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Smart City Issue Reporting Portal (CityPluse)

Pooja Gavhane[1], Om Sugandhi[2], Sparshika Wagdarkar[3], Nidhi Sontakke[4], Atharv Sonawane[5], Soham Sondkar[6]
[1]Associate Professor, Dept. of DESH, Vishwakarma Institute of Technology, Pune, Maharashtra, India,
[2,3,4,5,6]UG Scholar, Dept. of Information Technology, Vishwakarma Institute of Technology, Pune, Maharashtra, India
Emails: *pooja.gavhane@vit.edu[1], om.1251130023@vit.edu[2], sparshika.1251130200@vit.edu[3], nidhi.1251130512@vit.edu[4], soham.1251130451@vit.edu[5], atharv.1251130321@vit.edu[6]*

Abstract
CityPluse is a web-based smart city issue reporting platform that aims at bridging the communication gap between citizens and municipal authorities by allowing real-time issue reporting and tracking of civic issues such as garbage accumulation, streetlight issues, potholes, water supply problems, and electricity issues. The system takes advantage of modern web technologies such as the usage of the latest versions of web technologies (i.e. HTML5, CSS3, JavaScript, Google Maps API for geolocation and mapping, and services of the cloud vendor with a managed, Network Database and Authentication, and cloud storage, such as Cloud Datastore). Citizens can submit the problem along with photo evidence and precise locations on GPS, and the administrators have the ability to efficiently trace, update and resolve the complaints using a secure admin panel. The platform includes a gamified points system to encourage citizen participation and active participation as users gain badges and recognition for genuine reporting. Real-time analytics and data visualization features give insights into the distribution of issues on categories and locations, which enables authorities to prioritize resources effectively. The system represents practical implementation of cloud computing, responsive web design, and geographic information systems contributing to the development of smart cities in terms of promoting both transparent governance and participatory urban management with digital transformation.

Keywords: *Civic Engagement, Cloud Computing, Firebase, Geolocation Services, Google Maps API*

1. Introduction
Increasing urban population in developing countries has been unprecedented putting extreme pressure on the municipal governance and civic infrastructure systems. It is estimated by the United Nations that by the year 2050, almost 68 percent of the world population will be living in cities, which increases pressure on the efficient provision of public services. The city authorities are increasingly struggling to keep count of utility, road, sanitation, and utility maintenance with their areas of operation increasing at a higher rate than the administrative capacity. To this situation is the inefficiency of traditional methods of complaints, either visits to offices, telephone hotlines, or paper-based messages, which are inherently sluggish, opaque and inefficient to large urban areas [1-3]. When citizens are faced with overflowing trash cans, broken streetlights, potholes in the streets, water cuts or power outages they do not have an effective system to report or monitor these issues and the lack of trust in local governance ensues. The Smart Cities paradigm has become popular across the world as a logical reaction to these governance shortcomings in the cities. Through the implementation of information and communication technologies (ICT), smart city models aim to streamline service provision, facilitate evidence-based resource distribution and promote participatory governance. At the core of this vision, there is the idea that active citizens with access to the right digital tools will become a kind of extended network of city sensors that will sense and report any failure of infrastructure in real-time. Countless national initiatives, such as the Smart Cities Mission in India have acknowledged the significance of digital platforms with citizen focus as the backbone infrastructure, but viable, scalable applications are as yet few in number and capability. Previous attempts to develop digital civic reporting have delivered

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useful albeit limited in scope solutions. Mobile-only applications limit users to smartphone users that have adequate storage capabilities and connectivity. There is no formal interaction in social media-based platforms, but informal interaction [4-7]. Image-processing and AI-prototypes enhance accuracy of detection but do not include built-in dashboards, live-time geolocation mapping, and citizen interaction capabilities. There have been suggestions of web-based systems which do not meet the needs of integrating geospatial visualization, data cloud-synced, gamified participation and formal administrative control into a single unified architecture. This bifurcation is a driving force towards coherent and comprehensive and scalable platform based on open web standards. In order to fill these gaps, this paper introduces CityPluse a full stack browser-based issue reporting and management platform. CityPluse enables residents to make complaints which have geotags and photos validated, and do so on any device with a standard web browser, removing any installation obstacles and increasing its accessibility. At the administrative level, the municipal officers will be exposed to a purpose-built dashboard, which consolidates, classifies, and visualizes real-time incoming complaints, allowing prioritization of field responses based on the data. The front end is developed in HTML5, CSS3 and JavaScript, with Firebase Realtime Database being used to store data in the cloud in multi-user, real-time format, and the Google Maps JavaScript API being used to display it interactively and geospatially. CityPluse stands out of the current systems with three innovations that interlock. First, the actual localization of complaints through the Google Maps API eliminates the ambiguity of locating complaints, which enables the field workers to get to the locations of complaints without any confusion. Second, a gamification layer, including experience points, tiered achievement badges, and a public leaderboard is created to keep participants involved in the long term past the novelty phase beyond the bounds of the research done in gamified e-participation. Third, a real-time analytics module will consolidate complaint information in terms of category, area, and time, giving the planners effective intelligence on how to schedule a preventive maintenance and invest in the infrastructure. The four main goals of this work are as follows: (i) to develop and deploy a cross-platform, web-based civic complaint system with geolocation and photographic evidence; (ii) to measure the efficiency of a gamification system in stimulating, long-term citizen participation; (iii) to offer a real-time dashboard to municipal administrators that enables prioritized and transparent issue resolution; and (iv) to determine how well the system works, is usable and scalable in practice conditions. This research paper contains a presentation of the complete development journey, the technical implementation, challenges faced and results achieved with CityPluse

