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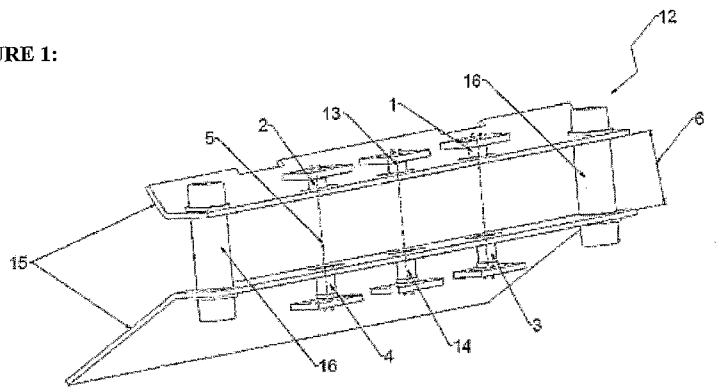
(54) Title: OVERLAPPED NOTE DETECTOR

FIGURE 1:



(57) Abstract: The present invention relates to a cost effective and reliable means of detecting overlapped sheets or notes in the feed path used within systems like cash dispensers and ATM machines. Further the present invention relates to a method and system of detecting overlapped notes to avoid excess sheets or notes being delivered. Advantageously the present invention detects overlapped notes and variations in the note profile consistently.

OVERLAPPED NOTE DETECTOR

FIELD OF INVENTION

The present invention relates to a cost effective and reliable means of detecting overlapped sheets or notes in the feed path used within systems like cash dispensers and ATM machines. Further the present invention relates to a method and system of detecting overlapped notes to avoid excess sheets or notes being delivered. Advantageously the present invention detects overlapped notes and variations in the note profile consistently.

DESCRIPTION OF THE PRIOR ART

Cash dispensing mechanisms in ATM machines typically contain a cassette for note storage, a transport path to convey the notes individually and a bunch-presenter. The notes are picked from the cassette one after another and moved to the presenter. The total number of notes to be presented is counted during this act. In this act it is likely that two or more notes are erroneously picked, instead of only one, due to various factors. This could lead to excess notes being presented wrongly. So it is essential to accurately detect overlapped/ multiple notes in cash dispensing mechanism. The method followed may involve electrical or mechanical means of thickness measurement in the note transport path, in order to allow only single notes to be presented and overlapped notes to be internally diverted.

Mechanical methods pose challenge in building a highly sensitive system to differentiate soiled single notes from overlapped fresh notes, since the thickness measured in both cases is likely to be similar.

Electrical methods traditionally involve using light emitters and optical sensors. Light sources are placed over notes while they travel in transport path, optical sensors are placed on either sides of the notes to detect light that is reflected from and transmitted through the note. The variation in the intensity of light transmitted by a single and overlapped note is used to detect overlapping of notes.

US4577096 relates to a multiple sheet or transparency detection device to detect the presence of superposed sheets or transparencies advanced along a sheet path and to indicate to a machine control that a multiple sheet or transparency feed condition has occurred.

US4703172 relates to a document handling and counting system and more particularly to novel microprocessor-based control means to provide substantially automatic operation of such system during both normal counting and batching operations and for significantly enhancing the sensitivity and capability of the system for detecting the presence of multiple-fed sheets thereby enabling the accurate counting of sheets fed in a skewed and/or overlapping manner.

US 4723072 relates to a sheet discriminating system for detecting the soiling of sheets such as bank notes and classifying the sheets in accordance with the soiling.

US 7194151B2 relates generally to an optical media detector and in particular to a note detector for use in an Automated Teller Machine.

US 5236072 relates to a device for detecting the size of documents, and more particularly concerns document size for identifying the size, and therefore the value denominations of paper currency bank notes, where the bank notes have different lengths and/or widths which correspond to different value denominations in many countries.

US 7419156 relates to an overlapped – sheet detection system and more particularly, to an overlapped-sheet detection system for detecting overlapped sheets such as bank notes and postal matters, wherein the overlapped sheet detection system measures a length of sheets along a conveying distance at its entrance.

US Application 20050207634 relates to document processing systems such as automatic teller machines and currency redemption machines.

