



A Digital Certificate of Authenticity Framework for Protecting Traditional Stone Sculptors and Enabling Sustainable Artisan Ecosystems

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Abstract—

The traditional stone sculptors, especially those in heritage places like Hoysala, have great expertise in generations but do not have any structure regarding Intellectual Property rights, raw material source, and direct markets. The artisans suffer problems ranging from imitation of their products to shortage in obtaining the material (soapstone). Moreover, they need intermediaries to market their creations which results in reduced incomes and loss of profit margins. This study presents an actionable digital platform based on Certificate of Authenticity (COA) for the initial layer of IPR mechanism. The framework will

include a digital COA for authenticating the product, a digital identity for the artisan, a raw material procurement process for establishing connections between the quarries and the sculptors, a marketplace to help them sell directly to customers, and a document management system for knowledge acquisition using digital means. The proposed solution takes into consideration ease of use, less complexity of deployment, and applicability in reality.

Keywords— Certificate of Authenticity (COA); Traditional Knowledge Systems; Intellectual Property Rights (IPR); Artisan Platforms; Stone Sculpting; Digital Identity; Heritage Preservation; Supply Chain Integration



I. INTRODUCTION

Traditional stone sculpture making represents a culturally significant form of artistry that embodies rich cultural heritage of a particular region, e.g., Halebidu where Hoysala ruled once. Artisans of this culture possess special skills acquired throughout generations, including specific techniques, materials, and symbolic design approaches. In spite of their significance to cultural heritage and tradition, most artists remain part of fragmented and unstructured ecosystems that inhibit economic growth and sustainable development. Lack of structured digital presence, dependence on intermediaries for selling sculptures, and lack of reputation mechanisms prevent artisans from earning higher profits and gaining additional exposure. One of the biggest problems many artisans face is the lack of convenient and efficient mechanisms for IPR. Patent, design and copyright registration may prove problematic for artisans because they require substantial efforts, costs and knowledge of law. Such a state leads to easy imitation and copying of designs made by artisans, thus depriving them of their rights for creation and income generation. Besides, consumers may find it hard to determine whether purchased items on an online platform were actually produced by hands of an artist in question. Artisans also face several operational difficulties, such as inability to secure access to quality raw like soap stone, which is essential for traditional carving. Also, identifying quarries that give away soap stones which are not usually useful for them, and transporting these stones to the place of their work, involves dealing with police check posts who often question the identity of the sculptors who do not have one leading to legal complications. In response to these challenges, this paper provides a digital framework to integrate supply chain support, digital identity of artisans, documentation of knowledge. Along with this the important part, is the Digital

Certificate of Authenticity(COA) system, to provide authorship for artisans and improving buyer trust. This framework also includes, artisan digital identity, raw material sourcing mechanism, digital market place like an e-commerce, and documentation of traditional techniques of sculpting.

II. PROBLEM STATEMENT

Traditional stone sculptors, like those from Halebidu work in a system that's not very organized and they do not get the technical, legal and financial help they need. Even though they have skills and make things that are important to our culture they face many problems that stop them from earning a good income being recognized and being able to do their work for a long time. One big problem is that they do not have a way to protect their Intellectual Property Rights. There are laws like patents and copyrights. They are not easy for these artisans to use because they are complicated and expensive. So when they create a design someone else can copy it and they cannot prove that they made it first. This means they do not get the credit or the money they deserve. When people buy things online they also cannot be sure if they are buying something a fake. This makes it hard for people to trust what they are buying. Another problem is getting the materials they need like soapstone, which's necessary for their work. The artisans spend a lot of time finding the stone checking its quality and arranging for it to be transported. This process is not efficient. Sometimes it can even lead to legal problems because they do not have the right papers. Also a lot of stone is wasted because it is not used or shared properly. The way they sell their products is also a problem. Many artisans have to rely on people to sell their work, which means they do not get to keep all the money they earn. They also do not get to meet the people who buy their products, which makes it hard for them to build a reputation. Because they do not



