Indian Currency Recognition System

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Abstract **-** For blind people, it is very difficult to recognize the value of banknote. Despite of this, Indian currency have some special identical features like RBI mark, number, which are recognized by ATM's and our Indian banks. This paper represented a new methodology for currency recognition by using size parameter of banknote. To measure the size of banknote, encoder is used which generates the pulses according to the length of banknote which is to be tested and then recognized. Since the size of banknotes Rs50 and Rs20 are same. To distinguish these banknotes, edge detection is done. For edge detection, LDR sensor is used. These pulses that are generated by encoder are compared with the database of microcontroller and then result is announced by speaker. This device is very helpful for visually impaired and blind people.

Keywords **-** Currency recognition, visually impaired and blind, banknote.

I. INTRODUCTION

In year 2002, the World Health Organization has calculated that, visually impaired people were 161 million that is 2.6% of the total residents. Among these statistics, visually impaired people were 124 million and blind persons were 37 million [1].While interacting with environment, visually blind people have to suffer from many problems. Among these problems, one specific problem is the recognition of banknote value which is in their hand. Values of Indian Currency are Rs. 1, Rs. 2, Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100, Rs. 500, and Rs. 1000. Indian banknotes differ from each other by their own different features. These features are like colour, size, and numeric text printed at centre or corner of banknote or some other marks of identification. To recognize these features is easy for sighted person but for blind people, it is tough. Applications of Currency recognition system are: Automatic selling goods system, bank system and for blind people.

Blind person cannot recognize the value of banknotes. To help such people different technologies were established to recognize the value of banknote. But these are expensive and not convenient. Also in many technologies, Camera is used [9]. The Systems have to face some problems which are using camera, like storage problem and positioning of banknote. Some technologies used the method of edge detection, but the designed system based on these technologies is not handheld [4].

Value of Indian currency can be recognized by different parameters like

- Text numeric printed at centre and corners of notes.
- Length and width of banknote
- Face diagrams at backsides
- Different colours of banknotes

In this work, size parameter of banknote is used for recognition purpose. Based on this parameter, a newly designed device can be carried by blind person. The technologies for banknote detection whether it is counterfeit or not, has been established already. For example, banknote can be detected by testing the metal wire present in a banknote and also Ultra violet rays can be used. Dollar bills are fluorescent when ultra violet light is shined on them.

II. RELATED WORK

For currency recognition, many technologies have been established. Some of them are as follows:

XiaodongYang et al. proposed a component-based framework method to recognize banknotes by using SURF technique [1]. But this technique was more complex. Currency can be recognized by using image histogram method with the help of size, colour and texture parameter of banknotes. This method was given by Hassanpour [2]. By using electromagnetic detection technique, Currency can be recognized. The basic principle of this technique was based on pulse eddy current [3]. Researchers had also discussed about the process of recognition by using Canny and sobel edge detector. In this, firstly the image was converted into grey scale image. Since there was presence of noise, to discard the unwanted noise in the grey scale image, median filters were used. Sobel edge detector and canny edge detector were used for edge detection. To measure the edges of the horizontal and vertical axis, present around the text region in grey scale image canny edge detector was used. To measure the edges of overall boundaries of the horizontal and vertical axis, present in the grey scale image sobel edge detector was used [4]. But the system was not handheld. Support vector machine can be used for banknote recognition purpose by using algorithm that was given by Shan Gaiet [5]. One author had described about the system, which consists of 2 sections: hardware and software. In hardware section, there were 3 main parts: input part, processing part, and output part. The input part gets the image from the camera. In the processing part, banknotes and coins were categorized by microcontroller. The output part consists of voice recorder IC and speaker to give the output of microcontroller in the form of voice [6]. One paper had represented the fast edge assisted adaptive binarization technology for improved extraction of text from license plate images, captured by using mobile phone camera [7].

Based on colour clustering method, researchers had represented the technology for extraction of text and segmentation of document image, captured with the help of

camera. The drawback of this method was locating the large size of text with severe illuminations changes [8]. And this system was very complex. Jian Yuan et al. had published a paper which represented the text extraction from the sign boards, by capturing the image with mobile phone camera [9]. But there arises some problems like positioning of banknote and storage problem because of camera usage. In another paper, to identify counterfeit currency, two types of mechanism were included. One of them was Ultra Violet (UV) detection by using lab view and another was the polarization of light by passing through the currency. The output will be positive, if both the results were positive [10]. Malaysian bank notes can be easily recognized by using a device, which was based on their different colours that was designed by Mohamed et al. [11]. But the result was not much accurate.

A system was designed, that was reliable for banknote positioning and ambient light. The banknote which is to be tested is simply lean on the flat glass, the system detects whether the banknote is counterfeit or not, as well as recognized the value of banknote with the help of near infrared camera [12]. By using neural technologies, currency can be detected and recognized [13]. Words that are present in printed text can be recognized by using handheld pointer that resembles to a pencil. A micro camera is interfaced on this pointer. When user drops the pointer, then the voice synthesizer gives the result. In this, firstly region is analysed with the help of pointer. If there is existence of any text above the pointer, then the image is fragmented into blocks. Each block is categorized as 'character'. Then next step is to binarize the 'character' blocks. Further next step is to analyse the image polarity. If the polarity is negative, then the pixels of binarized image gets inverted [14]. Based on Java platform, a system was designed that is known as text reader system to assist the visually impaired people. In this, the text was converted into speech [15].

Other techniques to detect the text from the image are: Novel edge based method, sparse representation and unsupervised feature learning method [17, 18, and 16]. T.A.More et al. had proposed embedded technology. In this, ARM 11 microcontroller was used for image and video data extraction. [19]. SiddharthMody et al. had developed a portable device, known as "Text-to-Speech Converter". Speech processor converts the input text into speech that is given by keyboard [20].

Fig.1: Bank Note Reader [21]

Polymer Canadian banknote consists of three key elements, from which the visually impaired and blind persons can recognize the Canadian banknotes. These key elements are: sight (visually impaired people can see large numerals), touching, electronic signal. Polymer Canadian banknotes are different from paper notes as the polymer notes are lighter and smoother than paper notes.

To recognize the banknote, the blind person has to just put his two fingers on banknote and then has to slide it inside the device (Bank note reader). But this device can recognize only Canadian banknote [21].

In the previous work as discussed above, some technologies worked on software like lab view, many had used the camera, some worked on software like lab view, and some technologies were based on colour parameter of banknote. But in these technologies, some problems are encountered, for example: with the usage of camera, pixels storage problem occurs and another is, if the blind person places the banknote in the device other than the defined position, then it will create problem. And the devices based on other technologies like edge detection, sparse representation etc. are more complicated and not handheld. If the technology is based upon colour parameter only, then this technology is not more effective and it will not give correct result. By measuring the size of banknote, is very efficient method and gives the correct result. So this device is based upon size parameter of banknote. This device is more supportive for blind persons to recognize the banknote because it is handheld and not much expensive.

COMPARISION BETWEEN DIFFERENT TECHNOLOGIES

AUTHOR	TITLE/YEAR	TECHNOLOGY/ ALGORITHM	REMARKS/RESEARCH GAP	LIMITATIONS
1. Mohamed, Aisah, Ishak, Mohd Ikram,Buniyamin, Norlida	Development of a Malaysian currency note Recognizer for the vision impaired / 2012	Colour based	Currency Note Recognizer (CNR) detects different colors of the Malaysian bank notes using color sensor and gives output in various beeping sound to indicate the respective Malaysian bank note value.	Less accuracy
2. M. satish, Lajish V Lt and Sunil Kumar Kopparapu	Edge assisted fast binarization scheme for improved vehicle license plate recognition /2011	Binarization	In this paper, they propose and describe a fast edge assisted adaptive binarization technique for improved extraction of text from license plate images captured using mobile phone camera.	More complexity
3. M.RAJESHBABA, T.ANITHA	DETECT AND SEPARATE LOCALIZATION TEXT IN VARIOUS COMPLICATED COLOUR IMAGE / 2013	Edge detection	The image is converted into grayscale image then median filter is used to discard the unwanted noise in the gray scale image. Edge detection is mentioned by using canny edge detector and sobel edge detector. And morphological operation is performed,	More Complexity
4. ADISORN SIRIKHAM , WERAPON CHIRACHARIT AND KOSIN CHAMNONGTHAI	BANKNOTE AND COIN SPEAKER DEVICE FOR BLIND PEOPLE /2009	Embedded technology	The input part will get image from the camera (CMU cam l). The processing part uses a microcontroller MCS-SI for classify banknote (COLOUR) and coin (SIZE). The output part uses voice recorder IC and speaker to show the voice of bank note and coin value.	Storage problem
5. Arcangelo Bruna Giovanni Maria Farinella , Giuseppe Claudio Guarnera and Sebastiano Battiato	Forgery Detection and Value Identification Of Euro Banknotes / 2013	IR Camera is used	In this paper, banknote is detected using IR light and value of banknote is recognized using template patches parameter.	Storage problem
6. Gargi Rajadhyaksha , Siddharth Mody , Sneha Venkateswa	Portable text to speech convertor / 2013	Text to speech	In this paper, When the text is provided as an input to the controller, it sends to TTS256 IC (separate entered string to word), which works with Speak jet (for comparison) and provides a voice output of the text written.	More computational time
7. Ms.S.J. Wamane, T.A.More	Embedded technology based image and video data extraction / 2014	Embedded technology	Text extraction is used for converting the grey scale image of a text region into the binary image in which all picture elements of characters are in black and others are in white.Arm 11 Microcontroller with keyboard and LCD Display is used.	Slow speed
8. Kamesh Santhanam , Sairam Sekaran , Sriram Vaikundam and Anbu Mani Kumarasamy	Counterfeit currency detection technique using image processing, polarization principle and holographic technique/2013	Image processing, polarization, holographic	In this paper, highly sensitive photo detector is used to detect the reflected laser beam from the translucent material (intensity of light) of banknote. Holographic detector can be used to detect the reflected laser beam from the currency with holographic sticker.	Not handheld device

