Turkish Online Journal of Qualitative Inquiry (TOJQI)

Volume 12, Issue 3, June 2021: 2298-2306

Research Article

Note to Coin converter: A Survey

Manasa Lakshmi G[1] Octavia M[2] Pooja S[3] Preethi Shilpha S[4] Dr. Shirley Selvan[5]

Abstract

Lately, coins have become requisite. The need for it is increasing in social places like bus stands, railway stations, markets, parking and entry lots and many others. People do not carry enough of these. To get away from this problem, smaller and lighter systems which dispense coins instead of notes were designed. One advantage is that they need not be supervised. The machine checks for its trueness by colour recognition techniques using digital image processing. It then dispenses the required change by following the coded MATLAB instructions. Devices like UV diodes, micro-controllers and Arduino were employed in this process. This survey paper shows a comparative study of various methodologies that were proposed to design a real-time note to coin converter machine.

Keywords- Fake Note Detection , Note to Coin Exchanger, UV LED, LCD, Photodiode, Coin Dispensing, RGB Model, DC Motor, RFID Detection.

I.INTRODUCTION

A note to coin converter checks originality of notes and provides equivalent coins according to its value. Today, the note to coin converter machine is being used widely. Many countries have implemented the machine in order to avoid having trouble in public places. In India, however these machines are not many in number.

[1]3rd year, Department of ECE St. Joseph's College of Engineering St. Joseph's College of Engineering Chennai, India. manasaraju92@gmail.com
[2]3rd year Department of ECE St. Joseph's College of Engineering Chennai, India. [2]octavia.ezhil@gmail.com
[3]3rd year Department of ECE Chennai, India. poojashaa33@gmail.com
[4]3rd year Department of ECE St. Joseph's College of Engineering Chennai, India. preethishilphas21@gmail.com
[5]Department of ECE St. Joseph's College of Engineering Chennai, India. shirleycharlethenry@gmail.com

In order to make these available in public places, we have to build them in such a way that they are small in size, less in weight and cost effective. The implementation is simple. First it is identified whether the placed note is real or fake. If fake, the note will be returned, if real it will be

taken inside for further processes. According to the user's amount in rupees, the machine will deliver coins. Image processing is used for this purpose.
The various techniques used in designing the note to coin converter is discussed briefly along with their pros and cons in the following section.

Madhav Thigale et al proposed a method to determine the originality of the note, if real it will be taken for further process, else its serial number will be noted. Canny edge detector is used to pinpoint the boundaries in pictures. The identified objects differ from the background. Gradient image is calculated by using the operator and for generating binary mask, threshold can be put in. Threshold can pass only white pixels but the black pixels whose values were 0 are not passed.

They detected faces in images by use of Viola-Jones algorithm. For coin dispatching, MATLAB is used. When the user types the amount he needs, the available value is checked with the typed amount, if same, the indication is conveyed to the microcontroller. The motor is fixed to deliver coins, it rotates for N times for N number of coins for a particular duration. The hardware used are Arduino Uno, Relay Module and DC Motor. Arduino Uno is used here, out of its various pins, only 6 are used. Furthermore, it has USB connection, a power jack, ICSP header and almost all required to assist microcontroller. To handle the high current/voltage, which microcontroller cannot grasp, a relay module is used. In this module, three various connections are used such as normally closed, normally open and common .DC motor converts electrical energy into mechanical energy. It is primarily used to alter the way of current flow in motor's parts.[1]

Ashish Ramdas et al implemented a note to coin conversion system that performs different tasks. Basically, it contains two sections software and hardware. In the software section, image processing algorithm and the calculations for the coin to be dispatched will be decided. In the hardware section, with the help of a microcontroller, different operations such as image capture, RFID detection, coin dispatch etc. are performed. This process has a note detection unit which scans the note using a camera. The image is obtained from the camera. A Coin container's unit contains different containers to hold the coins and coin dispatch unit dispatches the coin based on the input.–The image is converted into grey scale and then pre-processing is done to suppress undesired distortions followed by resizing the image and finally image smoothening to reduce the noise.

