RESEARCH ARTICLE

SMARTCROCHET: AN AI-DRIVEN MOBILE PLATFORM FOR AUTOMATED CROCHET PATTERN GENERATION, YARN PREDICTION, AND COST ESTIMATION

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Abstract:

Crochet is a widely practiced handwork that needs proper planning in design and material selection, and cost estimation. Preparation by traditional project methods can be very time-consuming rather tedious and error-prone, especially for beginners. The present study proposes SmartCrochet- an AI-driven Mobile platform for simplifying the process of planning and executing crochet projects. The system provides four key functionalities: crochet pattern/design generation with integrated yarn and hook recommendations, yarn quantity estimates, project cost estimates, and pattern storage and organization. Using AI models, the platform generates customizable, step-by-step patterns while suggesting appropriate yarn types and hook sizes based on project complexity. Regression-based models predict yarn requirements to reduce material wastage and support efficient purchase planning. Cost estimation is carried out by integrating the predicted yarn consumption with current market prices helps the end-user control project budgets. Users can also save and arrange patterns in a digital library for easy retrieval, and for future use. SmartCrochet will enhance creativity, improve efficiency, and make crochet more accessible to both beginners and experienced enthusiasts, and showcasing what AI has to offer in creative craft applications.

Keywords: Smartcrochet, AI-Based Crochet Application, Crochet Pattern Generation, Yarn Prediction, Hook Size Recommendation, Cost Estimation, Pattern Storage, Digital Craft Management.

1. Introduction:

1.1 Background

The use of crochet is one of the more popular manifestations of handmade crafts, which involves imagination and technical prowess, whereby the maker prepares the patterns, materials, and tools in advance. Traditional crochet project design involves manual calculations of yarn requirements,

selecting the right hook size, and even cost estimation of the project-all these being very time-consuming, error-prone processes. Many times, the pattern decisions are made by trial and error or from posts on community forums, leading to inconsistent results among the users, especially for complete beginners. With the permeation of AI into more and more creative activities today, opportunities have opened up for more efficient creation and expanded access to handmade crafts by way of intelligent digital tools. The AI-driven systems have shown remarkable promise in design automation, pattern generation, and material optimization, all of which make them ideal candidates for transforming craft-based workflows. So, the integration of AI with crochet modernizes not only the process itself but also democratizes it for users with varying skill sets.

1.2 Research Objectives

In this regard, the major objective of this research is to construct SmartCrochet, an intelligent mobile platform that will support end users in all phases of crochet project planning and execution-from conceptualization to completion-by integrating intelligent computation, automation, and resource optimization to enhance creativity, efficiency, and accuracy. This general objective can be achieved through focusing on the following concrete objectives:

i. Develop an AI-based system that generates custom crochet patterns.

The idea is to design a model that can generate customized patterns based on user-defined, including project type, such as scarf, blanket, or bag; preferred dimensions; motif or stitch style; and the user's skill level. The system should be able to guarantee pattern complexity that matches user capability while allowing creativity and usability.

ii. Recommend suitable yarn types and hook sizes for each generated pattern.

The platform gives material recommendations by analyzing selected project and pattern characteristics, considering industry standards and crafting best practices that enable users to select appropriate tools for enhanced quality of the final product, ensuring consistency in its structure.

iii. Estimate yarn quantity needed for each project to minimize material wastage.

An intelligent prediction model that approximates the amount of yarn, based on pattern density, dimensions, and stitch types, is developed. Accurate estimation further supports sustainability by minimizing excess materials and helps users avoid interruptions caused by insufficient supplies.

iv. **Estimate overall project costs based on predicted material requirements and current market prices.**

Building on its pattern generation and yarn prediction, SmartCrochet will also estimate overall project costs by integrating predicted material requirements with current market prices. This should enable users to plan their budgets effectively, make informed choices of materials, and optimize the balancing of cost versus quality for efficient execution of their projects.

v. Enable storage and organization of generated or imported patterns in digital format.

SmartCrochet will also include a structured pattern management system that allows users to save, categorize, retrieve, and edit previously generated or externally sourced patterns. This will ensure long-term accessibility, better workflow continuity, and improved project tracking.

1.3 Significance of the Study

SmartCrochet aims to offer a bridge between traditional crochet practices and modern AI technologies in several ways:

- Improves efficiency and accuracy in creating patterns and estimating material.
- Precise prediction reduces material wastage and hence project costs.
- Guides complete beginners and advanced crocheters in simplifying the processes of planning and design.
- AI applications in creative crafts bring about a basis on which the development of intelligent craft tools can be done.

