Pokemon Pre-Grading AI Project
Personal Project

Pre-Graded Cards
PGC

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Revision History

Revision	Date	Author(s)	Description
0.1	12.16.2025	AA	Initial document creation with draft sections for background, related work, and system overview
0.2	12.18.2025	AA	Added roles and responsibilities, cost proposal, and facilities sections
0.3	12.20.2025	AA	Completed constraints, assumptions, risk table, and major documentation deliverables
1.0	12.20.2025	AA	Finalized document for submission including updates for cross-platform support and editing for clarity

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1 Problem Statement

Collectors and enthusiasts who own Pokemon cards face uncertainty when deciding whether to submit their cards for professional grading by PSA, since grading can be costly and the outcome may not meet their expectations. Currently, there are no reliable AI tools that can detect fine defects such as scratches, whitening, print lines, or ink dots, and provide a pre-grade for psa expectations with explainable visual feedback. This leaves collectors relying on subjective judgment or expensive professional grading, which can lead to inconsistent decisions and potential financial loss. This AI Card Pre-Grading Tool simplifies this process by providing automated defect detection, PSA style pre-grade estimation, and annotated visual outputs in one accessible platform. By aggregating multiple images per card and supporting continuous validation via user-submitted grades, the app saves time for collectors, improves the quality of pre-grading decisions, and provides a more consistent, reliable assessment of card condition.

2 Methodology

Building an AI powered Pokemon Card Pre-Grading Tool that helps collectors and enthusiasts assess card condition and estimate PSA style grades efficiently. Currently, collectors must rely on subjective judgment or costly professional grading to evaluate their cards. Our app will mitigate this uncertainty by combining defect detection, multi-angle image aggregation, and PSA style pre-grade estimation into one user-friendly platform. The system will highlight defects such as scratches, whitening, print lines, and ink dots, provide confidence scores, and support continuous validation through user submitted grades. By automating and explaining the pre-grading process, the app reduces the burden on collectors and provides actionable insights to inform submission decisions.

3 Value Proposition

The Pokemon Card Pre-Grading Tool provides significant value to collectors and enthusiasts by addressing a common challenge, determining whether to submit a card for professional grading. A typical submission to PSA costs around $20. While higher value cards may have higher submission costs, the financial outcome depends heavily on the grade received. For example, a perfect grade of 10 can dramatically increase the card's resale value, whereas a grade of 9 often allows the collector to only break even. Lower grades typically result in a financial loss and higher burden in being able to find a buyer.

This app simplifies the decision-making process by offering automated defect detection, multi angle analysis, and PSA style pre-grade estimation. Users can assess the potential risk and reward before submitting a card. By providing visual feedback and explainable outputs, collectors can make informed choices and avoid unnecessary costs.

While initially focused on Pokemon cards, the underlying technology and methodology can be extended to other collectible card games or graded collectibles, providing scalability and potential for future development.

4 Development Milestones

- Project Charter first draft December 2025
- System Requirements Specification SRS December 2025
- Architectural Design Specification ADS January 2026
- Dataset collection and preprocessing demonstration January 2026
- YOLOv8 defect detection model initial training February 2026
- Multi-angle image aggregation prototype February 2026

- Patch-based defect detection methodology demonstration March 2026
- Preliminary PSA-style grade calculation implementation March 2026
- Integration of defect detection, multi-angle analysis, and PSA-style grading April 2026
- Mobile app prototype for Android and iOS April 2026
- Internal testing and performance tuning May 2026
- User submitted grade validation pipeline May 2026

5 Background

Collectors and enthusiasts of Pokemon cards often face the challenge of deciding whether to submit their cards for professional grading, such as PSA, due to the financial risk, long wait times, and uncertainty involved. Submitting a card typically costs around 20 dollars, and the potential resale value depends heavily on the grade received. Cards graded 10 can dramatically increase in value, whereas lower grades may result in minimal gains or even financial loss. Additionally, PSA grading can take several weeks or even months, which creates delays for collectors who want to sell or evaluate their cards quickly. The Pokemon Card Pre-Grading AI project addresses the need for a reliable, objective method to evaluate a cardâs condition before committing to professional grading, helping users save time and avoid unnecessary submissions.

The recent surge in popularity and hype around Pokemon cards has led to increased demand for grading services and higher stakes for collectors. Many cards are submitted with uncertain value, creating inefficiencies and frustration. Currently, there is no accessible tool that accurately detects fine defects, assesses card centering, or estimates PSA-style grades in an explainable and visual manner. Collectors must rely on subjective judgments, which can be inconsistent, and existing apps do not provide multi-angle analysis or aggregate information from multiple images for a comprehensive evaluation.

The system is designed around the PSA grading scale because PSA is the most widely recognized and trusted standard in the trading card community, ensuring that pre-grade estimates are meaningful and aligned with the market. The Pokemon Card Pre-Grading AI project will provide an AI-powered system that automatically identifies defects such as scratches, whitening, print lines, ink dots, and dents. The system will analyze multiple images from different angles, aggregate results, and generate PSA-style pre-grade estimates. By offering visual feedback and annotated outputs, collectors can make informed decisions, avoid unnecessary costs, and save time by filtering out cards unlikely to receive high grades.

This project not only improves accuracy and efficiency for collectors but also provides a framework for continuous improvement as user-submitted PSA results are incorporated to refine the AI models. While initially focused on PokÃ©mon cards, the methodology and AI pipeline can be extended to other collectible card games or graded collectibles, enabling scalability and future expansion of the platform.

6 Related Work

There are several existing tools and platforms aimed at card evaluation, but they differ significantly from the comprehensive preâgrading system proposed here:

Professional Grading Companies: PSA, Beckett Grading Services, CGC, and TAG are official grading services that provide authenticated, certified grades after cards are submitted physically. These services are reliable but often costly and slow, with turnaround times measured in weeks or months. They do not offer a true automated preâgrading tool for collectors to assess cards before submission.

AI Based Pre Grading and Scanning Tools: A number of emerging platforms attempt to provide AIâbased card assessment to help collectors estimate condition before submission. Examples include Card Grading AI and Card Grading Tool for TCG, which analyze front and back images to give instant grade estimates and notes on corners, edges, and surfaces using machine learning models. App Store +1 Tools like TCGrader use AI to provide instant grade estimations and downloadable reports based on uploaded images, offering a lightweight preâgrading experience. tcgrader.app PokeGrade provides free AI based preâgrades and basic condition analyses, and SnapGradeAI offers detailed condition breakdowns and collection management features. Official PokeGrade

Some general card scanners like TCG Scan also include AI grade estimates, pricing insights, and multiâangle capture guidance. tcg-scan.com CenterGrade focuses specifically on automated centering analysis, helping users determine if cards are centered well enough to justify grading submission. CenterGrade

Condition Classifiers and API Services: Services like Nyckels card grading classifier let developers integrate AI models that predict condition labels, but they are primarily image classification APIs and not full preâgrading platforms. nyckel.com

While these tools bring value, most do not fully address the multi angle defect analysis and PSAâstyle preâgrade estimation that collectors need. Many focus on single snapshot evaluations, centering only, or market price insights, and often lack comprehensive defect categorization or the depth of analysis required to approximate a PSA grade reliably.

Our system differentiates itself by combining multiâangle image analysis, detailed automated defect detection (including surface whitening, print lines, scratches, ink dots, and dents), and a PSA style preâgrade computation into a unified workflow. It also incorporates explainable visual feedback and the ability to learn over time through userâsubmitted PSA results, offering a more robust, objective, and continuously improving solution compared to existing preâgrading services.

7 System Overview

8 SYSTEM OVERVIEW

The PokÃ©mon Card Pre-Grading AI app is designed to help collectors and enthusiasts evaluate the condition of their cards quickly and accurately, providing a PSA-style pre-grade estimate before submitting to professional grading services. At a high level, the system consists of four main components:

- **User Interface:** The mobile app interface allows users to upload multiple images of a card from different angles, view detected defects, and receive PSA-style pre-grade estimates. Annotated images highlight scratches, whitening, print lines, ink dots, dents, and centering issues. The interface is designed to be intuitive and visually clear to encourage repeated use and accurate submissions.
- **Application Core:** This component manages the workflow between image input, AI processing, and output visualization. It handles image preprocessing, patch-based defect detection, multi-angle aggregation, and the calculation of PSA-style pre-grades. The core also incorporates user-submitted PSA grades to continuously refine and improve the AI models.
- **Backend Data Storage:** A secure database stores user-uploaded card images, AI-generated defect annotations, predicted grades, and optionally user-submitted official PSA grades. This enables historical tracking, continuous learning, and future analytics.
- **Analytics and Reporting:** The app provides users with visualizations of detected defects, aggregated confidence scores, and PSA-style pre-grade summaries. Users can compare pre-grades with actual PSA results if available, helping refine submission strategies and track trends across their collection.

The app workflow begins when a user uploads one or more images of a card. The application core preprocesses the images, applies AI-based defect detection on patches, aggregates results across angles, and computes a pre-grade. The results are displayed on the user interface with annotated visuals and summarized scores. Users can optionally submit verified PSA grades to improve the model, creating a feedback loop that enhances the accuracy of future predictions.

Figure 1: System Overview

9 Roles & Responsibilities

10 ROLES & RESPONSIBILITIES

Since this project is being developed individually, all roles and responsibilities are carried out by the sole developer, Ajay Ahluwalia. The primary goal is to design and implement a mobile app that allows Pokemon card collectors to evaluate card conditions and receive PSA-style pre-grade estimates efficiently and accurately.

Project Management: As the sole developer, Ajay is responsible for planning, scheduling, and tracking all development milestones. This includes defining the system requirements, architectural design, and ensuring the project stays on track for timely completion. The project follows an iterative approach, similar to agile methodology, allowing flexibility to incorporate improvements and additional features as development progresses.

User Interface Design: Ajay is responsible for designing and implementing the mobile app interface. This includes creating an intuitive layout for uploading card images, displaying defect annotations, visualizing aggregated results, and presenting PSA-style pre-grade estimates. Special attention is given to usability, clarity of information, and interactive elements to ensure collectors can efficiently understand the results.

Application Core Development: Ajay handles all aspects of the backend logic, including image preprocessing, patch-based defect detection, multi-angle aggregation, and calculation of PSA-style pre-grades. Integration of AI models, optimization of inference pipelines, and management of continuous learning from user-submitted PSA grades are part of this responsibility.

Data Management: Ajay sets up and manages the backend storage system, including secure storage of uploaded images, AI-generated defect data, predicted grades, and optionally user-submitted verified PSA grades. This ensures reproducibility, continuous learning, and historical tracking of card evaluations.

Analytics and Reporting: Ajay develops the analytics and reporting features, providing users with clear visualizations of detected defects, aggregated confidence scores, and pre-grade summaries. These features help users make informed submission decisions and track trends across their card collection over time.

Testing and Validation: Ajay is responsible for validating the accuracy and usability of the system. This includes running tests on defect detection models, verifying PSA-style pre-grade outputs, and ensuring the app functions correctly on mobile platforms. Feedback from early users or testers is incorporated iteratively to improve both the AI models and the app interface.

Documentation and Maintenance: Ajay maintains thorough documentation of the system design, methodology, and usage guidelines. Future maintenance, model retraining, and feature expansion will also be managed by Ajay, ensuring the app remains functional and scalable.

By managing all aspects of development, Ajay ensures consistent vision, rapid iteration, and full integration between AI models, mobile interface, and backend systems, creating a cohesive and reliable tool for Pokemon card collectors.

11 Cost Proposal

12 COST PROPOSAL

The primary expenses for the Pokemon Card Pre-Grading AI app will come from software tools, cloud services, and potential AI model training costs. To minimize expenses, the project will prioritize open-source frameworks and free-tier services whenever possible. Key cost considerations include:

- **Cloud Hosting and Storage:** Costs for hosting the mobile backend, storing user-uploaded images, and maintaining AI model data. Free-tier cloud services or low-cost options will be used during

initial development, with potential upgrades as user demand increases.

- **AI Model Training:** Running YOLOv8 models for defect detection and PSA-style pre-grade estimation may require GPU compute resources. Training will initially be done using free or low-cost GPU resources such as Google Colab, with potential paid cloud compute for large-scale training.
- **Mobile Development Tools:** Any required licenses for mobile app development frameworks or testing tools. Preference will be given to open-source or free cross-platform solutions to reduce costs.
- **Continuous Improvement and Maintenance:** Minimal costs may be incurred for ongoing maintenance, dataset updates, and storage expansion as more users submit cards and provide PSA results.

Overall, by leveraging open-source software and cost-effective cloud solutions, the project aims to keep development and operational expenses low while providing a robust and scalable pre-grading tool for Pokemon card collectors.

12.1 Preliminary Budget

Service	Purpose	Estimated Cost
AWS (Amazon Web Services)	Cloud hosting, image storage, AI compute	$50 - $200/month
Microsoft Azure	Cloud hosting, AI compute	$50 - $200/month
Google Cloud Platform (GCP)	Cloud hosting, AI compute	$50 - $200/month
Firebase (Google)	Mobile backend, storage, authentication	$0 - $50/month for small projects
Google Colab Pro	GPU for AI training	$10 - $50/month

Table 1: Preliminary budget for cloud, storage, and AI compute services

13 Facilities & Equipment

The project will primarily require software development and AI model training. No specialized physical lab or testing facilities are necessary. Development and testing will be performed on personal computers and laptops equipped with sufficient processing power for AI inference and image processing. Cloud-based services such as AWS, GCP, or Google Colab will be used for model training and storage as needed. All software tools, frameworks, and libraries will be obtained through standard licenses, open-source distributions, or free-tier cloud services. No additional specialized equipment is required.

14 Assumptions

The following are critical assumptions for the implementation, testing, and deployment of the PokÃ©mon Card Pre Grading AI app:

- The developer will have access to a personal computer with sufficient processing power and required development software.
- Cloud services and storage for AI model training and inference will remain available and functional.
- Users will have devices that meet minimum requirements to run the app and view annotated card images.
- All software frameworks, libraries, and AI models used will be compatible with the chosen mobile platforms (Android and iOS).

- Internet access will be available for users to upload images and receive pre-grade analysis.
- AI model training, patch-based defect detection, and multi-angle aggregation will function correctly within the application core.
- Documentation and code will be maintained to reflect updates and improvements in the app and AI models.

15 Constraints

The following list contains key constraints related to the implementation and testing of the Pokemon Card Pre-Grading AI app:

- Final app prototype must be completed by the end of the semester to align with project deadlines and potential showcase events.
- User feedback and PSA grade data submissions may be limited, which could affect AI validation and model improvement speed.
- All development and testing must be done within the semester timeframe while balancing other academic and personal commitments.
- Total development and deployment costs must remain within budget, primarily for cloud services and AI model training.
- All card image data used for AI training must be either publicly available, synthetic, or anonymized, ensuring no copyrighted or sensitive proprietary images are included.
- AI model training and mobile app functionality must work within the hardware limitations of personal computers and standard mobile devices.

16 Risks

The following high-level risk assessment identifies the primary project risks and their potential impact. Mitigation strategies will be defined in future planning sessions.

Risk Description	Probability	Loss (days)	Exposure (days)
Solo developer unavailable due to sickness or personal schedule	0.40	14	5.6
Limited user-submitted PSA grades for model validation	0.50	10	5.0
AI model training takes longer than expected	0.30	15	4.5
Difficulty integrating AI backend with mobile app	0.35	7	2.45
Attempting to implement too many advanced features before MVP	0.20	10	2.0

Table 2: Overview of highest exposure project risks for Pokemon Card Pre-Grading AI app

17 Documentation & Reporting

17.1 Major Documentation Deliverables

17.1.1 Project Charter

The project charter will be created at the start of development and will serve as the guiding document for the Pokemon Card Pre Grading AI app. The initial version will define the project scope, objectives, and intended outcomes. Updates will occur whenever there are major changes in project direction, such as modifications to the AI pipeline, mobile app scope, or feature prioritization. The final version will be included in the project closeout package at the end of development.

17.1.2 System Requirements Specification (SRS)

The system requirements specification will be developed early in the project life cycle. It will capture functional and nonfunctional requirements, user stories, AI model specifications, mobile app interface requirements, and backend data storage needs. Updates will occur after each development cycle as new requirements are identified or refined. The final version will document all requirements implemented during the project.

17.1.3 Architectural Design Specification

The architectural design specification will be created after the SRS is reviewed and approved. The initial draft will outline the high level architecture of the mobile app and AI system, including front end components, backend services, AI defect detection pipeline, multi angle image aggregation, database integration, and visualization modules. Updates will be made if architectural changes are needed, such as adjustments to the AI framework or data storage approach. The final version will be delivered as part of the complete project documentation.

17.1.4 Detailed Design Specification

The detailed design specification will expand upon the architectural design by defining the system components, classes, interfaces, and AI model implementation details. The initial draft will be prepared once the architecture is approved. Updates will occur throughout development to track changes to the AI model, patch based detection logic, mobile app UI modifications, and database schema refinements. The final version will serve as a complete technical blueprint for the app and AI system.

17.2 Recurring Development Items

17.2.1 Product Backlog

The product backlog will be derived from the SRS. Requirements will be broken into tasks, such as image preprocessing, AI model training, defect detection modules, mobile app UI components, and analytics features. Prioritization will focus on the most impactful features for accurate PSA style pre grade estimation. Progress will be tracked using GitHub Projects for transparency.

17.2.2 Sprint Planning

Each development sprint will begin with planning where tasks from the backlog are selected based on priority and feasibility. Sprint timelines and goals will be determined to ensure steady progress toward the final app.

17.2.3 Sprint Goal

The sprint goal will summarize the purpose of the sprint, such as improving defect detection accuracy, integrating multi angle aggregation, or refining PSA style pre grade outputs. The goal ensures focus and measurable progress within each sprint cycle.

17.2.4 Sprint Backlog

The sprint backlog will include selected tasks achievable during the sprint. Progress will be tracked via GitHub issues, with task statuses updated regularly to ensure accountability and visibility of the workflow.

17.2.5 Task Breakdown

Tasks will be broken down into smaller actionable items, including preprocessing images, training AI models, implementing defect detection, aggregating results, creating annotated visuals, and developing UI components. Each task will have estimated effort and completion criteria.

17.2.6 Sprint Burn Down Charts

Progress will be visualized using burn down charts where the X axis represents sprint days and the Y axis represents remaining work in story points or hours. The chart shows whether development is on track and highlights potential delays.

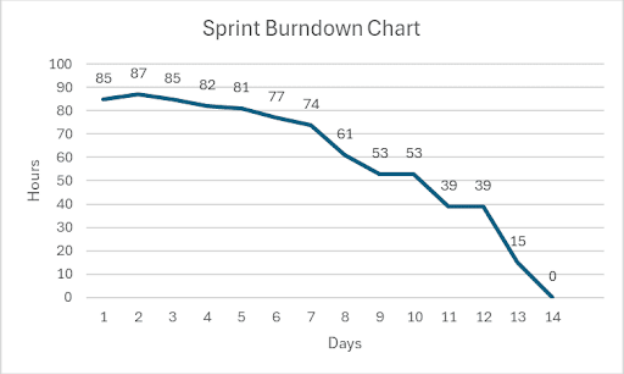

Figure 2: Example sprint burn down chart

17.2.7 Sprint Retrospective

At the end of each sprint, a retrospective will review what went well, what challenges occurred, and how processes can improve in the next sprint. This ensures iterative improvement of development practices and the app itself.

17.2.8 Individual Status Reports

Status reports will be maintained weekly, documenting completed tasks, challenges faced, time spent, and progress toward sprint goals. These provide transparency and help track development velocity.

17.3 Closeout Materials

17.3.1 System Prototype

The final prototype will include a fully functional mobile app with AI powered pre grading capabilities. Users can upload multiple card images, view annotated defect highlights, and receive PSA style pre grade estimates. The prototype will demonstrate the full AI workflow and UI features. The app will be developed to support both Android and iOS platforms, ensuring broad accessibility for collectors.

17.3.2 Project Poster

The poster will summarize the project motivation, problem statement, AI methodology, mobile app architecture, implementation details, and testing outcomes. It will highlight how the app assists collectors in estimating card grades before PSA submission.

17.3.3 Web Page

The project web page will include the background, problem, solution, and a description of key features. It will also document the AI pipeline, mobile app workflow, and instructions for usage.

17.3.4 Demo Video

A demo video of approximately 10 15 minutes will showcase the AI pre grading process, defect visualization, multi angle aggregation, and PSA style pre grade results.

17.3.5 Source Code

The source code will be maintained using GitHub, including the mobile app, AI modules, backend logic, and visualization code. The final deliverable will include compiled installable packages for both Android (APK) and iOS (IPA) devices, along with instructions for setup on each platform.

17.3.6 Source Code Documentation

The repository will include detailed documentation, covering setup instructions, AI model details, data processing, and mobile app usage, enabling reproducibility and future enhancements.

17.3.7 Installation Package

The app will be delivered as installable packages for Android and iOS devices. Minimal setup will be required for users to begin using the AI pre grading tool, and in app guidance will direct users through image uploads and interpreting defect highlights.

17.3.8 User Manual

The app is designed to be intuitive and straightforward, so no formal user manual is required. In app instructions and visual annotations will guide users on both Android and iOS devices through uploading images, interpreting defect highlights, and understanding PSA style pre grade estimates.

References