III. WORK DONE

This device works on the mechanism of edge detection and measuring the size of paper currency. As shown in Fig. 2, two rollers (R1, R2) are used to insert Indian banknote of desired length and width. However, both the rollers will be in working condition when an external +12V battery is connected to a DC motor throughout with the rollers. Despite this, a sensing device LDR (light dependent resistor) is inserted between both of the rotators to check the intensity of light with the help of LED. Individually, a light emitting diode (LED) is attached to one roller whose intensity will vary according to Indian paper currency inserted. Since, when no paper currency is inserted, the intensity of light (LED) will be enormous. Further, when an Indian paper currency is inserted to the device with the help of rotator, LDR detects it as the intensity level of light varies as compared to, intensity of light when no paper currency is inserted. Due to variation in intensity, LDR resistance value varied and a binary signal '1' is conveyed to microcontroller to indicate the controller that banknote has been entered through rollers.

Furthermore, after getting signal from LDR, an encoder starts to count pulses. Meanwhile, the length and Indian paper currency is detected from number of pulses counted. Simultaneously, when an Indian paper currency is completely ejected by second roller, LDR again senses and it retains its light intensity to original level (when no Indian paper currency inserted) and sends the signal '0' to microcontroller to indicate that banknote has been ejected. After getting signal from LDR sensor, microcontroller stops the DC motor as well as encoder stops working.

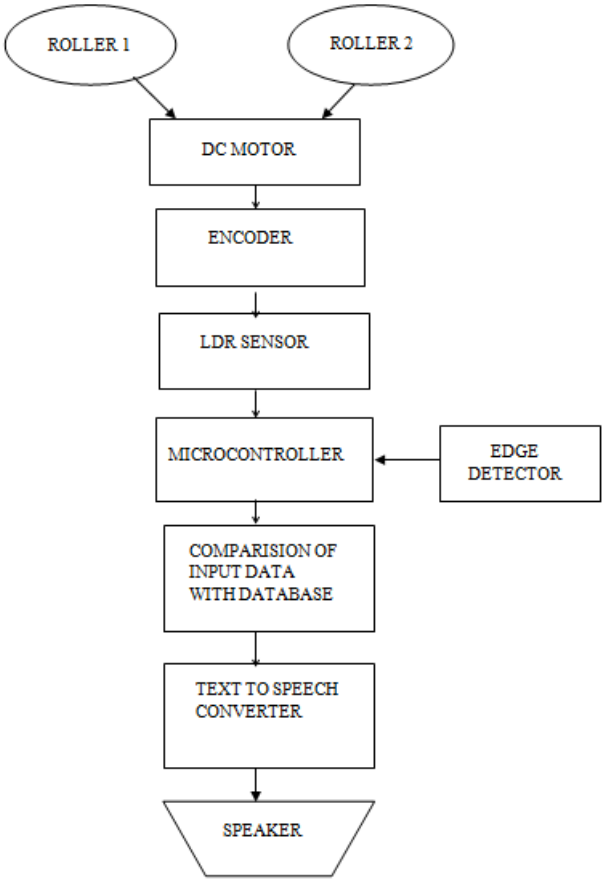

Fig. 2: Flow chart diagram of banknote recognition system

Database of all Indian banknotes are saved on some ports of microcontroller in terms of pulses (according to length).

LM 324 op- amp is used, whose three pins are used. One pin act as an input that is interfaced with the output of LDR sensor and another pin act as an output, which is interfaced to microcontroller. Meanwhile, third pin act as a reference voltage. Variable resistor is used to set reference voltage. The op- amp reference pin is considered at 2V.

When no Indian paper currency is inserted, then LDR will give response at 4.5V. But when any Indian paper currency is inserted, LDR senses and compare that voltage with the reference voltage. In conclusion:

I/p voltage across LDR <2V = 0 and 2V<LDR volt=1

0: banknote is inserted

1: no banknote is inserted

APR 9600 IC is used to converts the output of microcontroller into speech form.

Since the length of Rs50 and Rs20 banknotes are same. For that, second LDR sensor is attached on the corner of one roller for edge detection of banknote of Rs50 and Rs20. The width of Rs50 is more than the Rs20 banknote. When banknote of Rs50 is inserted into device, the second LDR sensor gives '1' signal to microcontroller because width is more, LDR sensor detects the edge of this banknote by receiving the reflection of LED light from banknote. After receiving the reflection of LED light from banknote, value of voltage across LDR is 1.8 volts which are referred as signal '1'.

When banknote of Rs20 is inserted into device, LDR sensor will give '0' signal to microcontroller because the width of this banknote is less as compare to Rs50 banknote, the LDR

sensor will receive the reflection of LED light of minor value that is 0.45 volt, that is negligible. This value is denoted as signal '0'. By this method Rs50 and Rs20 banknotes are distinguished.

IV. RESULTS

Fig. 3: Testing of Rs10 banknote

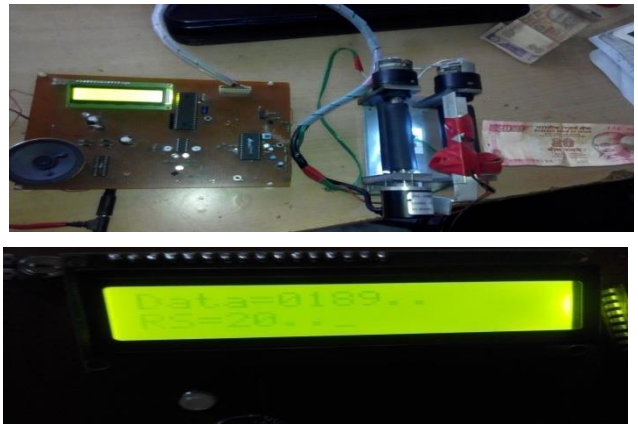

Fig.4: Testing of Rs20 banknote

Fig.5: Testing of Rs50 banknote

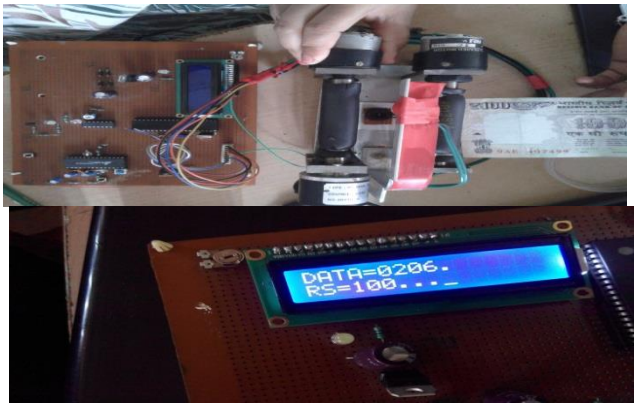

Fig.6: Testing of Rs100 banknote

Fig.7: Testing of Rs500 banknote

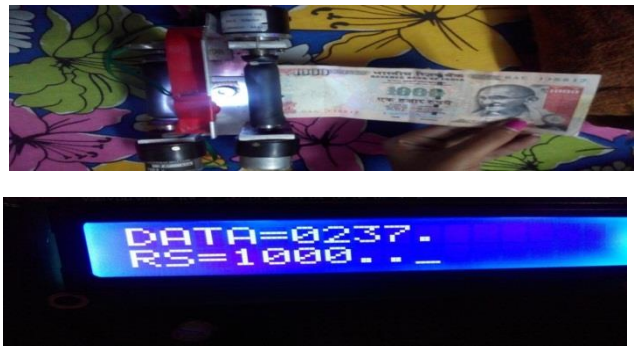

Fig.8: Testing of Rs1000 banknote

Length Measurement of Banknotes

S. NO	NO OF PULSES	NO OF PULSES	NO OF PULSES	NO OF PULSES	RANGE OF PULSES	OUTPUT OF INDIAN PAPER CURRENCY
1	175	178	180	181	175-181	10
2	182	187	189	191	182-191	20
3	182	185	188	190	182-191	50
4	192	199	203	208	192-208	100
5	209	214	217	220	209-220	500
6	221	229	234	237	221-237	1000