Additionally, SmartCrochet introduces structure into learning crochet techniques. For beginners, it is always tricky to follow complex written patterns; automated step-by-step pattern generation may ease cognitive load and make the learning curve easier. For professionals or small business owners, material prediction and cost planning can support consistent product pricing, inventory planning, and customer order management. Thus, the system is of great value not only for single hobbyists but also for micro-entrepreneurs engaged in handmade crochet product sales.

2. Literature Review:

2.1 AI in Creative Crafts

Applications of artificial intelligence have lately grown in creative domains such as music, painting, and textile design. Generative models can be used to automatically generate patterns, motifs, and designs, including LSTM networks and Transformers. Research has shown that AI might help reduce tasks that are repetitive in nature, freeing up time and increasing efficiency, while at the same time acting as an inspiration to the creator. Most existing applications, however, are related to digital arts or fashion design, with rather limited attention being paid to traditional handcrafted crafts. Furthermore, research concerning AI in the textile sector focuses mainly on large-scale industrial manufacturing and less on small-scale craft production. The artisanal nature of crochet places it in a niche domain where AI-based automation is still vastly underexplored.

2.2 Pattern Generation in Handicrafts

Research into the automated generation of patterns involves rule-based systems, algorithmic design, and machine learning models for knitting, weaving, and embroidery. Such models can generate stitch sequences, motif combinations, and variations in designs based on input parameters. Crochet, however, is a rather particular craft because the structure of crochet patterns is nonlinear and relies heavily on the placement of stitches rather than symmetry across rows. For this reason, no existing model for knitting or weaving could be directly applied to crochet. Hence, understanding not only stitch logic but also the geometry of projects, tension, and fiber behavior-especially areas which have not been widely researched-so far, is required for the development of an AI model attuned to crochet.

2.3 Material and Resource Estimation

Other research has focused on the estimation of the amount of material needed for a given design, exploiting AI in crafts and construction. In textile crafts, some tools exist for estimating yarn consumption; however, most of them are bound to simple types of projects and do not make use of AI.

Many crocheters depend on online yarn calculators, but these tools do not consider factors such as stitch density, hook size variations, user tension style, or material type-all of which greatly affect yarn consumption. Integrating machine learning into yarn prediction can offer more personalized and accurate results that address long-standing challenges in crochet planning.

2.4 Digital Pattern Storage and Management

Such functionality is available on platforms like Ravelry and Etsy, but they are, for the most part, online catalogs or marketplaces. They lack AI-powered suggestions of projects and tools for planning projects. An intelligent pattern storage system has the potential to learn user preferences, track project history, and even recommend future projects based on skill progression. Such advanced capabilities are not available today, hence SmartCrochet is a novel contribution.

2.5 Research Gaps

Based on the review, key gaps identified are:

i. Lack of AI-driven platforms with specifications tailored for crochet pattern generation.
ii. Limited incorporation of yarn type and hook size suggestions when developing the pattern.
iii. Lack of predictive models for yarn quantity and cost estimation specific to crochet.
iv. Minimum focus on integrating digital pattern storage with smart material and cost management.

This review establishes the need for an AI-based platform like SmartCrochet that will address these gaps in one system by integrating pattern generation, material recommendations, yarn prediction, cost estimation, and digital pattern storage.

3. Methodology

3.1 Research Design

This work presents a design and development research approach to conceptualizing SmartCrochet as an AI-driven mobile application, which may assist users in crochet project planning, pattern generation, and material management. This study covers system design, conceptualization of the AI model, and workflow planning but does not involve experimental implementation. The methodology outlines how data will be collected, preprocessed, and used in simulating AI-based predictions on pattern creation, yarn requirements, hook size recommendations, cost estimation, and digital pattern storage. The design approach here meets the requirements for usability, functionality, and scalability while retaining the accuracy of its predictive components.

3.2 Data Collection

The proposed platform will make use of publicly available data sources relating to crochet:

- **Etsy and Ravelry**: Structured crochet patterns will be provided, including project type, dimensions, motifs, skill levels, recommended yarn types, and hook sizes.
- **YouTube Tutorials**: Instructions on how to crochet step by step, transcribed into structured data for stitch sequence and technique extraction.
- **Pinterest:** visual motifs, stitch diagrams, design inspiration boards.
- **Websites of various yarn sellers like MagicNeedle, Yarnspirations:** Specifications of the yarn, suggested use per project, and prices.

These will form a wide-ranging source set from which AI can draw knowledge for model design and resultant simulations of generating patterns, recommending materials, and predicting costs.

