ISSN No:-2456-2165

Implementation of Efficient Inception V2 model for Apparel Counterfeit Detection

Aditya Umesh Shet , Sheikh Rameez Ibrahim, Mayuri Joshi, Shon Lesly Menezes, Ramalingam H.M
Electronics and Communication Engineering
Mangalore Institute of Technology & Engineering (MITE)
Moodabidri, India

Abstract:- The problem is, the available technology are does not work to eliminating counterfeit goods. QR codes and holograms are widely used but can be easily duplicated. According to research, the footwear and clothing industry is the industry that has suffered the most losses as a result of counterfeit products. We have seen situations in the Apparel industry where the packaging of counterfeit clothing is as good as the real thing, and this comes as a major concern for brands that provide genuine clothing. So here, we propose a solution that promises to identify counterfeit items on the market using AI and image processing algorithms. In some cases, the acquisition of counterfeit products is a challenge for consumers and can sometimes be dangerous as well. Misconduct of fraudulent practices is most commonly encountered with premium quality products due to its small risk and huge revenue benefits. The counterfeit accessories and actions of counterfeit goods are quickly transformed from mobile marketplace into e-commerce sites. Currently, counterfeit prices of clothing and accessories hinder the financial growth of the luxury goods and the fashion industry. There has been an increase in the adoption of track and trace technology by leading fashion apparel manufacturers around the world. To combat these fraudulent processes, we propose an AI based anti-fraud system. This study suggests a fraudulent anti-fraud management system for designer apparels based on AI-based image statistics. This program ensures a complete follow-up of the production of designer clothing. The end user can personally verify the authenticity of the product by sharing the product details in a fixed format.

Keywords:- *Counterfeit; QR code; Apparel Industry; AI;*

I. INTRODUCTION

In some cases, the discovery of counterfeit product is a challenge for consumers and can sometimes be counterproductive counterfeit versions of the product or to impersonate. Counterfeit products often contain counterfeit company logos and products, resulting in a trademark or copyright infringement. Anything can be counterfeit, but most counterfeit items is of clothing and other small items such as bags, money, watches. Most items can be sold without realizing it and may even break the law by buying counterfeit goods. Today people prefer to watch clothes differently and want to have their own sense of style. Computer vision has greatly improved eliminating image recognition and classification. Methods of Processing Images should identify the fabric of the garment, the sewing quality, the style, the size. Attachment of interlinings is very important area of textile design where the other process has taken a lot of stitching. When interlinings are sewn in, it may be difficult for parts such as collars to avoid the interlining of the collar and pucker at the edges. For large parts such as front jacket, sewing interlinings by sewing is expensive and requires a skill if it is to achieve high quality. Fusing Technology can achieve this in clothing.

In the fast fashion, counterfeit merchandise are called as the knock offs. These forgeries are frequently sold at marketplaces and on public streets. While buying a product may seem harmless to the buyer, it is really financing the most destructive institutions. Sometimes the intention is to deceive an easily deceived consumer who simply looks at the label and has no idea what the actual product looks like, whereas others make a great attempt to mimic the elements of fashion. According to studies, the fashion sector will lose even more than USD 70 billion by 2022 as a direct result of counterfeit items. The most counterfeit items are premium clothing, followed by cosmetic products, watch, jeweler, and baggage. The worldwide trade in counterfeit goods is anticipated to reach USD 5.2 trillion by 2025.

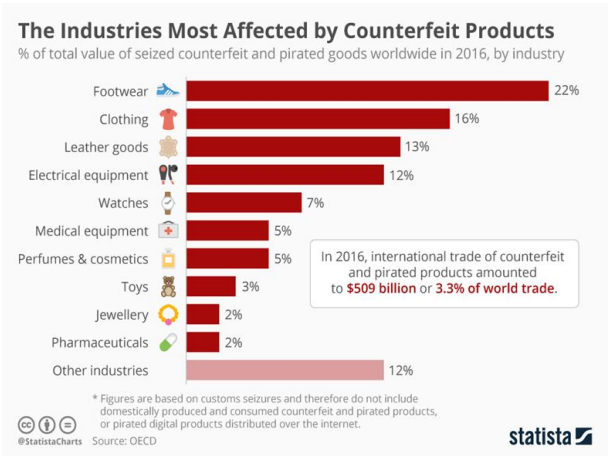

Fig.1 Graph of Industries affected by counterfeit products

As we all know, the Apparel industry is the worst hit by counterfeit products, inflicting huge losses on companies. Therefore, in this project we use a model in one of the features of the anti-counterfeit domain, which distinguishes the false features from the actual products. It is currently required that the testing process be performed