EP0747138A2 relates to object detectors, and in particular to an overlapped object detector for detecting an object overlapping another object.

All the above methods involve using a light source and optical sensors, but differ in the measuring circuits, data correlation and error correction methods employed. The above detection method poses a challenge in the sensitivity required to differentiate single soiled note from overlapped fresh notes. The optical sensors used in these systems suffer from signal errors due to low margin of signal change between single and overlapped notes.

Accomplishing this involves the fulfillment of the following independent requirements for an Optical based overlapped note detector:

a) a system with optimized Luminous intensity, need to choose a cost effective Light source which would provide the needed Light intensity for desirable illuminance of the Notes.

b) a system with high illuminance, it is important to arrive at the minimum illuminance levels required to differentiate single soiled note from overlapped fresh notes. It is required to design a cost effective system to achieve the above desired illuminance.

c) a system with high sensitive light sensor, the illumination variation levels of a overlapped note to a single note poses significant challenge in reliably detecting them due to marginal variation. Hence it is required to identify and optimize a high sensitive Light sensor which can reliably measure the above illuminance variations without any inherent measurement errors.

d) a system which can selectively profile useful areas of notes which can be useful in effective detection of illuminance variations.

e) a computing system which can record, calibrate and discriminate the illumination variations of the notes transported thereby reliably identifying overlapped notes and any note profile changes. The system should also be capable of alleviating the errors due to light source and light sensor variations over the usage of system.

Therefore there is need in the art to develop for a cost effective and reliable means of improving the overlapped note detection system and method for use within ATM or Cash Dispenser units.

OBJECTS OF THE INVENTION

One or more of the problems of the conventional prior art may be overcome by various embodiments of the present invention.

The primary object of the present invention is directed to provide a system and method to detect overlapping of sheets or notes in the feed path used within systems like cash dispensers and ATM machines.

It is another object of the present invention wherein the method and system is cost effective and reliable.

It is another object of the present invention wherein the currency notes having varying profile of dark and white areas is used to the advantage of detecting overlapped notes.

It is another object of the present invention wherein the main function of the system is to detect overlapped notes and variations in the note profile consistently.

It is another object of the present invention to provide an overlap note detector system with features that includes:

- high illuminance;
- optimized luminous intensity;
- high sensitive light sensor;
- dark pattern detection; and
- computing system for overlap note detector.

A still further object of the present invention is to provide a method to detect overlapping of notes.

A still further aspect of the present invention is to provide a method to detect overlapping of notes, wherein overlapped note detector with high illuminance is achieved by LED-LDR mount, and LED, LDR holders.

A still further aspect of the present invention is to provide a method wherein differentiation of overlapped notes with greater margin is achieved by reducing the distance between the LED light source and light sensor to an optimum level.

SUMMARY OF THE INVENTION

Thus according to the basic aspect of the present invention there is provided a system for detecting overlapping of notes for use in note transport mechanism within cash dispensers and ATM machines or the like comprising:

one or more light emitting diodes (LEDs);

one or more light dependant resistors (LDRs); and

a computing system,

wherein the LED with a viewing angle of 15degree or less and with a selected luminous intensity is adapted to function as light source, used in conjunction with other elements of the said system produces a transmitted illuminance variation of at least 3 times between overlapped notes to a single note,

wherein said LDR with selected sensitivity is adapted to sense the intensity of transmitted light, the selected LDR's resistance to illuminance characteristics producing a minimum of twice the resistance variation for said corresponding three times variation in illuminance, while measuring transmitted illuminance of the single notes and overlapped notes,

wherein the LED and LDR are positioned at desired mutual distance and alignment to capture the transmitted illuminance of the notes transported,

wherein said computing system is adapted to record, measure, calibrate and discriminate the illumination variations of the notes as they are transported thereby reliably identifying overlapped notes and any optical profile changes of notes, by means of illuminance measurement, note profile calibration and note discrimination methods,
wherein said system provides the desirable illuminance variation levels between an overlapped note vis-à-vis a single note, and
wherein said system provides sensitivity to measure illuminance variation to discriminate overlapped note vis-à-vis a single note.