have a way to sell their products online they cannot reach as many people as they could and they cannot show everyone what they can do. This means they don't get paid much as they should for their hard work. There is also a problem with passing on the skills and knowledge that these artisans have. They learn how to do their work from their families. This knowledge is not written down anywhere. Because not many young people are interested in learning these skills there is a risk that they will be lost. If there was a way to record and teach these skills more people could learn them and the traditional stone sculpting could continue. In traditional stone sculptors like those from Halebidu face many challenges. They do not have a way to protect their work they have trouble getting the materials they need they cannot sell their products easily and they are not passing on their skills. All these problems together make it hard for them to earn an income and to keep their traditions alive. That is why we need to find a way to help them with these problems using technology to make things better, for stone sculptors.

III. PROPOSED SYSTEM

The proposed system is a digital platform designed to support traditional stone sculptors by integrating authenticity verification, artisan identity, supply chain support, marketplace access, and knowledge preservation. The system aims to provide a practical and accessible framework that addresses key challenges in intellectual property protection, raw material sourcing, and commercialization. The architecture is modular, consisting of five primary components: Digital Certificate of Authenticity (COA), Artisan Digital Identity, Raw Material Supply Chain Module, Marketplace Module, and Knowledge Documentation Module.

A. Digital Certificate of Authenticity (COA): The Digital Certificate of Authenticity (COA)

constitutes the core component of the proposed system and is designed to provide a practical mechanism for authenticity verification and authorship attribution in traditional stone sculpting. Unlike formal Intellectual Property Rights (IPR) systems, which may be complex or inaccessible to grassroots artisans, the COA framework offers a lightweight, technology-driven solution for establishing trust and traceability. In the proposed system, a COA is generated for every artifact uploaded by a registered artisan. During the artifact submission process, the system captures essential metadata, including artifact name, dimensions, material type (e.g., soapstone), description, and a set of images representing the work from multiple angles. Each artifact is assigned a unique Product ID, which is linked to the corresponding Artisan ID. Additionally, a precise timestamp is recorded at the moment of submission. To ensure data integrity and uniqueness, a cryptographic hash is generated using a combination of key parameters such as Product ID, Artisan ID, and timestamp. This hash functions as a digital fingerprint of the artifact and prevents tampering with the associated metadata. The generated hash, along with the artifact details, is stored securely within the system. Based on this information, the platform generates a digital certificate containing the following elements: artifact name, artisan name, material details, dimensions, creation timestamp, Product ID, and the corresponding hash value. The certificate is made available in a downloadable digital format (e.g., PDF) and is associated with a Quick Response (QR) code or verification link. The QR code directs users to a dedicated verification page within the platform, where the authenticity of the artifact can be validated. This page displays the stored metadata, confirms the association between the artifact and the registered artisan, and indicates the verification status. Any discrepancy between stored and presented data can be detected through hash



comparison, ensuring reliability. The COA system enhances transparency in digital marketplaces by enabling customers to distinguish genuine handcrafted products from imitations. It also provides artisans with a verifiable record of their work, which can serve as supporting evidence in cases of dispute or unauthorized reproduction. Although the COA does not constitute a formal legal IPR, it functions as a practical and scalable authenticity assurance mechanism tailored to informal artisan ecosystems.

B. Artisan Digital Identity: The Artisan Digital Identity module creates a verified and structured digital identity of the traditional stone sculptors in the suggested system. The module will help fill the gap of lack of formal recognition and credibility that artisans usually have to contend with in digital marketplaces, which will increase the level of trust between artisans and customers. When registering, every artisan would supply necessary information such as name, geographical location, years of experience, and specialization area (e.g., idol carving, decorative panels, custom sculptures). With this information, the system creates a unique Artisan ID, which will be used as the main identifier of all the activities related to the artisan on the platform. A digital identity representation can be generated with a hash of key attributes, namely artisan name, email and timestamp, to ensure consistency and traceability. The identity hash serves as a sort of digital signature, which can be used to securely connect the artisan with the uploaded artifacts. All products that are registered by the artisan are orderly related to this identity, which is then clearly attributed with authorship. The platform also supports a profile interface per artisan, which contains a portfolio of uploaded works, artifact details, as well as related Certificates of Authenticity (COAs). This enables the customers to consider the craftsmanship, experience and authenticity of the artisan before making a buying decision.

