

Qsign Comparator Ex: Tool for Handwriting Characteristics Analysis

Jay-lyne¹, May S. Escalona²

¹Ph.D. candidate at University of the Cordilleras in Criminal Justice, Baguio city

²Associate Professor of Bachelor of Science in Criminology, College of Criminal Justice Education, Data Center College of the Philippines Laoag

Abstract

The activation of electronic signature commences a new interest in handwriting examination in the field of forensic discipline and the criminal justice community. The study was designed to develop a tool that is more available and usable to the students or trainees in Forensic Questioned Document Examination. Waterfall software development methodology was used in this study which consists of several phases such as requirement, design, implementation, verification and maintenance. This Handwriting Analysis Tool enables the users to experience its features through web browser. Several significant features of this tool are the following; actual signature comparison, navigation, characteristics labelling, snapshot and the over-all conclusion of the examination. This effort may increase the technical competency of the students in a specific handwriting examination.

Keywords: QSign Comparator-Ex. Handwriting Analysis Tool, Questioned Document Examination, Signature comparison, Characteristics, web-based application

1. Introduction

1.1 Background of the Study

The field of forensic evidence is founded on the application of scientific principles along with the laboratory techniques with involvement of various other branches of natural sciences. The priority tasks of the law enforcement in the field of criminalistics is to develop innovative principles of forensic support that has a promising practical opportunity that will optimize the activities of the body and their judicial trial; (Shevchuk, V. (2021), innovations are component of forensic support for investigation of criminal offenses and in the structure of the latter new modern forensic knowledge and skills acquire special significance.

The study of Angel, M.J.S.K., 2020 states that, computer-generated documents are prevalent, and electronically-captures signature are at the new trend of daily transactions. As presented by (Guarnera et al., 2017) an automated tool in handwriting documents is an aid for forensic experts. This allows the detection of elements like texts lines, words and character. The comparison also includes of handwriting or hand-printing; detection of alterations or photocopier and computer manipulations; restoration or decipherment of erased and obliterated writing; visualization of latent impressions; the identification of printing processes; and differentiation of inks. The work of Abdulbaq et al., 2021 supports that the current age of digitalization, recognizing the writer of a handwritten text plays an important role in information proceeding. Handwriting recognition aims to enable the machine to recognize the

handwritten characteristics based on the digitalized images. Recognizing the potential value and applicability of hybrid learning frameworks within the criminal justice with the opportunity to explore how technology could aid in forensic science teaching and education with more focus and vigor. With the modern application for iOS, Android smartphones and web-application the criminal justice system is also developing its direction of introducing innovative information and digital forensic investigation. For example, CEDAR the Center of Excellence for Document Analysis and Recognition at the University at Buffalo. CEDAR- FOX software has capabilities for interaction with the questioned document examiner to go through processing steps such as extracting regions of interest from scanned document, determining lines and words of text, recognize textual elements (*Cedar Fox Questioned Documents - a Technology Transition Workshop | Office of Justice Programs, 2007*); MovAlyzer a mobile education tool for FDEs, this application accurately record handwriting, allowing FDEs to visualize movements in time. It can process scanned images, segmenting them into visual strokes. By this, FDEs can improve their experience in recognizing speed and pen pressure from handwritten documents by recording handwriting movements on a pen tablet using an inking pen (*NeuroScript Handwriting Analysis Software for Forensic Document Examiners, 2016*). Meanwhile, (Mohammed, 2021) developed a Handwriting Analysis Tool or HAT, this software is used to analyse handwriting styles of different scribes and sort them according to their similarity to specific (possibly unknown) handwriting styles. A similarity score will be produced for each of the different handwriting styles (scribes) so that the user can have a relative comparison between the similarities of handwriting styles with respect to specific handwriting styles (possibly from unknown scribes).