In accordance with another aspect of the present invention there is provided a system, wherein illuminance variation between the single note and overlapped note increases by a factor of 2 for every 10mm decrease in distance between said light source and light sensor.

In accordance with another aspect of the present invention there is provided a system, wherein said illuminance variation is at least 3 times between overlapped notes to a single note.

In accordance with another aspect of the present invention there is provided a system, wherein recording optical profile of sample set of notes, using the recorded samples to compute various optical thresholds namely overlapped detection threshold level, and lower threshold level.

In accordance with another aspect of the present invention there is provided a system, wherein said note discrimination method to select overlapped notes, notes of unacceptable quality and wrong denomination notes from being presented comprising:

recording illumination samples of the dispensed note; and

comparing illuminance profile of the dispensed note with optical thresholds set in said note profile calibration method,

wherein if the note illuminance profile is above overlapped detection threshold then it is marked as overlapped note and not presented,

wherein if more number of notes are detected above the overlapped detection threshold level or below lower threshold level then it would be a suspected note profile that is not fit to be presented, and

wherein said note whose profile passes all the optical threshold checks will be successfully presented.

A further aspect of the present invention relates to a system for detecting dark color pattern used for detecting overlapping of notes in note transport mechanism within cash dispensers and ATM machines or the like comprising:

recording transmitted illuminance levels of the each note at atleast two areas of the note, including one on the left and one on the right side of the note;

selecting only samples recorded from dark colored area of each note, to maximize the variation in the illuminance recorded from a single note to a overlapped note, to reliably distinguish between the two when the notes are of heterogeneous opacity;

calibrating sample set of notes; and

discriminating each note during normal dispensing,

wherein sample set of notes are calibrated by:

transporting notes in either orientation,

recording transmitted illuminance levels of each note at various areas of the note,

selecting illuminance samples recorded from darker colored area of each note, to compute various optical thresholds namely overlapped detection threshold level, and lower threshold level,

wherein during normal dispensing, each note is discriminated by:

transporting notes in either orientation,

recording transmitted illuminance samples of the note while it is transported,
selecting samples recorded from dark colored area of the note,
comparing said illuminance profile of the dispensed note with optical thresholds set in said calibration,

wherein if the note illuminance profile is above overlapped detection threshold then it is marked as overlapped note and not presented,
wherein if more number of notes are detected above the overlapped detection threshold level or below lower threshold level then it would be a suspected note profile change, that is not fit to be presented, and
wherein said notes whose profiles pass all the optical threshold checks will be successfully presented.

A further aspect of the present invention relates to a method for detecting overlapping of notes in note transport mechanism within cash dispensers and ATM machines or the like comprising:
relative illuminance measurement to remove errors due to drift in intensity of light source, wherein relative illuminance intensity is the ratio of illuminance measured when note is in the light-path, to that measured when there is no note in the light-path,
wherein sample set of notes are calibrated by,
transporting notes in either orientation,
recording transmitted illuminance levels of each note at selected areas of the note,
applying said relative illuminance measurement for all the samples that are recorded,
compute various optical thresholds namely overlapped detection threshold level, and lower threshold level,

wherein during normal dispensing, each note is discriminated by
transporting notes in either orientation,
recording illumination samples of the note while it is transported,
applying said relative illuminance measurement for all samples that are recorded,
comparing said illuminance profile of the dispensed note with optical thresholds set in said calibration,
wherein if the note illuminance profile is above overlapped detection threshold then it is marked as overlapped note and not presented,

wherein if more number of notes are detected above the overlapped detection threshold level or below lower threshold level then it would be a suspected note profile change, that is not fit to be presented, and

wherein said note whose profile passes all the optical threshold checks will be successfully presented.

The details of the invention, its objects and advantages are explained hereunder in greater detail in relation to non-limiting exemplary illustrations as per the following accompanying figures:

BRIEF DESCIPTION OF THE ACCOMPANYING DRAWINGS:

Reference will now be made to the several drawings for a more particularized description of the invention. It is to be understood that these drawings must be considered as largely diagrammatic in nature. They are presented here however, for illustrative purposes only and intended to express the operative features of the invention. In the drawings:

Figure 1: Illustrates the overlap note detector of the present invention.

Figure 2: Illustrates a preferred aspect of the invention that exhibits illuminance and luminous intensity control of the present invention.