The authors have made use of an image processing algorithm based on Local Binary Pattern (LBP) and Optical character recognition (OCR). Optical character recognition is a process that detects and recognizes characters from an input image and converts it into ASCII or other equivalent machine edible form. In this process, the camera acts as a digital eye for input to the computer system. Controller AT89C2051 is designed with static logic operation. RFID provides a unique identifier for an object. USB to TTL is used for serial communication between microcontroller and computer. The authors have used L293D motor driver IC to connect motors to the microcontroller. A set of two DC motors is controlled by 16-pin IC simultaneously in any direction. This motor device helps the coin dispatch unit to dispatch the coins.[2]

Ajitkumar Khachane et al introduced a system to exchange notes with coins. It comprises of two units i.e., fake note detection unit and note to coin exchanger. Firstly, the value of threshold

voltage is set in the comparator which processes in a serial manner. After the note is sent to the system, UV LED source sends out the rays on the currency note. The Indian currency has a unique feature of absorbing a small amount of UV rays while a fake note reflects it. Based on this, the note is checked by using an UV photodiode and an amplifier. If the note is fake, it is ejected out. If not it is send to the serial port. A snap of the currency note is taken. The captured image is an RGB image which is converted to a HSI image from which the "S" plane is extracted. It is snipped and binarized. To find the denomination, percentage of 1 is calculated from the image matrix based on which the counter is filled. When the eject key is pressed, the motor starts up and the coin counter tray comes out. The denomination of the note is checked by the uploaded MATLAB code. The user is now asked for the choice of coins. After it is specified, it checks for coin sufficiency. If available, the coins are ejected by the rotation of the motor.[3]

Harshali Rambade et al put forward this methodology to convert a note to coin which comprises of hardware and software designing. The hardware components required to carry out this process are an Arduino atmega328, RFID (Radio frequency identification), LCD (16 x 2 display) and a servo motor. Arduino has a physical programmable circuit board where the programmed software is stored. RFID consists of a tag (tiny chip) that holds and carries the details to a RIFD reader which is linked to a computer. The TowerPro SG90 9g Mini Servo equipped here, has a 180° flap rotation

Firstly, the artificial note embedded with a chip is taken and it is scanned by the RFID reader which stores the identification information. The value of the note is checked and it is displayed on the LCD screen. The user is now asked for the value of coins needed in exchange of the notes. The coins needed are stocked in 4 different switches i.e., based on their values. The program which is stored in the Arduino instructs the server motor according to the user's requirement. The flaps in the server motors are rotated in accordance to the commands in the program. For example, if the user demands 1 rupee coins in exchange for a 10 rupee note, the flap will have to rotate 10 times in order to get the desired exchange. Each rotation ejects one, 1 rupee coin. In this way the prototype is carried out to convert notes to coins.[4]

M.E Ingale et al proposed a method for converting notes to coins. Primarily, they used a note placing unit, which accepts the note.10RPM DC motor is used to take the note inside the machine. To detect whether the note is fake or real they used metal strips of the note. When UV light falls on the metal strip of the note, it appears partially green. The webcam placed in the system captures the image of that part and processed in MATLAB. The most preferable technique of image processing is colour based recognition. It is performed by counting the number of pixels of each colour. Three parameters are required to represent a color, those models must be in a 3-D format. Some of these colour models are RGB, CMY and HSI. RGB colour model consists of three major colours (red, green, blue)and their combinations indicats different colors according to their weights. The HSI model is based on the characteristics of the Human's visual system. In this model 'I' symbolises the light intensity, 'H' signifies the shade that specifies color purity and 'S' symbolises the saturation. MATLAB transfers the data in the form of 1's and 2's.

The controller pick out that data and generate coins in multiples of 5,2,1 or mix coins as per user demand. Matrix keypad is the user interface (4*4 matrix) and it has 4 keys for 1 rupee,2

rupees,5rupees and for mix coins. They proposed a coin converter that consists of 3DC motors. ICL293D is the preferably used motor device. It will let out the 1 rupee, 2rupees and 5rupees coins from the motor. As per the user obligation, the mix coins will be delivered to the user. If the receptacle is empty, a message will be displayed on the LCD as "Insufficient coins".[5]

Rajesh Khotre et al implemented an operation for converting notes to coins. Incipiently, the camera is turned on and the note must be placed in a delicate slot where the camera captures a clear image of it. The picture will be further converted into a frame (stored in computer). It helps to compare the image which is stored in a database using the digital image correlation technique. The note will be considered as real if the images were matched and allows the user to choose the value of the coin.