using some automation technology to improve the quality and reduce the manufacturing cost of the final textile product. Machine vision and image analysis can lay the foundation for closing this commercial gap. We will look at the smallest details of the costumes and use some algorithms to produce different features to train our model.

II. PAPERWORKS

"An Anti-Counterfeit and Traceable Management System for Brand Clothing with Hyperledger Fabric Framework". This paper proposed a transparent anti-counterfeit management system for designer merchandise based on Hyper ledger Fabric Framework[1]. By exposing the product's information on the immutable framework, the final may self-verify the product's genuineness. It addresses issues such as information asymmetry, impenetrable supply chain data, and simple falsification in the branded clothes production process.

"Multideep Feature Fusion Algorithm for Clothing Style Recognition". This paper helped understand the concepts related to extracting key attributes of clothes and apparel. At first it implements the enhanced object tracking model for retrieving multi category regions, as well as an better Reset for extracting deep features[2]. Finally, the feature pyramid structure, frame, soft-NMS, and multideep features fusion technology substantially fuse the three multi-deep features together. Finally, clothing style detection which is both accurate and rapid was achieved.

"Logo Detection with Artificial Intelligent". This research focuses on detecting the brand symbol and considering the similarity of the sample brand symbols[3]. The validity of the output values will be evaluated in comparison with the testing picture from high to low similarity. The image detection technique is described in Python using a dark net framework and YOLO algorithm, as well as OpenCV image classification by using DNN.

"Research on QR image code recognition system based on artificial intelligence algorithm". To increase the identification rate of QR image codes, this study employs an improved median filtering filter technique and a QR code distortion correction approach based on back propagation (BP) neural networks[4]. This combination of artificial intelligence algorithms can fit the warped QR picture into the geometrical distortion sequence, resulting in QR code recognition.

"Blockchain-Based Counterfeit Medicine Authentication System". Implementation and evaluation of the Pseudo code blockchain-based secure infrastructure for the medical supply chain. In the current working prototype, several of the most popular open-source libraries are used. This prototype's major modules include the validation module, blockchain module, key generation module, and transaction logic module[5]. The key generator module generates a secret key for each user using elliptic curves. The validation module receives the waiting user validation request and provides the secret keys for them using the key generator module. The drug administrator maintains the validation process. The transaction module creates the transaction between users, and after the transaction is validated, the blockchain module uploads the transfer to the chain on a block.

"Implementation of Tesseract Algorithm to Extract Text from Different Images". Optical character recognition (OCR) is a powerful tool used for scanned documents that converts printed text into editable text in order to have perfect output due to the difference in the nature, size and colour of different characters[6]. Tesseract was utilized to solve this challenge. Tesseract is a free and open-source OCR engine.

"Fabric Defect Detection Using Computer Vision Techniques: A Comprehensive Review". This paper gave a brief on fabric fault identification for the textile industry[7]. The suggested study provided a complete review of methodologies for detecting fabric defects. The drawbacks and limits of the existing published studies are thoroughly examined, as are potential future study areas. Also shown and addressed are the performance assessment criteria for automated fabric flaw identification.

"Improving fake product detection using AI-based Technology". For detection, the end consumer takes pictures of a product packaging containing product text information, logos, and maybe certification marks/logos[8]. Common categories for anticounterfeiting: overt, covert, and track and trace are discussed.
10

"Fractal Anti-Counterfeit Label Comparison Using Combined Image Features and Clustering". The research proposes an improved way to enhance the standard and efficiency of relations of fractal anti-counterfeit labels[9]. The suggested thoroughly analyzed the feature point, image filtering, and geometric features of fractal anti-counterfeit labels to ensure complete feature extraction.

