Portable Fake Currency Detector in Indian Scenario

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Abstract

As of late, a ton of illicit forging rings make and sell counterfeit coins, and simultaneously counterfeit note cash is also printed, which have made incredible misfortune and harm the general public. Along these lines, it is basic to have the option to identify counterfeit cash. We propose another way to deal with identify counterfeit Indian notes utilizing their pictures. A cash picture is spoken to in the disparity space, which is a vector space developed by contrasting the picture and a lot of models. Each measurement quantifies the uniqueness between the picture viable and a model. To get the uniqueness between two pictures, the neighborhood key focuses on each picture are recognized and depicted. Because of the attributes of the cash, the coordinated key focuses on the two pictures can be recognized effectively. A post preparing strategy is additionally proposed to evacuate bungled key focuses. Because of the predetermined number of phony cash, SVM is directed for counterfeit money identification, so just real money are expected to prepare the classifier.Our country is a developing economy and creating a nation, generation, the printing of case duplication of 100 notes, 500 notes, 200 notes, and 2000 notes are debasing and falling apart the monetary development of our nation. From the most recent couple of years on account of innovative headway in shading printing, copying, and filtering, falsifying issues are coming into the picture. The acknowledgment of paper cash with the assistance of Arduino based innovation methods is portrayed.

1.Introduction

Cash duplication, otherwise called fake money, is a powerless risk on the economy. It is presently a typical wonder because of cutting edge printing and filtering innovation. Bangladesh has been confronting the difficult issue by the expanding pace of phony notes in the market. To dispose of this issue different phony note discovery techniques are accessible around the globe, and the greater part of these are equipment-based and expensive. Programmed acknowledgment of phony Indian cash note is significant in numerous applications, for example, mechanized products dealer machine and computerized merchandise teller machine. These framework is utilized to distinguish the substantial Indian money note.The framework comprises of eight stages includes picture procurement, dark scale transformation, edge identification, highlight extraction, picture division, examinations of pictures and yield . Programmed machine increasingly accommodating in banks since bank face the issue of fake money notes or decimated notes. In this way including machine makes note acknowledgment process more straightforward and efficient. Programmed machine is progressively imperative to distinguish counterfeit cash note in each nation. The framework intended to check(find) the Indian cash 200 notes, 500 and 2000 rupees notes. The framework show cash notes are certified or phony and money group. The Reserve bank of India evaluates that there is in any event Rs.2 trillion of phony rupees note available for use all through India. The bank staffs are uncommonly prepared to recognize fake notes yet issue starts once such notes are invaded into the market and flowed through ordinary citizens. In any event, accepting fake notes from ATM counters have additionally been accounted for at certain spots. With improvement of present day banking administrations, programmed techniques for cash acknowledgment become significant in numerous applications, for example, in ATM and Automatic Goods Seller Machines. Innovation is developing in a matter of moments of late. Thusly, the financial division is moreover acquiring present step by step.

1.1. Background Study

The Reserve Bank is only particular sole position to give monetary orders in India. Hold Bank,   as other banks(i.e national banks) the world over, these banks may changes the plan of certified receipts every now and then It is a machine that will look at the money embedded. It will filter the bright properties and the attractive ink present on the back. In the event that a fake is discovered the machine will stop to work and