1.2 Statement of the Problem

The gap between the conventional practices and latest technology requires serious attention both AI community and experts in signature characteristics analysis. At one point, Stovpets, O. (2022) states that, real physical model of a forensic polygon and its virtual analogues for the purposes of training is possible. The wider use technologies in the equipment of forensic training grounds will hold a growing digital diversification of forensic. Trainers, experts and learners shall adapt new technologies in the field of signature and handwriting analysis due to the apparent trend of modern crime needs for a modern criminalistics innovation, as well as the new approaches to criminalistics training to experts and investigating officers (Savel'eva et al., 2021). This study is designed to develop a tool for handwriting characteristics analysis for not only criminology students but also for those who are taking specialization in Signature and Handwriting characteristics analysis. The main research question was: What is the systems architecture of the QSign Comparator-Ex Tool?

2. Methods and Design

The Software Development Lifecycle (SDLC) is a systematic process that gives a step-by-step approach that produces well-structured software (Altvater, A., 2021) This also provides a framework for technical and non-technical activities to deliver a quality system that manages decision-making progression. The Waterfall Model is a classified model used in the system development life cycle to create a system with a linear and sequential approach. This means that any phase in the development process begins only if the previous phase is completed. Thus, this method works in a chronological manner that relies on fixed requirements, dates, and outcomes. In this model, the phases do not overlap.

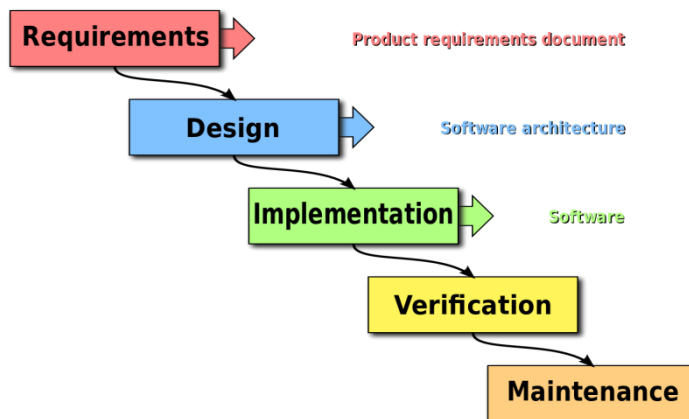


Figure 1. Waterfall Software Development

Requirement Analysis

This phase involves the data collection, user requirement and the operational requirements in developing the system. The purpose of this phase is to capture all the requirements, understand and conduct a feasibility test to ensure that the requirements are testable or not. This includes the assumptions, possible risks, costs and timeframe.

The researcher gathered all the necessary information to identify the needs in developing the system. One of the most important requirements in developing, design and full implementation of a system is sufficient financial resources. This is also involved in conducting interview to the target users. Taking considerations to the possible risk or assessing the expectations of the end users. Anticipating and resolving conflict is valued in this phase.

System Design

The system design is created to achieve the project result. This includes the conceptual diagrams, system architecture, features and characterization of the system, HTML screen designs, photo impressions, prototypes and UML schemas (Halwai, S.,2021). The key activities of the design phase are SDLC includes User Interface (UI), design review, technical design creation, and quality verification and validation (Kovalenko, O.,2022).

This phase, the researcher conceptualized the process and features of the system. The concept is solely based from the manual process of examination of characteristics of signature. It was then put into a prototype design to illustrate the features and its functions. Communicating with the team is vital in discussing the relationship between various characteristics of the system development process and its improvement.

Implementation

The purpose of the implementation phase is to deploy and enable operations of the new information system to satisfy its usability, which is referred to as Unit Testing. Target users are the Criminology students. This phase may overcome the implementation barriers, increase the pace and effectiveness of implementation and sustain interventions over time.

The researcher conducted alpha testing of the system. In this phase, the researcher let the faculty to navigate the systems interface, features and functions. This intend to ensure that the system is functioning.

Verification

Verification is a process of checking the work-products of a development cycle to decide whether the products meet the specified requirements. The main goal of the verification process is to ensure quality of software application, design and architecture. This can be done through reviews, walkthroughs, inspections and desk-checking. (Hamilton, T.,2022).