"Finding Fake Logo Using CDS Logo Detection and Recognition Algorithm". The study focuses on detecting fake logos by matching and acknowledging them with the original logo[10]. This is accomplished by dividing the logo image into rows and columns, with each cell having its own index value.

"QR code Generator". An approach for creating QR codes by which the users enter text into a web browser and get the QR code generated QR Code are made up of black and white patterns on a 2-D geometric plane surface[11]. It uses black pattern to represent binary number one, and white pattern to represent binary number 0. Drupal module was used in conjunction with the popular libqren code C library to develop user interface on the web browser and encode data in a QR Code symbol.

"Word Matching and Retrieval from Images". Tesseract is best open-source tool for extracting text from image documents, as a result of which we will get the best retrieval of user queries of image documents[12].

Researchers present an efficient and robust system that can handle large amounts of data while retrieving the word efficiently and accurately. Constantly updated trained data contributes to the system's increased accuracy.

"Document Segmentation and Language Translation Using Tesseract-OCR". A procedure for integrating segmentation and translation to a separate a document in such a way that it will reduces the complexity to understanding a document and makes that document easily accessible in the most explicit structure anyone could require[13]. The platform used for OCR will aid in quickly converting that document into the characters.

"A Morphological Approach to Match Two Colour Images Using Deep Learning". Analyzing color images and determining their magnitude of difference is a key applications in the area of digital image processing[14]. If distinct characteristics from two images are retrieved and compared, the magnitude of difference can be determined by examining the result.

"Traceability of ready-to-wear clothing through blockchain technology". In this research, it is analyzed how Blockchain may assist the garment sector to address key traceability requirements. The adoption of such technology enables designers, dwellers, and end-users to track clothes[15]. Blockchain is an open, decentralized, and distributed database that keeps records of digital transactions, with a network of identical databases (nodes), in a peer-to-peer link that is possibly visible to anybody inside the network.

"Text Extraction from Images using Tesseract". The phases of text extraction from picture include detecting the text in a given image, determining the position, and extracting the text. Differences in these texts because of size, orientation, alignment, low resolution/pixelated image, and complicated and noisy background make the issue of text extraction extremely difficult. This paper attempts minimize these problems using Tesseract OCR and display it using React JS and flask. The System proposed consists of a Web application made using React JS, with flask acting as a backend. The text extractor will use the Tesseract OCR Engine to extract the Image text[16]. The Web application will contain a section to submit/upload an image which will then go through our text extraction program, after the program outputs the result, Flask will pull an API request to get the output text and display it on the Web page.

"A systematic literature review on QR code detection and pre-processing". The study also reveals the multi-step process of QR code recognition, by this paper it is achieved to help organizations optimally adopt the technology for their respective need's optimal adoption and future innovation. Getting information from a QR code in real world environments comprises of three vital steps: localization, image pre-processing and decoding[17]. Localization refers to the detection of a QR code and its exact coordinates or location in an image. Image pre-processing is an intermediate step where the detected QR code's image is improved to reduce blur, noise, distortion, angular perspective, etc. to enable accurate decoding. Decoding is the final step where the information/data is retrieved and relies on the main standard architecture of the QR code.

"Distributed Secret Sharing Approach with Cheater Prevention based on QR Code". . In this article, we are developing a QR code sharing method to protect confidential QR data with a secure, secure distributed systems. The proposed method differs from related QR code programs in that it uses QR features to access private sharing and can withstand printing and scanning operations[18]. The encryption can be split and transmitted by QR tags in the distribution application, and the system can retrieve it. a secret that is not lost when an authorized participant cooperates. Standard browsers can read original data from QR tags marked with a barcode reader, which helps reduce the risk of security. Based on our experiments, a new method is possible and provides readable content, fraudulent visibility, as well as a configurable QR barcode payment.

