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**A Modern Writing Instrument Used as a Weapon for Committing  
Bank Cheque Fraud**

Vivekkumar Mangilal Chayal<sup>1,\*</sup>, Rakesh Rawal<sup>1</sup>, Deepak R. Handa<sup>2</sup>,  
Vijay Verma<sup>2</sup>, Narendrakumar Mangilal Chayal<sup>3</sup>, Himanshu A. Pandya<sup>1</sup>

<sup>1</sup> *Department of Biochemistry and Forensic Science, Gujarat University, Ahmedabad - 380009,  
India*

<sup>2</sup> *Document Division, Central Forensic Science Laboratory, Central Bureau of Investigation (CBI),  
Ministry of Home Affairs, Government of India, New Delhi-110003, India*

<sup>3</sup> *Department of Information Technology, Raksha Shakti University, Lavad, Gandhinagar, India*

\* Corresponding author. Email: [vivekchayal@gmail.com](mailto:vivekchayal@gmail.com), Phone: (+91) 97250-35388

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**Abstract.** In the recent era, investigation of dye, pigments and powder-based ink examination are big challenges. Literature and survey reveal that, some erasable ink pens were consistently used to commit economic frauds in bank instruments like cheques, withdrawal slips, demand drafts, fix deposit receipts, counterfeit currency, and other essential documents. Some manufacturers provide magic erasable writing instruments. Here, we deciphered this type of ink on different documents with the help of VSC-6000/HS. The main aim of this research work is to develop simple, rapid, sensitive, eco-friendly to retrieve original writings of erasable ink. Total of 640 test samples were prepared under the same conditions with different ink pens on different papers/cheques, where each sample was written with the ReWrite-erasable ink pen, thermal ink pen, roller ball high tech ink pen, normal ballpoint pen and gel pens for the comparison purpose. The test samples were examined under different types of scientific instruments, physical examination before and after exposing to different environmental conditions, sunlight and at room temperature (25° C) for the period of one hundred and eighty-one (181) days. This technique to retrieve the original disappeared writings done with a ReWrite-erasable ink pen is very easy, simple, rapid, non-destructive, eco-friendly, convenient and sensitive to detect manipulations done in forgery and in suspect documents. Detection of ghost strokes under VSC-6000/HS with different functions, like fluorescence spotlight and specific (300 to 365 nm) UV range will provide a new avenue by, which the forensic document

scientist can identify the erased writing that might otherwise go undetected with other more frequently used methods.

**Keywords:** Forensic science and investigations; Financial and bank frauds; Questioned document; ReWrite-erasable ink pen; VSC-6000/HS; Erasures.

## 1. Background

Fraud is defined as “any action by which one person intends to gain a dishonest advantage over another”<sup>1</sup>. Due to easy availability of literature on the internet, increased computer literacy, smartphones, desire for a luxurious life, search for the quick and easy route for success, get quick rich syndrome, alcohol and drug consumption, poverty, and unemployment, etc., white-collar crimes are increasing day by day<sup>2,3</sup>. In the field of scientific forensic examination of questioned documents, forensic scientists observed that fraudsters produced an exact copy of forgery for own benefit and cheat the innocent people<sup>4,5</sup>. Document scientists have examined disputed documents in Forensic Science Laboratories, related to signature, handwriting, typewriter, writing instruments and printer inks, etc. The review and literature suggest that ballpoint technology is the most common technology used in making writing instruments<sup>6,7</sup>. Financial institutions like banks, insurance companies are the softest target of white-collar criminals<sup>8</sup>. A literature survey reveals that mostly, fraudsters are using ‘cut and paste methods’ to manipulate the documents and commit the bank frauds<sup>9</sup>. The banking industry fights with different types of white collar-crimes and loses millions of dollars every year and the graph of the loss is steeply or rising<sup>10,11</sup>. Inks are made up of different types of dyes/pigments, a minute quantity of oil for lubrication, quick-drying agents, glycol, stabilizers, and solvents, etc.<sup>12</sup>. Scientific research and developments are always beneficial to society but hardcore, as well as white-collar criminals, misused the scientific technologies for personal gain<sup>13</sup>. Nowadays, purchasing of products is very easy with the help of the internet, computers, smart phones, etc. all over the world. E-commerce companies, as well as local markets, are providing various products including erasable/magic ink pens of various types and technologies, which fraudsters misused in bank frauds like cheques, legal and essential documents<sup>14</sup>. Fraudsters used different types of erasures like chemical, mechanical, physical and detergent to temper the cheque and to change the amounts. Till date, fraudsters used different types of chemical solvents like acetone, bromine, water, benzene, and sharp objects, etc. for tempering the cheques and other