Figure 3: Illustrates dark pattern detection of the present invention.

DETAILED DESCRIPTION OF THE INVENTION WITH REFERENCE TO THE ACCOMPANYING DRAWINGS

The present invention as discussed hereinbefore relates to a cost effective and reliable system that is capable of detecting overlapping of currency notes in ATMs and cash dispensers.

Reference is invited to accompanying Figure 1 and Figure2 that illustrates the schematic illustration of integrated overlap note detector, for use in ATMs and cash dispensers, in combination with appropriate computing system able enough to fulfill the following functions of an ATM machine for dispensation of media such as currency notes.

Overlapped Note detector comprising of

i) system with high illuminance

ii) system with optimized luminous intensity

iii) system with dark pattern detection

iv) system with high sensitive light sensor

Computing system for overlapped note detector with

i) illuminance measurement method

ii) note profile calibration method

iii) note discrimination method

The overlapped note detector system (Figure1, 2) adapted for detection of overlapping of notes in ATM and cash dispenser modules (not shown here) comprises of:

LED-LDR mount (15) which houses light sources and Light sensors used in measuring optical profile of the notes (7, 8) being dispensed by ATMs. Light source right LED (3), left LED (4), center LED (14) provide the necessary illumination for detection of the notes, light sensors right LDR (1), left LDR (2), center LDR (13) measures the illuminance through the notes as the note passes through the said LED-LDR mount (15), part of the dispensing note flow path (note shown here) in a ATM/ cash dispenser.

For a light source of given luminous flux, it is desired to have a higher intensity of illumination on the sensor area. This is achieved by reducing the distance between the LED light source and light sensor an optimum level. This helps in differentiating overlapped notes with greater margin. The light sensor orientation is axially aligned to the LED light source to gain higher illuminance. It is observed that the illuminance measurable by a light sensor plays a major role in defining the sensitivity of the said system.

The said LED-LDR mount (15) is designed to achieve desired illuminance to discriminate single note to a overlapped note. Desired illuminance on the LDR sensor area can be achieved by reducing the distance between the LED and LDR to a minimum level. The illuminance variation between the single note and overlapped note, improves by a factor of 2 for every 10mm decrease in "distance between the light source and light sensor" (6).

However, bringing them too close could lead to physical interference with the note being transported. It is an object of the present invention – "Overlap note detector system with high illuminance" to keep the distance between the LED and LDR sensor at a defined range of 10mm to 20mm so as to provide well differentiated illuminance change on the light sensor while

detecting a single note to a overlapped note. The mount plate spacers (13) maintain the distance between said LED and LDR.

Desired illuminance is also achieved by axially aligning the said LEDs and said LDRs, the LED holder(10) and LDR holder(11) are designed to clamp these components axially and they in-turn are mounted to the LED-LDR mount plate. The mount plates are held parallel through said mount plate spacers (13) to provide for "LEDs and LDRs alignment (5).

Most light sources do not radiate equally in all directions. For a light source of given luminous flux, the luminous intensity quantifies the intensity of the light source in a specific direction without distance. The present invention is to identify the need to maximize the luminous intensity in order to more easily differentiate between overlapped notes and single notes. The overlapped note detection threshold improves by choosing the said LEDs with sharper viewing angle and with a minimum desired luminous intensity.

The said right, left and center LEDs (3, 4, and 14) are chosen to provide maximum luminous intensity to precisely discriminate overlapped notes and single notes. The overlapped note detection threshold improves by choosing the said LEDs with sharper viewing angle and with a minimum desired luminous intensity. The object of present invention – "Overlapped note detector with optimized luminous intensity" achieves this by choosing an appropriate LED with a viewing angle (9) of 15 degree or less and a minimum luminous intensity of 4000mcd.

The above said "overlapped note detector system with high illuminance and optimized luminous intensity" provides a minimum illuminance variation levels of 1:3 for an overlapped note to a single note for different type of notes.

The system needs highly sensitive light sensors to detect very marginal changes of light that is transmitted from the source. Traditionally photo diodes or photo transistors are used to detect light. These are not well suited for detecting weak signal changes, and using a stronger light source to improve detection leads to signal saturation in the detectors.