"Blockchain Based Inventory Management by QR Code Using Open CV".) The QR code scanning process is performed using Open CV Open Computer Vision. Details of the sold product are distributed on the P2P network with the creation of a new blockchain[19]. By finding these product details in a blockchain database, the manufacturer can easily calculate inventory. PyEVM is a new implementation of the Ethereum protocol in Python. Contains the first level of the Ethereum 1.0 chain and emerging support for the upcoming Ethereum 2.0 Serenity spec To use PyEVM we use the Ethereum blockchain to store product details for sale.

"Brand Logo Detection Using Convolutional Neural Network. This paper outlines a logo acquisition method using in-depth reading algorithms and the python system. Images provide brands with an amazing opportunity, they not only have the ability to transmit more than text, are widely distributed, clicked, and digested. CNN contains input and output layer as well as hidden layers[20]. layers. CNN's hidden layer usually contains transition layers. includes, integration layers, fully integrated layers and standard layers. The CNS layers are made up of neurons arranged in dimensions of 3 sizes, length and depth. The neurons within the layer are connected to only a small area of the anterior layer, called the receiving field. Different layers of layers, both local and fully connected, are stacked to form CNN architecture.

"Image feature extraction and analysis algorithm based on multi-level neural network" :The object image is accurately compared and fully analyzed with all test object images and their asset data stored in this system before. The use of computer image recognition technology to effectively visualize content also requires the development of compatible processing modules, which include various sub-systems, such as websites, point-out programs, neural

network learning programs, and parameter comparison programs. This research project aims to design a model based on a multi-level neural network using the output pipeline[21]. The essence of in-depth learning is feature learning, which is intended to acquire knowledge of the sequential element through the network sequence network. The frame is verified by processing the image. The proposed algorithm is modeled on a public website.

III. METHODOLOGY

The proposed solution ensures an end-to-end solution from the manufacturer to the consumer using Artificial Intelligence and Machine Learning Algorithms and Blockchain technology for supply chain traceability. The model consists of a client website that will have an option of feeding the real time image. The client has to upload/scan the logo in the camera frame. The model will use machine level algorithms at the backend and apply some image processing techniques to check for spelling, logo, etc., and give the output as to whether the scanned logo is original or counterfeit.

The basic frontend website consists of two options. First is to scan/upload the image in real time and the second option to pass the QR code. When the user clicks on the first option, the camera frame pops up and will give the user an option to scan the image of the logo. Here we make use of DeepLogo algorithm which focuses on detecting the logo in an image file by extracting its features from the training dataset and then checking it with the test dataset.

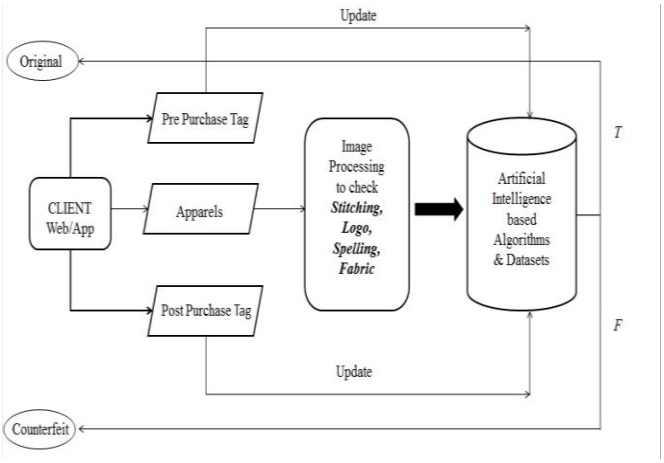

Fig. 2: Basic Block Diagram

Image Processing Techniques: Here we will check for Stitching, Logos/Spelling & Fabric pattern features. Here we will look for minute details of the apparel and apply some algorithms to extract unique features to train our model.

For Pre-Purchase Tag: The tag is tightly algorithmically linked to the post-purchase tag. So, if someone purchases a product and then scratches and scans the post-purchase tag, the pre-purchase tag's position is also updated in the system. If a scammer duplicates the pre-purchase tag and replicates it, the first scan of the post-purchase tag invalidates all items associated with the pre-purchase tag. All further scans of the pre-purchase tag fail the counterfeit check.