documents<sup>15-17</sup>. Various security features are present in currencies, bank cheques, demand drafts, and other bank instruments. Printing inks used in cheques and other essential documents, which are sensitive to chemical erasures and when the forger makes efforts to temper the cheques with such erasures, cheques' sensitive ink dissolves and produces the bleeding spot on the cheque<sup>18,19</sup> and the bank employees could identify the manipulation done in cheques. In the present time of high technology, some writing instruments are being used by fraudsters as weapons to commit financial frauds and secret writings<sup>20,21</sup>. Nowadays, many types of high technologies of magic erasable ink pens<sup>22-24</sup>, which do not cause damage to cheques, essential documents and do not disturb cheque printing ink are easily available in the market. Literature and surveys reveal that mainly three types of magic erasable writing instruments are used for fraudulent purposes – First (1<sup>st</sup>) thymolphthalein-blue dye-based disappearing inks, Second (2<sup>nd</sup>) inks based on thermochromic substances, disappearing inks due to changes in the heat, Third (3<sup>rd</sup>) felt-tip based erasable inks. Above First and Second types of writing instruments used in fraudulent purposes were published<sup>25,26</sup>. In the present research work, we discussed the Third type of inks, which is felt-tip writing instrument ink. The identification of entire disappeared writing strokes, also difficult to a layman, which were not visible by naked eyes and even underhand magnifier with UV functionality. Literature and survey revealed that there are two types of felt tip pens available in the market. One is having a very thin plastic tip, which is usually housed in a metal funnel. The viscosity of the ink is very low, so it dispenses the ink evenly and smoothly with very little pressure. These types of pens are used for writing purposes. The other one is having a thick, spongy, fibrous tip usually shaped like a cone. Such types of pens are used as sketch pens, markers, high lighters, etc. The mechanism of the felt tip pen is based on capillary action. In the side of the barrel of the pen, a special type of sponge is kept, filled with liquid ink and the plastic tip directly attached to it<sup>27,28</sup>. A new type of writing instrument named ReWrite®-erasable ink pen is nowadays available in the market to have felt tips on both sides. Such a pen having two separate chambers in the barrel of the pen, each chamber serving as an independent pen. This pen has a thin felt tip on one side, which is used to write. The sponge in the chamber of the barrel of the pen on this side is provided with special ink, which is used to write. Another side of the pen has a cone type thick felt tip. This thick felt tip is connected to a sponge inside the chamber of the barrel of the pen on this side, which is provided with a special liquid chemical eraser. When the thick felt tip is applied to the writings

made with the thin felt tip of this pen, the writings are erased, disappear and no marks or traces could be seen with naked eyes. To commit fraud by using a ReWrite-erasable ink pen, the forger writes to say a bank cheque or fills in the main body of a document using a ReWrite-erasable ink pen. Thereafter, the fraudster erases the original writings by applying the thick felt tip on the other side of the pen, which contains a special chemical eraser and re-writes over the erased writings for own benefits, thus manipulating the bank instruments, documents, wills, bills, deeds, etc. and cheating the innocent person. Such manipulated instruments cannot be identified with the naked eye and can be considered genuine by the unsuspecting banker or another person. In the present research work, we explained a demonstrable description of Third type of felt-tip of magic erasable writing instrument, which can be used as a weapon for committing documents frauds. This research paper is an alert to the banking industry, insurance companies and legal departments, government departments, law enforcing agencies, etc. to make them aware of the ReWrite-erasable ink pen used for fraudulent purposes as well as how to identified and retrieve such types of erasable writing. As per our best knowledge no work has been reported to date on such type of ReWrite-erasable ink pen used in frauds.

