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**A REVIEW ON CHARRED DOCUMENT DECIPHERMENT, FINGERPRINT  
ENHANCEMENT AND VISUALIZATION FROM BURNED SURFACES AND  
USE OF VIDEO SPECTRAL COMPARATOR FOR DIFFERENT STUDIES**

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**ABSTRACT**

A questioned document is a scientific field that deals with different cases like fraud, forgery, ransom, white-collar crime, arson and murder, which relate to examining paper, inks and security features. There is an increase in arson cases in India, where burned documents are also found. Different methods for handling, collection, transportation and decipherment are present in this. But with it, fingerprints are also found in many cases, which present in arson cases or fraud cases. The presences of this chances print were the due composition of sweat. This latent print development and enhancement are done by different physical, chemical, and fuming methods from porous and nonporous surfaces. Further, Video spectral comparator (VSC), which was found useful for question document examination also used for stain examination. This review focus on the study of chance print presences on burned surfaces, its examination and visualization.

**Keywords: Burned documents, handling and decipherment, composition of sweat, latent print, enhancement, VSC**

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**INTRODUCTION**

A questioned document examination is the examination of papers that could be challenged in court. Its main goal is to use scientific processes and methodologies to produce proof concerning a suspicious or ambiguous document. One of the most crucial shreds of evidence seen in cases of arson and fire are charred

documents that might contain important content to help for solving the case. Burnt documents are those that have been exposed to extreme heat, either intentionally or negligently, and have turned black and brittle. These records are crucial to the inquiry because they may contain essential information, which is why they were destroyed. But with burnt documents, there might found of documents which are not completely burned due to preserved in bundles so on those documents might possible to get the important evidence such as written. Now in this one, the more crucial evidence possible to find are fingerprints on burnt documents. The presence of latent fingerprints in the crime scene was due to its composition, grease and dirt. Even its presence depends on surface type. And its visualization by non-destructive method.

### Papermaking and composition

Paper is the fundamental medium for written communication and information sharing. Cellulose fibres are collected and processed to Pulp from a variety of sources,

and Pulp is derived from Spruce, Pine, Fir, Larch, Hemlock, Eucalyptus, Aspen, Birch, cotton, and waste. These are mixed with water and placed on a paper-producing machine, where it is flattened, dried, and cut into sheets and rolls. To manufacture Pulp, there are three primary components that must be separated. Bark, fibre, and Lignin are all removed mechanically or chemically and then used to make paper with machinery [1, 2]. Lignin which is present in wood and makes the paper weaken and discolour rapidly, so it's necessary to remove it for making a long colour life span to have an impression on it. Pyrolysis gas chromatography and mass spectrometry were utilized to investigate a collection of Eucalyptus globulus woods from varied sources and growth conditions that generated a broad array of cellulose yielding (around 40 to 60 percent) following wood chips boiling. Another method for pulp production by enzymatic bleaching. Here India is trying for eco-friendly production of paper [3, 4].

Paper composition effective in charred doc.	Method used	References
The Pulp goes through mechanical and chemical methods for separating fibres and Lignin from wood. Paper made from Pulp after machinery process.	Mechanical, Chemical method	[1],[2]
Pyrolysis, gas chromatography, and mass were used for knowing quantity of lignin for pulp output.	Pyrolysis- GC-MS method	[3]
Pre- enzymatic bleaching for pulp output to remove chemicals hazardous for environment.	Eco-friendly method (non-destructive)	[4]

In this review the analysis of charred documents from (1955-to 2021) has been

done. which shows old method(destructive) to new high-tech method(non-destructive)

used for handling collection and decipherment of burnt documents.