For Post Purchase Tag: Each tag is physically protected, which means it can only be scratched or opened once after purchase. Once scanned, their status gets updated on the system and they cannot be used again for validity check by any other device.

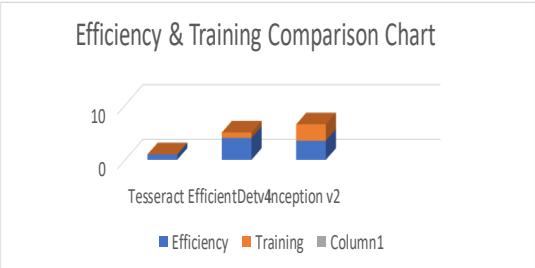

Fig. 3: Efficiency v/s Training Comparison

As in the above chart, we compared two different algorithms. Tesseract and EfficientDetv4. When we compared both the algorithms, it was found that the efficiency of tesseract was high yet it could detect the characters in the logo. But we could not train the model. In the EfficientDetv4 model we could efficiently detect the logo and train it to an extent. So we developed a third model which would combine the efficiency of scanning the image in real time of the Tesseract Model and the training efficiency of EfficientDetv4 model. Thus we were able to increase the efficiency of the overall model.

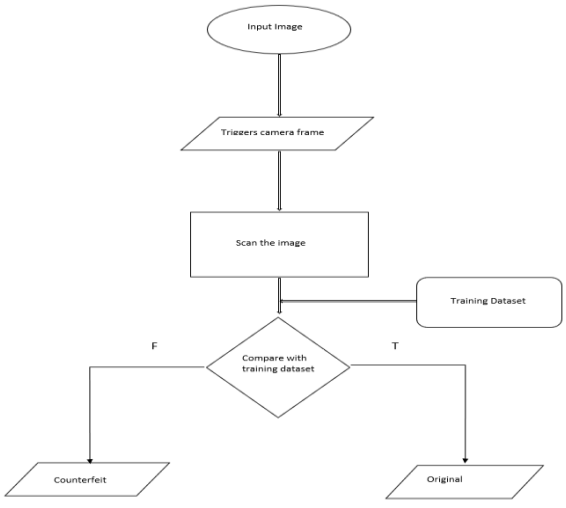

Fig. 4: Sequence of activities carried out by the algorithm

The input is taken as an image from the user. Once the image is received, the algorithm triggers the camera frame. It then scans the image and then compares it with the trained dataset in the backend. If the image matches, the output is given as Original else Counterfeit.

ISSN No:-2456-2165

For QR codes: A QR code is generated with the details such as Brand name, Date of Manufacturing encoded within it. This will serve as Pre-purchase Tag. The Post-Purchase tag will be encoded with further details such as Brand Name, Location, Warranty Information etc.

The Pre-purchase Tag will be stamped on the product and the Post purchase tag will be covered and will be stamped on the product. Once the Post Purchase Tag is scanned, the timestamp and the user's location are stored in the Ethereum framework.

IV. RESULTS

This section discusses the experimental results that were obtained. The proposed system is designed and configured for practical use. For the practical purpose, we used a DeepLogo Algorithm that focuses on detecting the logo in an image file by extracting its features from the training dataset and then checking it with the test dataset. If there is a good match, it detects the logo in the image file and saves it in the detect results folder. Below are the images of the detected images from the dataset.