quickly advise its specialists. It is anything but difficult to utilize however utilizing this methodology has its impediments like we can't have the machine any place we need, perhaps just at ATMs and Banks.[1]. The battle to avert falsifying has been continuous since the Roman occasions. With the advancement of modern printing methods, the fake monetary forms have become comparable to the first cash. Probably the most punctual strategy was to utilize UV recognition. It depends on the rule of recognition of extraordinary sorts of inks that are just noticeable under UV light [2]. An anti-counterfeit of fake money identification strategy is revealed wherein neighborhood edge data is used for precisely distinguishing lines and bends of real notes. The technique can all the more precisely decide the area and direction of an example and in this manner gives progressively solid cash location(currency detection).[3]. One of the best strategies to quit forging can be the across the board utilization of fake identification instruments/programming that are effectively accessible and are proficient as far as cost, unwavering quality and exactness[4].The money acknowledgment framework is one of the quickly developing exploration fields under picture handling. Our proposed methodology distinguishes section by extricating highlights like center numeral, RBI seal, latent image, micro letter and shape [5]. Banks are introduced money store machine wherein clients are able to store money in their record without visiting the bank. A cash recognizer is requires to check saved cash, sort the cash dependent on categories[6]. The insignia is a particular element of the Indian cash with an almost consistent perspective proportion. The proposed framework identifies the image via preparing a course object indicator in MATLAB [7]. In india PAPER cash is as yet a broadly acknowledged method of cash exchange other than such huge numbers of substitutes. The alluring highlights of the paper money incorporate protection, effortlessness, toughness and full oversight. In any case, as a methods for esteem exchange it needs inborn worth, and component of inversion if there should be an occurrence of renouncement, aside from the qualification support by the state. Late marvels of money related self help being bolstered by the banks and other budgetary foundations have begun different administrations of computerized banking frameworks which having cash acknowledgment as unique key movement makes robotized cash acknowledgment and order key issue. Abundant measure of the exertion has been given for the equivalent. The textural highlight contains the exceptional conveyance of tonal variety inside the band. Tone is immersion levels of different tints in that picture.[8],[9]. Consequently the majority of the paper money acknowledgment strategies include picture preparing and some classifier for the most part neural systems. Other than moving nearly the all inclusive economy will makes the assignment of papers cash acknowledgment considerably additionally testing as the utilization of the plain money related portrayal may be troublesome. Consequently we should search for some characteristic portrayal for the money acknowledgment [10]. The paper utilized in money note has cotton type based filaments as base material which shows almost no UV fluorescent properties. Different kinds of papers convert occurrence radiation of UV into noticeable light. Measure of reflected Ultraviolent light and fluorescent these are complimentary as of higher is remainder of fluorescence and less is sum reflected and other way around. In this way, the estimation either gives comparative data. Transmittance likewise relies upon fluorescence, if huge fluorescence is decrease the transmitted component[11]. Money exchange machines have paper cash affirmations system balanced for seeing the authenticity of the implanted paper cash. The paper money affirmation structure is presented in a moving instrument downstream of the cash expansion opening[12]. Perceiving counterfeit banknotes is practiced by planning brilliant light at a model from source and assessing level of splendid light reflected from the model using a first photocell and the proportion of glaring light made by the model using a second photocell . The recognized levels are differentiated and reference levels and just if both savvy and fluorescent criteria are satisfied is the note declared genuine[13][14]. This method can be robotized with the use of devices by giving a sensor and a comparator which takes a gander at the intensity of the glaring light identified with a reference level so as to offer a hint concerning whether the paper is a sensible phony or not[15]. Practically all fake cash imprinted in the previous 15 years has been produced using cloth stock which has a clear chromamorphic reaction in the blue range when initiated by appropriately sifted bright light. The present innovation perceives this element and the development is predicated thereon[16]. A strategy for recognizing sheets which don't have a veritable watermark (for example watermarks which result from varieties in fiber dissemination presented during fabricate) the retention of ultra-violet radiation is estimated for each sheet in the region where the watermark is relied upon to be available, and the transmittance of light by this zone of the sheet is likewise estimated. Sheets for which the ingestion estimation doesn't show a considerably consistent worth, and sheets for which the light-transmittance shows a significantly steady an incentive over the said territory, are rejected[17]. The advancement of covering printing progression has broadened the pace

of phony cash note printing and duplicating the notes on a huge scale. Barely any years back, the printing ought to be possible in a print house, however now anybody can print a money note with most significant exactness utilizing an immediate laser printer.As needs be the issue of fake notes as opposed to the real ones has been extended as it were. India has been disastrously castigated with the issues like debasement and dim money. What's more, phony of cash notes is moreover a major issue to it[18]. The Government of India (GOI) has propelled this new cash of a Rs 2000 note in November, 2016. Since the estimation of note is extremely high, in this way there is parcel of chances by gatecrashers to produce the phony money and during the consequent months police division of India has likewise recuperated the large lumps of Rs 2000 from the different spots. Later on these two obtained pictures have been in RGB shading and changed over into the Hue-immersion esteem (HSV) format.[19][20].

2. Method used for Detect the Fake Note

2.1 Through Register on Note

The little floral structure is imprinted in vertical band and beside the watermark. Flower planned on front is empty and in back is topped off. The flower configuration has consecutive enrollment. The plan will see as one botanical structure when seen against the light.

Watermarking on the Note: Mahatma Gandhi watermark has accessible on monetary orders(banknotes). Mahatma Gandhi watermark is with a shade influence and multidirectional lines in watermark.

2.2 Optically Variable Ink on the Note

Optically factor ink is utilized for security include; this sort of highlight is in the Rs.200, 500, and Rs. 2000 ensured receipt. Optically factor ink as security consolidate for certified receipt is displayed in Nov 2000. The division respect is printed with the assistance of optically factor ink. The shade of numerical 2000 or 500 has all the earmarks of being green when the note is level yet change the covering to blue when it is held in an edge.

2.3 Fluorescence

Fluorescent ink is utilized to print number sheets of the notes. The note in like way contains optical fiber. The number board in fluroscent ink and the optical fiber can be seen when acquainted with Ultraviolent light.