### **Paper as a Charred document**

The treatment of burned remains should be done with extreme caution. Some somewhat calcinate shards may be plying able and relatively damage-resistant. Black recommended using plain bladed forceps, which are often found effective for picking up all pieces, and four regular 18x20 ferrotype plates were employed for reassembling and storing the burned paper for decipherment procedure then its Visualisation by alcohol-Glycerine Immersion Method and potassium ferrocyanide method. Mitchell and others recommend warming the document bundles in hot water and then in a moderate glycerine-water bath, which not only separates the documents but also makes them more flexible. John Tyrrell recommends in his case study without the use of liquids, solvents, or other chemical methods, it is feasible to separate the different sheets. Separating every curled side and divided into fragments, which would then be assembled with neighbouring sections to decipher the message., was discovered to be essential. And its visualization by Contact photography, filter photography, and oblique light photography. Dr. Gross recommended used glass and gum for

handling the trace of paper. And visualization by Reflectivity Method. According to H. D. Murray, for visualization, Silver Nitrate was used. H. J. Walls and W. D. Taylor recommended chloral Hydrate Treatment for visualization. Julius Grant does visualization by Fluorescence in Ultraviolet Light. Paper handling and visualization are more difficult. The different methods used for handling and visualization are based on the composition of the paper [5-9]. Burned sheets of paper are placed in contact with the emulsion of fast or medium speed photographic plates, and the effect is positive instead of negative. Results similar to those produced by photographic plates can be obtained by washing a film in clean water for a brief period and drying it (in darkness) before bringing it in contact with the burned [10]. Alterations, additions, obliteration, erasures, invisible handwriting, and charred papers are the most typical forms of tampered documents discovered by forensic professionals. The emphasis was on photography and visual evaluation tools, which included different filters, infrared, and ultraviolet photography. Instrumentation systems for detection and decipherment of altered papers have received very little investigation [11].

Old methods for handling, collection and decipherment of charred	Method	References
Contact photography, filter photography, and oblique light photography are three of Tyrell's preferred techniques.	Photographic (non-destructive method)	[6][8][9]
David A. Black recommended 18x20 ferrotype plates were employed for reassembling and storing the burned paper for then its visualization by alcohol-Glycerine Immersion method and potassium ferrocyanide method. Mitchell recommends soaking the document bundles in hot water. And Others recommend soaking in a mild glycerine-water bath, which makes them more pliable. John Tyrrell recommends in his case the use of manual method, for separation of different sheets. It was revealed that separating each folded side into pieces, then joined together for decipherment, And its Visualization photography method. According to Dr. Gross glass and gum were used for handling the tracing paper, and its visualization by Reflectivity method. According to H. D. Murray visualization method used Silver Nitrate. where H. J. Walls and W. D. Taylor recommended chloral Hydrate Treatment for Visualisation. Julius Grant recommended method for Visualisation was Fluorescence	Handling, Collection, and decipherment, for charred document (destructive and non-destructive method)	[5][11]
Decipherment of documents stuck in bundles in the box during the war was done by the chemical method: 70 percent alcohol (rubbing alcohol), 20 parts water, three parts glycerin, 20 parts waters. Visualization under sunlight	A chemical method (Semi-Destructive)	[7]
The burned sheets are placed in contact with Photographic plates are produced by burning over a period of time and then exposing it to the emulsion of fast or medium speed photographic plates.	Photographic film (non-destructive) method	[10]

The study shows printed, or any ink impression on burned papers that are difficult to visualize or decipher are visualized by the employment of infrared photography found more effective than used before in 1999 by infrared luminesces [12, 13]. Liquid inks have now been

replaced with viscous or gel-based inks, which are used in ballpoint and gel pens, respectively. The experiment includes decoding the lettering on the experimentally burnt documents using an ammonia solution [14].