Maintenance

This phase occurs after the product is in full operation. Maintenance of software involves software upgrade, repairs, and fixes of the software if it breaks. This will help address any bugs that may still be present in the system.

3. Result

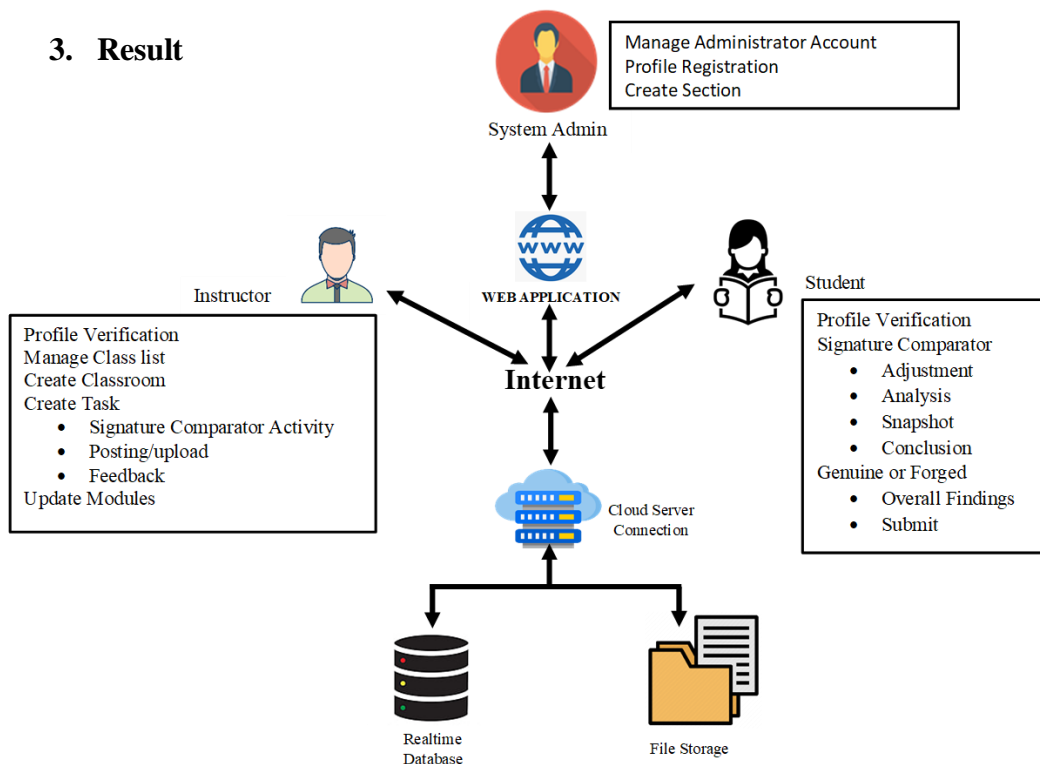


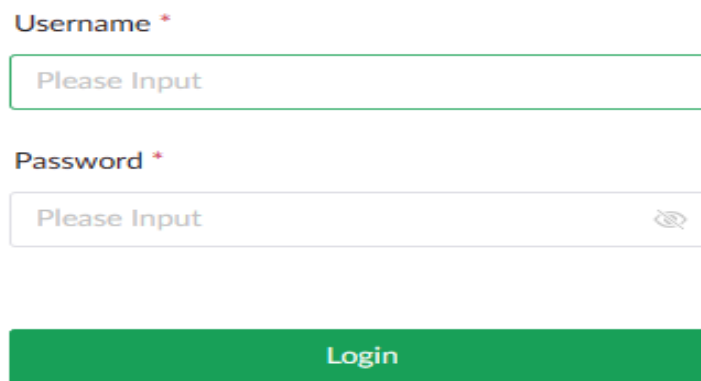
Figure 2. System Architecture of the Qsign Comparator-Ex Tool

In figure 2, it illustrates the system architecture of the application, the student, instructor and system admin. To access the system’s server, internet connection is necessary. This web application requires a username account both the instructor and student to access their profile. The instructor manages the class list and create task in signature comparator tools, while the student enables to access and comply with the required task given by the instructor using the adjustment features; analysis and; characteristics label. Snapshots is used to capture the analysed characteristics for the purpose of comparing the similarities and dissimilarities between the questioned handwriting and the collected seven (7) standard handwriting along with the required conclusion each after analysis. If the questioned handwriting is genuine, the student is required to give justification of his/her findings which will be considered as the overall findings of the examination, then submit, vice versa. The instructor will then view and can leave comments and scores to the submitted activity.

The application uses a cloud server connection which provides the services in authenticating the mobile application users and to access the database, and file storage of the system. The system admin uses a web application in managing the data provided by other users.

QSign Comparator-Ex: Handwriting Characteristics Analysis Tool

This section illustrates the features of QSign Comparator-Ex Tool.



The login form consists of three main elements: a 'Username *' field with a placeholder 'Please Input', a 'Password *' field with a placeholder 'Please Input' and a toggle icon for visibility, and a green 'Login' button.

Figure 3. Log in. *The user is provided with username account to access the given task. This provides security of students and instructors' profile.*

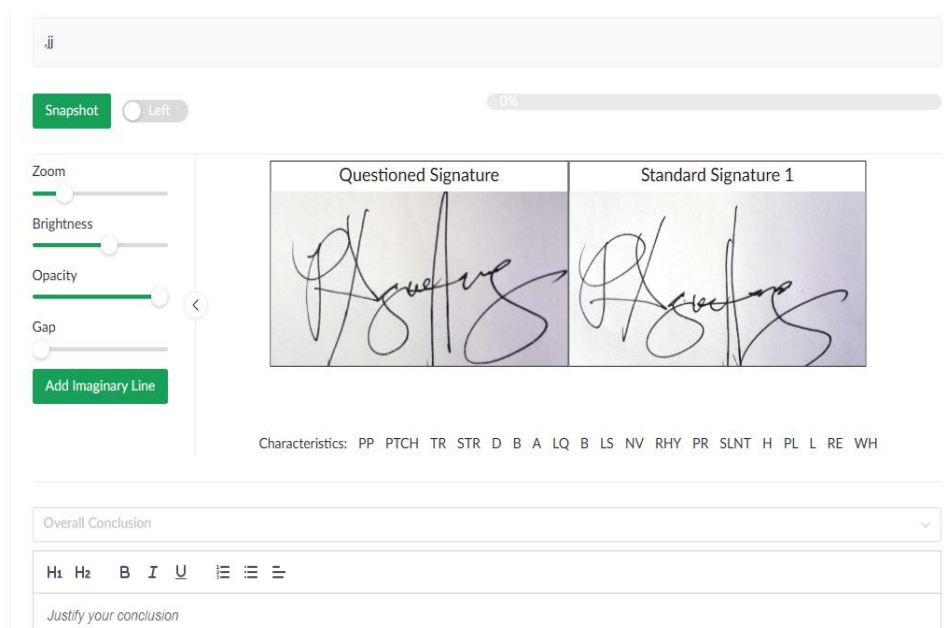


Figure 4. Actual interface of signature comparison.

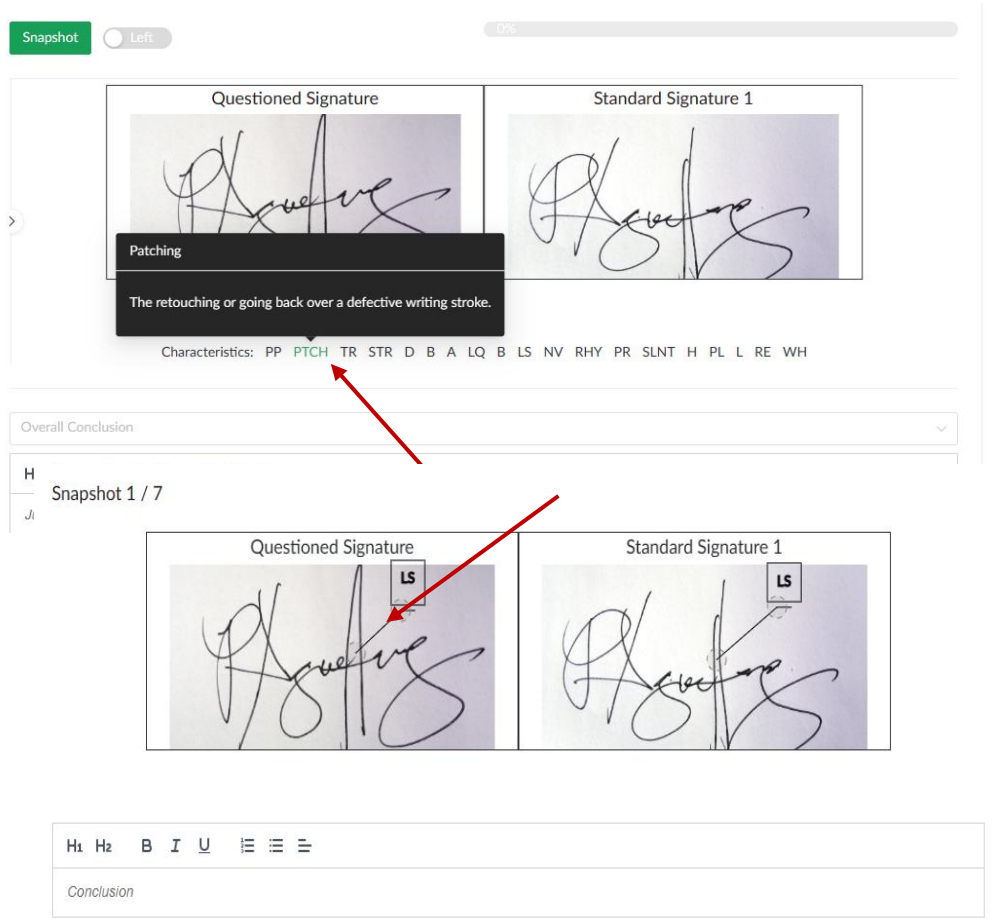


Figure 5. Characteristics Labelling.

