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Development of Jury Evaluation System for Innovation Competitions

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ABSTRACT

Innovation competitions play a vital role in encouraging creativity, problem-solving, and entrepreneurship across students, academicians, professionals, and industries. With the increasing shift towards virtual platforms, traditional manual judging methods are becoming less effective and often impractical. Therefore, ensuring fair, consistent, and transparent evaluation of submissions remains a significant challenge, particularly when assessments are made by multiple jurors. This research focuses on the design and development of a digital Jury Evaluation System tailored specifically for innovation competitions. The system provides a structured, criteria-based evaluation framework that allow jurors to assess entries using predefined weighted rubrics. The system was developed using Google Sheets for data storage, with the frontend built using Bootstrap 5.3, Vue 3, and HTML, while the backend was implemented using Google Apps Script. The development followed the Waterfall Model methodology, involving sequential phases: Analysis, Design, Implementation, Testing, Deployment, and Maintenance. As a web-based application, the system incorporates role-based access control, real-time scoring, automated result aggregation, and feedback mechanisms. It streamlines the evaluation workflow, minimizes human error and bias, and enhances the credibility of competition outcomes. The system has been successfully tested across various innovation competitions involving multiple judges and numerous entries. This project offers a scalable and user-friendly solution that can be adopted by educational institutions and other organizations to ensure a transparent and objective judging process in both online and hybrid competition formats.

1. Introduction

Innovation competitions have become key platforms for fostering creativity, entrepreneurship, and applied problem-solving across academia and industry. Their success relies heavily on fair and transparent evaluation processes where expert juries assess entries based on novelty, feasibility, and

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market potential, as noted by Li *et al*., [1]. However, traditional manual judging methods often suffer from bias, inefficiency, and scalability issues. With the increasing shift to online platforms, manual or paper-based evaluation methods are inefficient and impractical, especially when involving multiple jurors and entries. Manual compilation and aggregation of scores from multiple judges is time-consuming and prone to human error. Consequently, current evaluation systems often lack of transparency in scoring, which can lead to perceived or actual bias, undermining the credibility of competition results. Yu *et al*., [2] highlighted that unequal task distribution among jurors leads to inconsistent assessments, underscoring the need for systematic digital solutions.

Adamczyk *et al*., [3] emphasized that credible jury systems are essential to ensure fairness in innovation contests. Thus, the Jury Evaluation System was developed to facilitate structured and transparent evaluation for innovation competitions using predefined, weighted rubrics. This system also allows jurors to score entries based on customizable criteria and weightage.

Projects submitted to innovation competitions are generally assessed by a panel of expert judges, industry professionals, or academic reviewers using predefined criteria such as innovation, practicality, potential for scale, and overall significance [1]. On many online platforms, a multi-stage evaluation process is used, where entries are initially screened either through automated systems or crowd-based review before being formally evaluated by the expert panel.

In the digital era, online platforms have been widely adopted to facilitate organizers in managing evaluation processes and monitoring participants. One of the main challenges in this context is the imbalance between the number of projects and the expertise of jurors available to evaluate them. Yu *et al*., [2] found that entropy information was used to optimize task distribution to avoid overlapping between jurors and imbalanced workloads. The Jury Evaluation System, which controls how entries are assessed, graded, and chosen for prizes or further development, is therefore an essential component of these contests.

According to recent studies by Adamczyk *et al*., [3], an efficient jury system is crucial for ensuring credibility, fairness, and transparency, especially in digital or hybrid environments. Research by Chen *et al*., [4] explained that competitions with large participant pools and diverse projects require automatic systems to avoid inefficient management. Moreover, Gimpel *et al*., [5] noted that reliance on physical expert juries involves significant time, cost, and human resource constraints. Their findings showed that digital jury management systems deliver results more efficiently. In any innovation competition, such systems assist jurors in handling evaluations based on rubrics or criteria set by organizers.