"Light Dependant Resistors"-LDR are used to detect marginal changes in illumination levels between overlapped notes and single note, this is done by optimizing LDR's unique characteristics of resistance variation as a logarithmic function of incident light intensity.

Further, LDRs work on the principle of semiconductor conductivity, directly proportional to the incident light. This offers greater advantage over photo transistors which are charge amplifiers and hence can be affected by noise signals. Some prior art devices employ modulated light signal circuits and synchronizing receiver circuits to remove the base noise.

The above said overlapped note detector needs a high sensitive light sensors to detect changes in light at very low illuminance levels, which is transmitted from single or overlapped notes. The illuminance measured typically varies in the range of 10Lux to 500Lux while detecting transmitted light from range of overlapped to single notes using the said "Overlapped detector system". As said earlier it is observed that the minimum illuminance variation between overlapped note and single note is in the order of 1:3. Traditionally photo diodes or photo transistors do not provide desired sensitivity in the above said illuminance levels, detecting weak signal changes leads to errors in overlapped note detection.

The object of the present invention – "Overlap note detector system with high sensitive light sensor" - is to use the said LDRs for detecting changes in transmitted light with higher sensitivity, using LDR's characteristics of resistance variation as a logarithmic function of illuminance expressed as ?* Log(I1/I2) = Log(Rn2/Rn1)

I1/I2 is the ratio of illuminance between single notes to an overlapped note

Rn2/Rn1 is the ratio of said LDR resistance measured at illuminance levels of I1, I2.

? is the resistance characteristics to illuminance as provided by manufacturers of LDRs.

The said "Overlap note detector system with high sensitive light sensor" is optimized using the above said LDR characteristics, and as explained below

As said earlier it is observed that the minimum illuminance variation between overlapped note and single note is in the order of 1:3, hence the (I1/I2) will be a minimum of value of 3 in the overlap note detector system.

The said LDRs are chosen with ? value such that the (Rn2/Rn1) ratio provides better sensitivity in measuring illuminance.

In the below case,

(I1/I2) at a value of 3, ? is selected at a minimum value of 0.7 for illuminance of 1 to 100Lux, yields a value of ~2 for (Rn2/Rn1),

Log (Rn2/Rn1) = ?* Log (I1/I2) = 0.7 * Log3

Log (Rn2/Rn1) = 0.33

(Rn2/Rn1) ~ 2.

The above said method gives a minimum of 2 times variations in LDR resistance value between overlapped note and single note. The LDR resistance is in the range of 20Kiloohms for the maximum illuminance level of an overlapped note in the said overlapped notes detector system, now providing 2 times variation for single note will provide sufficiently high sensitivity, and can be recorded without much of errors and thereby reliably discriminating the overlapped notes. Hence constructing the apparatus with 3 times illuminance variation for single to overlapped note and choosing a LDR sensor with needed sensitivity provides a reliable Overlap note detector system.

A typical currency note exhibits substantial variations in the darkness of printing. The darker colored area generally exhibits higher opacity to transmitted light compared to lighter colored areas. This phenomenon is exploited to get a better margin of difference in signals between single and overlapped notes. The transmitted light received through overlapped notes is significantly lower in darker areas, as compared to that from lighter areas due to increased opacity resultant of both darker colored area and heterogeneous nature of the overlapped note. When compared with single-note values, this difference provides a good margin to uniquely identify overlapped notes.

Selectively using the illumination of darker area of the notes provide better margin to discriminate overlapped notes. As said earlier it is observed that the illuminance variation between overlapped note and single note is in the order of 1:3 in the overlapped note detector system, this is typically obtained in the darker colored areas of the note. Lighter colored area (no print) has only illuminance variation of 10-25% between overlapped note and single note, which will lead to errors in discriminating overlapped notes.

Typical currency notes have at least one dark colored pattern, this section might be oriented to the right, center or left of the note transport direction.

The object of present invention – "Overlapped note detector with dark pattern detection" achieves this by positioning LED, LDR modules to the minimum of left and right areas of the note, as shown in Figure3, and marked as right, center, left LEDs(3,4,14), right, center, left LDRs(1,2,13).