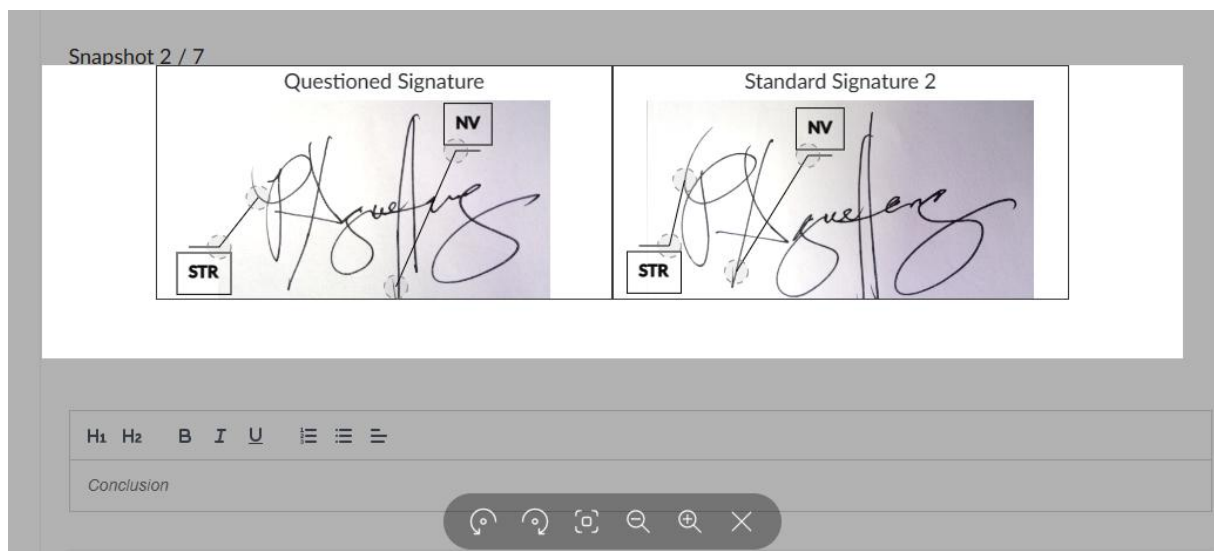


Figure 6. Snapshot and overview of the examined Questioned and Standard Signature.

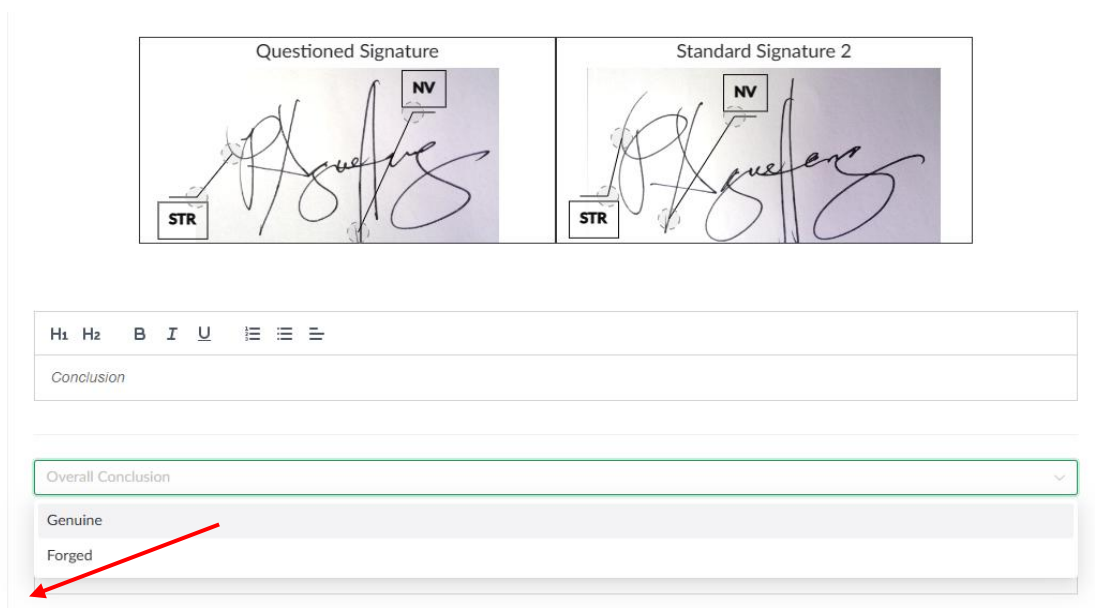


Figure 7. Overall Conclusion. Upon analysing the dissimilarities and similarities of the handwriting characteristics. The student shall select whether the handwriting/signature is genuine or forged.