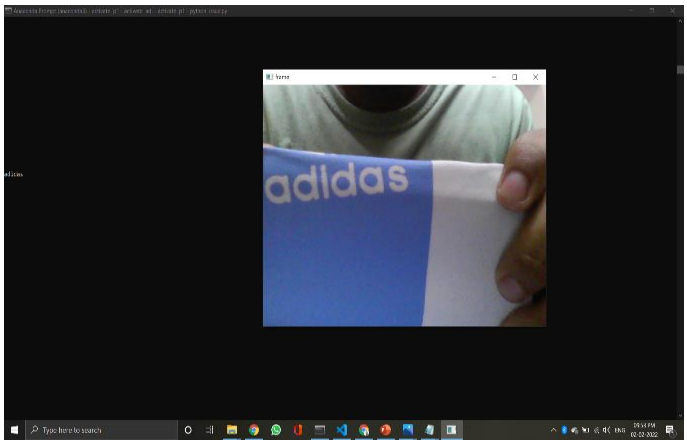

Fig. 5: Output of Tesseract OCR

The ML model is tested and verified for different brands and the results obtained are highly satisfactory. The success rate of the model for all the images are almost similar. To optimize the results of detection and prediction, the number of epochs can be increased.

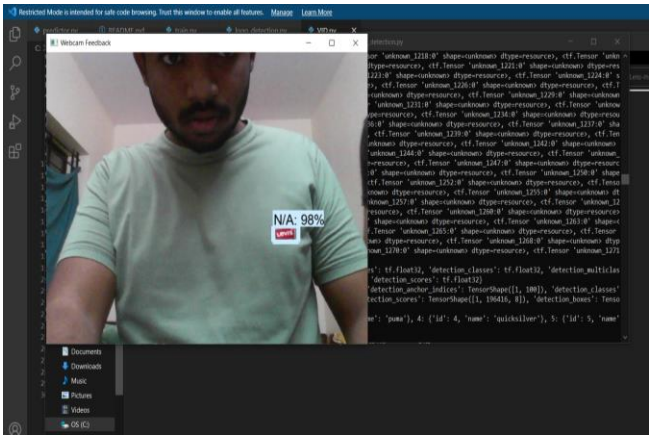

Fig. 6: Detected Logo Output

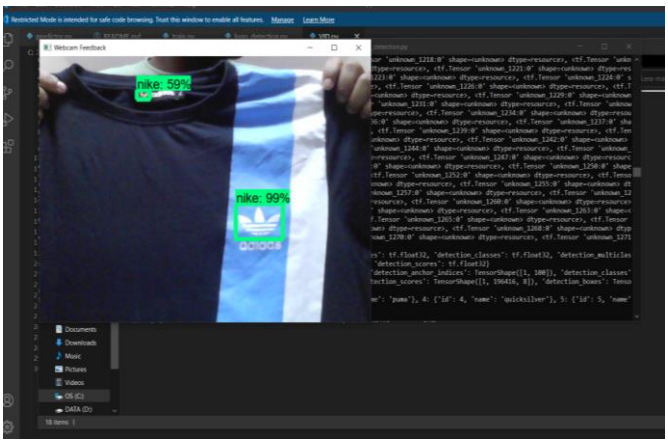

Fig. 7: Detected Logo output

We generated two QR codes with the necessary details encoded within it.