## 2. Materials and methods

### 2.1 Materials and instruments

**Table 1.** Writing instruments and writing surfaces used in proposed research work as below.

Sr. No.	Writing Instrument	Manufacturer
1.	Erasable ink pen (ReWrite, model-E250) having fine felt-tip having blue ink.	G.M. Pens International Pvt. Ltd., an exclusive licensee of Reynolds®, India
2.	Sample of Pilot Frixion ballpoint pen with 0.7 mm tip	Luxor®, Japan having blue ink
3.	Ten samples of roller ballpoint high-tech ink pens having 0.5 mm tip	Luxor®, Flair®, Cello®, Raynolds®, Claro™, Uniball®, Zebra®, Aihao®, Submarine® and Schneider® brands having blue inks
4.	Five ballpoint pens having 0.5 mm tip having blue inks	Montex®, Cello®, Flair®, Claro®, and Raynold® brands
5.	Five ball point pens having 0.7 mm tip having blue ink	Parker®, Milton®, Today's®, Pentek®, and Saino® brands
6.	Ten gel pens having 0.5 mm tip having blue ink	Cello®, Montex®, Add®, Pilot®, Flair®, Wander®, Uniball®, Nataraj®,

		Classmate®, and Linc® brands. All the writing instruments were procured through online e-commerce shopping channels
7.	Samples of foolscap notebook ruled papers	Arihant Stationery, Ahmedabad obtained from the local market
8.	Samples of bank cheques.	-

Total 640 test samples were prepared under the same conditions with different ink pens on different papers/cheques, where each sample was written with the erasable ink pen, thermal ink pen, roller ball high tech ink pen, normal ballpoint pen and gel pens for the comparison purpose respectively. The test samples were examined under different types of scientific instruments, physical examination before and after exposing to different environmental conditions, sunlight and at room temperature (25° C) for the period of one hundred and eighty-one (181) days.

**Table 2.** Scientific instruments used in proposed research work as below.

Instruments	Description	Manufacturer/ Supplier
Hand magnifier with Ultraviolet features	Corning, with 9 V–50 Hz mini 10x magnifying glass.	Pia international ®
Compound Microscope vision-2000	With 100x magnification.	Labomed ®
Electrostatic detection apparatus (ESDA)®	Works by creating an electrostatic image of indented writings which visible by charge sensitive toners.	<b>Foster + Freeman®, London, U. K.</b>
Video Spectral Comparator (VSC-6000/HS) ®	Connected to a monitor with different functions are used for the study.	<b>Foster + Freeman®, London, U. K.</b>

The VSC®6000/HS, the flagship product in document examination, is a comprehensively equipped laboratory system for the examination and analysis of the entire **suspect document**. All the test samples were examined and photographed under VSC.

## 2.2 Sample preparation

The proposed research study explained the age of the writings done with ReWrite-erasable felt-tip ink pens with comparison to different technologies like gel, high-tech ink, ballpoint, thermal ink pens, etc. We utilized pens of different make, model, brands

and manufactured by different manufacturers using different writing technologies. Twenty (20) test samples were prepared with each pen, out of which Ten (10) test samples were prepared on foolscap notebook ruled paper and Ten (10) test samples were prepared on bank cheques. For investigation purposes, in the present research work, we utilized 32 writings instruments using different types of inks and writing technologies like *ReWrite-erasable ink pen*, Frixon-thermal ink pen, rollerball point high-tech ink pens, ballpoint pens and gel pens in preparation of the test samples. In typical sample preparation, a total of Six Hundred Forty (640) samples were prepared out of which Three Hundred Twenty (320) samples on foolscap notebook ruled papers and Three Hundred Twenty (320) samples on bank cheques were prepared. The list of writing instruments used is shown in a tabulated form given below.

