WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Image-Based Complaint Management System for Educational Institutions

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ABSTRACT :

Educational institutions regularly experience maintenance problems such as damaged furniture, electrical faults, water leakage, plumbing issues and computer-laboratory equipment failures. Conventional complaint handling often depends on verbal communication, paper forms or text-only submissions. These approaches can delay reporting, make the actual fault difficult to understand, and provide limited visibility into repair progress. This paper presents an image-based complaint management system designed for college facilities. Students submit a photograph of the issue together with a short description and facility location or QR-based location information. The proposed workflow uses image analysis and natural language processing (NLP) to estimate the complaint category, determine priority, and identify possible duplicate reports. Complaints are routed to the responsible department or faculty member. Maintenance staff update the repair status and upload an after-repair image, which is reviewed by faculty before closure. A web-based prototype is described using Flask, HTML, CSS, Bootstrap and SQLite. The prototype supports complaint submission, category estimation, rule-based priority assignment, possible duplicate detection, staff assignment, repair tracking, faculty verification, dashboard statistics and CSV report generation. The paper distinguishes implemented workflow features from AI capabilities that require further model training and validation; no new accuracy figures are claimed. The approach aims to improve traceability, accountability and transparency in campus maintenance.

Keywords: Image-based reporting, complaint management, educational institutions, CNN, NLP, maintenance tracking, duplicate detection, priority estimation.

1. INTRODUCTION

The effective maintenance of classrooms, laboratories, hostels and other campus facilities is important for a safe and supportive learning environment. Problems such as broken fans, damaged desks, electrical faults, water leakage and malfunctioning computers require timely attention. In many institutions, students report these problems through phone calls, verbal messages or manual forms. Such reports may be incomplete, difficult to trace or delayed before reaching the responsible department.

Text-only complaint descriptions may not communicate the physical condition of an asset clearly. A photograph provides visual evidence and can help staff understand the issue before visiting the location. Combining an image with a short description and location information can therefore make complaint registration more informative. Existing research has explored online grievance platforms, AI-based complaint classification, image-supported civic reporting and mobile asset-maintenance systems [1]–[25].

This paper presents an image-based complaint management workflow for educational institutions. The system is intended to connect complaint submission, automated analysis, departmental routing, maintenance action and faculty verification in one process. It is designed around three user roles: student, maintenance staff and faculty/administrator. The principal contribution is the integration of image and text evidence with repair-status tracking and post-repair verification.

2. BACKGROUND AND RELATED WORK

Earlier web-based grievance systems focus on online registration, centralized records, complaint history and status tracking [1], [2], [7]–[9], [12], [16], [18], [20], [21]. These systems reduce dependence on paper-based processes and improve communication, but many rely mainly on manual category selection or text-based reporting. Student review and complaint platforms also support media attachments, notifications and feedback, although language ambiguity can affect text-based analysis [3].

AI-based systems extend complaint handling through machine-learning classification, priority estimation and automatic routing. Research on college complaint analysis and smart grievance systems describes classification and department assignment, while also identifying future needs such as hierarchical categories, better language handling and escalation [5], [6], [13], [15]. Large-language-model-based complaint handling has also been explored for classification and summarization, although computational requirements and human oversight remain relevant considerations [10].

Image-oriented complaint research is particularly relevant to physical maintenance. Smart civic complaint systems combine text and image analysis, duplicate detection and priority modelling [4], [11]. Snap2Fix explores QR-based reporting and evidence of completed repairs [23]. An Android-based

asset-maintenance system demonstrates role-based complaint handling and real-time records, reporting an eight-of-eight functional test pass rate and a System Usability Scale score of 79.42 from 30 participants [24]. These studies motivate a campus-focused workflow that combines visual evidence, automatic categorization and verification of completed repairs.

The reviewed literature indicates a gap between systems that classify complaints and systems that provide a complete maintenance lifecycle. The proposed approach addresses this by linking the initial complaint image to department routing, staff action, an after-repair image and faculty approval.

3. PROPOSED SYSTEM

3.1 Objectives

- Allow students to submit maintenance complaints using an issue photograph, description and location or QR information.
- Estimate the complaint category from image and text information using CNN- and NLP-based analysis.
- Assign a priority level and identify potentially duplicate complaints.
- Route each complaint to the appropriate maintenance department or faculty member.
- Track repair progress and require after-repair image evidence before faculty verification.
- Maintain complaint history, notifications and reports for institutional monitoring.