Table 1: Length Measurement of Banknotes

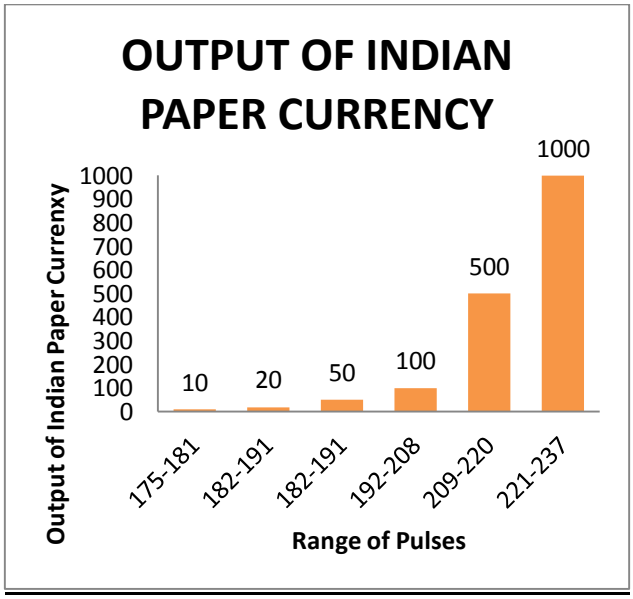

Fig. 9: Graphical representation of Indian currency

Edge Detection to Distinguish between Rs20 and Rs50 Banknotes

S .NO	VOLTAGE ACROSS LDR	OUTPUT
1	0.45	Rs20
2	1.8	Rs50

Table 2: Edge Detection of Rs20 and Rs50 Banknotes

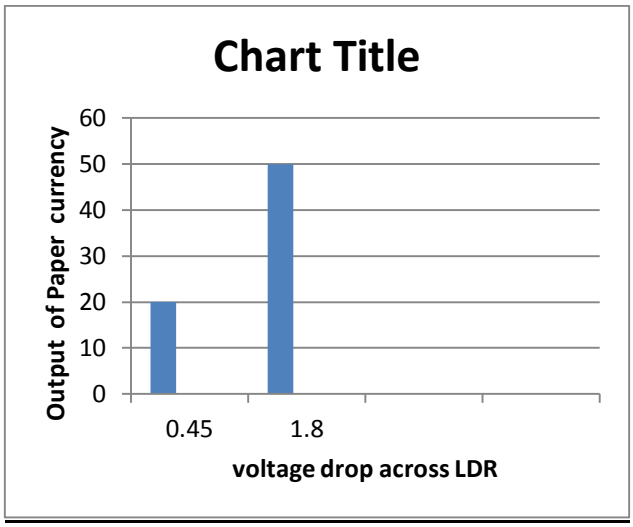

Fig 10: Graphical representation of Rs20 and Rs50

Banknotes

V. CONCLUSION AND FUTURE SCOPE

The banknote recognition by blind people is very difficult. Despite of this Indian banknotes have some special identical features by which our Indian banks and ATM'S recognized the banknotes. This paper conducts a new methodology for currency recognition by using size parameter of banknote. To measure the size of banknote, encoder is used which generates pulses according to the length of banknote which is to be analysed.

Two rollers (R1, R2) are used to insert a banknote of desired length and width. To rotate them, DC motor is used. Despite this, a sensing device LDR (light depending resistor) is inserted between both of the rotators to check the intensity of light with the help of LED. Individually, a light emitting LED is attached to one of input roller whose intensity will vary according to Indian paper currency inserted.

This device recognizes only Indian banknotes that are Rs10, Rs20, Rs50, Rs100, Rs500, and Rs1000. But in future, it can be enhanced to recognize currency of all countries. This device does not give accurate result for wrinkled and bent banknotes. Also this technology can be further implemented on mobile phones by using android application.

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