**Table 3.** Different technologies of writings instruments used in proposed research work.

Brand of pens	Manufacturer	Quantity of pens	(Total) Samples prepared	Samples prepared on cheques	Samples prepared foolscap
Blue ReWrite erasable E250 pen	G.M. pens international Pvt. Ltd. Exclusive licensee of Reynolds®, India.	1	$1 \times 20 = 20$	$1 \text{ (pen)} \times 10 \text{ (samples)} = 10$	10
0.7 mm blue Frixon ink pen	Pilot, Luxor®, Japan	1	$1 \times 20 = 20$	$1 \text{ (pen)} \times 10 \text{ (samples)} = 10$	10
0.5 mm blue roller ball high-tech pens	Luxor®, Flair®, Cello®, Raynolds®, Claro™, Uniball®, Zebra®, Aihao®, Submarine®, Schneider®.	10	$10 \times 20 = 200$	$10 \text{ (pens)} \times 10 \text{ (samples)} = 100$	100
Five pens of 0.5 and five pens of 0.7 mm blue	Montex®, Cello®, Flair®, Claro®, Raynold®, Parker®, Milton®,	$5 + 5 = 10$	$10 \times 20 = 200$	$10 \text{ (pens)} \times 10 \text{ (samples)} = 100$	100

ball point pens	Today's®, Pentek®, Saino®.				
0.5 mm gel pens	Cello®, Montex®, Add®, Pilot®, Flair®, Wander®, Uniball®, Nataraj®, Classmate®, Linc®	10	10 × 20 = 200	10 (pens) × 10 (samples) = 100	100
<b>Total</b>	<b>32</b>	<b>32</b>	<b>640</b>	<b>320</b>	<b>320</b>

On prepared test samples (on foolscap notebook ruled papers and bank cheques) written with this ReWrite-erasure ink pen, i.e. writings with the thin felt the tip of the pen, the thick felt the tip of the pen was applied. The cheque samples were prepared by writing the payee name as "Paresh bhai Patel", amount "5000" in numerical and in words "Five thousand only". After applying the thick felt tip of the pen on the writings, the writings were erased and disappeared which were subsequently rewritten the payee name to "Prakash bhai Patel", amount "2, 00,000" in numerical and amount in words "Two lacks only". When the thick felt tip of the ReWrite-erasable ink pen was applied on the writings on the samples done with the different types and technologies of the writings instruments as per table-2, the writings did not erase, did not disappear and were visible with naked eyes. Acetone and Benzene were applied to the writings done with the ReWrite-erasable ink pen. We observed that the writings were not erased and were visible with the naked eye.

### 2.3 Method development

In the present study, all the Six Hundred Forty (640) samples were prepared for research purposes only. The prepared test and control samples were exposed to direct sunlight as well as stored inside the room temperature (25 °C) for Three (03) months. All the control and test samples were subjected to the following observations. In this study, the prepared test as well as control samples were exposed to direct sunlight and stored inside the room at room temperature (25 °C) for 181 days. We used a non-destructive method in this proposed research work to reappear the ghost writings. We



utilized different types of highly sophisticated scientific instruments and aids, which are mentioned below.

**(1) Examination under Hand Magnifier with ultraviolet features:** All the test samples were examined under the Hand magnifier with ultraviolet features.

**(2) Microscopic examination:** All the test samples were examined under the Compound Microscope vision-2000 With 100x magnification.

**(3) Examination under ESDA:** All the test samples were examined under the ESDA to develop the indented writings.

**(4) Examination under VSC-6000/HS:** All the test samples were kept under VSC and examined under multiple functions like different light sources, direct and oblique light, transmitted light, spotlight, Ultraviolet and Infra-red lights with different filters, spotlight, etc.

### 3. Results and discussions

All the test samples were examined under the mini Hand magnifier (10x) with ultraviolet features, Corning, with 09 V–50 Hz, but no significant observations were found. In the microscopic examination of all test samples at 100x magnification, it was found that they did not show any traces of written material except some discontinuous line of paper threads.

