to the present problem [5], [6] were evaluated only through simulation or were not evaluated at all. There is accordingly a need for a simple, practical online system for the Revenue Department that combines multi-level verification, real-time status tracking, email notification and easy certificate verification, and that is tested with real users, which is the objective of the present work.

IV. MATERIALS AND METHODS

This study follows a design-and-development approach, in which a web-based system was designed, built and then tested with users. The work was carried out in four stages, namely requirement analysis, system design, implementation, and testing and evaluation, following an incremental model in which the login module was built first, followed by the application, verification and certificate modules, so that each module could be tested before the next was started.

Requirement Analysis:

The requirements for the system were collected in two ways. First, the existing caste certificate process was studied from the literature, in particular the description given by Ashwinjit Singh [8] of the documents required and the scrutiny carried out by caseworkers and the revenue official before a certificate is issued. Second, the workflow of the reviewed systems [5], [6], [7] and [10] was compared to identify the roles and the features needed for the proposed system. The problems identified from this analysis were repeated visits to the office, the absence of any facility to see the status of a pending application, delay at the verification stage, and duplicate applications for the same certificate. The requirements derived from these problems include applicant registration and login, an online application with document upload, verification and approval by different officials, application status tracking, an email notification on every status change, and certificate generation as a PDF that can be verified publicly using its certificate number.

System Design:

Following the role-based workflow used in [5] and [6], the proposed system defines four roles, namely the applicant, the clerk, who checks that the submitted documents are complete, the revenue officer, who verifies the details in the application, and the administrator, who gives the final approval and issues the certificate. Each role is given access only to its own dashboard. In the workflow, the applicant submits the form and the required documents, after which the clerk checks them and either marks the application as verified or returns it to the applicant. A verified application is then checked by the revenue officer, who either recommends or rejects it, and a recommended application is finally approved by the administrator, at which point the certificate is generated. A reason must be entered by the official whenever an application is returned or rejected, and this reason is shown to the applicant. Applications are handled in the order in which they were submitted. The complete workflow is shown in Figure 1.

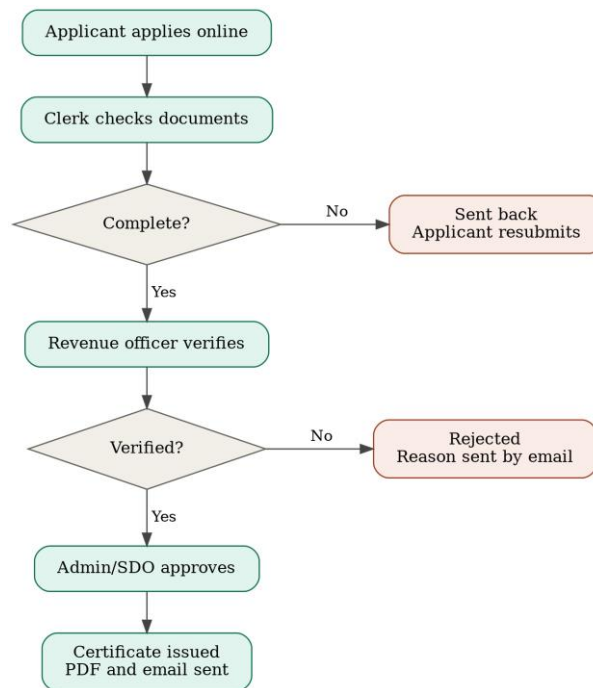


Figure 1: Proposed system design

Module Description:

The system is organised into four modules that correspond to the four roles described above. The applicant module allows a citizen to register, log in, fill in the certificate application form, upload supporting documents, monitor the status of a submitted application and download the certificate once it has been approved. The clerk module presents the clerk with a list of pending applications ordered by submission time and allows the clerk to check the completeness of the uploaded documents before forwarding an application for verification. The revenue officer module allows the officer to examine an application together with its documents and to record a recommendation or a rejection, with a reason required in either case. The administrator module allows the final approval of a recommended application, the generation of the PDF certificate, and the creation of a record in the Certificates table that can later be queried through the public verification page. Each module interacts with the same underlying database, so that a change made in one module, such as a status update by the clerk, is immediately reflected in the dashboards of the other roles and in the applicant's tracking page.