Role of ink on burnt document and its decipherment from old to new methods	Method	References
The ashes were humidified before with acrylic lacquer. Followed with for inscriptions of written content from Swiss passport using infrared luminescence	Infrared luminescence (Non-destructive)	[12]
The ink from a ballpoint pen, fountain pen, or gel pen is typically used to complete papers so the technique of infrared reflected photography can be used to retrieve the contents.	Infrared reflected photography (Non-destructive)	[13]
For deciphering ballpoint pen with oils and fat composition on burnt sheets at different temperatures. This ballpoint written content decipher by ammonia solution.	Chemical method (Non-destructive)	[14]

The samples were burnt until the writings were no longer visible. By varying the wavelengths, the burnt sample is seen under the white beam and the floodlight. Under the white spot beam, the writings were more apparent than under the floodlight beam. Photographs were taken

using VSC-2000. Employment of video spectral comparator was found more effective for visualization of an impression on a burned document [15]. After charring, some official stamps samples are evaluated for their numerous characteristics and security aspects. The samples were then

properly gathered and evaluated using (non-destructive sources) various light sources such as Retro-reflective, IR, and U.V., the light seen at various bands using equipment Projectina inspec-8 [16-18]. New technologies were used for decipherment as a non-destructive method; this study shows video spectral comparator found more effective than Projectina.

It is a common occurrence in everyday life where some documents are damaged, and some useful contents of documents are lost or hidden intentionally or accidentally due to a variety of damaged conditions, such as water-soaked or submerged documents in a library or any institution in a flooded area, charred in an arson case, ink spreading, whitener application, torn by hand or in any machine, damaged by chemicals such as

alcohol, acids, or different types of oil such as vegetable-based oil. This entails sensing the light after it passes through the damaged paper, both in terms of reflection and transmittance, and then using image processing by DOCUCENTRE Expert instrument and analysis to the recorded pictures in order to recover lost or concealed data [19]. the development of techniques for retrieving what was written on a paper document after it had been erased using procedures such as burning or bleach and observed by Sony Ericsson Cell Phone with such a 2.0-megapixel pixel camera and designed light., to reduce economic costs [22]. The idea is to employ off-the-shelf technology instead of pricey high-tech imaging and infrared equipment.

New technologies for decipherment of charred document	Method used	References
By varying the wavelengths, the charred papers were seen under white beams and floodlights. Then Photographs were taken using VSC.	Video spectral comparator (non-destructive method)	[15]
The charred stamps samples characteristic was evaluated using various light sources (non-destructive sources) such as U.V., I.R., and Retro-reflective light seen at various wavelengths using equipment Projectina inspec-8.	Projectina-inspec (non-destructive) method	[16]
Bond paper, newspaper paper, photographic paper, and thermal paper sorts of Paper samples and then burned in a wood box. Comparison of effectiveness of VSC and Projectina for revealing of written content.	VSC and Projectina (Non-destruction) method	[17]
(Bank cheques and bank credit cards) of U.A.E. and these roasting reports were then collected and examined using a Projectina inspec-8 with a variety of light sources.	Projectina inspec-8(non-destructive method)	[18]
Damaged and some useful contents of documents are lost or hidden intentionally or accidentally due to a variety of damaged conditions; for this reflection and transmittance.	DOCUCENTRE Expert instrument (non-destruction) method	[19]
Burnt or bleach sample are observed by Sony Ericsson Cell Phone with such a 2.0-megapixel pixel camera	Ericsson cell Phone of Sony (Non-destructive)	[20]

### Stabilizer on charred documents

Experiments in sorting, decoding, and conserving burned and ashes papers have

been done. As the temperature rises, the paper becomes flimsier and must be stabilized. Two approaches are suggested

by Bartha and Duxbury for this purpose: 1. NEATAN and 2. LAMINATION therapy [21, 22]. Earlier, experts have had success using polyvinyl acetate in acetone solution for strengthening char and ash. As an

intermediary step before P.V.A. treatment, pre-treatment with the alkyl-2-cyanoacrylate ester (superglue fumes) may be useful [8, 23].