Also, a verification indicator or trust badge can be granted to artisans with a profile satisfying predefined validation criteria, which further enhances credibility. The Artisan Digital Identity module is important in facilitating the COA framework by ensuring that every artifact can be most trusted traced back to its creator. It is also a conceptualised version of digital recognition or licensing, which allows artisans to form a continuing identity without necessarily going through the process of complex formal recognition. This module would facilitate increased market participation and sustainability in the long-term of artisan livelihoods due to improved visibility, traceability, and trust.

C. Raw Material Supply Chain Module: The Raw Material Supply Chain module is developed to help solve the problem of traditional stone sculptors being unable to find appropriate raw materials, especially the soapstone, which is necessary to carve. In the current operations, artisans use informal networks, personal contacts or physical search of quarry locations to get stone which has led to inefficiencies, inconsistent prices and a lot of time wastage. Moreover, lack of a systematic documentation on transportation could be subject to administrative or legal issues. To address these shortcomings, the proposed system will introduce an online quarry and supplier database, which will serve as an organized system of connecting artisans with trusted raw material suppliers. The owners of quarry and suppliers are able to register on the platform and list available rock resources and other relevant information, including the type of stone, block size, weight, price, availability status and location. The system also facilitates the registering of leftover or waste stone materials that can be put to a second use to form smaller artifacts, which will lead to efficiency and sustainability of resources. The search interface can enable artisans to search the



registry by filtering by variables like geographic proximity, price range, and required stone specifications. This will allow making informed decisions and save time associated with finding appropriate suppliers. When a supplier has been chosen, the system facilitates a request or procurement type of interaction between the supplier and the artisan. The system can also create a digital document of reference of transportation to further enhance traceability and uncertainty in the transportation process. The information contained in this document includes suppliers, artisan, material description, quantity and date and a reference ID. A QR code can be incorporated so that it can be quickly verified when necessary. Although this document is not a substitute to official legal permits, it is a structured record that enhances transparency as well as facilitating communication among the stakeholders. This module enhances efficiency and reduces operation delays by digitizing the raw material sourcing process, improving accessibility to quality material. It is also sustainable in that it will encourage the use of the leftover stone resources, as well as minimizing unnecessary travelling, which will benefit not only the economic but also the environmental sides of the artisan ecosystem.

D. Digital Marketing Module: The Marketplace module offers a digital platform that is structured and provides the traditional stone sculptors an opportunity to directly present and offer their products to the consumers so that they do not have to rely on the intermediaries. In the traditional systems, the artisans usually use local agents or middlemen to access the markets and this leads to low levels of profit margins and lack of interaction with the customers. The proposed marketplace will overcome these limitations by providing a clear and accessible direct-to-consumer interface. In this module, registered artisans are able to add detailed

product listing through uploading various images of each artifact and descriptive information of the product such as product name, size, type of material used, price, and approximate time of completion or delivery. Every product listing is associated with the respective Artisan Digital Identity and is provided with a Digital Certificate of Authenticity (COA), which enables customers to check the origin and authenticity of the artifact. The customers would be able to navigate the site by using categorized listings, search features, as well as filters based on parameters like the price range, the type of artifact, or material. When a user selects a product, they will be redirected to a more detailed view of the product which will include image galleries, product specifications, information about the artisan profile and the associated COA verification link. The platform also includes typical e-commerce features, such as a shopping cart system, order placement, and payment processing. Only authenticated users can access the purchasing features to have a secure transaction. An order record is created upon successful payment and linked to the customer and the artisan in order to track the order. The market place helps increase transparency in the pricing and enables artisans to receive a greater portion of the income they generate through their work. This combination of the authenticity checking also bolsters the confidence of the customers, making them make informed decisions in purchasing their products. All in all, this module is critical in enhancing the accessibility of the market, improving the economic viability of the traditional stone sculpting practices, and supporting the long-term sustainability of the traditional stone sculpting practices.