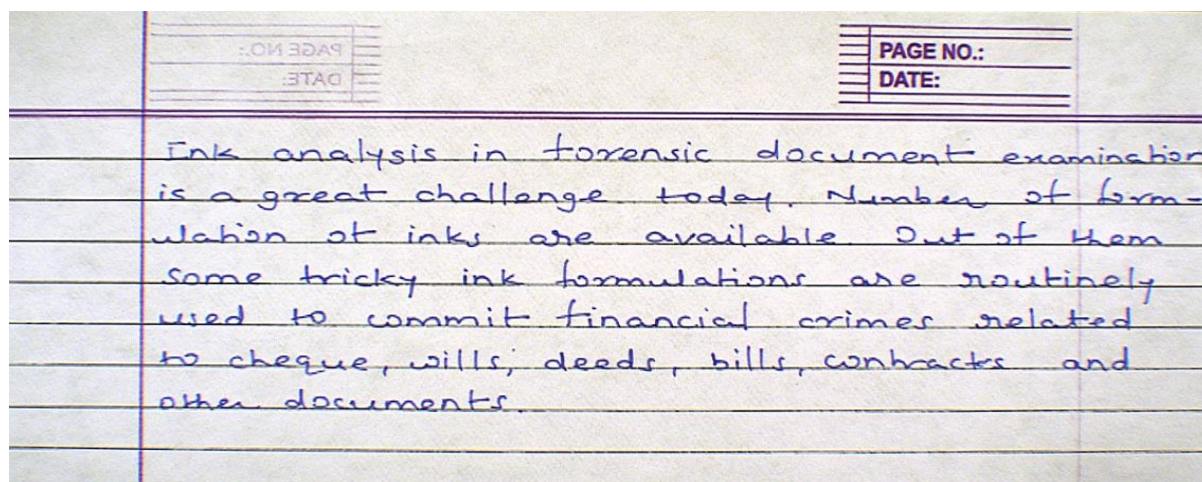
ESDA instrument is used to develop the indentations marks of ghost-writing strokes, but the writing instrument is available in felt-tip soft fiber technology. So, the strokes of the indentations are not visible by using this technique. This kind of writing instrument doesn't produce indentation marks on paper due to the theory of tool marks, which states that "the harder of two objects, which when brought into contact with each other, results in the softer one being marked"<sup>29</sup>. In our research work, soft fiber tip contact with the paper, which is soft in nature. When the writer tries to write by applying pressure to create writing marks on paper but in such condition felt-tip fiber tip damaged and writer could not write, so indentation marks can't be produced.

The samples were examined under VSC-6000/HS. Photographs were taken and results were collected. Samples of writing in thermal ink pen, ballpoint pen, roller ball high-tech ink pen, and gel pen compared with the writing in blue ReWrite-erasable ink pen. We observed a ReWrite-erasable ink pen, looked like written with a normal ink pen and the durability of this type of ink was good at room temperature (25 °C). During the investigation, the tint and luster of the ink observed periodically. After three



months, the tint and luster of the writings with the ReWrite-erasable ink pen were a little bit faded, after six months some strokes were faded due to the reaction of environmental conditions like temperature, moisture, humidity, etc. Some samples were exposed to direct sunlight. After 20 days, it was observed that the tint and luster of the writing with the ReWrite-erasable ink pen was faded a little bit and after Thirty (30) days writing became more faded but still readable. Detection of the tempering done in the original writings with ReWrite-erasable ink pen is very difficult to detect in normal conditions by observation with the naked eye since there are no signs of physical or chemical tampering.