Database Design:

The database supporting the system consists of five main tables, namely Users, Applications, Documents, Certificates and Status History, together with the relationships between them, as shown in Figure 2. The Users table stores one row for every applicant, clerk, revenue officer and administrator, distinguished by a role field, so that a single authentication mechanism serves all four modules. Every application is linked to exactly one applicant and may have several associated documents, but at most one certificate, since a certificate is created only after the application has been approved. The Status History table records the user who changed a status, the time of the change and the reason given, and it serves as the audit trail for the system, so that both the applicant and the administrator can see why an application was returned or rejected at any stage.

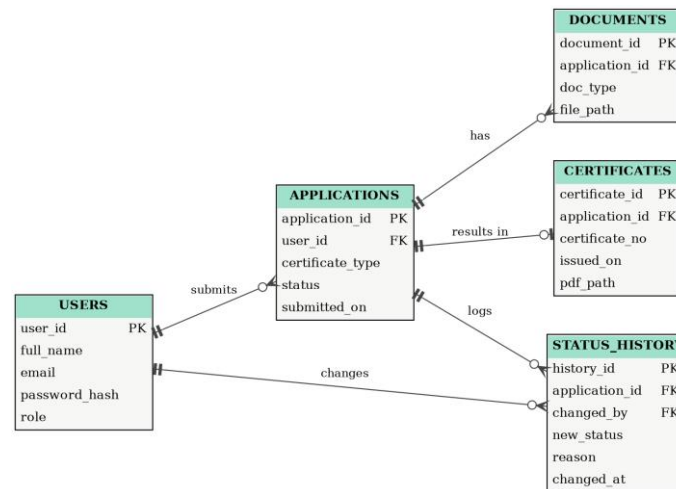


Figure 2: Entity relationship diagram of the proposed system

Tools and Technologies:

The system was implemented using Java and Spring Boot for the back end and MySQL as the database, with HTML, CSS, JavaScript and Bootstrap used for the front end. Email notification was implemented using the JavaMail API over SMTP, and the PDF certificate was generated using the iText library. These technologies were selected due to Spring Boot's enterprise-grade security and modular architecture, MySQL's robust relational data integrity, and iText's efficient PDF generation capabilities.

User passwords are stored only in hashed form using the BCrypt algorithm, and role-based access control prevents a user of one role from opening the pages belonging to another role[9]. Uploaded files are restricted to a fixed set of allowed types, such as PDF, JPG and PNG, and to a maximum file size, and every change of application status is logged in the Status History table as described above.

Testing Methodology:

The system was tested at three levels. Functional testing checked each module against a table of test cases covering registration, login, the application form, document upload, verification, approval, tracking, notification and public certificate verification. Role testing separately checked that each type of user could see only the pages permitted for that role. Finally, the system was evaluated by a small group of participants, each of whom applied for a certificate or acted as a verifier, and the time taken to complete each task and the participants' responses to a short questionnaire were recorded.

V. RESULTS AND DISCUSSION

The proposed system was implemented as a web application with four roles, providing screens for registration and login, the certificate application form with document upload, the verifier dashboard showing pending applications, the administrator's approval screen, the applicant's tracking page showing the history of status changes, the email notification sent at each stage, the generated PDF certificate, and a public page for verifying a certificate using its certificate number. All screens were tested using sample data only, and no real citizen records, Aadhaar numbers or caste documents were used at any stage of development or testing.

