IMAGE-BASED PROCESSING OF NAIRA CURRENCY RECOGNITION

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ABSTRACT: The traditional system of identifying and recognising Nigerian Naira currencies in Sokoto Metropolis during daily cash transactions is done by manually checking for specific features on each currency. This approach poses a lot of challenges such as error in differentiating between the original and fake copies of the currency which can easily occur due to some salient details of the currency that cannot be genuinely identified by the concerned individuals. This research work aims at developing a currency recognition system using image-based processing technique to identify and recognize the different kinds of currencies. The application was implemented using Visual Basic and the MS Access relational database management system. The result of the experimental evaluation using some sample users of the selected domains has demonstrated that, the average users score of the overall system is 77.7%. This implies that, the proposed system improved the effectiveness of the currency recognition processes based on the result obtained during evaluation.

KEYWORDS: Image-Based Processing, Currency Recognition, Naira.

1. INTRODUCTION

Naira is the name given to the currency note used in Nigeria. The Naira currency denominations in circulation typically looked totally different in paper size, color, and pattern. This brings the idea of using an automated machine to detect and recognise currency. People who used currency in their daily cash transaction or work in currency exchange offices find it very difficult to recognise the currencies by mere touching, some even squeeze the paper currencies or look at some familiar features of the currencies in order to be able to know whether the currency is genuine or fake and whether to accept it or not. This work will explore the possibilities of helping people to reduce the problem of handling fake currency in circulation.

Automatic techniques for paper currencies recognition become an important component to be taken into consideration for the betterment of the economy of any country. Introducing information technology to the financial system is a milestone in protecting the economic prosperity and maintaining social harmony. The Central Bank of Nigeria (CBN) is the only one which has the full authority to issue banknote in Nigeria. But still there are some dishonest groups of people making fake currencies for their own benefits. Counterfeit or fake money is the imitation of the real currency produced without the legal sanction of the government of the concerned state or country ([APR14]). It become necessary to educate and to bring to the notice of the general public about the fake Nigerian naira notes in circulation especially ₦100, ₦200, ₦500 and ₦1000 that has the highest tendency of being fake. The aim of the proposed system is to help people who need to recognise different currencies in a convenient and efficient manner by an image processing technique system for paper currency recognition. The system will enable users to register with the system, log into the system, add suspicious Naira currency, determine whether the currency genuine and much more. The system will also guide prospective users to know some specific features of interest needed to be taken into account while identifying the genuine or original currency notes.

2. RELATED WORKS

Roogi ([Roo14]) proposed bar code scanner method to detect the fake currency note by utilizing the unique serial numbers of the Indian denomination. This method has to be integrated into the government database which is not easily implementable due to sensitive nature of the records to be requested. Thakur and Kaur ([TK14]) discussed the various fake currency detection techniques with a view to providing solid information to the reader about the different methods and algorithms used for fake currency recognition. Deborah, Soniya and Prathap ([DSP14]) used image processing approach to compare the currency status of being either original or fake. This proposed approach cannot classify the given currency note to whether it is original or forgery. Nagpure et. al ([N+16]) implemented currency recognition and fake note detection application using a webcam and java to recognize Indian currency note. This application performed both the detection and

classification of notes. But, this work cannot be adopted for Nigerian currency since each country has its own currency salient features to be identified. Elsaid ([Els16]) proposed using feature extraction technique from both original and sample currency images for detecting fake Egyptian paper currency. Based on the investigated literature, none of the currency recognition systems reviewed is based on the Nigerian currency denomination. There is need to incorporate image currency recognition application properly in our shops in order to reduce the menace of fake currency during cash transactions. This form the basis and motivation for this research work.

3. MATERIALS AND METHODS

This section of the paper describes the image processing algorithm, different tools, methods and techniques used in this research work.