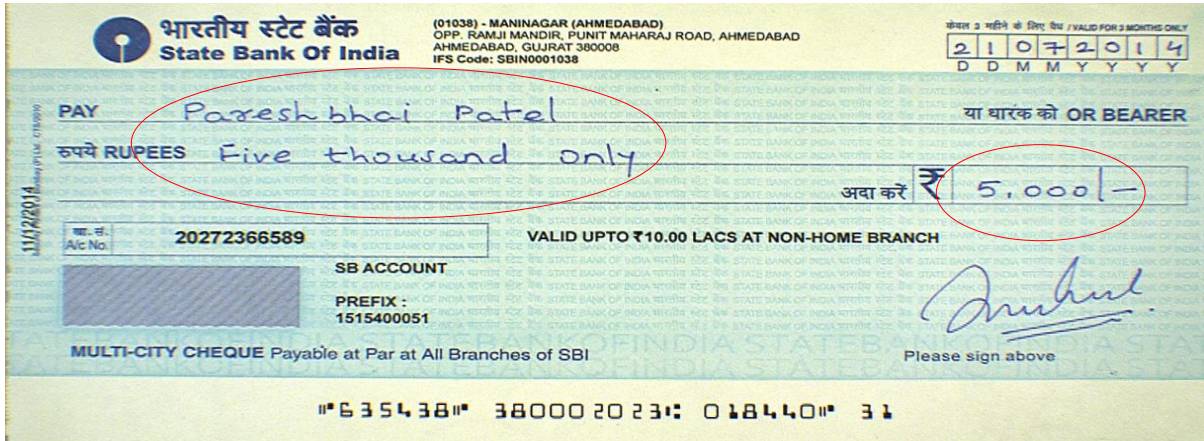
Figure 1. is written in blue colour with a ReWrite-erasable ink pen with a felt tip. For the investigations point of view, the sample kept at room temperature. Samples were subjected to hand magnifier and microscopy examination at 60x to 100x magnification but did not show any traces of erased, disappeared original writings except some discontinued lines on the paper and its fibers. The test samples look alike if they were written with an ordinary ink pen. So, it is very difficult to identify, whether the writings were done with a ReWrite-erasable ink pen or with an ordinary ink pen.



**Figure 1.** Sample of ReWrite-erasable ink pen, which look like written with normal ink pen.

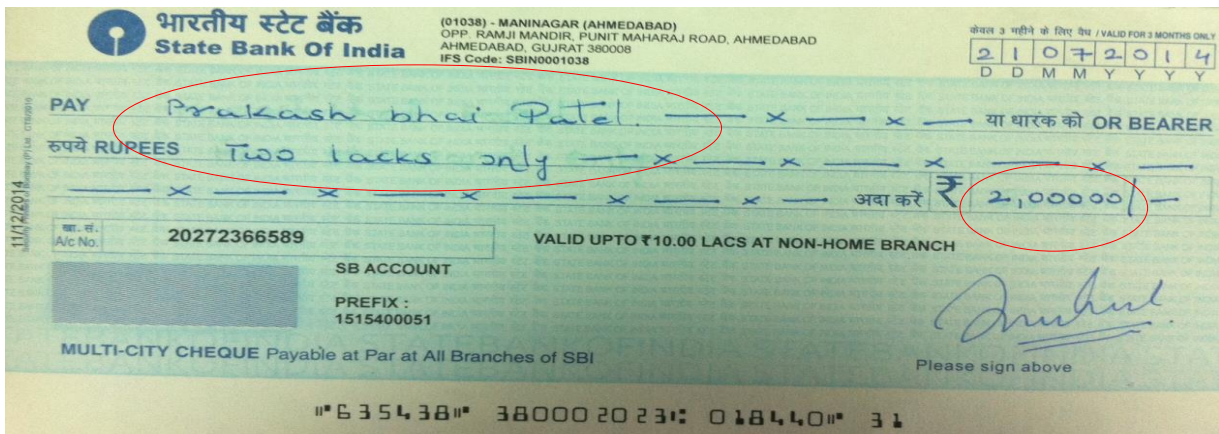
As shown in Figure 2, a cheque was written by using a ReWrite-erasable ink pen. The pen is special having felt-tips on both sides. One side of the pen is provided with a thin felt tip and blue ink for writing and another side is provided with a thick felt tip and a special liquid chemical when the thick felt tip was applied on specific areas

like amount, payee name, etc., which is indicated with red colour circles. The original was writings erased and not visible.