2. Method

2.1.System Architecture

CityPluse is created as a web-based intelligent civic issue reporting platform, which will provide citizens with the opportunity to report local issues and authorities to track and address them effectively. The architecture is based on a client-cloud-service system with the frontend interface communicating with cloud-based backend services and third-party APIs. This architecture guarantees the scalability, real-time availability of data and smooth user experience.

2.2.Operational Workflow

The collaborative approach of the system is divided into the next steps:

- Issue Reporting by Citizens:

Users report civic problems via a web form by listing the category of the problem, give a description, selecting a geographic place with the help of an interactive map, and may post any photographic evidence of the problem.

- Geolocation and Mapping:

Google Maps API is to retrieve the precise latitude and longitude coordinates with the help of marker-based selection and location autocomplete. Reported issues are also geo-tagged, and can be accurately visualized on a live issue map on a city-wide scale.

- Cloud-Based Data Management:

Firebase Fire store is used to store all the data related to issues, and uploaded photos are safely handled with the help of Firebase Storage. The records of the issues contain category, location coordinates,

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description, timestamp, and status (New, In Progress or Solved). Live audiences guarantee immediate data consistency among all the users.

- Administrative Control:

The authorized administrators have access to a secure admin panel which allows them to see reported issues, update them on their resolved status, remove invalid entries and view them on the map. This role-based control enhances better accountability and efficiency of governance [7-12].

- Analytics and Gamification:

Analytical insights given in the system include total issues, categorical distribution and a ratio of resolutions. A points-based system that is gamified will give rewards to active users in the form of badges to ensure continuity in citizen engagement.

2.3.Algorithmic Flow

Launch cloud and frontend services. Take in user entries and location information. Checking of inputs and posting image (where given). Record store information in Fire store. Update user points and leaderboard. Display issues on live map. Enable admin status updates. Real-time refresh analytics dashboard.

2.4.Implementation Tools

Frontend: JavaScript, CSS, HTML. Backend / Database Firebase Fire store, Firebase storage. Mapping Service: Google Maps API. Authentication: Firebase Authentication.

2.5.Methodological Significance.

The offered methodology can make civic issues reporting in real-time, minimize the handling of complaints manually, enhance transparency between citizens and authorities, and offer a scalable basis of the further improvement, including artificial intelligence to prioritize issues.

Table 1 Firebase Cloud Services Used in CityPluse v2.0

Firebase Services	Function in System(v)	Data Type Stored
Cloud Firestore	Issue reports, user profiles	JSON documents (No SQL)
Firebase Authentication	User login/registration	Email, UID, session tokens
Firebase Storage	Issue photographs	PNG, JPEG (CDN-served)
Google Maps API	GPS coordinate capture	Latitude, Longitude

Table 2 System Module Descriptions

Module	User Role	Key Features
Report Issue	Citizen	Form input, map pin, photo upload, GPS
Live Issue Map	Public	Real-time colour-coded markers (New/In Progress/Solved)
Leaderboard	Public	Top reporters ranked by points
Admin Panel	Admin	Status update, delete, map view per issue
Analytics	Admin	Category-wise distribution, resolution rate, location stats

2.5.1 Tables

CityPluse v2.0 is summarized in terms of system architecture and functionality with the help of structured tables to make the information clearer and more understandable. Table 1 shows the cloud services within the system with emphasis on the role played by each service in the system including data storage, user authentication, media handling and location tracking. All these services guarantee performance in real-time, data security, and scalability of the platform.Table 2 describes the major modules of the system, roles of users and the main features. It outlines the interaction of various stakeholders such as the citizens, public users, and

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administrators with the system. The modules are intended to have certain functionalities to carry out the assigned tasks, including issue reporting, real-time monitoring, administrative control, and data analysis, to facilitate proper and transparent smart city management.

2.5.2 Figures

CityPluse v2.0 workflow and operation process are depicted with the help of flowcharts to provide a visual representation. Figure 1 shows the step-by-step procedure of how a citizen can submit a report of an issue, which involves authentication, entry of data, capture of location and posting to the cloud database. It emphasizes the way the inputs of the users are arranged and stored. The administrative workflow of reported issues handling is shown in figure 2. It describes the order of activities of reading reports, updating the status, fixing problems, or deleting invalid records. This visualization assists to comprehend the interaction between various system elements and to make sure the issues management is transparent.