Digital jury systems also enable continuous improvement [6]. Results and feedback from jurors can be recorded and analyzed to refine criteria for future competitions. Through such systems, organizers can reassess jury effectiveness, identify inconsistencies in scoring, and enhance the overall quality of evaluations. Mohamad Rahimi *et al*., [7] introduced the i-Jury Management System during the COVID-19 pandemic to address challenges in remote competition management. This system does not only simplified judging but also improved professionalism and credibility for higher education institutions. Additionally, digital systems have the potential to automate jury management processes, including registration, online evaluation, result analysis, and data storage, ensuring efficiency and integrity throughout the evaluation.

Developing a judging system with Google Sheets offers an efficient, collaborative, and low-cost way to manage evaluation processes, including innovation competitions, academic assessments, and project judging. Google Sheets, a cloud-based tool within Google Workspace, allows real-time collaboration, automation, and data analytics [8]. In a judging system, Sheets can serve as the central tool for collecting scores, calculating weighted averages, ranking participants, and visualizing results. Integration with Google Forms enables jurors to enter scores via web forms that instantly populate

the spreadsheet, improving speed and openness while centralizing all data [9]. The system can be further enhanced with Google Apps Script (GAS) to automate total computation, ranking updates, and participant notifications, thereby increasing efficiency [10].

Google Apps Script (GAS), a cloud-based scripting language created by Google, extends the functionality of Workspace applications such as Sheets, Docs, and Gmail. Based on JavaScript, it allows users with basic programming skills to build small applications that run on Google's servers without additional infrastructure [11]. In education, GAS supports administrative automation and interactive learning systems. Sismanto *et al*., [12] noted that institutions use GAS to automate grade calculation, attendance tracking, evaluation, and report generation. Son [13] demonstrated how integrating Google Sheet and GAS can improve program registration, scheduling, progress tracking, and reporting in higher education. Gonzales *et al*. [14] highlighted GAS's role in fostering innovative learning environments by enabling educators to build dashboards that extend Google Classroom. Qinghua *et al*., [15] emphasized GAS's ability to integrate with APIs and third-party services such as Slack, Trello, or external databases, offering flexibility for tailored organizational solutions.

Bootstrap, a popular front-end web development framework, is widely used to design responsive and visually consistent user interfaces. In developing an online judging system, Bootstrap ensures design uniformity, responsiveness, and usability. Originally created by Twitter, Bootstrap provides pre-built components for creating user interfaces [16]. It is particularly suitable for systems that must be accessible across diverse devices and screen sizes, enabling developers to build responsive web applications quickly using HTML, CSS, and JavaScript. Roy and Basak [17] emphasized that each framework has distinct strengths and trade-offs, and developers should evaluate them based on project scope, performance requirements, and developer experience.

While several digital jury systems have been introduced in prior research, many remain proprietary, costly, or narrowly focused on specific aspects such as workload distribution [2] or pandemic-driven adaptations [7]. Existing digital judging systems are inadequate because they often fail to combine fairness, efficiency, automation, flexibility, and usability into a single platform. They may collect data or support basic scoring, but do not provide transparent, systematic, and adaptable tools that handle large-scale competitions effectively while supporting continuous improvement.

Hence, the novelty of our approach lies in integrating widely accessible, low-cost cloud tools using Google Sheets, Google Apps Script, and Bootstrap into a unified evaluation framework. This integration enables structured rubric-based scoring, automated aggregation, responsive interfaces, and real-time collaboration, features that differentiate it from existing platforms. The scientific contribution of this work is the demonstration of how open, extensible technologies can democratize jury evaluation, reduce bias and inefficiency, and provide a replicable model for innovation competitions and academic assessments.

Therefore, this study presents the design and development of a digital Jury Evaluation System for innovation competitions integrating Google Sheets, Google Apps Script, and Bootstrap. The novelty of this system lies in its integration of accessible cloud technologies into a replicable, automated, and responsive jury framework that can enhance fairness, efficiency, and credibility in digital competition management.

2. Methodology

Software development methodologies offer structured frameworks for the systematic planning, development, and maintenance of software systems. Among these, the waterfall model remains one of the most historically influential, having shaped software engineering practices and academic instruction for many years [17].

The Waterfall model comprises six phases: requirement analysis, system design, implementation, testing, deployment and maintenance [19]. Characterized by its linear and sequential nature, the waterfall model requires each phase to be fully completed before progressing to the next. In line with this approach, the waterfall model was utilized in the development of the Jury Evaluation System. Figure 1 visually represents these sequential phases within the Waterfall Model.