3.1. Currency recognition algorithm

Currency recognition is the process to be followed in order to determine the originality or authenticity of the suspicious (or fake) currency. In this recognition approach the overall percentage match (at 95% to attain maximum accuracy) computed by the system is used as a criterion to determine if the currency note under investigation is a fake or not. The Pseudo code of the image processing recognition algorithm for the proposed system used in this study is outline below

a. Supply the image of suspected currency denomination to be identified.
b. Detect the currency by identifying the pixel information and position of each feature that makes up the naira image supplied.
c. Compare the supplied image pixel information with the equivalent image of the original note of the currency already stored in the system database.
d. Calculate the percentage match value of the compared image features such color, strip, watermark etc.
e. Determine if the calculated value of the overall percentage match is greater than 95% then the currency note in question is original or genuine, otherwise the currency note is suspected to be fake.

3.2. Development tools used

The Database used in this work is implemented with Microsoft Access in which three tables were created; login table for users access to the system which contain Username and Password, the Currency table for keeping the record of the original currency notes which were used as the test cases and the Fake table which stored the fake currency detected by the system. A Scanner is a device used to capture the image of the currency to be submitted to the application for recognition purposes. Visual Basic is used to implement the different user interfaces for the various modules of the recognition application. It provides the required interaction with MS Access database which enable retrieval and comparison of original and fake currency notes.

3.3. SYSTEM DESIGN APPROACH

The design phase of this paper describes how the recognition system operates. It describes the structure of the system and method of input, output and the various procedures by which the users interact with the currency recognition system for the purpose of detecting fake currency notes. This is a very useful phase because it illustrates how a user of the system works using a certain type of system design method. In this case we adopted the use case diagram design for the proposed system showing the actor and the set of actions to be performed as depicted in figure 1.

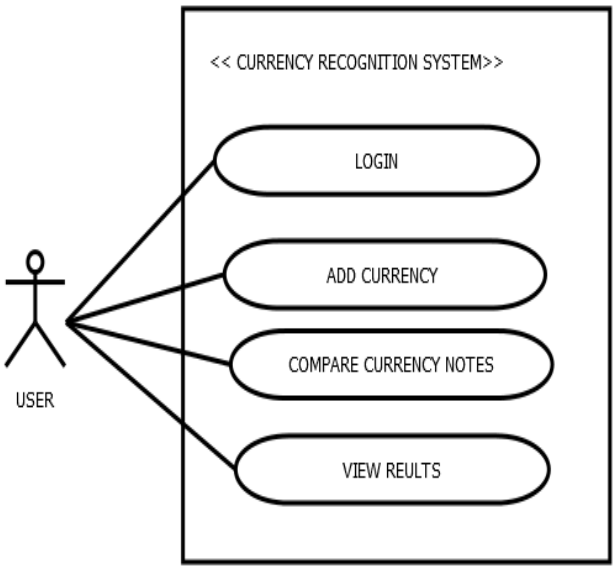

Figure 1: Recognition System Use Case Diagram

3.4. SYSTEM IMPLEMENTATION APPROACH

The developed system is implemented in two stages namely front end and back end. The Visual Basic is used for front end implementation of currency detection interfaces and their interaction with database. The system uses MS Access which is a Database to store the application original currencies and the fake ones identified in an organized format that is easily accessible by the Visual Basic programming language. It describes the various

functionalities of the step by step under each module of the new system with the expected output. The new system will have a database containing the original notes of the currency for various denominations. The image of the note to be investigated will be captured by the scanner. This captured image will then be uploaded and compared with the original image using the algorithm outlined in section 3.1. After the recognition process is completed, and then the output parameters displayed by the proposed system are used to justify the originality of the tested currency based on the result of the overall percentage match obtained.

3.4.1 Currency recognition components

This module is used to check the authenticity of the currency note to be verified against the original image. Figure 2 shows the currency recognition testing of a fake 1000 naira note. The result obtained after analysing the currency detected features stated that there is a low likelihood that the currency note is original, meaning that the note tested is fake.
Similarly, figure 3 illustrates the currency recognition testing of a genuine 1000 Naira note. The result obtained after analysing the currency detected features stated that there is a high likelihood that the currency note is original meaning that the note tested is original.

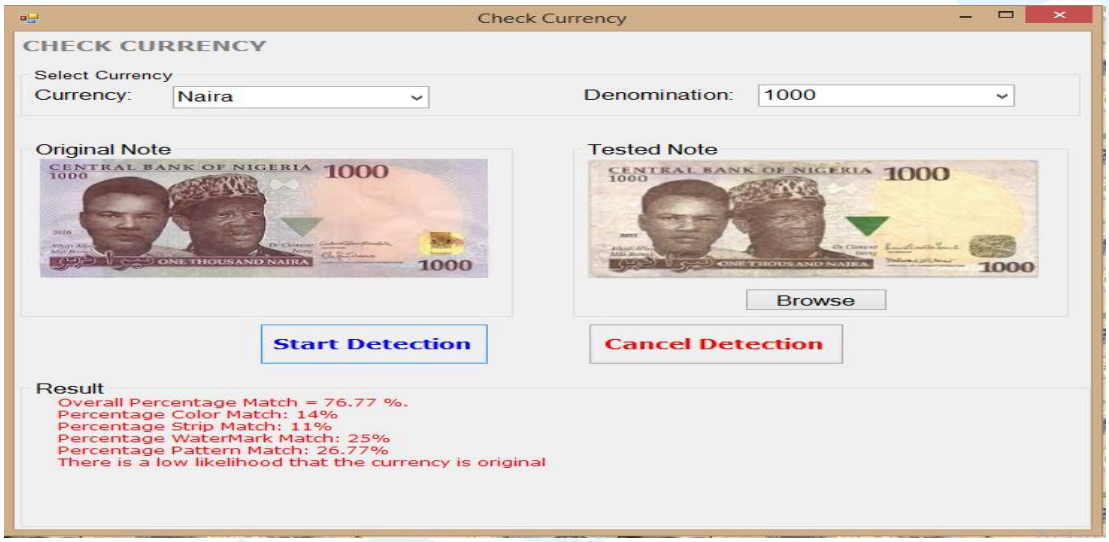

Figure 2: Fake 1000 Naira Detection

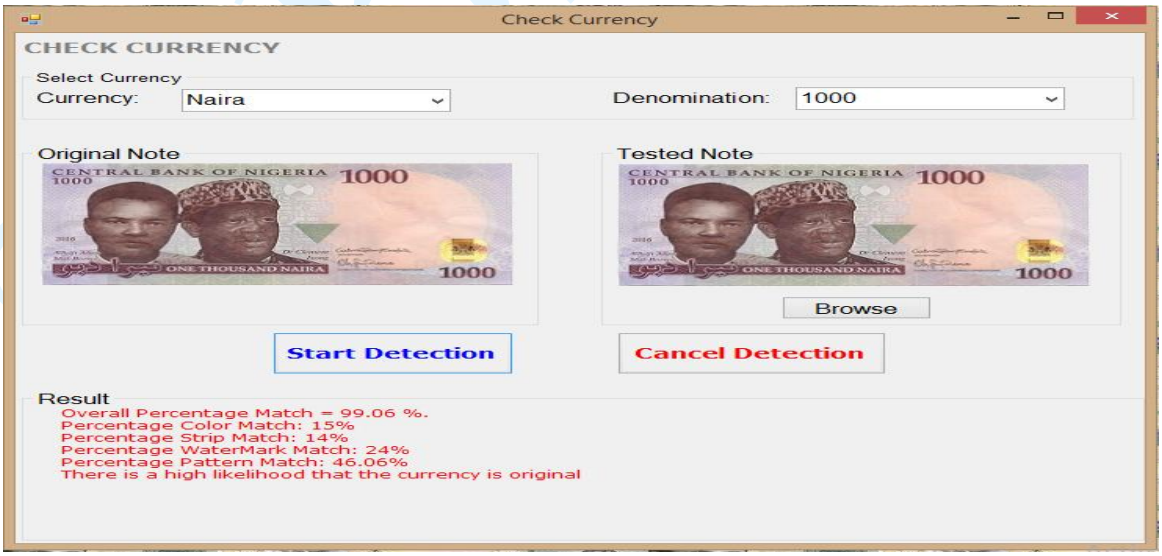

Figure 3: Original 1000 Naira Detection

3.5. SYSTEM EVALUATION TESTING

The effectiveness of the developed image-based recognition system was evaluated based on the accuracy of the currency notes recognized by system. The main target of this evaluation is to assess the system in order to identify whether the system detect the currency submitted by the users as expected. This system evaluation process considers the following criteria:

a. Correctness: Does the system recognise the currency note given to it by the users correctly as expected?
b. Efficiency: How fast is the currency recognition process of the proposed system?
c. Simplicity: Is the system easy to use and/or assist layman to identify the fake currency notes by himself?
This experimental evaluation is conducted using some users from the selected shops within Sokoto metropolis where daily cash transaction is taking place, by allowing each participant to use the system and provide the feedback based on the system recognition result provided. The usefulness of the proposed system is captured by taking the above mentioned three criteria into consideration. The questionnaire used for the experimental study was administered to the sample participants and it consists of 10 questions to be answered after exploring functionality of the system. The participant later filled the questionnaires based on their interactions with the system. Those participants were expected to answer those 10 questions by selecting a score point from 1- 5 (strongly disagree … strongly agree). A total number of 22 questionnaires were administered to the sample population, but only 15 questionnaires were duly completed and submitted. This analysis was based on the 15 duly completed and returned questionnaires by the participants. To obtain the total score of each questionnaire filled by the participants, we sum the scores of all the 10 items scored by the users.

4. RESULTS AND DISCUSSION

The usefulness of the proposed currency recognition system was evaluated based on the feedback obtained from 15 participants that filled the questionnaires after using the system. The System Usability Scale (SUS) questionnaire which comprises of 10 items to be assessed by the users in question is used in this study ([Bro86]). The SUS questionnaire is considered due to its simplicity and ease of use to the participants of this evaluation. The overall effectiveness of the system is captured by analysing the currency recognition system SUS questionnaire filled by the users. The summary of the result obtained from the evaluation study of the 15 participants and their respective SUS scores in this study is given in a statistical bar chart as depicted in figure 4.