Stabilizers used in charred document for strengthen and decipherment	Method used	References
As the temperature rises, the paper becomes flimsier and must be stabilized. Two approaches are suggested for this purpose: 1. NEATAN or LAMINATION therapy.	Semi-destructive	[21]
Three different methods for stabilization of burnt document: 1. Gum acacia 2. Plasticizer 3. PVA	Chemical (semi/destructive)	[22]
As an intermediary step before P.V.A. treatment, pre-treatment with the alkyl-2-cyanoacrylate ester (superglue fumes) might be effective.	Chemical stabilizer for stabilization	[23][8]

### Composition of sweat

Fingerprints are one of the most found pieces of evidence in any crime scene. So, according to the author, porous substrates, such as paper, cardboard, wood, and other cellulose-based materials, are usually absorbent. Fingerprints left on these surfaces absorb into the substrate and persist for a long time. Amino acid techniques are especially useful in this case since amino acids are stable and do not migrate when consumed. These glands secrete a mostly water-based secretion that also contains several other substances in trace amounts, including essential amino acids. Eccrine sweat, fatty acids, and sterol compounds have all been found to include lipids. The apocrine gland is another sudoriferous gland found in the skin. The coarse hair of the armpits and pubic region is related to these sweat glands. Proteins, carbs, cholesterol, and iron have all been

documented to be separated from apocrine secretions. Lipids are the most common chemicals found in sebaceous secretions. Sebum contains about a percent wax ester. A fatty acid is present in this compound that has been esterified by fatty alcohol [24]. The sweat glands' perspiratory secretion, which is continuously accumulated through the pores onto the friction ridges of the hands, is composed of 98 percent or more water, with minute amounts or traces of potassium and sodium chlorides, lactic acid, albumin, carbohydrate, urea, fatty acids, sulphates, phosphates, carbonates, and possibly creatinine and creatine. This discharge, along with a little amount of sebum taken up by hand contact with hair-producing skin, forms the somewhat impermanent, latent picture from which a clearly apparent pattern is to be produced using two methods: physical and chemical [25].

Fingerprint composition helps to solve any crime	Method used	References
Eccrine sweat, fatty acids, and sterol compounds have all been found to include lipids. The apocrine gland is another secrete a mostly water-based secretion that also contains, essential amino acids. Lipids are the most common chemicals found in sebaceous secretions. Sebum contains about 20–25 percent wax esters.	Fingerprint sweat composition.	[24]
All secretion, along with a small amount of sebum picked up by touching hair-producing skin with the hands, forms the ephemeral, latent picture from which a clearly apparent pattern may be formed using two methods: physical and chemical.	Composition of fingerprint and its development by physical and chemical method	[25]

In This review study from (1937-2021) on fingerprint shows the analysis of fingerprint from different surfaces (porous, non-porous and semi- porous) and on burnt surfaces. Arson case study from 2009 to 2019.

**Effect of temperature or heat on the composition of sweat**

According to the study thermal effect on sweat composition also play an important role in the presence of fingerprint in arson or fraud cases. Since the heat of the hotter temperatures evaporates the oil and water in the fingerprints, fingerprints lifted from the cooler surface temperatures were clearer than those lifted from, the hotter temperatures.<sup>26–28</sup> Depending on the time of year, the proportion of recognized fingerprints formed by eccrine sweat deposits was comparable to that of sebaceous sweat deposits. The summer increase in the proportion of recognized eccrine sweat deposits was statistically

significant (p 0.0001) when compared to winter eccrine sweat deposits [29]. Fourier transform infrared micro spectroscopy allowed for authentic monitoring of changes in the Infrared spectra, exhibiting an increase in the O.H. stretch band (3250 absorption band) over 5 hours at all temperatures tested, confirming oxidation reaction. Unsaturated lipids extended their O.H. stretch band in the same way as latent fingerprints did, while saturated molecules did not.<sup>29</sup> sauna exposure(heat) reveals the production of greater Mg<sup>+</sup> and Ca<sup>3+</sup> from perspiration. Once again, the results are best explained in terms of active sweat composition modulation [31]. This study shows the amino acid, urea, oil, grease, salts all get degraded at some temperature when exposed to heat, and this examines by both destructive and non-destructive methods.