E. Knowledge Documentation Module: The Knowledge Documentation module is meant to conserve and spread traditional stone sculpting techniques which are in danger of



being lost due to a lack of formal documentation and a reduction in interest amongst younger generations. In current practice, this is passed orally via apprenticeship-based learning, which has a limited scalability and long-term preservation. To overcome this problem, the proposed system will allow the artisans to record and upload instructional materials that can show the various stages of the sculpting process. It involves: stone selection, tool handling, rough shaping, detailing, finishing and polishing methods. The content uploaded is structured in order and organized in structured modules, which enables the learner to access the step-by-step instructions. The system can be enhanced with AI-assisted applications of speech-to-text transcription and language translation, especially converting the content of regional languages (e.g., Kannada) to widely understood languages, such as the English language. This enables the knowledge to be disseminated to a larger audience, such as students, researchers and amateurs who might not be familiar with the local language. Each tutorial module can consist of video, text, important steps of the procedure, and visual aids. It can also be used to classify content in terms of skill level (beginner, intermediate, advanced), and type of artifact, facilitating organized learning pathways. This module, along with preservation, also provides the opportunity to practice skills and monetize them in the form of advanced or specialized tutorials as premium learning products. This offers a new source of income and promotes sharing of knowledge. This module will help maintain cultural sustainability and preserve valuable craftsmanship techniques to be used by future generations by digitalizing and structuring traditional sculpting knowledge. It supplements the rest of the elements of the system by reinforcing the continuity of the artisan ecosystem in the long run.

IV. METHODOLOGY

The proposed system methodology explains the operational process flow of the platform, describing the series of interactions between artisans, customers and system components. The system is structured as a user-driven modular architecture implemented with contemporary web technologies like React (frontend), Node.js or FastAPI (backend), and MongoDB/Firebase (database). It brings together the creation of artifacts, the verification of authenticity, the support of supply chains and the process of digital commerce in a single framework.

A. Artisan Registration and Identity Creation: It starts with the artisan onboarding where the sculptors are registered via a web interface developed using React.js. The registration form provides information about name, location, experience, and specialization that is sent to the backend via REST APIs implemented using either Node.js (Express) or FastAPI. After successful registration, the system is used to generate a unique Artisan ID based on a UUID generation library (e.g., uuid in JavaScript or Python). A digital identity hash is computed using the hash-256 hashing algorithm (implemented in libraries, such as crypto (Node.js) or hashlib (Python)). All artisan data, including identity hash and profile data are stored in a NoSQL database, like MongoDB or Firebase Firestore, where data can be readily and efficiently retrieved. Next, the artisan profile is initiated, and one can get access to the dashboard to execute other operations.

B. Artifact Upload and Metadata Capture: Once authenticated, artisans provide information about artifacts via a structured interface. The frontend supports multiimage upload where file input components are used to upload images where cloud storage services like Cloudinary or Firebase storage are used to store images. The metadata, which comprises artifact name,



dimensions, type of material, price and description are sent to the backend and stored in the database. When submitting, the system assigns a unique Product ID based on UUID and stores an accurate timestamp based on time-server time functions. The artifact metadata and image references are stored in the MongoDB/Firebase that forms the base dataset of further processing, such as the COA generation and marketplace listing.

C. COA Generation and Verification Mechanism:

After submitting the artifact, a system will produce a Digital Certificate of Authenticity (COA). The input is concatenated Product ID, Artisan ID and timestamp: Hash=SHA-256(ProductID+ArtisanID+Timestamp) This hashing operation is done with Node.js crypto module or Python hashlib, which guarantee a tamper-evident digital signature. The COA is created as a digital document with libraries like jsPDF (frontend) or ReportLab (backend). The certificate has metadata of the artifact, artisan details, timestamp, and hash value. Libraries like qrcode (Python) or qrcode.react (React) are used to create a QR code. The code in this QR is a verification URL (e.g., /verify/;ProductID;). When a user visits the verification page, the backend reads the stored metadata, re-computes the hash and also compares it with the stored value. When both values are the same, the artifact is denoted as verified. This will guarantee real-time authenticity validation.