2.4 Security Thread on the Note

The security string is in 2000 and 500 note, which shows up on the left side of Mahatma Gandhi's depiction. In security string the conspicuous segment of RBI and BHARAT. Precisely when currency is kept against the some light, the security string can be viewed as one solid line.

2.5 Latent Image on the Note

Idle picture shows separate group an incentive in the numerical. On watch side of notes, inactive picture is available on the correct beside of Mahatma Gandhi representation on perpendicular band. At that point when the currency is kept on a levels plane at eye level then idle picture is unmistakable.

2.6 Micro Lettering on the Note

The micro scale letters shows up in middle of the picture of Mahatma Gandhi and the vertical band. Smaller scale letters contain the section approximation of monetary certificate in miniaturized normalized letters. This division worth can visible well under amplifying glass.

2.7 Identification Marks on Note: Every note have its extraordinary distinguishing proof imprint. There are various states of distinguishing proof imprint for various category (Rs.200-H, 500-circle and 2000-Square). Distinguishing proof imprint is available on left of the water mark.

3. Specifications of Indian currency

Currency Note	Colour	Size	Back Image
• **New Rs 10 note**	chocolate brown	123mm X 63mm	Konark Sun temple
• **New Rs 50 note**	Fluorescent blue note	135mm X 66mm	Hampi with Chariot
• **New Rs 100 note**	Lavender coloured	42mm X 66mm	Rani Ki Vav
• **Rs 500 note**	Stone grey coloured	150mm X 66mm	Red Fort
• **Rs 2000 note**	New Magenta	166mm X 66mm	Mangalyaan

4. system model and problem description

Counterfeit cash is an issue that can't be overlooked. As the exceptionally advance to Demonetize the 500 and 1000 rupees on 8 Nov 2016 exhibited how noteworthy and essential development was taken by the lawmaking body to deal with the fake illegal, distant set away money. A consistently expanding number of examples of phony came considerably after the demonetization of the Indian money. Counterfeit Indian money of 100, 500 and 1000 rupees notes seems to overpowered entire structure, there is no real technique for oversee them to an average person and there is need to structure the system which can help in seeing the money notes with snappy speed and less time. So to check or confine such grave issue we need convincing response for area it effectively. Before you put a point of confinement on the issue we need to see the qualification between a fake note and Original note. In spite of the way that the Banks and other far reaching affiliations have acquainted Automatic machines with perceive fake money notes, it is amazingly problematic for an ordinary individual to perceive the two. So to decrease this opening of data we need a flexible cash distinguishing proof system available to average residents rather just the banks where the structure isn't exorbitant and present day to work.
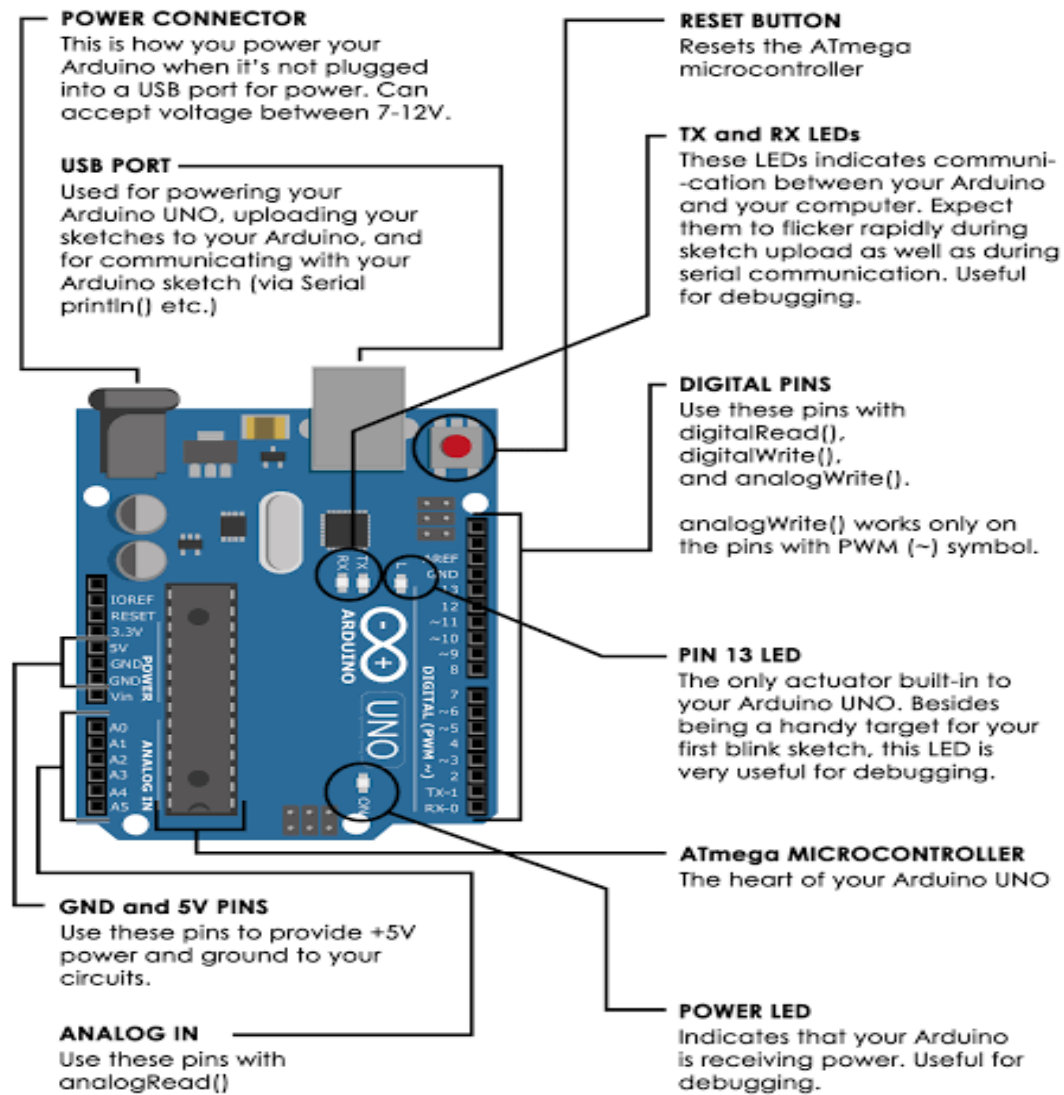
Fig. 1 Block Diagram
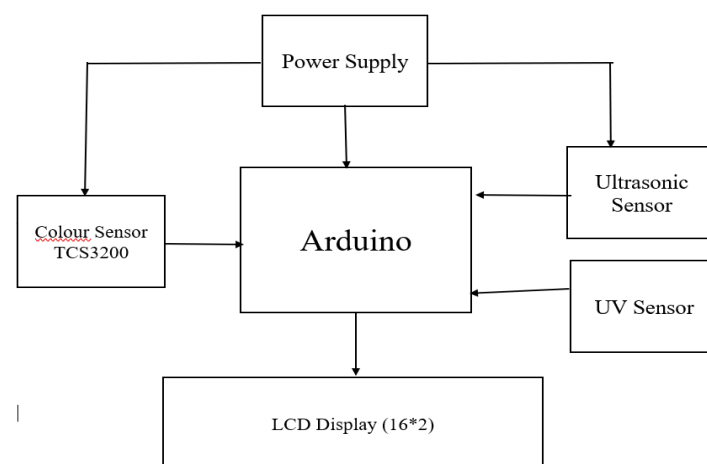
4.1 Components Explanation