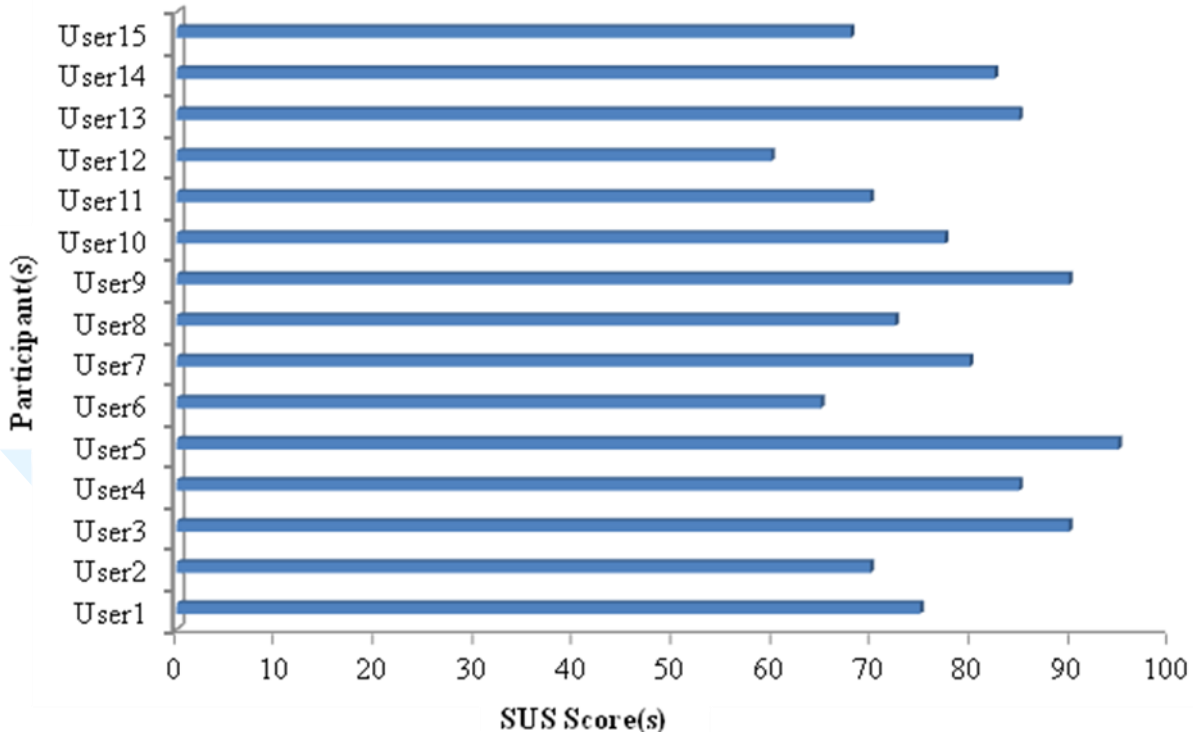

Figure 4: Experimental Evaluation Results

It can be seen that from the above results, three users rated the system overall performance 90% and above, four users rated the system 80% and above, five users rated the system 70% and above while the rest of the three users rated the system 60% and above. The overall result average of the users that participated in the experiment is 77.7% which indicated that the system usability scale (SUS) has been satisfied. The results also suggest that the proposed system will be very helpful to the people within the selected who used cash transactions daily

in their businesses based on the responses obtained in this study.

5. CONCLUSIONS

This research work has presented Naira currency recognition application for the shops owners and other people who used cash transactions in their daily business within Sokoto metropolis with a view to improve the fake currency identification methods currently being used. The new system was developed using the Visual Basic programming language for the logic implementation of the image processing detection algorithm as well as the front end development while the backend was implemented using the MS Access database management system. It is noted that achieving maximum correctness of the detection and getting 100% accuracy for the currency to be verified is very difficult especially when the physical state of currency note is not good, this will always be a very big challenge for the researcher. The newly developed system was able to detect fake and genuine Naira currency denominations supplied by the users. The proposed application will improve the level of awareness and identification of the fake or counterfeit currency notes in circulation to the people who used cash transactions regularly in their various businesses.

However, as future work, two or more image processing algorithms should be used to compare the original currency notes with the tested notes in order to determine the most accurate algorithm in Naira currency recognition processes. Further research should also investigate the usefulness of incorporating mobile applications paradigm to the currency recognition systems. There is need to provide a mechanism to deal with damage or bad currency notes that the system cannot determine its status.

REFERENCES

[APR14] **Alekhya D., Prabha G. D. S., Rao G. V. D.** - *Fake Currency Detection Using Image Processing and Other Standard Methods*. International Journal of Research in Computer and Communication Technology, Vol 3 (1): pp. 128-131.

[Bro86] **Brooke J.** - *SUS- A "Quick and Dirty" Usability Scale*. Digital Equipment Co. Ltd. 1986. [online] Available from: http://cui.unige.ch/isi/icle-wiki/_media/ipm:test-suschapt.pdf [Accessed 17 April, 2017]

[DSP14] **Deborah D., Soniya C., Prathap M. E.** - *Detection of Fake Currency Using Image Processing.* International Journal of Innovative Science, Engineering and Technology, Vol 1(10): pp. 151-157, 2014.

[Els16] **Elsaid W. K.** - *Fake Egyptian Currency Detection System Using Texture and Shape Characteristics.* International Journal of Computer Applications, Vol 143(2): pp. 31-36

[N+16] **Nagpure R., Shetty S., Ghotkar T., Yadav C., Kanojiya S.** - *Currency Recognition and Fake Note Detection*. International Journal of Innovative Research in Computer and Communication Engineering, Vol 4(3): pp. 3659-3666, 2016.

[Roo14] **Roogi R. H.** - *Fake Currency Detecting using Bar Code System*. Journal of Computer Science and Technology, Vol. 4(8): pp. 1-2, 2014.

[TK14] **Thakur M., Kaur A.** - *Various Fake Currency Detection Techniques*. International Journal for Technological Research in Engineering, Vol. 1(11): pp. 1309-1313, 2014.