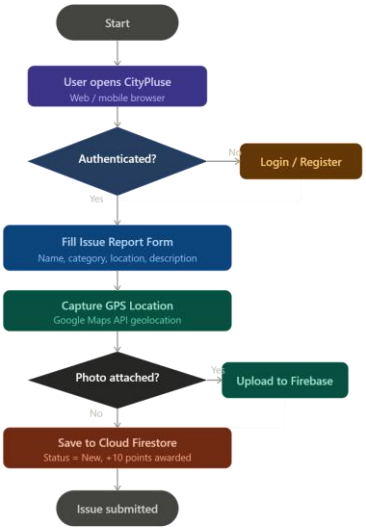

Figure 1 Flowchart depicting the citizen issue reporting process in CityPluse v2.0

Figure 2 Admin Resolution Flowchart

3. Results and Discussion

3.1.Results

The CityPluse system was implemented and tested in a control environment with multiple users simulating real-world civic issue reporting scenarios. The system was able to cope with issue submission, synchronization of data in real time, visualization of maps, and administrative activities without performance loss. The results prove that the platform can effectively record and handle civic issues while having accurate geotags and instant updates to all the people connected. Shown in Figure 3.

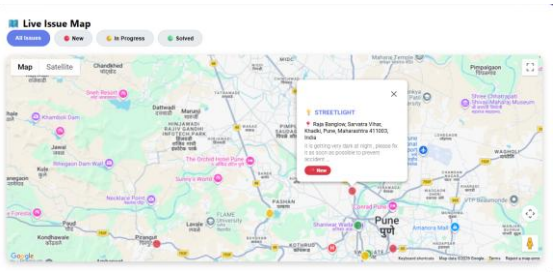

Figure 3 Live issue map, where color coded pins show status of issues

Key observations include: Successful submission and storage of issues with complete metadata (category, description, location, image and timestamp). Accurate placement of issue markers on the live city map by using latitude and longitude coordinates. [12-15] Real-time updates were reflected immediately in the analytics dashboard and the admin panel. Smooth

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transition of status of issues between New, In Progress and Solved. Shown in Figure 4 and 5.

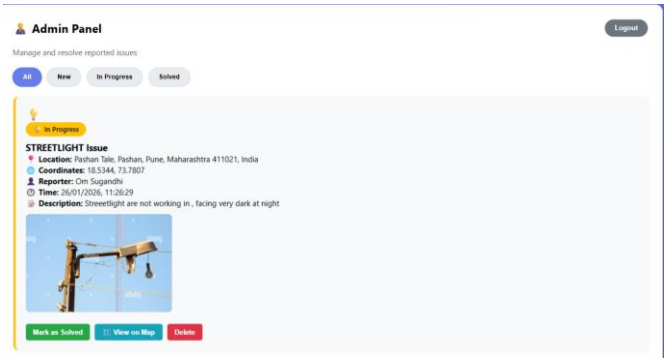

Figure 4 Admin Panel, where issue status will be marked

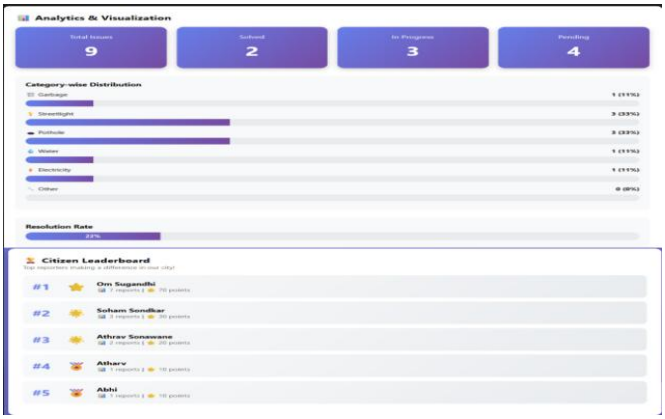

Figure 5 Analytics dashboard and Citizens engagement factor

3.2.Discussion

These findings prove that the suggested system can be used as an efficient means of reporting civic issues in the real world because it provides sufficient convenience and stability with data management. Combining geolocation with real-time updates would mean that the problems are properly logged and reflected in the platform as soon as possible. This enhances transparency and enables people and administrators to be aware of the progress of reported issues. The analytics and visualization service offer valuable information on the issue distribution and resolution patterns that allow making improved decisions. Also, the leaderboard system fosters citizen involvement, which fosters the community involvement in the management of the city. In general, the system demonstrates a high potential to be used as a scalable and efficient platform to apply smart city features, but its performance can be further optimized by adding automated prioritization and extended data analysis.

Conclusion

This study provided CityPluse, a web-based civic problem reporting platform, which is smart and aims at improving the involvement of citizens and the management of urban problems. The system combines well geolocation, photo-based reporting, real-time cloud synchronization, and administration monitoring to maintain transparency and effective problem fixing. The suggested platform shows how online technologies would help in bridging the communication gap between citizens and authorities and promote data-driven decision-making. The findings suggest a better issue monitoring system, a quicker process of responding, and the involvement of people. CityPluse can be embraced by towns to provide them with a convenient way to govern their cities through a smart city solution because of its scalable architecture and modular design. The system provides a firm base on which there can be extensions in the future like intelligent automation and predictive analytics and the large-scale implementation that could be realized in urban centers.

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