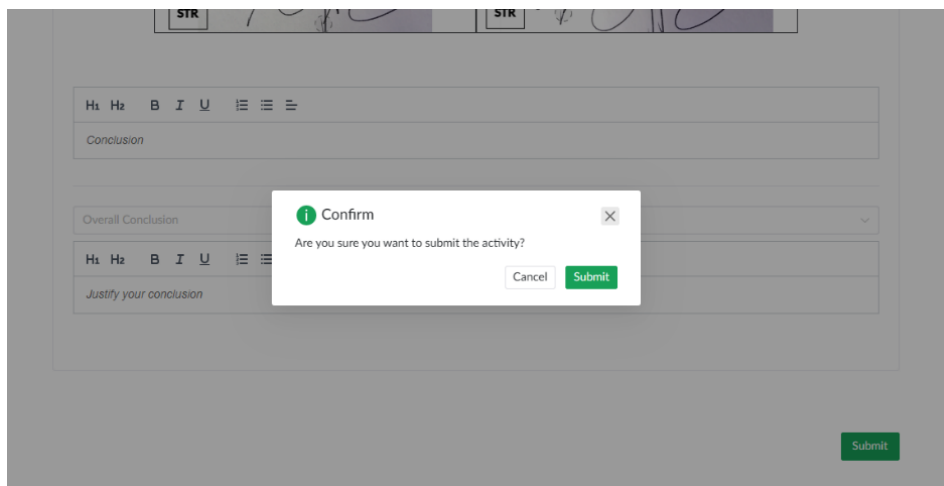


Figure 8. Submit Task. The student may submit the completed task.

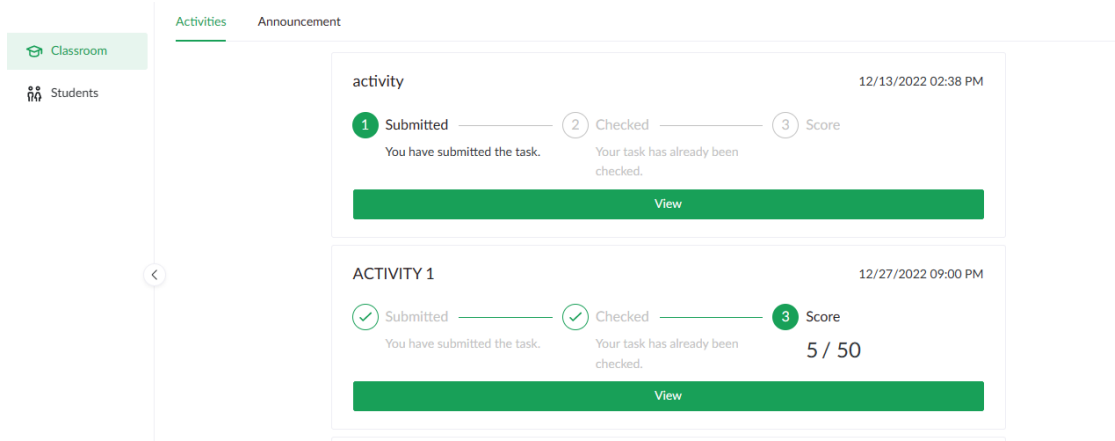


Figure 9. View Feedbacks and scores. The instructor is responsible in viewing and giving feedback and scores on the completed task.

Discussion

The essence of innovative principles of forensic in law enforcement be considered on the specific type of innovative forensic activity. A new forensic knowledge and means (technical, tactical, methodological and forensic ones) and constant readiness of pre-trial investigation bodies to solve forensic issues using innovative forensic products; is to know they should carried out in order to optimize, improve efficiency and quality of investigation, hearings and crime prevention (Stovpets, O. (2022). To develop practical skills in the work of a forensic specialist, it should be used training facilities, simulators, and various specific techniques (Stovpets, O. (2022). Primarily the forensic testing ground (i.e. the criminalistics polygon) helps to implement a practical approach to learning. The criminalistics polygon serves as a place for experiential training sessions and for practicing exercises. According to the research and analysis of (Morocho et al., 2016), it is noted that, merging the benefits of a manual and an automatic system of signature recognition could lead to the development of a high-performance automatic system with human oversight; (Morocho, Morales, et al., 2016) there is a potential of these recognition schemes in applications involving human intervention.

4. Conclusion and Recommendation

This newly developed web-based application QSign Comparator Ex tool for handwriting characteristics analysis is a benchmark in solving problems involving criminalistics area such as technical and tactical forensics. Hence, the researcher highly recommends to adapt this application to allow learners and experts in simulating the system. The existence of this tool may give awareness to the questioned document examination field experts community and their feedbacks for further improvement of the system.