D. Marketplace Interaction and Transaction Flow: This marketplace module is deployed on a React-based frontend, which displays product listings, dynamically loaded on a request basis through the backend. Each listing contains photos, information, craftsman, and COA verification status. The customers are able to engage the system by use of features like product browsing, filtering, and cart management. Cart functionality is implemented with the help of

frontend state management (e.g. React state or context API) and backend APIs handle order processing. To process payments the system will combine Razorpay API (or a fake payment system to emulate the prototype). When a successful transaction is made, an Order ID is created and stored in the database which connects the records of the customer and artisan. This module makes sure that transaction is safe, real-time updates, and smooth user interaction in which the system remains stable in data consistency.

E. Raw Material Sourcing Workflow: The supply chain module is initiated as a searchable interface which shows the quarry and supplier data stored in the database. Listing is registered and posted in similar forms as artifact uploads. The listing of each of them contains parameters like the type of stone, size, price, and location. The system allows filtering by backend queries, and frontend filtering components. Upon an artisan to select a supplier, the system will create a digital transport reference document, which entails the supplier information, the artisan information and the trade information. The document can be created with the help of PDF libraries (jsPDF or ReportLab) and it can optionally include a QR code that can be quickly scanned to verify its authenticity. This module enhances the efficiency of procurement by exploiting search, database representation of data, and so on.

F. Knowledge Documentation and Access: The knowledge documentation module allows artisans to upload tutorial videos, which are stored using cloud storage platforms such as Firebase Storage or YouTube (unlisted links). AI-based processing can be integrated using external APIs such as: • Google Speech-to-Text API for transcription • Google Translate API for language conversion The processed data is structured into modules and stored in the



database, enabling retrieval through a React-based interface. Users can access categorized learning content, enhancing knowledge dissemination and long-term preservation of traditional techniques.

G. System Integration and Data Flow : The entire system is integrated using a RESTful API architecture, where frontend components communicate with backend services through HTTP requests. All core entities—Artisan ID, Product ID, and Order ID—are maintained within a centralized database, ensuring relational consistency. The COA module acts as the central linking mechanism between artifact creation and marketplace validation, while supply chain and documentation modules operate as supporting subsystems. This integrated architecture ensures scalability, traceability, and efficient data flow across all stages, from artifact creation to verification and commercialization.

V. CONCLUSION

This paper introduces a digital framework designed to help traditional stone sculptors protect their work and connect with wider markets. At its core is the Digital Certificate of Authenticity (COA). This digital certificate gives artists a straightforward way to claim authorship, track their creations, and build trust among buyers—a big step forward compared to old-school Intellectual Property Rights systems, which are often too complicated for informal artisan communities. The COA approach uses everyday technology, making it much easier for sculptors to join in. By including an Artisan Digital Identity, the system ensures each artifact is tied directly to its maker. That boosts credibility and recognition—artists actually get credit for their work. The Raw Material Supply Chain module tackles soapstone sourcing problems through a digital registry of quarries and suppliers, cutting down on wasted time,

lowering costs, and clearing up confusion. With the Marketplace module, artisans interact directly with customers, which means bigger profits and a broader audience. Knowledge Documentation preserves traditional sculpting techniques in digital form, making sure valuable skills don't disappear. This framework pushes for sustainability in several ways. Economically, it opens up better income opportunities by cutting out intermediaries. Culturally, it safeguards important heritage by digitizing and organizing traditional knowledge. Operationally, the use of structured data and digital tools makes sourcing and product verification faster and more reliable. Yet, hurdles exist. Not every artisan is comfortable with digital tools, and consistency in authenticity standards is still a problem. The next steps might involve tying this framework into formal IPR systems, using data analytics to predict what buyers want, and working with governments or cultural organizations to scale up the effort. All in all, the framework gives a clear example of how digital technology can support traditional craftsmen. It connects heritage practices with the modern world, protecting artisan communities while paving the way for sustainable growth.

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