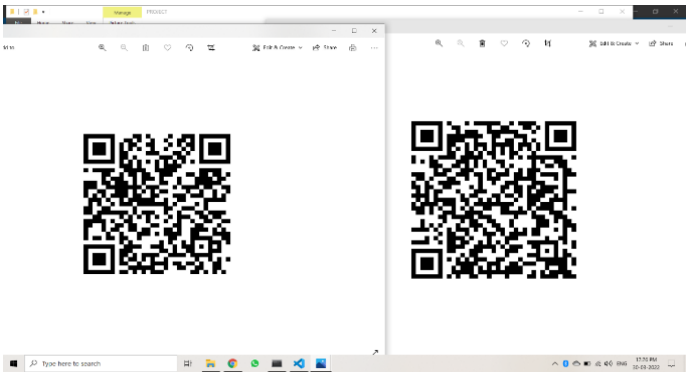

Fig. 8: Generated QR Codes

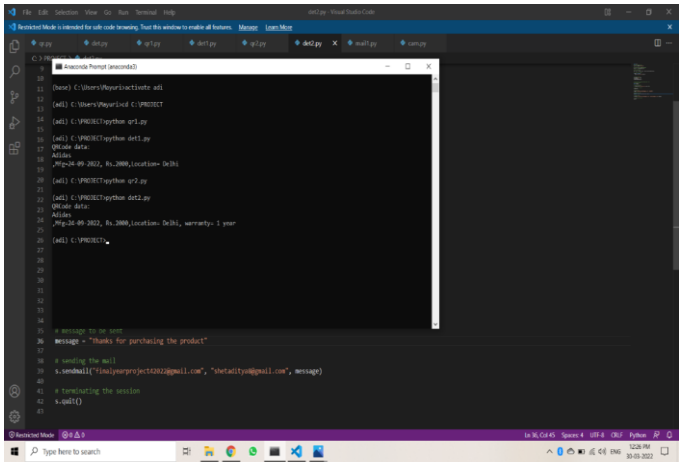

Fig. 9: Embedded Information of QR Code

V. CONCLUSION

Having a swift and digital technology that allows us to scan a product tag quickly is necessary for many businesses to manage inventory. The proposed system will allow users to easily identify and gather information about the product they want to check. The proposed system is designed and configured for practical use, user can scan QR code issued to product to obtain information such as transaction records and ownership, which allows the user to determine whether the product is legitimate or not. QR codes offers several advantages, we can store product data, website URLs, and plain text in QR codes attached to our inventory. QR codes can assists us in tracing a product code or where a product was manufactured or imported from. These codes are also easily accessible, since they may read by the cellphones that we're all carrying around or using a camera. The blockchain technology is known for its immutable and decentralized properties. It keeps track of all transactions that take place on a given blockchain. We can introduce blockchain to manage the supply chain or product authentication purposes by taking advantage of this feature.

The proposed system will be using an Ethereum network as a main blockchain to keep all the records and manage all the transactions regarding the products of the company listed. The reason for implementing the system on Ethereum is that it supports smart contract which allows consumers and suppliers to easily manage changes and keep the data record updated. The idea is to integrate the QR code with Blockchain Ethereum framework, so as to improve the security and transparency. Then the whole model will be deployed as a frontend website including all the necessary features.

ACKNOWLEDGMENT

We express our gratitude to our project guide Mr. Ramalingam H M Senior Assistant Professor, Department of Electronics & Communication Engineering, Manglore Institute of Technology & Engineering, Moodabidri who always stood behind us and supported in each and every step of this project. We would like to thank him for his continuous encouragement and cordial support during the preparation of the project and the project report.

REFERENCES

[1.] C. L. Chen et al., “An anti-counterfeit and traceable management system for brand clothing with hyperledger fabric framework,” Symmetry (Basel), vol. 13, no. 11, Nov. 2021, doi: 10.3390/sym13112048.

[2.] Y. Li, Z. He, S. Wang, Z. Wang, and W. Huang, “Multideep Feature Fusion Algorithm for Clothing Style Recognition,” Wireless Communications and Mobile Computing, vol. 2021, 2021, doi: 10.1155/2021/5577393.

[3.] K. Pinitjitsamut, K. Srisomboon, and W. Lee, “Logo Detection with Artificial Intelligent,” in Proceeding of the 2021 9th International Electrical Engineering Congress, iEECON 2021, Mar. 2021, pp. 408–411. doi: 10.1109/iEECON51072.2021.9440236.

[4.] L. Huo, J. Zhu, P. K. Singh, and P. A. Pavlovich, “Research on QR image code recognition system based on artificial intelligence algorithm,” Journal of Intelligent Systems, vol. 30, no. 1, pp. 855–867, Jan. 2021, doi: 10.1515/jisys-2020-0143.

[5.] M. R. Hasan Tanvir, S. A. Shanto, F. Israt, A. Rahman, and S. Momotaj, “Blockchain based counterfeit medicine authentication system,” in ISCAIE 2021 - IEEE 11th Symposium on Computer Applications and Industrial Electronics, Apr. 2021, pp. 214–217. doi: 10.1109/ISCAIE51753.2021.9431789.