3.2 System Architecture

The system is organized into connected layers. The student interface captures complaint information; the analysis layer processes image and text inputs; the management layer assigns priority and routes the complaint; the maintenance layer records repair activity; and the verification layer controls closure. The database maintains complaint details, uploaded images, role information and status history.

Layer / module	Input	Main responsibility
Complaint interface	Image, description, facility location or QR	Register a complaint and issue a unique complaint record.
AI analysis	Uploaded image and complaint text	Use CNN-based image analysis and NLP to estimate the issue category.
Priority and duplicate check	Category, severity and existing complaint records	Estimate Low/Medium/High priority and flag possible duplicates.
Routing and assignment	Classified complaint and location	Forward the complaint to the responsible department or faculty.
Maintenance workflow	Assigned complaint	Record worker assignment, progress and after-repair image.
Verification and tracking	Repair evidence and status updates	Allow faculty approval or rework request and notify the student.

3.3 User Roles

Student: submits a complaint with an image, description and location; views complaint history and status. Maintenance staff: views assigned complaints, updates work status and uploads an after-repair image. Faculty/administrator: reviews complaints, assigns staff, verifies repair evidence, approves closure or requests rework, and monitors dashboard information.

4. METHODOLOGY

4.1 Complaint Submission and Pre-processing

A student selects the affected facility, captures or uploads an image, enters a short description and provides the location. A QR code may be placed at a classroom, laboratory or facility to simplify location selection. The system validates required fields and stores the complaint details with a timestamp and a unique identifier. Image files are stored with a reference in the complaint record.

4.2 Image and Text Analysis

The proposed analysis combines two information sources. The image-processing component is based on a Convolutional Neural Network (CNN), which can learn visual patterns associated with maintenance faults. The text-processing component uses NLP to prepare the description and estimate its complaint category. The term-paper implementation discusses NLP with Logistic Regression and CNN as the intended analysis methods. Model training, dataset preparation and quantitative validation are necessary before treating these components as production-ready classifiers.

The expected output categories include Electrical, Plumbing, Furniture and Other. For example, an image showing a damaged chair, together with the description “classroom chair leg broken”, can support a furniture-related category estimate. The final category should remain reviewable by authorized staff, especially when the image is unclear or the description is ambiguous.

4.3 Priority Estimation and Duplicate Detection

After category estimation, the system assigns a priority level of Low, Medium or High. The prototype uses rule-based priority assignment; a future trained model may estimate severity from issue type, description and visual evidence. A possible duplicate is identified by comparing the new complaint with existing records. Text similarity or cosine similarity can help flag reports that describe the same issue. Duplicate detection should flag a record for review rather than automatically discard it, because two similar reports may refer to different locations.

4.4 Automatic Routing and Repair Workflow

The classified complaint is forwarded to the appropriate department or faculty member. The faculty member assigns a maintenance worker. The worker changes the status to In Progress, performs the repair and uploads an after-repair photograph. Faculty then checks the evidence and either approves the work or requests rework. On approval, the complaint is marked Completed/Resolved and the student receives a status update.

4.5 End-to-End Workflow

Step	Action	Result
1	Student uploads image, description and location/QR.	Complaint registered.
2	Image and text are analysed.	Estimated complaint category.
3	Priority and duplicate checks are performed.	Priority level and duplicate flag.
4	Complaint is routed to the responsible department.	Staff assignment.
5	Worker repairs the issue and uploads an after-repair image.	Repair evidence and updated status.
6	Faculty verifies the repair and approves or requests rework.	Verified closure or return for correction.
7	Student receives updates; records remain available.	Traceable complaint history.

5. PROTOTYPE IMPLEMENTATION

A web-based college maintenance complaint management prototype is described in the source report. The implementation uses Python with Flask for the backend, HTML5, CSS3 and Bootstrap 5 for the interface, and SQLite for complaint records. Supporting libraries include Werkzeug, Pandas and Scikit-learn. TensorFlow/Keras is identified for CNN integration. The prototype workflow includes student complaint submission, category estimation, rule-based priority assignment, duplicate checking, staff assignment, repair-status updates, after-repair image upload, faculty verification, complaint history, dashboard statistics, notifications and CSV report generation.

Component	Technology / specification
Operating system	Windows 10/11
Programming language and backend	Python 3.14; Flask
Frontend	HTML5, CSS3, Bootstrap 5
Database	SQLite
Libraries	Werkzeug, Pandas, Scikit-learn
Image analysis	TensorFlow/Keras for CNN integration
Development environment	Visual Studio Code; Google Chrome

The prototype is a workflow demonstration and should not be interpreted as evidence that a fully trained CNN has achieved a particular classification accuracy. The source report does not provide a labeled image dataset, model-training configuration or measured performance statistics for the proposed image classifier.

6. CASE STUDIES AND COMPARATIVE OBSERVATIONS

6.1 AI-Based Smart Civic Complaint Management

The reviewed civic complaint approach uses complaint text, images, location details and historical records. Its described techniques include NLP, TF-IDF with Logistic Regression, cosine similarity for duplicate detection and image processing. The study is relevant because it combines text and image evidence. However, a civic or city-level complaint workflow needs adaptation to campus-specific categories, roles and faculty verification [4], [11].

6.2 Android-Based Asset Maintenance Complaint Management

The reviewed Android-based asset-maintenance system uses a Waterfall development process, Kotlin, Android Studio and Firebase Realtime Database. It supports role-based complaint submission and monitoring. Its reported functional testing passed all eight tested modules, and the overall usability score was 79.42 from 30 participants. The study demonstrates the value of structured maintenance workflows, while the proposed paper adds an emphasis on integrated image/text analysis and after-repair faculty verification [24].

6.3 Comparison

Aspect	AI-based civic complaint system	Android asset-maintenance system	Proposed campus workflow
Input	Text, images, location and history	Facility complaint records and status	Image, text and campus location/QR
Main technique	NLP, TF-IDF, Logistic Regression, similarity and image processing	Waterfall, Kotlin, Firebase	CNN/NLP concept, rule-based priority and duplicate flagging
Main strength	Classification and duplicate detection	Role-based workflow and tested functionality	End-to-end repair tracking and faculty verification
Identified gap	Needs campus-specific workflow	No central AI image/text classification	Requires further model training and evaluation

7. RESULTS AND DISCUSSION

7.1 Prototype Outputs

For each submitted complaint, the prototype workflow is designed to produce the following information:

- Complaint category: Electrical, Plumbing, Furniture or Other.
- Priority estimate: Low, Medium or High.
- Duplicate status: New Complaint or Possible Duplicate.
- Repair status: Pending, In Progress or Completed.

The implemented workflow supports complaint submission with images and location details, category estimation, rule-based priority assignment, possible duplicate detection, staff assignment, repair tracking, after-repair image upload and faculty verification. These functions provide a traceable path from reporting to closure. The results are functional outputs of the described prototype, not measured evidence of classification accuracy or reduced repair time.

7.2 Interpretation

Image evidence can reduce ambiguity in maintenance reports, while text provides context that may not be visible in a photograph. Combining both sources is expected to support more informative categorization than relying on text alone. Automatic routing can reduce manual forwarding, and the after-repair image gives faculty a basis for checking whether the reported issue has been addressed. Complaint history and dashboard statistics can also help identify recurring facility problems.

The approach has practical limitations. Image quality, lighting, occlusion and variation in fault appearance can affect image analysis. Short or unclear descriptions can affect NLP classification. Similar complaints may be incorrectly flagged as duplicates. Priority rules need agreement from institutional maintenance personnel. The system also depends on users reporting issues and on network access for online updates. Human review is therefore retained for routing exceptions and final repair verification.

7.3 Evaluation Plan

A formal evaluation should use a labeled dataset of campus maintenance images and descriptions covering each supported category. Training and test data should be separated so that near-duplicate images from the same incident do not appear in both sets. Classification should be measured using accuracy, precision, recall and F1-score. Duplicate detection should be assessed using precision and recall for duplicate pairs. Operational evaluation should measure complaint submission time, routing time, time to first staff acknowledgement, repair duration, notification delivery and faculty verification outcomes. Usability can be evaluated with students, staff and faculty. These measurements are proposed evaluation criteria; the source report does not provide new experimental values for them.

8. CONCLUSION AND FUTURE WORK

This paper presented an image-based complaint management workflow for educational institutions. The system enables students to report campus maintenance issues using photographs, descriptions and location information. The proposed design combines CNN-based image analysis and NLP-based text processing for category estimation, rule-based priority assignment, duplicate flagging and automatic routing. Maintenance staff can update repair progress and upload after-repair images, while faculty verify the work before closure. The described Flask-based prototype supports the main complaint-management workflow, dashboard information and CSV reporting.

The paper does not claim unreported model accuracy or large-scale deployment results. Future work includes preparing a diverse campus-maintenance image dataset, training and validating CNN/NLP models, improving semantic duplicate detection, developing more adaptive priority prediction, adding a dedicated mobile application, strengthening real-time notifications, deploying the system in the cloud and evaluating security, scalability and usability in an operational campus environment.

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