Arduino UNO :-
 Arduino Uno is a microcontroller board which has ATmega328P .Arduino has singular board microcontroller expected to make application progressively accessible which are instinctive things and its surroundings.In essential words an Arduino is used to scrutinize the things and control the motors and lights. It has 14 data pins and yield pins of which 6 of them used of them are for PWM yields, 6 basic data pins and a 16MHz quartz crystal.It has 16 Mega Hertz dirt resonator, an ICSP header, control Jack and reset button and a USB affiliation. Arduino is open source sort out used to making and programming of the rigging. It gets or send the info to most of equipment, and the web to bearing the specific electronic contraption.

Pin Description of Arduino UNO :

POWER CONNECTOR
This is how you power your Arduino when it's not plugged into a USB port for power. Can accept voltage between 7-12V.

USB PORT
Used for powering your Arduino UNO, uploading your sketches to your Arduino, and for communicating with your Arduino sketch (via Serial println() etc.)

RESET BUTTON
Resets the ATmega microcontroller

TX and RX LEDs
These LEDs indicates communi--cation between your Arduino and your computer. Expect them to flicker rapidly during sketch upload as well as during serial communication. Useful for debugging.

DIGITAL PINS
Use these pins with digitalRead(), digitalWrite(), and analogWrite().

analogWrite() works only on the pins with PWM (~) symbol.

PIN 13 LED
The only actuator built-in to your Arduino UNO. Besides being a handy target for your first blink sketch, this LED is very useful for debugging.

ATmega MICROCONTROLLER
The heart of your Arduino UNO

GND and 5V PINS
Use these pins to provide +5V power and ground to your circuits.

ANALOG IN
Use these pins with analogRead()

POWER LED
Indicates that your Arduino is receiving power. Useful for debugging.