The system captures the samples of the notes as it travels through the right, center, left LDRs, samples from the darker area are selectively used by the "Note profile Calibration method" and the "Note discrimination method" to detect overlapped notes.

The system can transport the notes in any orientation (7, 8) without any degradation in the illuminance detection levels by the positioning of the LEDs, LDRs as said above.

The system of the present invention comprises of: a computing system encompassing the functions of illuminance measurement, note profile calibration, and note discrimination methods.

The overlapped note detector involves calibrating the system for the single notes profiles that will be typically dispensed in the ATM or cash dispenser units. Calibrated profile data is stored and used during actual dispensation to discriminate overlapped notes and any note profile changes like denomination change etc.

In storing the calibration data -the illumination values of single note profile, it is desired to avoid any system parameter variations from the time of calibration to the time of normal dispensation. Any such variations will lead to errors in detecting overlapped notes during normal dispensation. One important parameter is the light source LED's luminous intensity drifts. The illuminance measurement method avoids the LED drift errors by recording relative illuminance of the notes with respective to "No note" illumination value.

Since the optical property of the note is measured as relative illumination, the LED intensity drifts errors are avoided.

The calibration and discrimination methods employ a unique technique in recording of illuminance of notes, to avoid common problem of LED's luminous intensity drift. The said invention method records relative illuminance of the notes with respective to full illuminance, i.e no note between LED light source and LDR sensor. By this method the relative illuminance of the note is only considered in the calibration and discrimination methods since only optical

characteristics of the notes is used in these methods which remains same with drift in light sources. Hence a relative illuminance record serves better in removing measurement errors due to light source drift.

The below steps are followed in recording relative illuminance of the notes.

1) When no note is there between LED and LDR, measure and store LED illuminance in terms of LDR resistance as Rnn.
2) When note passes through the LED and LDR, measure and store the transmitted light samples by measuring LDR Resistance as Rn
3) Calculate relative illuminance a = Rn/Rnn

The currency notes used in the dispenser would vary on various counts like denominations, quality (fresh or soiled) etc.

The calibration method involves sampling a typical set of notes that are expected for regular dispensation. The method captures the various optical threshold ranges of these notes segregating darker and lighter color area. The method defines the optical profile of the notes that are to be dispensed.

The calibrated optical threshold range is used to set detection levels for overlapped notes, and suspected note profile change.

The below steps are followed in note profile calibration

1) record and store LED luminance value in terms of LDR resistance as Rnn
2) dispense few notes, while the note is transported through the overlapped note detector, record their illuminance samples through LDR resistance measurement.
3) for each note, while sampling right, left, center LDR resistance, apply relative illuminance measurement "a" calculation for all samples. Choose illuminance samples recorded from darker colored area of each note.
4) overlapped detection threshold is arrived from a samples of all notes used for calibration. One way is to calculate mean of the samples for each note and choosing the maximum of mean values from sample set of notes. The overlapped detection threshold is set to twice of the said maximum mean value.

5) lower threshold is arrived from overlapped detection threshold, one way is to set it at half of the overlapped detection threshold.

During dispensation the "Note discrimination method" uses the overlapped detection threshold set during calibration to discriminate any presence of overlapped notes, which are then not presented. The method also employs a unique feature in discriminating if more number of notes is detected above "Overlapped Detection threshold" or below "Lower threshold" range which would be a suspected note profile change from previous calibration instance – like fresh notes to very soiled notes, note denomination change etc and hence will trigger recalibration. The method selects overlapped notes from being dispensed.

The below steps are followed in note discrimination

1) Check if present Rnn should not be drifted more than 50% of calibrated Rnn to avoid gross luminous intensity variations.
2) While dispensing notes, sample right, left, center LDR resistance; apply relative illuminance measurement "a" calculation for all samples. Choose illuminance samples recorded from darker colored area of each note.
3) Check if mean of a samples is greater than upper threshold then it will be suspected as overlapped note.
4) Check if more notes are detected above the "Overlapped Detection threshold" or below the "Lower threshold" then it will be suspected as note profile mismatch and trigger recalibration.
5) A valid note will pass though all the above checks, without any suspects.