The computer is connected to the microcontroller using USB to TTL. Once the computer corroborates the entered note, it directs the microcontroller to perform the essential operation. RFID is also connected to the computer and it provides access to the new coins in the coins stack. These are generally operated in the range of 125Hz to 960MHz.Here, AT89C2052 microcontroller is used which helps to operate the coin dispensing unit along with DC motor and LCD. L293D a motor device IC connected to the microcontroller can control a set of DC motors in any direction. The coin dispensing unit consists of 4 trays containing coins of 1 rupee, 2 rupees, 5 rupees and 10 rupees and disperses depending on the result of motor device. If there are no sufficient coins in the container, then the LCD will displays as "Insufficient coins".[6]

Rishit Kapadia et al worked on the process of converting notes into coins. GSM security is also involved in this operation. The webcam captures the image of the currency note and then the image processing is carried out. Changes in the image will be detected by Canny Detector. If the machine is shaken or disturbed GSM notifies that and sends a message. MAX 232, a 16 pin IC and a dual receiver is used. The microcontroller acts according to the information given by the image processing unit.

Color-based recognition technique is preferred. Webcam captures the image of the note. The first and second index of the array gives the co-ordinates of the pixels. 640 is the limit of the first index and 480 is the limit of the second index. The number of pixels are counted and compared with the original values to detect the originality of the note. MATLAB assigns the value of the note. The number of coins required are given as input by the user. Now the motor rotates to dispatch the coins equivalent to the value of the note. The motor rotates N times for N number of coins.[7]

Chavan et al preferred color-based recognition technique to detect the originality of notes. RGB, CMY and HSI are some color models used in this technique. RGB color model is reproduced by adding red, green and blue colors. The webcam captures the image of the currency note. The first and second index of the array gives the co-ordinates of the pixels. RGB color intensities for each co-ordinate are stored in third index. 640 is the limit of the first index and 480 is the limit of the second index. Depicting HSI model, I refers to the intensity of the light, H measures the purity of color, S is the saturation of the color.

Arduino compiler is connected with camera, relay module, dc motor and coin dispatching machine. The note is inserted in slots and the picture of the note is captured by the webcam and the picture

is pre-processed by the MATLAB. The relay is turned on and off by a low power signal. In coin dispatching machine MATLAB detects the originality of the note and assign the value of the note. The required number of coins is selected by the user. Now the motor rotates to dispatch the corresponding number of coins. As the system is fully automated it reduces human efforts.[8]

Gouri Desai et al designed a note to coin converter using IR Sensors and a Microcontroller. In many applications of coins at grass hood level an exchanger machine is made, which provides coins instead of notes. The note is first checked for its trueness. The originality of the note is detected by M algorithm and further the microcontroller processes. In the output we receive the coins as per user requirements. DC motor of 10 rpm requires 12V to be driven. DC motor is attached to the roller to take the note inside the machine. Two IR sensors, one before ŧ and the other after the roller are placed. When the 1st sensor is cut, roller takes the note in and stops when the second sensor is cut and it is further processed by the microcontroller. If the note is fake, motor rotates in opposite direction. The image obtained from the camera undergoes noise reduction, normalization and contract enhancement. The image is converted from RGB to gray and the edges presented in the image are detected through canny operator.

The obtained image is binary which has only two colors black and white. The metallic elements present in the note were highlighted by UV light which appears to be white and rest of the note is black. In the original note, five metallic strips could be observed. So by checking the present alternate weaving of metallic strip in note, we could detect the trueness of notes. The color-based recognition technique is preferred. Correlation function of MATLAB compares the whole note with standard image of original note. Output of this function is true whenever 90% of parameters are matched. Keypad is used for selecting desired amount of coins in exchange of notes. LCD displays the values. Micro controller PIC 16F877A performs all the controlling process. Coin dispension unit contains a coin container and motor to dispense coins. Motor lets out the coin required. LCD displays “INSUFFICIENT COINS” when the coin is not in the coin container.[9]

Seema S Patil et al proposed a way to provide coins after checking its originality. If the note placed is genuine, it’s image will be captured by a camera and its equivalent coin will be dispatched, else the note will be given outside. Since Indian currency absorbs UV light, they have built an unit which incorporates UV Led, photodiode, amplifier and comparator. If the placed currency reflects the UV light, then it will be identified as fake note. The output is given to comparator after amplification. After applying threshold to the comparator, output is given to the microcontroller. To identify the value of the placed note, edge detection is used. It is effective for finding boundaries in images by detecting discontinuities in brightness.