1) Ultrasonic Sensor :-

Ultrasonic sensors measure separations dependent on transmitting and getting ultrasonic sign. Ultrasonic sensors depend on the properties of acoustic waves with frequencies over the human discernible range frequently at generally 40kHz. The ultrasonic sensors works by emanating sound waves at recurrence unreasonably high for people to hear.

a)   *Pin Description :-*

| Types	Pin Symbol	Pin Function Description
HC-SR04	VCC	5V power supply
	Trig	Trigger pin
	Echo	Receive pin
	GND	Power ground
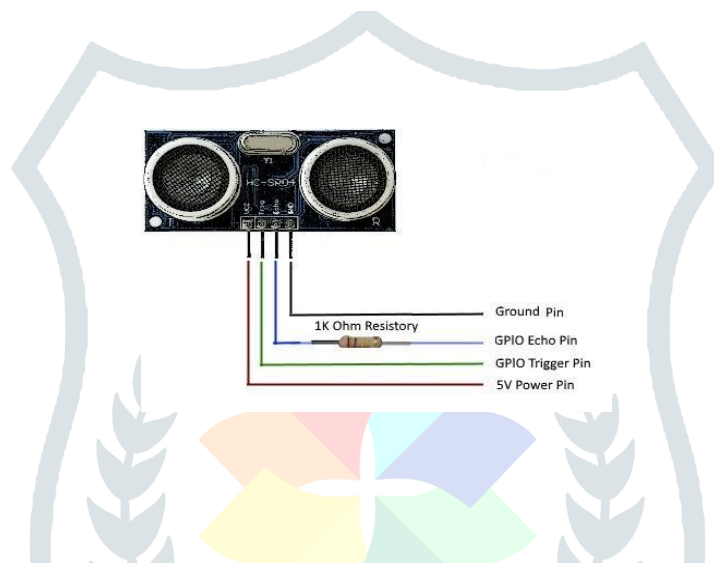
b)   Working :-
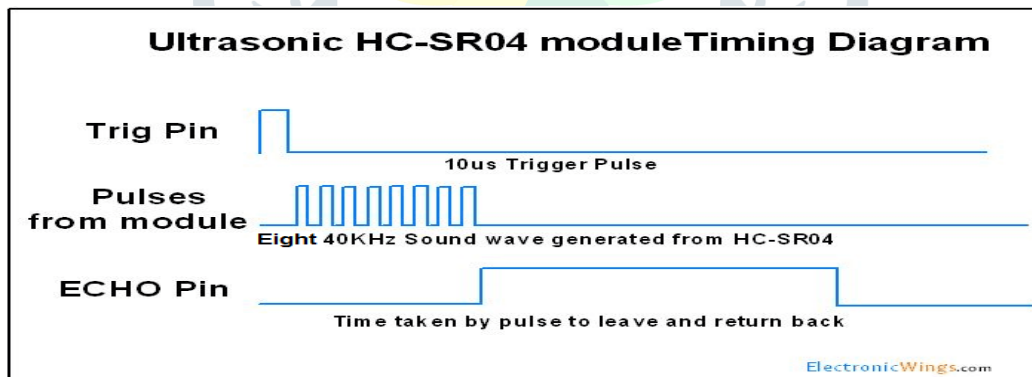
2) We need to transmits the trigger beat of 10 us in any event to HC-SR04 trig pin. By then, HC-SR04 therefore send eight 40 kHz sound wave and sit tight for the rising edge yield at the reverberation pin. The moment that the rising edge get occurs at reverberation pin, it start the clock and keep things under control for the falling edge on the Echo pin. When falling edge has gotten at the Echo pin, it read the count of clock, the time count is time required by a sensor for distinguish thing and return by and by from object . This technique sub-segments picture into it sub districts. The level of division depends upon the issue. Division estimation for pictures which are monochromatic relies upon properties of pictures like abnormality and likeness.

3) Colour Sensor TCS3200 :-

The TCS230 faculties shadings light with help of 8x8 bunch of the photodiodes. That guide utilizing

current toward repeat converter, values from photodiode cells are changed into square wave with a recurrent truly contrasting with light power. Utilizing Arduino Board we prepared to analyze square wave yield and the outcomes.

Pin Description:-

TCS3200 Color Sensor Pinout
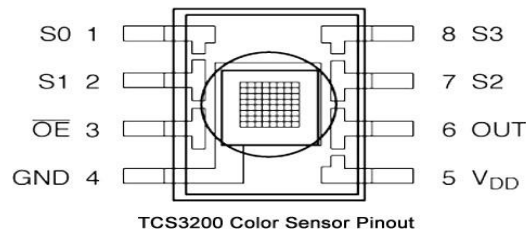
The sensor has four unique sorts of channel secured diodes. In the 8x8 exhibit of the photodiodes, 16 photodiodes are channels which are in red colour and 16 are blue channels and 16 are green channels and rest of 16 photodiode cells have clear without any of channels. Each type can be initiated utilizing the S2, S3 determination inputs. Since each photodiodes are covered with various channels every one of them can recognize the relating hues. For instance, while picking the red channel, just red episode light can overcome, blue and green will be avoided. By estimating the recurrence, we get the red light force. So also, when pick different channels we can get blue or green light.