Functional testing was carried out using 32 test cases covering the modules described in the previous section. A summary of the testing outcome is given in Table 2. Of the test cases executed, 27 passed on the first attempt and the remaining 5 failed initially; the failures observed were minor file-size validation errors during PDF uploads, email notification delays over SMTP, and session timeout mismatches and were corrected by increasing the server file upload threshold to 5MB, adjusting the JavaMail async pool, and updating Spring Security session policies. The two test cases checking that one applicant cannot open another applicant's application, and that an applicant cannot open an administrator page directly through its URL, were given particular attention, since these checks are often overlooked in similar systems.

Table 2: Summary of functional testing

Module	Test cases executed	Passed	Failed and fixed
Registration and login	6	5	1
Application form and upload	10	8	2
Verification and approval	9	8	1
Tracking, notification and public verification	5	4	1
Security (role and access control)	2	2	0
Total	32	27	5

The system was evaluated by 10 participants, comprising administrative staff and student users, who applied for a certificate and processed applications as verifiers using sample data. Table 3 summarises the measures recorded during this evaluation, along with the average scores given by participants in a short questionnaire using a five-point scale, where one indicates strong disagreement and five indicates strong agreement.

Table 3: User evaluation results

Measure	Result
Average time to complete an application	4.5 minutes
Average time for a verifier to process one application	2.1 minutes
Tasks completed without help	46 out of 50
Average score – the application form was easy to fill in	4.6 / 5
Average score – the status of the application was clear	4.8 / 5
Average score – overall satisfaction with the system	4.5 / 5

The problems reported in the literature for the manual process were repeated office visits, an unclear application status and delay at the verification stage [8]. In the proposed system, the applicant submits the application and all supporting documents online and can see each status change together with its reason on the tracking page, and the time recorded during testing for completing an application was 4.5 minutes. This measurement reflects the steps carried out within the software only and does not measure how quickly officials in a real office would act on an application, which remains a subject for further study. Compared with the related systems reviewed earlier, the proposed system resembles [5] and [6] in its use of role-based verification and email notification, but unlike [2] it includes a complete approval workflow rather than certificate generation alone, and unlike [7] it includes caste-specific steps such as a returned application with a recorded reason, together with a full set of test cases and a user evaluation. The turnaround time reported in [5] was obtained through simulation of a much larger load and is therefore not directly compared with the results of the present study.

An additional observation from the evaluation concerns the two roles that carry out verification before the final approval. Separating the clerk's completeness check from the revenue officer's detailed verification, rather than combining them into a single step as in [6], made it possible to return an incomplete application quickly without involving the revenue officer at all, which is consistent with the recommendation in [8] that document-related obstacles should be resolved as early as possible in the process. At the same time, this separation adds one more dashboard and one more set of test cases to the system, and a simpler deployment with only one verification role remains a reasonable alternative when development time is limited.

VI. CONCLUSION

This study presented the design and development of an online system for the issuance of caste and other certificates by the Revenue Department. The review of the literature showed that existing work either describes e-governance in

general terms [3], [4], addresses only one part of the certificate issuance process, such as certificate generation [2], or reports evaluation that is limited to simulation or is not reported at all [5], [6], [7], while the real difficulties faced by applicants, namely hard-to-obtain documents, repeated office visits and delay at the verification stage, are described in the literature [8] but not addressed together in a tested system. To close this gap, a role-based system was designed and developed with four roles, namely the applicant, the clerk, the revenue officer and the administrator, providing an online application with document upload, a step-by-step verification and approval workflow, status tracking with a recorded reason for every decision, email notification, and a PDF certificate that can be verified publicly using its certificate number. Testing with 32 functional test cases and an evaluation with 10 participants indicated that the system reduces the number of steps required from the applicant and keeps the status of an application visible at every stage, although the findings are limited by the small number of participants and by the use of sample rather than real citizen data. Future work includes integrating the system with Aadhaar and DigiLocker to reduce duplicate data entry, incorporating the separate caste validity process carried out by a Scrutiny Committee, adding SMS notification and a digital signature for the issuing officer, and deploying the system as a pilot in an actual Revenue Department office to measure its performance against the existing manual process.

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