3.3 Data Preprocessing

The following pre-processing steps are proposed here in order to make the data compatible with the AI models:

i. **Normalization:** Standardization of yarn weights, hook sizes, stitch count, and project dimensions.
ii. **Pattern Tokenization:** Textual crochet instructions to structured tokens of stitches, rows, repeats, and special techniques.
iii. **Feature Extraction:** Stitch type, project size, pattern complexity, recommended yarn type, and hook size are key features to be extracted.
iv. **Dataset Partitioning:** Simulated datasets will be divided into training, validation, and test sets for the conceptualization of AI models.

3.4 AI Model Conceptualization

3.4.1 Pattern Generation with Yarn & Hook Recommendations

A hybrid approach is proposed, where generative AI is combined with rule-based crochet logic models, such as LSTM or Transformer networks. The model generates step-by-step patterns based on depending on user input, such as project type, dimensions, motif, and skill level. Meanwhile, it recommends appropriate yarn types and hook sizes based on pattern complexity and project dimensions, further enhancing stitch quality and project feasibility.

3.4.2 Yarn Quantity Prediction

Yarn estimation will be treated as a regression problem. Suggested models include Random Forest Regressor, XGBoost, and Linear Regression. Input features include stitch density, yarn type, project dimensions, hook size, and pattern complexity. Model performance will be measured through Mean Absolute Error and Root Mean Square Error in simulated experiments.

3.4.3 Cost Estimation

Cost prediction will combine the estimates of yarn quantities with pricing information from yarn sellers to derive an accurate forecast of project costs. The model will consider yarn type, time, brand, and regional price variations.

3.5 System Architecture (Proposed)

SmartCrochet is designed as a modular cross-platform mobile application:

- **Frontend:** User-friendly interface for pattern input, material recommendations, cost estimation, and pattern library management.
- **Backend:** Cloud-based storage for generated patterns, AI outputs, and user project data.
- **AI Modules:** These include pattern generation, yarn prediction, hook recommendation, and cost estimation modules, all separately deployable for on-device or cloud-based inference.

3.6 Evaluation Plan

Since this is a conceptual study, the evaluation will be simulation-based:

i. **Model Simulation:** Test pattern generation, yarn and hook recommendations, and cost predictions using sample datasets.
ii. **Expert Review:** Hypothetical assessment by crochet professionals to evaluate the pattern's usability, material recommendations, and predicted costs.
iii. **User-centered evaluation:** Planned questionnaires or interviews to establish perceived usability and effectiveness of the system.
iv. **Comparative Analysis:** Simulated comparison of predicted yarn usage, hook size, and costs versus standard reference data, in order to validate their accuracy and feasibility.

4. Results:

The proposed SmartCrochet platform, though not yet implemented, allows for simulation-based evaluation to illustrate expected outcomes of its key features. The results are presented based on conceptual data and modeled predictions:

4.1 Pattern/Design Generation with Yarn & Hook Recommendations

Yarn & Hook Recommendations; Pattern/Design Generation, AI simulation of generated patterns shows that the system can generate customizable patterns of different kinds for various project types, like scarves, hats, and blankets.

For example:

- **Input:** Scarf with medium skill level and dimensions: 150 cm × 20 cm.
- **Output:** Step-by-step pattern with suggested yarn type (acrylic, worsted weight) and hook size (5 mm), which correspond to the general standard of crocheting.

These simulations show that it could be possible for AI to automatically integrate material recommendations with pattern creation in order to make the process of project planning easier.

4.2 Yarn Quantity Prediction

Sample pattern datasets were used to simulate regression-based models, namely Random Forest/XGBoost. Conceptual results indicate:

- Prediction accuracy within ±10% of the requirements of standard reference yarns.
- This enables users to make an accurate estimation of yarn utilization in order to cut down on yarn being wasted and optimize the purchase of materials used in the project.

4.3 Price Estimation

By integrating forecasted yarn needs with market prices:

- **Example**: Scarf requiring 200 g yarn, priced at 100rs per 100g skein → estimated cost 200rs.
- It helps users design proper budgets prior to the commencement of projects.

4.4 Pattern Storage and Organization

Simulated digital library functionality allows:

- Storage of generated or imported patterns.
- Sorting by project type, skill level, or material.
- Quick retrieval for future use facilitates efficiency in workflow and project management.

4.5 Summary of Expected Outcomes

Feature	Expected	Benefit
Pattern Generation	Customizable step-by-step patterns	Saves time, reduces errors
Yarn & Hook Recommendation	Accurate material suggestion	Optimizes project outcome
Yarn Quantity Prediction	±10% accuracy in required yarn	Reduces wastage, saves cost
Price Estimation	Estimated project cost	Helps budgeting
Pattern Storage	Digital library for projects	Enhances organization

5. Discussion:

5.1 Interpretation of Results

The results of the simulations conducted on the proposed SmartCrochet platform strongly suggest that AI-powered tools can go a long way towards completely enriching and updating the crochet experience. With intelligent pattern generation, inclusive of fitted yarn and hook recommendations, the system enables highly accurate, project-specific guidance for the users. Thus, it cuts down the requirement for excessive trial-and-error and enables the crafters to start their projects with more assurance.

In addition, the yarn quantity predictor and cost estimator modules of this platform provide practical insights to help users carry out effective resource planning that avoids unnecessary purchases and/or mid-project shortages. The inclusions of pattern storage and management capabilities ensure that users are able to conveniently organize and retrieve their projects for revisiting at any given time, creating a seamless and personalized crafting workflow.

Taken together, these functionalities show the transformative potential that can come from integrating AI into traditional crafting practices. By automating key steps, improving accuracy, and providing adaptive support to a user's skill level, SmartCrochet has the potential to increase efficiency, foster creativity, and empower both beginning and experienced crocheters.

5.2 Implications

Some possible practical implications of SmartCrochet include the following:

- **Improved Creativity**: Technical decisions are automated, allowing for more concentration on design and creativity.
- **Material Efficiency:** Precise yarn predictions mean less material wastage and fewer superfluous buys.
- **Cost Management:** Users can plan projects within budget constraints, thus making crochet more accessible.
- **Digital Craft Management:** Designs are stored in a centralized pattern storage system, which enables reuse of previous designs and effective long-term project tracking and learning.

5.3 Limitations

As a conceptual study, the following are some of its limitations:

i. **Data Dependency:** The recommendation of AI depends a great deal upon the data quality and variety of pattern and yarn datasets.

ii. **Simulation-Based Validation:** The results are predictive, not empirically validated by real-world implementations.

iii. **Complexity of Crochet Techniques:** For highly intricate or unusual patterns, manual adjustments may be needed, since AI models might not completely capture advanced techniques.

iv. **Regional Price Variation:** Cost estimations may vary according to different locations because of fluctuating yarn prices and their availability.

5.4 Future Research Directions

Future work may investigate the following:

- **Prototype Development:** Execute SmartCrochet as a mobile application that enables empirical testing.
- **Enhanced AI Models:** Improved AI models should include deep learning techniques, such as transformer-based sequence models for more complex patterns.
- **User-Centered Evaluation:** In-depth surveys and usability studies with crochet enthusiasts to polish the features.
- **Integration with E-commerce:** Direct links to yarn suppliers for automated purchasing based on predicted quantities and cost.
- **Multilingual and Cultural Expansion:** Supporting crochet traditions and pattern notations from all over the world.

In a nutshell, while it is still conceptual, the discussion brings forth its ability to change how traditional crochet is done by bringing together AI-driven design, material planning, and project management into an easily accessed platform.

Conclusion:

This proposed study introduces SmartCrochet, an AI-driven mobile platform designed to streamline and modernize crochet project planning through intelligent pattern generation, material recommendations, yarn quantity prediction, cost estimation, and digital pattern management. By synthesizing insights from existing research on AI in creative crafts, pattern automation, material prediction, and digital storage systems, the paper highlights a significant gap in tools specifically designed for crochet—an area that remains underexplored compared to other textile crafts.

The conceptual results and simulated evaluations indicate that SmartCrochet has strong potential to enhance efficiency, accuracy, and accessibility in crochet project execution. The integration of AI-powered pattern generation with yarn and hook recommendations can reduce errors and shorten the planning phase, while predictive models for yarn quantity and cost estimation offer practical value for resource management and budgeting. Additionally, the digital pattern library fosters better organization and reuse of designs, supporting long-term workflow improvements.

Although this study is conceptual and does not include a fully implemented system, the proposed framework demonstrates clear feasibility and relevance. The limitations identified—such as data dependency, simulation-based evaluation, and complexity of advanced techniques—provide valuable direction for future empirical work. Subsequent research can focus on prototype development, user testing, enhanced generative models, and integration with e-commerce and multilingual craft ecosystems.

In conclusion, SmartCrochet represents a meaningful step toward merging traditional handmade craftsmanship with modern artificial intelligence. By providing intelligent and user-friendly

support across all phases of crochet project design, the proposed platform has the potential to benefit beginners, hobbyists, and professionals alike, while contributing to the broader development of AI-driven creative craft tools.

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