I CLAIM:

1. A system for detecting overlapping of notes for use in note transport mechanism within cash dispensers and ATM machines or the like comprising:

one or more light emitting diodes (LEDs);

one or more light dependant resistors (LDRs); and

a computing system,

wherein the LED with a viewing angle of 15 degree or less and with a selected luminous intensity is adapted to function as light source, used in conjunction with other elements of the said system produces a transmitted illuminance variation of at least 3 times between overlapped notes to a single note,

wherein said LDR with selected sensitivity is adapted to sense the intensity of transmitted light, the selected LDR's resistance to illuminance characteristics producing a minimum of twice the resistance variation for said corresponding three times variation in illuminance, while measuring transmitted illuminance of the single notes and overlapped notes,

wherein the LED and LDR are positioned at desired mutual distance and alignment to capture the transmitted illuminance of the notes transported,

wherein said computing system is adapted to record, measure, calibrate and discriminate the illumination variations of the notes as they are transported thereby reliably identifying overlapped notes and any optical profile changes of notes, by means of illuminance measurement, note profile calibration and note discrimination methods,

wherein said system provides the desirable illuminance variation levels between an overlapped note vis-à-vis a single note, and

wherein said system provides sensitivity to measure illuminance variation to discriminate overlapped note vis-à-vis a single note.

2. A system for detecting overlapping of notes as claimed in claim 1, wherein illuminance variation between the single note and overlapped note increases by a factor of 2 for every 10mm decrease in distance between said light source and light sensor.

3. A system for detecting overlapping of notes as claimed in anyone of claims 1 or 2, wherein said illuminance variation is at least 3 times between overlapped notes to a single note.

4. A system for detecting overlapping of notes as claimed in anyone of claims 1 to 3, wherein said note profile calibration method comprising:
recording optical profile of sample set of notes, using the recorded samples to compute various optical thresholds namely overlapped detection threshold level, and lower threshold level.

5. A system for detecting overlapping of notes as claimed in anyone of claims 1 to 4, wherein said note discrimination method to select overlapped notes, notes of unacceptable quality and wrong denomination notes from being presented comprising:
recording illumination samples of the dispensed note; and
comparing illuminance profile of the dispensed note with optical thresholds set in said note profile calibration method,
wherein if the note illuminance profile is above overlapped detection threshold then it is marked as overlapped note and not presented,
wherein if more number of notes are detected above the overlapped detection threshold level or below lower threshold level then it would be a suspected note profile that is not fit to be presented, and
wherein said note whose profile passes all the optical threshold checks will be successfully presented.

6. A system for detecting dark colored pattern used for detecting overlapping of notes in note transport mechanism within cash dispensers and ATM machines or the like comprising:
recording transmitted illuminance levels of the each note at atleast two areas of the note, including one on the left and one on the right side of the note;
selecting only samples recorded from dark colored area of each note, to maximize the variation in the illuminance recorded from a single note to a overlapped note, to reliably distinguish between the two when the notes are of heterogeneous opacity;
calibrating the sample set of notes; and
discriminating each note during normal dispensing,
wherein sample set of notes are calibrated by:

transporting notes in either orientation,
recording transmitted illuminance levels of each note at various areas of the note,
selecting illuminance samples recorded from darker colored area of each note, and
computing various optical thresholds namely overlapped detection threshold level, and lower threshold level,

wherein during normal dispensing, each note is discriminated by:
transporting notes in either orientation,
recording transmitted illuminance samples of the note while it is transported,
selecting samples recorded from dark colored area of the note,
comparing said illuminance profile of the dispensed note with optical thresholds set in said calibration,

wherein if the note illuminance profile is above overlapped detection threshold then it is marked as overlapped note and not presented,
wherein if more number of notes are detected above the overlapped detection threshold level or below lower threshold level then it would be a suspected note profile change, that is not fit to be presented, and
wherein said notes whose profiles pass all the optical threshold checks will be successfully presented.