**Figure 2.** Sample of ReWrite-erasable ink pen in blue colour on bank cheque.

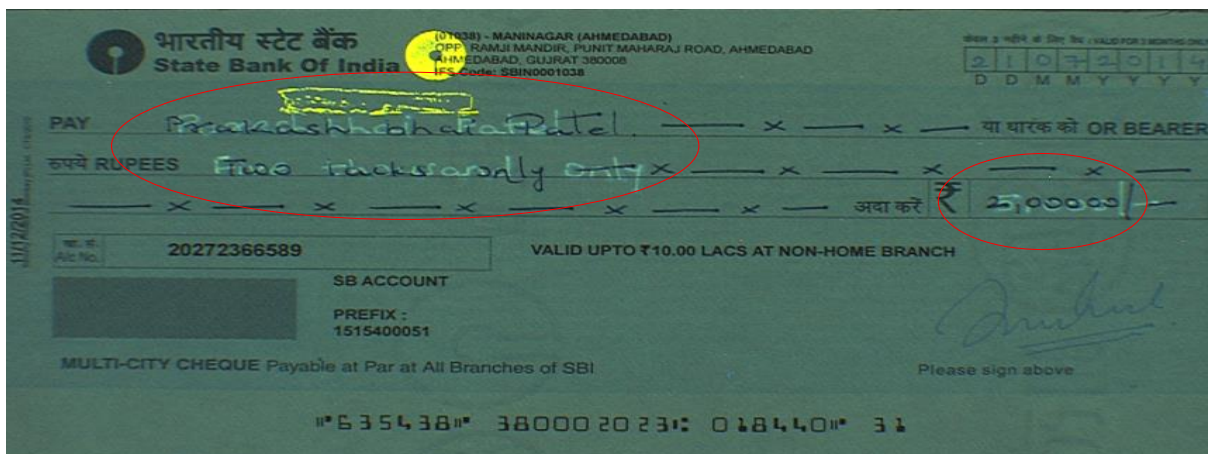
In Figure 3, the cheque was rewritten and the payee name, the amount in words and figures were changed. These disappeared original writings were not visible with naked eyes and no bleeding effect present on the cheque.



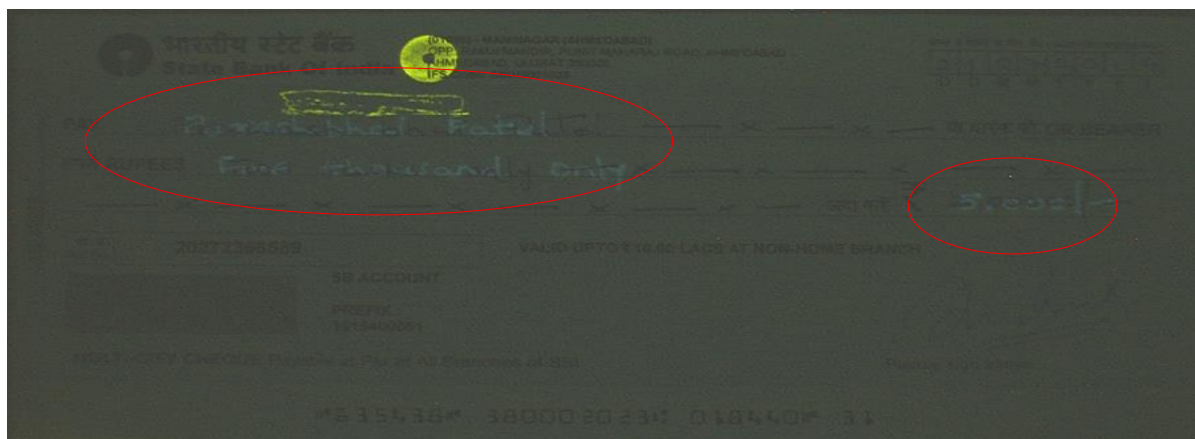
**Figure 3.** Sample of altered cheque written with blue colour.

In Figure 4, the tempered cheque was examined under VSC-6000/HS with the function of the UV-365 nm range, and the ghost strokes of original disappeared writings were visible clearly with bright sky-blue tint. The rewritten cheque was examined under VSC with the function of UV-312 nm specific range; ghost strokes of original disappeared writings were visible clearly with a bright blue tint (Figure 5).