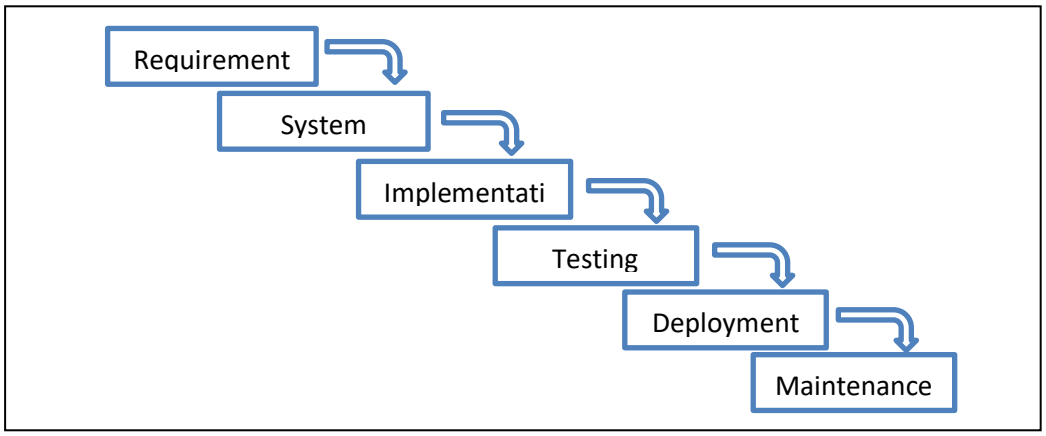


Fig. 1. Phases in the Waterfall Model

The development process begins with the requirement analysis phase, where the system's requirements are gathered, defined, and documented to ensure a clear understanding of the software's objectives. In the context of developing the Jury Evaluation System, this initial phase involved engaging with stakeholders such as competition organizers, jury members, and administrative staff to identify specific user needs. The careful identification and analysis of these user needs were essential to ensure the system would streamline the evaluation process, promote fairness and transparency, and enhance the overall efficiency of judging innovation-based events.

The design phase is where the overall architecture of the system is defined. This includes planning the structure of databases, determining the necessary software components, and designing user interfaces to ensure a seamless interaction between users and the system. In the case of the Jury Evaluation System, this phase involved designing a user-friendly interface for jury members to log in securely and submit evaluations, as well as an administrative dashboard for managing participants and evaluation criteria.

Once the design was finalized, the process moved into the implementation or coding phase, where developers translated the system design into working software. For the Jury Evaluation System, this included writing the backend logic for score calculations, developing secure authentication mechanisms, and implementing features that allow real-time submission and aggregation of jury scores. The outcome of this phase was a functional system that formed the backbone of the evaluation process during innovation competitions, ensuring consistency, accuracy, and ease of use for all involved parties.

Once the coding phase is complete, the process proceeds to the testing phase, where individual software modules are integrated and rigorously tested to identify and fix any bugs, errors, or inconsistencies. This step is crucial to verify that all components of the system work together smoothly and that the system functions in accordance with the original requirements. In the context of the Jury Evaluation System, this phase involved testing key features such as user authentication for jury members, the accuracy of score calculations, the reliability of data storage, and the responsiveness of the user interface. Functional and usability testing were conducted to ensure that jury members could easily input scores and administrators could retrieve results without issues.

After thorough testing confirmed that the system was stable and met performance expectations, the project moved into the deployment phase. The system was installed on a server and made accessible to jury members and competition organizers. Training or brief orientations were also provided to users to ensure smooth adoption. Deployment marked the transition of the system from development to real-world application, enabling it to support fair, efficient, and transparent evaluation processes during the actual events.

Finally, the maintenance phase plays a crucial role in ensuring the long-term reliability and effectiveness of the system. This phase involves ongoing monitoring of system performance, identifying and fixing any issues that arise after deployment, and implementing updates or enhancements based on user feedback and evolving requirements. For the Jury Evaluation System, the maintenance phase includes addressing technical issues reported by jury members or administrators, such as login problems, data discrepancies, or slow system response times. It also involves updating the system to accommodate changes in evaluation criteria, competition formats, or user interface preferences. Regular system improvements ensure that the Jury Evaluation System remains efficient, secure, and aligned with the needs of innovation competition stakeholders over time.

3. Development of Jury Evaluation System

3.1 Development using Google Sheets

The Jury Evaluation System was developed using Google Sheets and is organized into six tabs, each serves a specific function. Figure 2 shows the tab in the Google Sheets.

i. Setup 1 – Consists of login IDs and jury passwords for secure access.
ii. Setup 2 – Assign jury members to specific products or entries.
iii. Logger – Serves as the main input interface where jury members enter scores and provide suggestions.
iv. DataLog – Acts as a backup of the Logger tab, preserving all submitted data.
v. Help – Assists in identifying the winners based on predefined evaluation criteria.
vi. Winner – Automatically ranks participants based on their total scores to determine the winners.

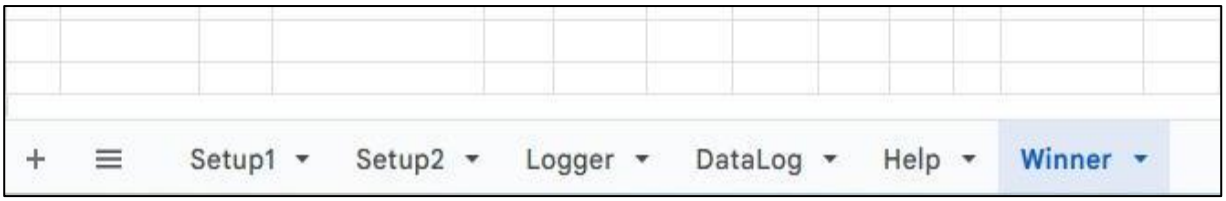


Fig. 2. Tabs in the google sheets of the Jury Evaluation System

3.1 Coding

The Jury Evaluation System was developed using a combination of modern web technologies and Google Workspace tools, with the coding primarily executed through the Extensions feature available in Google Sheets. This allowed continuous integration between the frontend interface and the backend logic within a cloud-based environment, ensuring real-time accessibility and ease of use for all jury members.

On the frontend, the system was built using Bootstrap 5.3, Vue.js 3, and HTML. Bootstrap provides a responsive and mobile-friendly design framework, ensuring that the user interface could adapt to various screen sizes and devices, while Vue 3 enabled the creation of dynamic and interactive components while HTML served as the structural foundation of the interface, defining the layout and elements visible to users.

The backend of the system was powered by Google Apps Script, a scripting platform based on JavaScript, which allowed for custom automation and data handling within the Google Sheets environment. This backend was responsible for processing data entered by jury members, managing user authentication, calculating scores, storing logs, and determining winners based on predefined criteria. By leveraging Google Apps Script, the system could interact directly with the Google Sheet tabs such as Logger, DataLog, and Winner. This enables efficient data flow and reducing the need for external servers or complex infrastructure. Figure 3 shows the Extensions used as the coding in the Jury Evaluation System.

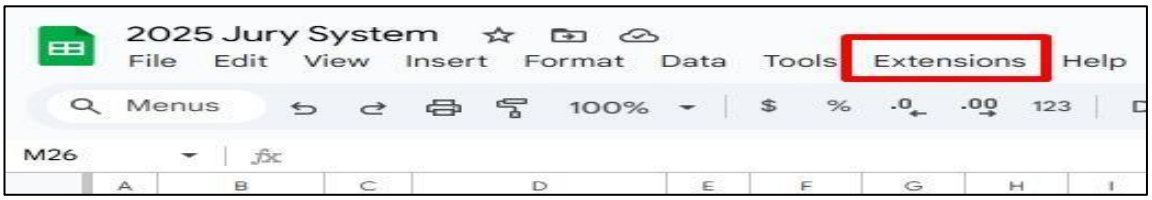


Fig. 3. Extensions used as the coding in the Jury Evaluation System

3.2 Steps in the Jury Evaluation System

Individuals interested in becoming jury members for the innovation competition are required to apply through the official competition website. The selection process primarily considers the applicant's Curriculum Vitae and area of specialization to ensure alignment with the competition's evaluation needs. Successful candidates will receive a confirmation email and will be officially registered into the Jury Evaluation System. Each selected jury will then be assigned a unique User ID and Password, which are necessary to log in and gain access to the system.

To begin the evaluation process, jury members must log in by entering their credentials into the Jury Evaluation System. Before access is granted, the system will verify the login information against the pre-registered data stored in the Setup 1 tab. If the entered credentials match the stored data, the user will be granted access. However, if there is any mismatch, the system will display a "Login Failed" message, preventing unauthorized access.

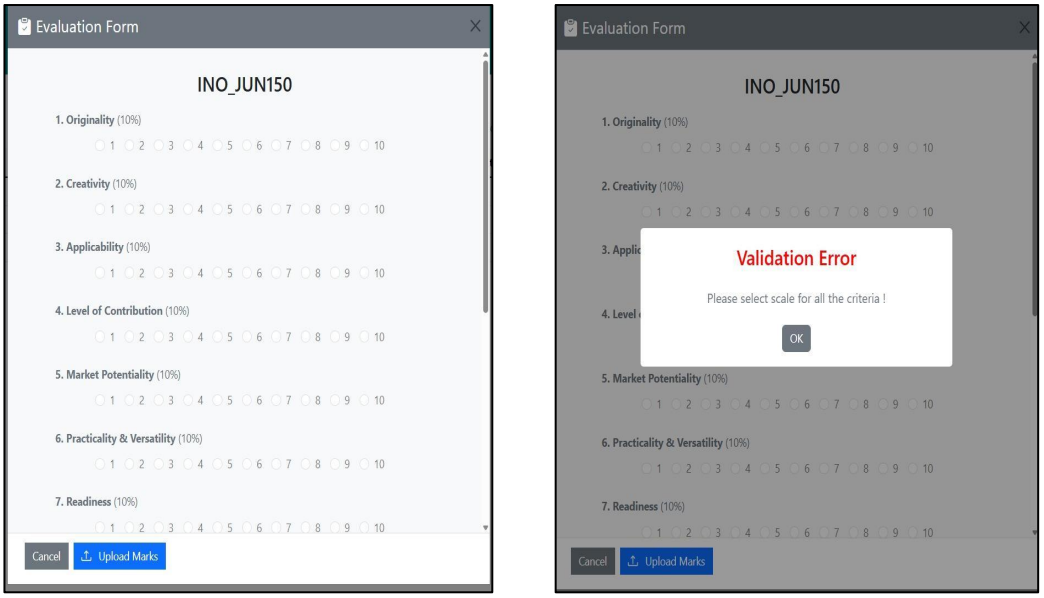
Figure 4 illustrates the interface of the Jury Login Page, where jury members enter their login credentials to begin the evaluation process.

Fig. 4. Jury login page

Once logged in successfully, jury members are granted full access to detailed information about each project they are assigned to evaluate. These project assignments are managed and stored within the Setup 2 tab of the system. Figure 5 provides examples of the projects allocated to individual jury members.

Fig. 5. Examples of assigned project

The evaluation link is used to display the evaluation criteria for each project. Jury members are required to assess the projects based on these specified criteria. Figure 6 presents the evaluation criteria used in the system. All fields must be completed; otherwise, an error message will appear, prompting the jury to fill in the missing information before proceeding.



(a) Evaluation criteria (b) Error message

Fig. 6. Evaluation criteria and error message

After completing the evaluation, the jury member proceeds to submit the marks through the system. This step finalizes the evaluation for the respective project. Upon successful submission, the system will confirm the action by displaying a notification box indicating that the marks have been uploaded successfully. This confirmation message helps ensure that the jury is aware their evaluation has been properly recorded. An example of this confirmation display is shown in Figure 7.

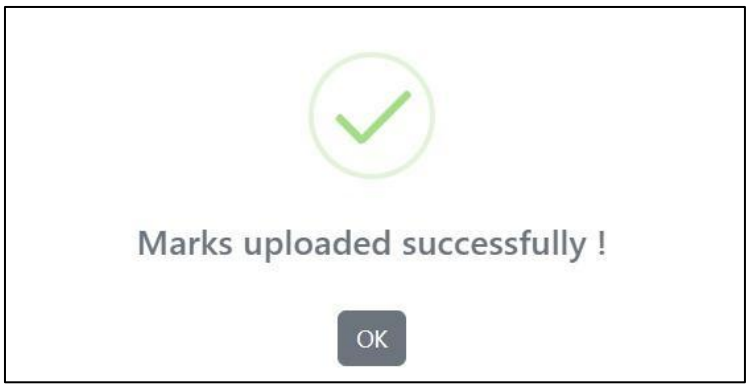


Fig. 7. Notification box of successful marks uploaded

Once the evaluation marks and feedback are submitted by the jury, the data is automatically recorded in the Logger tab of the system. This tab functions as the central repository for all evaluation entries, ensuring that each submission is securely stored and organized. The data is recorded in alignment with the project arrangement, meaning that each entry is placed according to the sequence or order in which projects are assigned and evaluated. This systematic organization helps maintain clarity and makes it easier for administrators to track and review individual evaluations.

Figure 8 illustrates the interface of the Logger tab, showing how the system captures and displays the submitted data in real time.

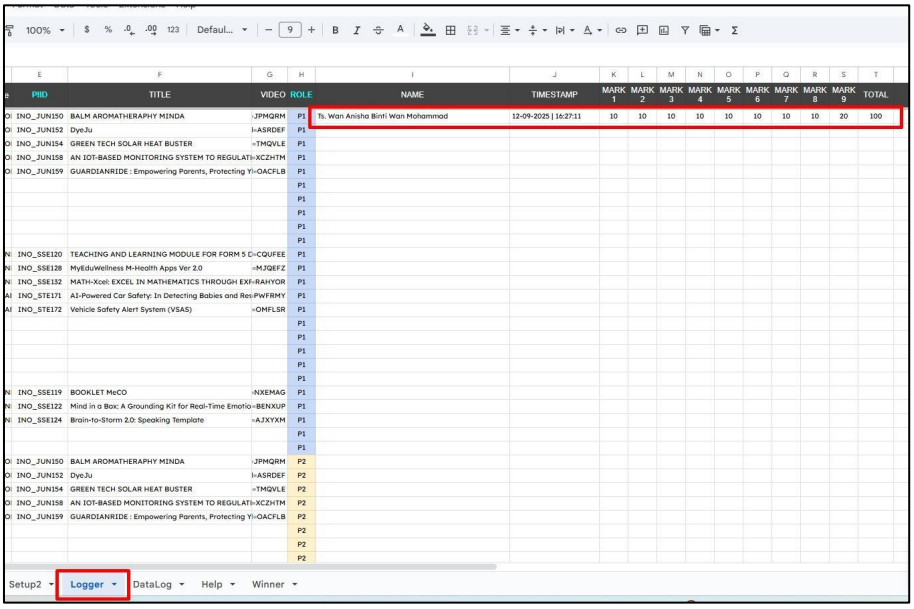


Fig. 8. Evaluation marks stored in Logger

The Help tab offers a comprehensive overview of the evaluation progress by indicating which jury members have submitted their scores for each project. Each project is assigned to a minimum of three jury members to ensure balanced and unbiased assessments. Once the evaluations are submitted, the system automatically calculates the total and average scores for each project. This averaging process helps to maintain fairness and consistency in the results. Figure 9 illustrates the submitted scores and the corresponding average for each evaluated project.

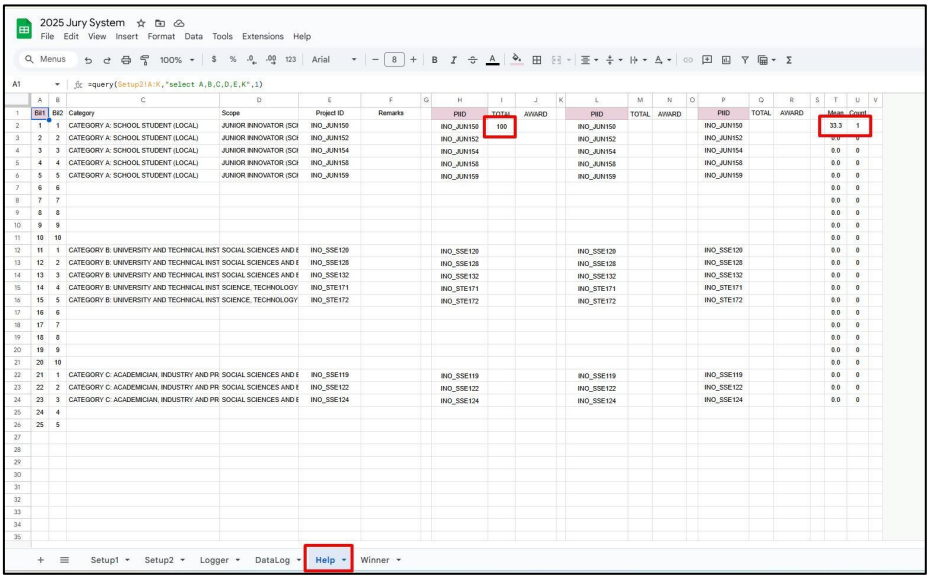


Fig. 9. Scores and average for each project stored in Help Tab

As jury members finalize their evaluations for each assigned project, the system automatically updates the Help tab. When a jury member has submitted scores for all the projects assigned to them, the corresponding cell in the Help tab will turn green. This colour change acts as a clear visual confirmation that the jury member's evaluations are complete. This feature helps to ensure that no projects are overlooked and simplifies the process of monitoring overall progress. By providing an organized and color-coded overview, the system promotes transparency and supports the efficient management of the entire judging process. Figure 10 shows the completed evaluation in Setup 2.

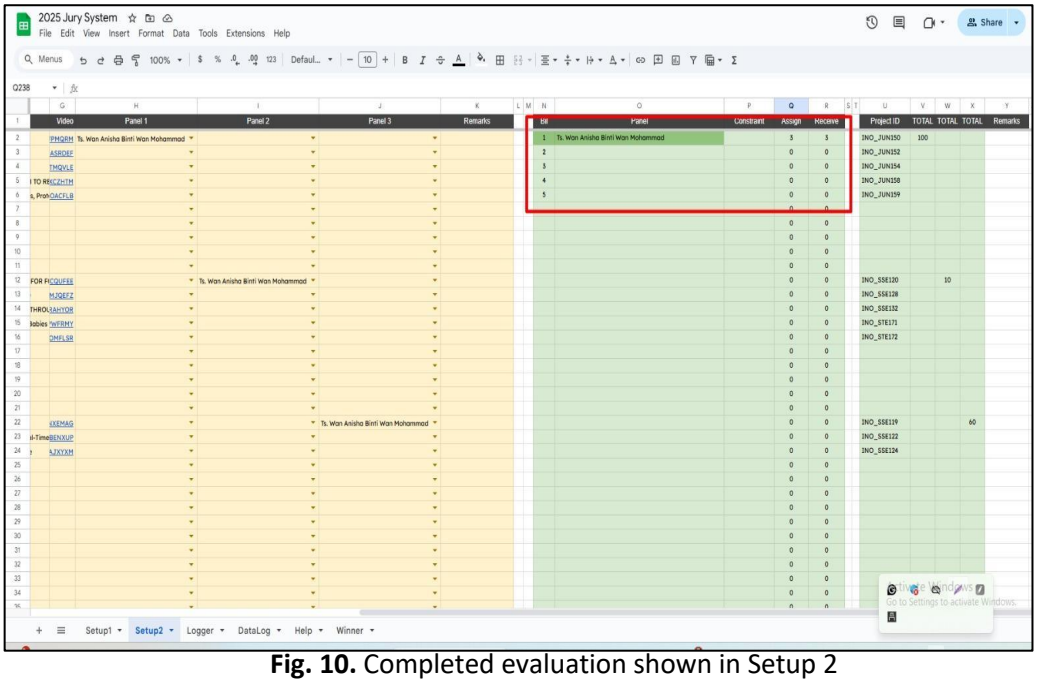


Fig. 10. Completed evaluation shown in Setup 2

To monitor the progress of the judging process, the system will include a feature that displays a chart summarizing the judging status of all jury members. This chart serves as a visual representation of each jury member's progress in completing their assigned evaluations. By providing a clear and organized overview, the judging committee can easily assess how far along the judging process is,

identify which jurors have completed their tasks, and determine who may still have pending evaluations. This functionality does not only enhance transparency and accountability but also ensures that the judging process remains on schedule. Furthermore, it enables the committee to send timely reminders to jurors who may be behind in their evaluations, thereby promoting efficiency and fairness in the overall judging workflow. Figure 11 illustrates the Judging Status based on the jury's progress.

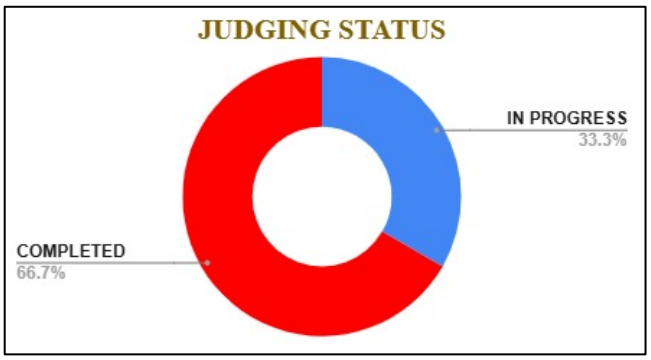


Fig. 11. Judging status based on jury's progress

4. Conclusions

The Jury Evaluation System is designed to provide a robust and innovative solution for addressing the persistent issues of fairness, transparency, and efficiency in the judging process of innovation competitions. The system was developed based on a combination of technologies, specifically Google Sheets, Bootstrap 5.3, Vue.js 3, and Google Apps Script, enabling it to function as an integrated digital platform. This platform not only streamlines data handling and automates scoring but also significantly reduces the potential for human error. The system's modular architectural structure, which includes dedicated tabs for initial configuration, detailed data logging, and result generation, empowers organizers to manage competitions with a high degree of precision, while simultaneously ensuring secure and systematic input from all jury members.

Throughout the development lifecycle, the application of the Waterfall Model ensured a disciplined and methodical approach, spanning from the requirements gathering phase to system maintenance. This structured methodology was a key factor in the formation of a stable, user-friendly, and scalable system, specially tailored to meet the specific needs of jurors, administrators, and event managers. The results from testing and implementation have confirmed the system's capability to alleviate administrative burdens, enhance consistency in scoring, and foster a culture of accountability among judging panels.

Beyond the enhancement of operational efficiency, the Jury Evaluation System also serves as a catalyst for sustainability and digital transformation initiatives in the organization of innovation events, both at the academic and professional levels. Leveraging its cloud-based infrastructure, the system offers broad accessibility and scalability across various institutions and can support both hybrid and fully virtual competition formats. Key features such as role-based access control, automatic result aggregation, and integrated feedback mechanisms clearly demonstrate the system's flexibility and significant potential for continuous improvement.

Despite the significant of the Jury Evaluation System, it does have some limitations. Since it uses Google Sheets for data storage, very large competitions may face issues because each sheet is limited to 10 million cells. Free Gmail accounts also have a 15 GB storage cap shared across Google services, which can restrict long-term data storage. In addition, Google Apps Script has execution time and

quota limits that may affect performance if many jurors use the system at the same time. The system also requires a stable internet connection, and while rubrics reduce bias, they cannot fully remove subjectivity in judging. Testing so far has been limited to a few competitions, so more trials are needed to confirm performance under heavy loads.

For future work, the system could be improved by using Google Workspace (paid Gmail accounts), which offer larger storage, higher quotas, and better administrative controls. This would make the system more suitable for bigger competitions. In the long term, moving to more scalable databases such as MySQL or Firebase could further improve reliability. Other possible improvements include adding offline support, expanding testing to larger events, and exploring tools to detect bias in evaluations. In conclusion, regardless of the limitation, the Jury Evaluation System strives to embody integrity, fairness, and transparency, aligning fully with the demands of digital innovation

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