PIN NAME	PIN NUMBER	DESCRIPTION
GND	4	Power supply ground. All voltages are reference to the ground.
VCC	5	Supply voltage
OE	3	Enable for FO (Active low)
OUT	6	Output frequency
S0, S1	1, 2	Select lines for output frequency scaling
S2, S3	7,8	Select lines for photodiode type.

Working:-
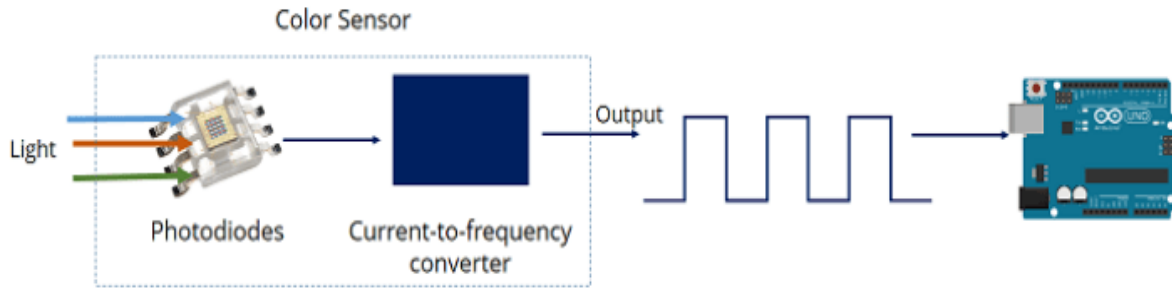
The TCS3200 is a 8×8 group of photodiodes. The TCS3200 concealing sensor perceives concealing and changes over concealing light to repeat. The yield of the sensor is comparative with the intensity of the light reflected off the outside of the thing. The TCS3200 module has RGB and clear Sensor nearby 4 LEDs embedded onto the board. The photodiodes have three differing concealing channels, 16 for red, blue, green and clear each. It on a very basic level includes the photodiodes which sense concealing light and after that a Current-to-Frequency Converter changes over them into a square wave with a repeat comparative with the intensity of light.

LCD Display :-

 A LCD is liquid crystal display, the meaning of LCD is define from the name. LCD utilize the fluid gem for deliver an unmistakable picture. The fluid gem is shows super-slim innovation display screen which are commonly utilize in TVs, PC, convenient computer games and mobile phones. LCD's innovations enable presentations to be more slender when contrasted with the cathode beam tube innovation.

Pin description:-
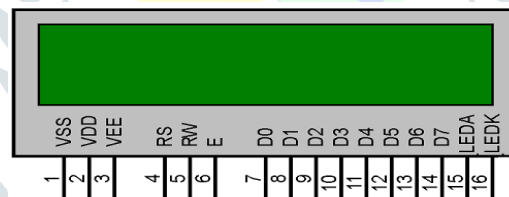

4) UV SENSOR

  It utilizes an UV photodiode, this recognize 240 to 370nm scope of light. The sign level from the photodiodes is extremely little, in the nano ampere level, which hurled on opamps to intensify sign to an increasingly sensible volt level.

  UV Sensor utilized for distinguishing the power of occurrence ultraviolet(UV) radiation like UV radation in daylight. These type of electromagnetic radiation have shorter wavelength than noticeable radiation. The module depends on the sensor SGM8521 and GUVA-S12SD Opamp, which have wide phantom scope of 200nm to 370nm. These module yields aligned simple yield voltage which fluctuates with the UV power.

Pin Descriptions: -

Pin Name	Details
OUT	Analog Output from 0 to 1V(1000mV)
VCC	+3.3V to 5V Regulated Power Input
GND	Common Power Ground

Circuit Diagram: -
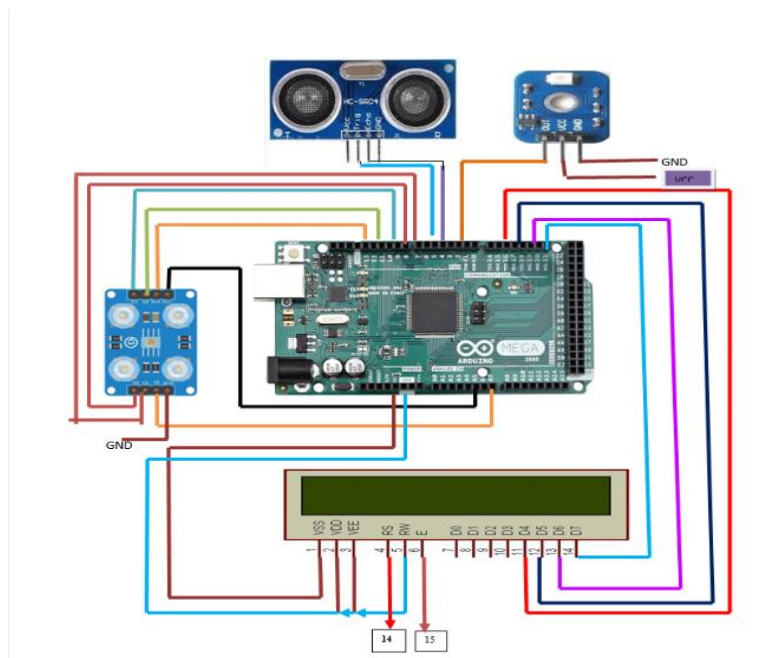
Working Process and Methodology: -