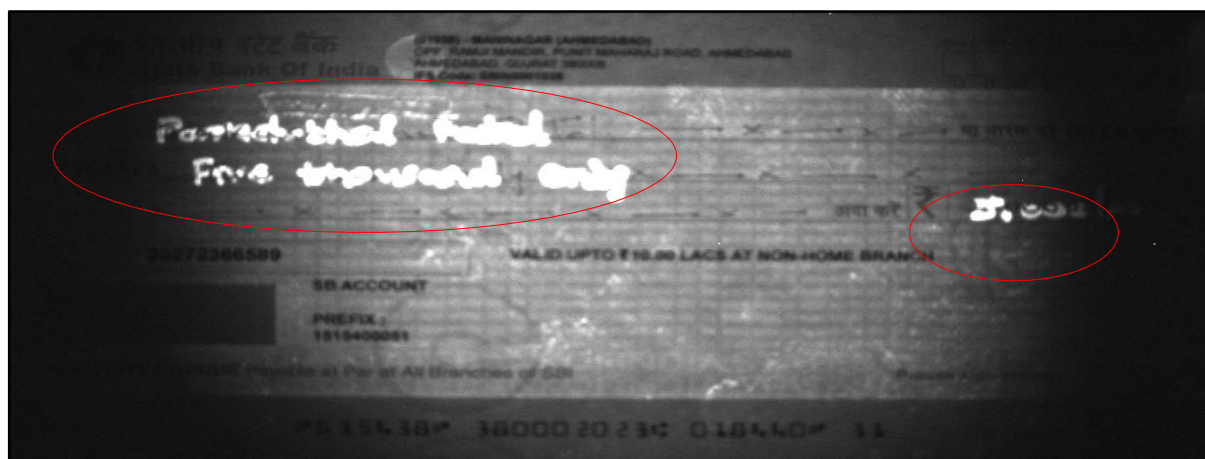
**Figure 4.** Ghost strokes of original disappeared writings in the cheque visible under specific UV range 365 nm under VSC.



**Figure 5.** Ghost strokes of original disappeared writings in the cheque visible under specific UV range 312 nm under VSC.

Figure 6, the rewritten cheque was examined under the VSC instrument with the function of fluorescence spotlight; the ghost strokes of original disappeared writing and rewritten writing were clearly visible with broad white tint. One of the modern techniques applied in committing bank frauds is the use of ReWrite-erasable ink pen in writing various bank cheques or other essential documents to withdraw money from one's account. Now in this era, this type of modus operandi of frauds were applied on bank cheques to change the amount and payee name without disturbing the cheque's printing ink and cheque's paper fibers, (cheques have covered with liquid sensitive printing, which was used as a security ink, which is specially designed to bleeding effect on application of liquid chemicals/solvents etc.<sup>30</sup> used to erase the writings and visible colourless strokes appear at the place of tampering done with chemical agents). This type of case was examined under the spotlights and different types of functions

available in VSC-6000/HS and under the above instrument one can see the ghost strokes (erased writings) under fluorescent spotlights and specific UV range 300-365 nm. When detailed investigation and examination of such cheques were done under the spotlight using VSC-6000/HS, the original set of writings below the visible writings was observed and complete set of disappeared writings done with ReWrite-erasable ink pen was visible. Ghost strokes of ReWrite-erasable ink are created according to “*Locard’s Ion Exchange Principle*”, which states “*Every Contact Leaves Its Traces*”<sup>31</sup>. Whenever two surfaces contact each other (pens’ point with ink and paper fibers), ions are exchanged and traces of such ion exchange are visible as ghost strokes. This technique to retrieve the original disappeared writings done with ReWrite-erasable ink pen is very easy, simple, rapid, non-destructive, eco-friendly, convenient and sensitive to detect manipulations done in forgery and in suspect documents.



**Figure 6.** Ghost strokes of original disappeared writings in the cheque visible under specific source of spot light under VSC.

#### 4. Conclusion

This research paper alerts the forensic scientists as well as banking and insurance companies, law enforcement agencies; vigilance departments, bank customers, laymen etc. about the ReWrite-erasable ink pens and describes a method of deciphering it. Detection of ghost strokes under VSC-6000/HS with different functions, like fluorescence spotlight and specific (300 to 365 nm) UV range will provide a new avenue by, which the forensic document scientist can identify the erased writing that might otherwise go undetected with other more frequently used methods. The authors suggest some precautions for bank customers and banks such as customers may be advised to use their own writing instrument to write and sign the bank instrument and

other essential documents and manufacturers may develop handy and convenient spotlight instruments for bank employees.

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