[6.] M. Chawla, R. Jain, and P. Nagrath, “Implementation of Tesseract Algorithm to Extract Text from Different Images.” [Online]. Available: https://ssrn.com/abstract=3589972

[7.] A. Rasheed et al., “Fabric Defect Detection Using Computer Vision Techniques: A Comprehensive Review,” Mathematical Problems in Engineering, vol. 2020. Hindawi Limited, 2020. doi: 10.1155/2020/8189403.

[8.] E. Daoud, D. Vu, H. Nguyen, and M. Gaedke, “IMPROVING FAKE PRODUCT DETECTION USING AI-BASED TECHNOLOGY,” Apr. 2020, pp. 119–125. doi: 10.33965/es2020_202005l015.

[9.] W. Wang, G. Han, and G. Sun, “Fractal Anti-Counterfeit Label Comparison Using Combined Image Features and Clustering,” IEEE Access, vol. 8, pp. 134303–134310, 2020, doi: 10.1109/ACCESS.2020.3011454.

[10.] Acs. Sheela, “Finding Fake Logo Using CDS Logo Detection And Recognition Algorithm,” International Journal of Scientific & Engineering Research, vol. 5, no. 3, 2014, [Online]. Available: http://www.ijser.org

[11.] Proceedings 2010 Eighth International Conference on ICT and Knowledge Engineering : November 24-25, 2010, Bangkok, Thailand. Siam University, 2010.

[12.] RVS Technical Campus, IEEE Electron Devices Society, and Institute of Electrical and Electronics Engineers, Proceedings of the International Conference on Electronics, Communication and

Aerospace Technology (ICECA 2017) : date: 20,21,22, April 2017.
[13.] Indian Institute of Technology Ropar, Institute of Electrical and Electronics Engineers. Delhi Section, IEEE Sri Lanka Section, Institute of Electrical and Electronics Engineers. Kharagpur Section, and Institute of Electrical and Electronics Engineers, 2018 13th International Conference on Industrial and Information Systems (ICIIS) : IEEE ICIIS 2018 : proceedings : December 1st-2nd, 2018 : Indian Institute of Technology Ropar, Rupnagar, Punjab, India.
[14.] S. Chattopadhyay, P. Pratim Acharjya, and C. Koner, "A Morphological Approach to Match Two Color Images Using Deep Learning."
[15.] J. J. B. Pérez, A. Queiruga-Dios, V. G. Martínez, and Á. M. del Rey, "Traceability of ready-to-wear clothing through blockchain technology," Sustainability (Switzerland), vol. 12, no. 18, Sep. 2020, doi: 10.3390/su12187491.
[16.] A. Shinde, P. Singh, J. Patil, J. Singh, and T. Baraskar, "Text Extraction from Images using Tesseract," International Research Journal of Engineering and Technology, 2021, [Online]. Available: www.irjet.net
[17.] V. Jain, Y. Jain, H. Dhingra, D. Saini, M. C. Taplamacioglu, and M. Saka, "IJTPE Journal A SYSTEMATIC LITERATURE REVIEW ON QR CODE DETECTION AND PRE-PROCESSING," International Journal on "Technical and Physical Problems of Engineering" (IJTPE) Issue, vol. 46, pp. 111–119, 2021, [Online]. Available: www.iotpe.com
[18.] P. Y. Lin, "Distributed Secret Sharing Approach with Cheater Prevention Based on QR Code," IEEE Transactions on Industrial Informatics, vol. 12, no. 1, pp. 384–392, Feb. 2016, doi: 10.1109/TII.2015.2514097.
[19.] G. V. Lakshmi, S. Gogulamudi, B. Nagaeswari, and S. Reehana, "BlockChain Based Inventory Management by QR Code Using Open CV," Jan. 2021. doi: 10.1109/ICCCI50826.2021.9402666.
[20.] S. Padmashree Professor, "Brand Logo Detection Using Convolutional Neural Network." [Online]. Available: www.ijert.org
[21.] E. Xi, "Image feature extraction and analysis algorithm based on multi-level neural network," in Proceedings - 5th International Conference on Computing Methodologies and Communication, ICCMC 2021, Apr. 2021, pp. 1062–1065. doi: 10.1109/ICCMC51019.2021.9418309.