There are 3 types of edge detector namely Sobel, Prewitt and Robert operators. Sobel operator enumerates an estimation of gradient. It considers only 0 and 90 degree kernels. Kernels amalgamated to discover absolute magnitude of gradient. The simplicity in calculation is relatively low. From the histogram, the threshold values are taken and automatically assigned. Therefore the entire process becomes automatic. For coin dispensing, the authors use IR sensors to discern the coins, hence if they are emptied the motor will stop automatically.[10]

II.CONCLUSION

As mentioned in the previous sections, we can transfigure note into coin for finer convenience. It helps us in many ways. The algorithms and methods required for this transformation has been discussed above in detail. The first step is to check for fake note detection, if this condition passes, the note will be taken inside or else the note will not be accepted by the machine. For segmentation, the item to be segmented varies substantially in disparity from the background image. In most of the techniques, microcontroller has been used. To support the microcontroller, an Arduino compiler is used. It has everything needed to assist the microcontroller. But a relay module is used for handling the high current/voltage instead of microcontroller. In some techniques, LCD is used for user interaction. The legitimacy of note will be exhibited through LCD. The various algorithms used here are viola jones algorithm, local binary pattern(LBP), optical character recognition (OCR).

The value of the note is identified by using a MATLAB program. The availability of coins is checked by the system. Based on the availability, the coins are handed outside. The note is given out if there is any shortage of coins. Thus the above mentioned real time system is designed for currency approval and dispersion of coins with the help of image processing. It has also proved to be helpful in public places.

TABLE I. COMPARISON TABLE

Article Name	**Author**	**Methodology**	**I.Pros II. Cons**
"Note to Coin Converter using Digital image processing" IRJET-Volume-04 Issue-03 March-2017	Prof. Madhav Thigale, Lina ladhone, Madhuri mangutkar, Neha Gaikwad	Segmentation Algorithm & Viola-Jones Algorithm is used.	Accuracy will vary according to the brightness, movement and speed.
"Effective currency note to coin conversion system using image processing" IJARIIE- ISSN(0)-2395-4396 Volume-03 Issue-2 2017	Prof. Ashish Ramdas Krishna Shahapur, Abhijeet Tigote, Pranali Betti, Mayur Pathare	Local binary pattern &optical character recognition is used.	Effective texture descriptor for images. Long histogram slows down
"Note to Coin Converter" IRJET Volume-05 Issue-03 March-2018	Mayuri Sewatkar, Prof. Ajithkumar Khachane	Transmitting UV light	Fake note reflects UV light. Most refrangible

"Note to Coin Converter" IRRESM Volume-3 Issue-3 March-2020	Viranchi Bhatt, Divyanshu Mishra, Shrikrishna Deshpande, Harshali Rambade	Using artificial plastic note with chip embedded in it	Strong and durable. Duplicating is impossible.
"Note to coin exchanger using Image processing" IJARECE Volume-04 ISSUE-03 March-2015	Prof. M. E. Ingale, Akash Deore, Rahul Sambre, Rakesh Karad.	RGB & HSI color model is used.	Produces best black and white images
"Note to coin converter using Digital Image Correlation technique in Image processing" IRJET Volume-05 Issue-03 March-2018	Nirmal Patade, Ravi Patel, Vivek Gupta, Jitendra Patra, Prof. Rajesh Khotre	Correlation technique is used.	No reinforcement effect.
"Note to Coin Converter" IJETR @ 2015	Rishit Kapadia, Abhinay Gupta, Sumit Patel, Nitesh Kadam	GSM security control	For detecting the vibration of the machine when it is shaken
"Currency Note Detection And Note to Coin Converter Using Digital Image Processing" IRJET Volume-06 Issue-05 May-2019	Komal Kapare, Punit Jain, Assist. Prof. H.P.Chavan	Uses color based recognition	Allows wider range of colors

"Note To Coin Exchanger" IRJET Volume-05 ISSUE-04 April-2018	Prof. Gouri Desai, Kajal Jadhav, Suyesha Bhandan, Poonam Patil	Uses microcontroller with mechanical structure	Once microcontroller is programmable then they can't be reprogrammed
"Intelligent Note to Coin exchanger with Fake note detection" Journal of Remote Sensing GIS & Technology Volume-05 Issue-02 2019	Seema S. Patil, Shilpa S. Patil, Sushant S. Patil	Sobel operator is used as it detects edges of the image	Fast to compute. Easy to calculate. Accuracy is low.

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