Declaration of conflict of interest

The author declares that there is no conflict of interest

Acknowledgements

The author acknowledges Data Center College of the Philippines Laoag City for funding this developmental research.

References

- Morocho, D., Proaño, M., Alulema, D., Morales, A., & Fierrez, J. (2016). Signature Recognition: Human Performance Analysis vs. Automatic System and Feature Extraction via Crowdsourcing. *Lecture Notes in Computer Science*, 324–334. Retrieved December 28, 2022, from https://doi.org/10.1007/978-3-319-39393-3_32
- Morocho, D., Morales, A., Fierrez, J., & Vera-Rodriguez, R. (2016). Towards human-assisted signature recognition: Improving biometric systems through attribute-based recognition. *2016 IEEE International Conference on Identity, Security and Behavior Analysis (ISBA)*. Retrieved December 28, 2022, from <https://doi.org/10.1109/isba.2016.7477227>

Software Development Life CYCLE- Waterfall Model.
(2022).Tutorialspoint.https://www.tutorialspoint.com/sdlc/sdlc_waterfall_model.htm

- Halwai, S. (2021, February 20). *SDLC Design Phase – Everything You Need to Know*. OpenXcell. <https://www.openxcell.com/blog/design-phase-in-sdlc/>
- Kovalenko, O. (2022, February 21). *SDLC Design Phase: Definition, Activities, Goals [2022]*. IDAP Blog. <https://idapgroup.com/blog/sdlc-design-phase/>
- Implementation Strategies / The.* (2012). CES Guide to Implementation. <https://implementation.effectiveservices.org/strategies>
- Shevchuk, V. (2021). Innovative principles of forensic support of law enforcement activity: issues of concept formation. *Theory and Practice of Forensic Science and Criminalistics*, 23(1), 7–23. Retrieved December 30, 2022 from <https://doi.org/10.32353/khrife.1.2021.01>
- Guarnera, L., Farinella, G. M., Furnari, A., Salici, A., Ciampini, C., Matranga, V., & Battiato, S. (2017, September). GRAPHJ: a forensics tool for handwriting analysis. In *International Conference on Image Analysis and Processing* (pp. 591-601). Springer, Cham.
- Abdulbaq, H. A., Mohialden, Y. M., & Jabbar, Q. A. Z. (2021). A Comparison of Handwriting Systems Based on Different Style Characteristics. *Intelligent Systems and Networks*, 641–653. https://doi.org/10.1007/978-981-16-2094-2_74
- Angel, M. J. S. K. (2020, December 22). *Forensic Document Examination in the 21st Century / Miriam Angel, Jan.* Taylor & Francis. Retrieved December 27, 2022, from <https://www.taylorfrancis.com/books/edit/10.4324/9780367853587/forensic-document-examination-21st-century-jan-seaman-kelly-miriamangel?refId=d4df7cc4-8281-4782-87db-7ba9c41625dc>
- Tools for measurement, recording, storage and movement analysis. movement analysis software solution for recording, storage, comparison, and analysis of handwriting and drawing movements, human fine motor control, with arm, hand, and fingers. (n.d.). *NeuroScript - ScriptAlyzeR - Handwriting Analysis Software System*. <https://neuroscript.net/scriptalyzer.php>
- Cedar Fox Questioned Documents - A Technology Transition Workshop | National Institute of Justice.* (n.d.). National Institute of Justice. <https://nij.ojp.gov/library/publications/cedar-fox-questioned-documents-technology-transition-workshop>
- Hamilton, T. (2022, June 4). *Difference Between Verification and Validation with Example*. Guru99. <https://www.guru99.com/verification-v-s-validation-in-a-software-testing>. Retrieved December 28, 2022
- Corrales, E. (2022, June 10). *What is the Waterfall Software Development Methodology?* Developer.Com. <https://www.developer.com/project-management/sdlc-waterfall-model/>