Step1:- Ultrasonic sensor for discovering thickness of the cash note.

A rough ultrasonic thickness check decides test thickness by estimating the measure of time it takes for sound to navigate from the transducer through the material to the back finish of a section and back. The ultrasonic thickness measure at that point computes the information dependent on the speed of the sound through the tried example.

Step2:- The recognizing unit recognizes the shade of the surface in the RGB scale. A concealing sensor works by shimmering white light onto a thing and a short time later recording the reflected light to choose its concealing. Concealing sensors empower us to accurately perceive the shade of articles which has a gigantic extent of employments. The concealing sensor used here is Industrial Color Sensor (IC) called TCS3200 shading sensor. The TCS3200 used has differing shading channels. The note is kept underneath the sensor and light is foreseen onto the money note. The unmistakable concealing channels to be explicit Red, green, blue are envisioned and get devoured by the note. The devoured concealing regard is then deciphered and appeared differently in relation to the fake note a motivator with isolated it from exceptional note.

Step3:- UV Sensor to discover UV Markson the money Note.

UV is the most routinely used fake acknowledgment system—it is found in by far most of the lower-end contraptions with the least worth core interests. An UV pointer affirms the UV stamps on true blue notes by shimmering brilliant light into bills and this UV marks made utilizing non-obvious hues which are recognizable under the UV lights. If UV print pictures shimmer when presented to UV light, by then confirmed receipt is depended upon to be true blue.

Step4:- Results showed on the LCD Screen

In LCD show the data is shown on the screen about the thickness shading and UV Marks of the cash **note.**

Fake Currency Detection using Image Processesing :-

The innovation of money acknowledgment essentially targets distinguishing and removing unmistakable and imperceptible highlights of cash notes. Up to this point, numerous methods have been proposed to distinguish the cash note. In any case, the most ideal route is to utilize the unmistakable highlights of the note . For instance, shading and size. Yet, along these lines isn't useful if the note is filthy or torn. In the event that a note is filthy, its shading trademark are changed generally. So it is significant that how we remove the highlights of the picture of the money note and apply legitimate calculation to improve exactness to perceive the note.

Process of Edge detection It is a key instrument in picture handling. It is commonly used in the district of feature acknowledgment and extraction. This strategy target perceiving point in the propelled picture at which picture quality emphatically changes.
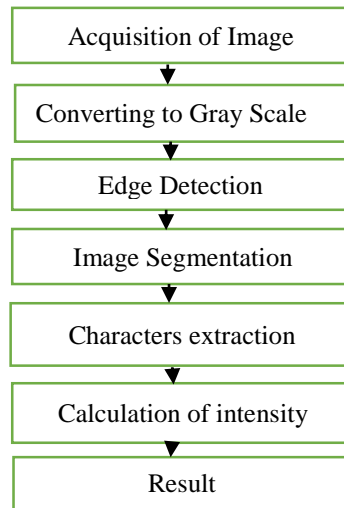
Process of Image segmentation: This method sub segments picture into it sub areas.The level of division depends upon the issue. Division calculation for pictures which are monochromatic relies upon properties of pictures like inconsistency and comparability.
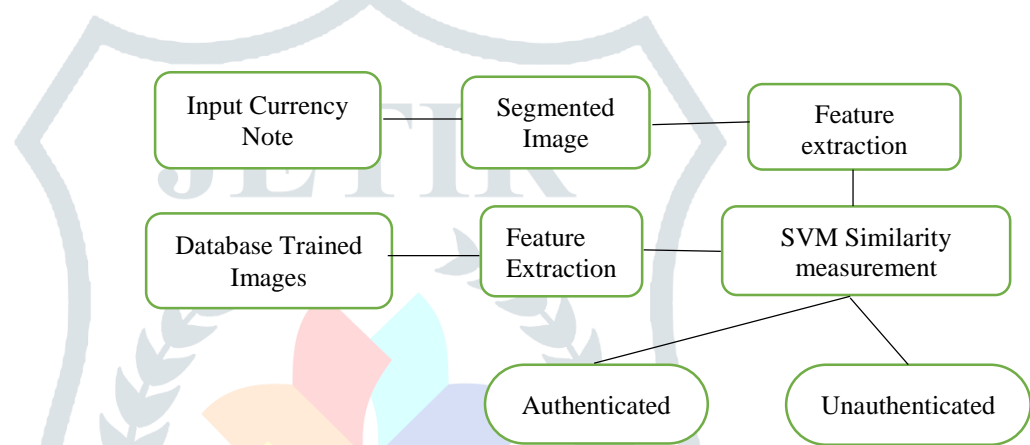
Proposed Approach :-