7. A method for detecting overlapping of notes in note transport mechanism within cash dispensers and ATM machines or the like comprising:
relative illuminance measurement to remove errors due to drift in intensity of light source, wherein relative illuminance is the ratio of illuminance measured when note is in the light-path, to that measured when there is no note in the light-path,
wherein sample set of notes are calibrated by,
transporting notes in either orientation,
recording transmitted illuminance levels of each note at selected areas of the note,
applying said relative illuminance measurement for all the samples that are recorded,
compute various optical thresholds namely overlapped detection threshold level, and lower threshold level,

wherein during normal dispensing, each note is discriminated by
transporting notes in either orientation,

recording illumination samples of the note while it is transported,

applying said relative illuminance measurement for all samples that are recorded,comparing said illuminance profile of the dispensed note with optical thresholds set in said calibration, and wherein if the note illuminance profile is above overlapped detection threshold then it is marked as overlapped note and not presented,

wherein if more number of notes are detected above the overlapped detection threshold level or below lower threshold level then it would be a suspected note profile change, that is not fit to be presented, and

wherein said note whose profile passes all the optical threshold checks will be successfully presented.

FIGURE 1:

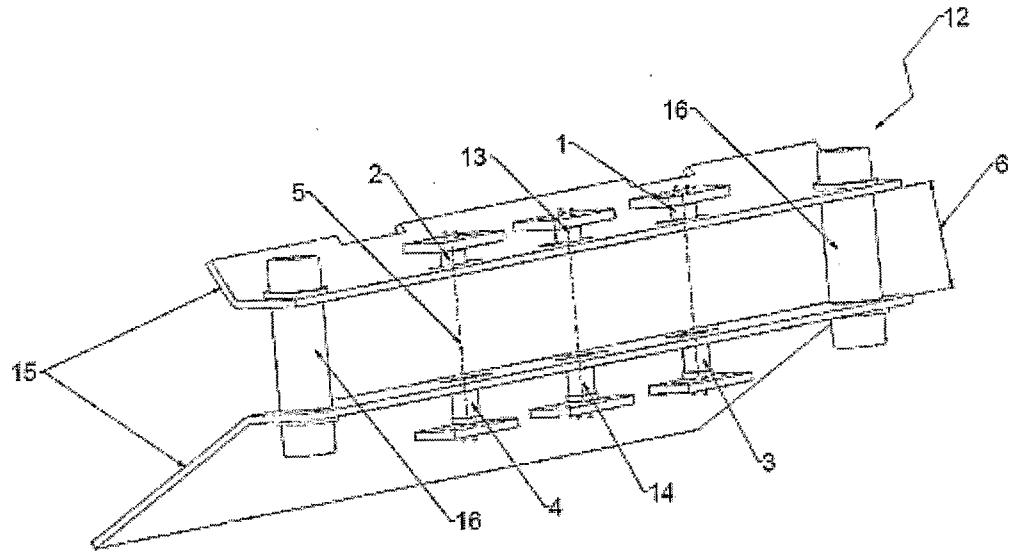


FIGURE 2:

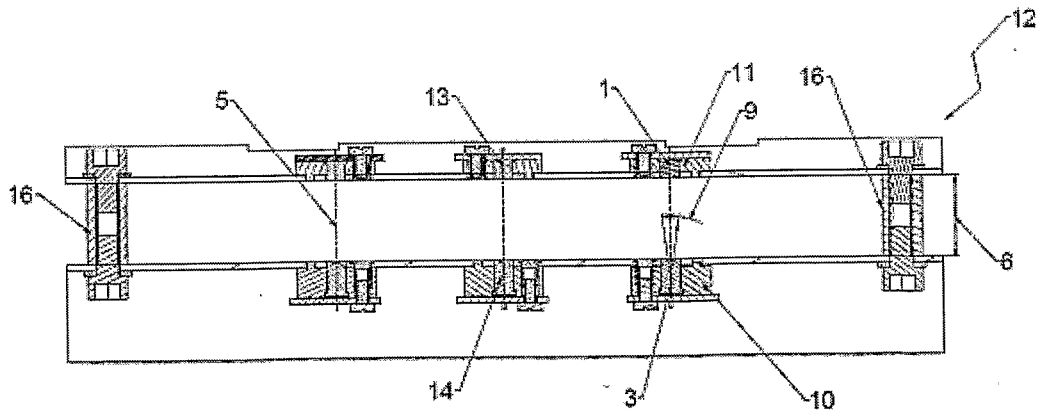


FIGURE 3: