ArtisanAI: An AI-Enhanced Crochet Assistant

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ABSTRACT
Crochet making is a hobby that is on a rise in popularity especially during the pandemic period where everyone was forced to stay within their households. Stitch counting is one of the most crucial steps in the process and is considered to be error-prone for crochet artists. Mistakes with manual stitch counting often lead to miscounts, frustration, or even affect the project output. This study aims to develop a trained artificial intelligence model that can aid crochet artists in the stitch counting process. Based on studies of available convolutional neural networks, Yolov8 computer vision model was selected for data training of crochet stitch images. It is included in a progressive web application that presents community engagement and creativity and its deployed website was tested by crochet artists from the Philippines. The website was successfully deployed using Heroku and ISO 25010:2011 software quality model is used to evaluate the progressive web application. The overall mean of the ISO Evaluation, computed by getting the average of all the mean scores of the individual criteria, is 4.50. This overall mean falls within the "Satisfied" range, affirming that the application meets the specified ISO standards and requirements. The results indicate that ArtisanAI, the created progressive web application, is beneficial for crochet stitch counting, invites creativity, and community engagement. An improved model version can be made through an expanded dataset and dedicated high-power computer for training.

CCS Concepts: • Computing methodologies ~ Artificial intelligence ~ Computer vision ~ Computer vision problems ~ Object detection • Information systems ~ World Wide Web ~ Web applications ~ Social networks • Human-centered computing ~ Interaction design ~ Interaction design process and methods ~ User centered design • Information systems ~ World Wide Web ~ Web searching and information discovery ~ Social recommendation

Keywords: *Computer Vision, Object Detection, Progressive Web App*

1 INTRODUCTION

The craft of crochet often involves the repetitive task of counting stitches, which can be time-consuming and prone to errors, hindering the efficiency of the process. Manual stitch counting poses challenges for crochet enthusiasts, especially when working on projects with a large number of stitches. A writer for the crochet magazine Happily Hooked, the need for stitch counting is crucial to avoid mistakes in crochet projects, especially when a project has a large number of stitches [1]. Human error, distractions, and the need to constantly shift attention between the project and the stitch count can lead to miscounts and frustrations. A possible approach to these challenges is computer vision technology. Automated stitch counting systems could be developed by utilizing recent developments in image processing, machine learning, and object detection. A model can be trained to identify multiple objects in one image and draw bounding boxes around each region of interest (Sturdevant, 2019) [2]. By leveraging computer vision object detection techniques, models can be trained to detect and count crochet stitches. Convolutional Neural Networks (CNNs) are particularly suited for this task due to their ability to learn complex visual patterns and their object detection and classification abilities (Maheshwari, 2019) [3]. The proposed system will utilize CNNs for stitch detection and counting, leveraging their ability to process images and identify and extract features from images. The objective of this study is to develop an AI-enhanced crochet assistant application that offers various crochet tools and resources, including an object detection powered stitch counter.

2 RELATED LITERATURES AND STUDIES

Complex algorithms are enabling new levels of design, engineering, and artistry. It is no secret that technology is becoming a more integral part of our lives, and that its impact is spreading to the realm of art [4]. Despite the skepticism of some, Alkhaldi (2022) discusses several ways that technology is being used in the arts [5]. It can assist artists at various phases of the development of their projects. Rather than depending on robots to complete projects on their

own, artists may utilize them to help with the creation process.

Recommender systems are used to suggest items to users based on their past behavior or interests. Content-based filtering uses the features of the items themselves to make recommendations to a user. Content-based filtering is less effective at making accurate recommendations, but it is better at recommending new items to users. The choice of which method to use for a particular recommender system will depend on the specific requirements of the system [6]. Modern APIs are used in the development of Progressive Web Apps (PWA), which help give improved features including dependability, functionality, and installability without taking up a lot of storage space [7].

Rahman et al. (2022) introduced an innovative integration of deep learning and the Internet of Things (IoT) in waste management [8]. Their architecture combined a convolutional neural network (CNN) with IoT technology for waste classification and real-time data monitoring. A smart trash bin design with microcontroller and sensors allowed real-time data control and monitoring through an Android application. The proposed system achieved high classification accuracy of 95.3125% and a positive system usability scale (SUS) score of 86%, showcasing its potential for household waste monitoring.

Khalid et al. (2023) employed Yolov8, a cutting-edge deep learning model, to concentrate on early pest identification in agriculture [9]. After testing several models, Yolov8 performed better than the rest, achieving an 84.7% mAP, and was included into an Android app for real-time pest identification. This study provides a useful method for improving agricultural pest management through the application of cutting-edge deep learning algorithms.

Thanh and Thu (2023) conducted a study that emphasizes how well YOLOv8 performs in a range of scenarios requiring accurate object detection [10]. The YOLOv8 model is used in the study to recognize objects in computer vision tasks. A peak accuracy of 95% was found during testing for large items, but only significantly lower (27.5%) for small or veiled ones.

3 DESIGN ARCHITECTURE

3.1 SSystem Design

Figure 1.0 shows the system architecture of ArtisanAI: An AI-Enhanced Crochet Assistant Progressive Web App. The user will provide the input needed in the system and interact with the application's various features. They will see the client-side of the application by accessing it using any platform, since the application is a Progressive Web App (PWA) that is designed to have a responsive and user-friendly interface. To access the app, an internet connection is required initially at first launch, but after the first launch some of the functionality of the application will be accessible even if the device is offline using PWA service workers. Different services and processes take place in the server-side of the system including user authentication, user profile, projects, stitch counter, crochet library, and community related processes. The stitch counter is an AI-enhanced object detection feature using a trained deep learning CNN model. Finally, the database includes the storage for various data used in the application such as user data, crochet library data, and data shared to the community.

3.2 FINAL EVALUATION

The assessment procedure follows the guidelines set forth in the ISO 25010:2011 standard, which encompasses criteria for Functional Suitability, Usability, and Portability. Evaluation involves gathering feedback from 52 respondents during the final phases of assessment. Utilizing the Likert Scale outlined in Table 1.0, each respondent is provided with an evaluation form. This form serves to gauge overall satisfaction and experiences concerning the successful implementation of all objectives within the progressive web application.

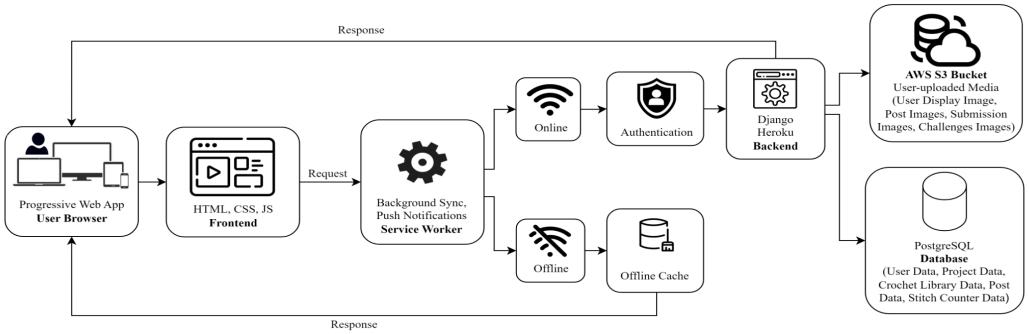

Figure 1.0. System Design of ArtisanAI

Table 1.0: Likert Scale

Numerical Scale	Descriptive Rating
5	Excellent
4	Very Good
3	Satisfactory
2	Fair
1	Poor

4 RESULTS AND DISCUSSION

The survey questions found within this part are included in the online forms made for the final evaluation of the progressive web application and details the experience of crochet artists while using the application. 52 respondents accomplished the system evaluation that utilized the ISO 25010:2011 software quality model.

4.1 FUNCTIONAL SUITABILITY

Figure 2.0 presents the results for the characteristic Functional Suitability of ISO/IEC 25010 wherein the system is complete, correct, and appropriate. The figure shows that 9.7% of the total respondents rated the system as satisfactory. Very good was given by 43.5% of the population and the rest of the 54.5% agreed that the system is excellent in terms of its functional suitability.

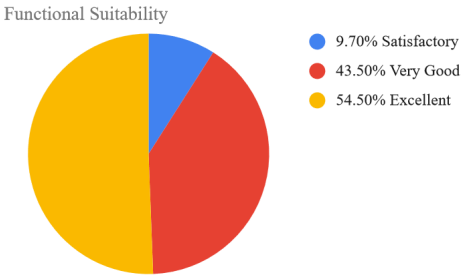

Figure 2.0: Pie Chart that visualizes the Functional Suitability of the Progressive Web Application

4.2 Usability

Figure 3.0 presents the results for the characteristic Usability of ISO/IEC 25010 wherein the system is easy to learn, navigate, and cater to different kinds of crochet users.

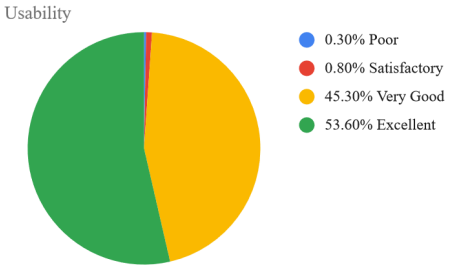

Figure 3.0: Pie Chart that visualizes the Usability of the Progressive Web Application

The pie chart presented shows that the majority of the population at 53.6% agrees that the application is excellent for this characteristic. 45.3 agrees that the performance was very good and only minimal respondents rated it as satisfactory and poor.

4.3 Portability

Figure 3.0 presents the results for the characteristic Portability of ISO/IEC 25010 wherein the system is capable of adapting to future technologies, its competitiveness to similar applications, and capability to be installed and uninstalled to devices conveniently.

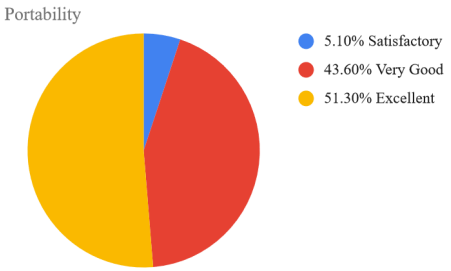

Figure 4.0: Pie Chart that visualizes the Portability of the Progressive Web Application

More than half of the population at 51.3%, confirms that the progressive web application is excellent for the portability characteristic. It is followed by the 43.6% percent that believes that it is very good and only 5.1% graded it as satisfactory for the respective characteristic.

4.4 Evaluation Results

The project underwent testing in accordance with ISO 25010. It was created as a method for evaluating the quality of software products. The five quality attributes that make up this ISO model can be used to evaluate the software's level of quality. The result of the functionality of the study "ArtisanAI: An AI-Enhanced Crochet Assistant", using the ISO are the following. The Functional Suitability of the progressive web application has a mean of 4.53, the Usability of the application has a mean of 4.52, the Portability of the application also has a mean of 4.46, which means that in terms of the characteristics functional suitability, usability, and portability, ArtisanAI progressive web application performed excellently at these categories.

4.5 Project Evaluation

The researchers conducted an evaluation through means surveys. All the questions in the survey form and evaluation form can be seen on this. The application was evaluated by the following criteria: Functional Suitability, Usability, and Portability.

Table 2.0: Numerical Scale

Numerical Scale	Descriptive Rating
5	Excellent
4	Very Good
3	Satisfactory
2	Fair
1	Poor

Table 2 displays the numerical scale associated with the qualitative interpretation of the Likert scale shown in Table 1. "Excellent" encompasses values from 4.51 to 5.00, "Very Good" spans from 3.51 to 4.50, "Adequate" falls within the range of 2.51 to 3.50, "Fair" ranges from 1.51 to 2.50, and "Poor" covers the range of 1.00 to 1.50. Table 3.0 shows the overall mean of the ISO Evaluation, measured by taking the average of all the mean scores of the individual criteria, is 4.50. This overall mean falls within the "Excellent" range, affirming that the application meets the specified ISO standards and requirements.

Table 3.0: Summary of Results

Criteria	Mean	Interpretation
Functional Suitability	4.53	Excellent
Usability	4.52	Excellent
Portability	4.46	Excellent

5 CONCLUSIONS AND RECOMMENDATIONS

Considering the challenges identified in the Statement of the Problem, the following conclusions were made:

1. Through the development of a progressive web application, the researchers produced an automatic stitch counter that is powered by computer vision and object detection. The stitch counter aids in the task of manually counting stitches in a crochet project and reduces the chances of committing errors, avoids the possibilities of losing track of stitch count, and improves the overall efficiency of crochet making process. Crochet artists can focus their energy on other aspects of crochet making because they are supported in one of the most crucial steps.
2. Through the development of a progressive web application, the researchers constructed a social media style feed that has a recommendation feature using content-based filtering. Crafter's block can be resolved because users can be motivated or inspired by projects that are significant to them. The crochet project preferences and user skill level will influence the experience of every user and further improves every time they interact with other users and their posts.
3. Through the development of a progressive web application, the researchers successfully created a platform of engagement for crochet users by having community challenges that ignites creativity and content sharing between users. The capability of offering seasonal themes and unique user profile personalization resolves the issue of user engagement because they can share their ideas, express their personality, and allow more avenues of interaction within the application.

For future development of similar applications, the researchers suggest a diverse and increased number of datasets because it can improve the performance of the model. A dedicated high-power computer used for training the model and additional features such as challenge perks, marketplace, and a moderator account can further enhance the experience of each user.

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