The framework proposed here work here on the picture of cash note under ultraviolet light obtained by a computerized camera. The calculation which is applied here is as per the following :

1. Obtaining of picture of money note under bright light by straightforward computerized camera or scanner. 2. Picture procured is RGB picture and now is changed over to grayscale picture. 3. Edge location of entire dim scale picture. 4. Presently attributes highlights of the paper money will be edited and fragmented. 5. After division, attributes of cash note are removed. 6. Force of each component is determined. 7. On the off chance that the condition is fulfilled, at that point the money note is said as unique generally phony.

Flow Chart :-

Acquisition of Image

Converting to Gray Scale

Edge Detection

Image Segmentation

Characters extraction

Calculation of intensity

Result

Block Diagram :-

Input Currency Note → Segmented Image → Feature extraction

Database Trained Images → Feature Extraction → SVM Similarity measurement

SVM Similarity measurement → Authenticated

SVM Similarity measurement → Unauthenticated

Algorithms used :-

K-means Algorithm: K Means calculation is a solo grouping calculation that describes the information data centers into various classes subordinate around their characteristic great ways from each other. The k-suggests system hopes to restrict the total of squared partitions between all concentrations and the gathering center. The figuring have free of relationship with k nearest neighbor classifiers, standard AI procedure for togethering that has much of the time confused with k-suggests considering the k in that name. We can apply 1st nearest neighbor classifier on the pack centers got by k means to describe new data into present gatherings. This known as Rocchio calculation or nearest centroid classifier.

SVM Algorithm: In Machine Learning, support vector machines are unsupervised learning models with related learning computations that investigate information used for ask for and lose the faith appraisal. Given a lot of arranging models, each set apart as having a spot with both of two requests, a SVM preparing computation assembles a model that doles out new consultants for one class or the other.

Description Sobel Algorithm : -

It is the derivative mask used for edge detection and it used for detect:

1. Vertical direction
2. Horizontal direction

Vertical Mask Sobel Operator code: -

-1	0	1
-2	0	2
-1	0	1

Working :-

At the point, when apply the spread on the image, its unquestionable vertical edges. Basically work like as first solicitation derivates and determines the qualification of the pixel powers in edge region.

As inside portion is of zeros by then it excludes first estimations of picture yet rather, it discovers qualification of left and right pixel regards around on that edge. Moreover within estimations of both first and third area is 2 and - 2 separately.

Horizontal Sobel Operator number code :-

-1	-2	-1
0	0	0
1	2	1

Working: -

This spread will conspicuous the level edges on picture. In addition take single took shots at standard of over the cover and the discovers contrast among that pixel intensity of express edge. Inside area of the shroud will be contain zeros by then it avoids the essential estimation of edge in picture yet rather it figure capability of above and underneath pixel powers of the specific edge in that capacity developing the unforeseen complexity in forces and making the edge constantly recognizable.

Algorithm Steps: -

Pseudo Codes for the Sobel Algorithm Edge Detection:

The Input: Normal Image

The Output: Magnitude of Detected Edges

Stage 1:- Take image as input.

Stage 2:- Apply the mask G(x), G(y) in input.

Stage 3:- Apply the Sobel edge discovery algorithms and inclination.

Stage 4:- Masks control of Gx, Gy independently on info picture.

Stage 5:- Results joined to locate outright extent of the angle.

Stage 6:- The outright magnitude is edges of output.

5. CONCLUSION AND FUTURE SCOPE

Utilizing the image processing, the examination of the currency picture is increasingly precise just as strategy has productive as far as cost and tedious contrasted with existing strategies. MATLAB Software is utilized for this investigation. Step by step inquire about work has expanding in these field and the different pictures handling methods were executed so as to get progressively exact outcomes. Proposed system is worked viably for extricating highlights of Indian cash pictures. Removed highlights of money picture will use for cash esteem acknowledgment just as for its confirmation. In the Future, an Application-based framework will be intended to get an appropriate outcome whether the cash picture is phony or certifiable. A similar framework can be produced for the staying Indian money notes and other nation's cash notes. Likewise, the application's interface can be additionally altered according to the user prerequisites.

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