Fingerprints composition affected on burning, found in arson cases	Method used	References
Fingerprints lifted from the cooler surface temperatures were clearer than those lifted from, the hotter temperatures.	Semi- destructive method	[26]
Due to grease of sweat the age of exposed fingerprint can be known by quantity of grease presence. The image of fingerprint traces is analyzed using a video comparator.	Semi- destructive and non-destructive	[27]
Fingerprints from arson place found on non-porous surface cover with soots and smoke due to its residues.	Water method for soot removal Non-destructive method	[28]

Comparing with winter eccrine sweat deposits, the increase in the proportion of discernible eccrine sweat deposits throughout the summer was statistically significant (p 0.0001).	Semi- destructive method	[28]
Unsaturated lipids increased their O.H. stretch band in a similar way as the latent fingerprints. They increased in all high temperatures. Fourier-transform infrared micro-spectroscopy used for analysis.	Non-destructive	[29]
Sauna bathing produced perspiration with greater [Mg <sup>++</sup> ] and [Ca <sup>++</sup> ] content than exercise, but [Na <sup>+</sup> ], [K <sup>+</sup> ], and [Cl <sup>-</sup> ] levels were equal in all three experimental circumstances.	Thermal method (non-destructive)	[30]

### Development of fingerprints from different surfaces

According to this study, non-conventional powders for the home are readily accessible. They used these powders on a variety of nonporous and semi-porous surfaces to produce latent fingerprints. The fineness of the powder, its adhesive capabilities, and the pigmentation of the powder, which must contrast with the layer in order for fingerprints to be seen, all impact the production of a fingerprint. This procedure is completely non-toxic and environmentally safe [32, 33]. then, in this paper, we will discuss current breakthroughs in the field of latent fingerprint detection. The latest advances in processing methods, such as physical, chemical and optical procedures, as well as sophisticated instrumental analytical techniques, are used [34]. Fumigation with cyanoacrylate is well known, a chemical

method for detecting finger marks on surfaces like nonporous (glass and plastic). The method works by depositing polymerized cyanoacrylate ester on latent finger-mark residues. It is an effective, non-destructive, and good method for building latent memos [35]. The efficiency of a physical developer, 1,8-diazafluoren-9-1 (D.F.O.), and ninhydrin as enhancer reagents for finger marks on papers had been subjected to extreme heats. Superglue was shown to be the most effective boosting method at all temperatures except 200 degrees Celsius (392 °F), followed by BY40. Because the nonporous surface may become moist during firefighting operations. Silver vacuum deposition has been seen to form finger marks after being exposed to extreme heat [36, 37]. superglue followed with BY40 is also used for enhancement of latent prints found in fire cases.

Used of different method for enhancing the prints from different surfaces	Method	References
Non-conventional powders for the home are readily accessible. They used these powders to create latent finger-marks on a variety of semi-porous and nonporous surfaces.	The powder method (non-destructive)	[31]
The latent fingerprints on nine different substrates (transparency sheet, plastic sheet, simple paper, bond paper, thermal paper, wooden surface (sun mica), aluminum foil, painted steel, and top surface of CD) were deciphered using	Powder method (non-destructive)	[32]

<b>turmeric powder.</b>		
The latest advances in processing methods, such as optical, physical, and chemical procedures, as well as sophisticated instrumental analytical techniques, are used for fingerprint development.	Non-destructive, semi-destructive, destructive	[33]
Fumigation with cyanoacrylate is a well-known chemical method for detecting latent finger marks on surfaces like plastic and glass (nonporous)	Fuming method by superglue	[34]
Temperatures of 300, 450, and 600°C were used to deposit prints on rear view mirrors of vehicles. The temperature range was determined using two: a cremation oven and automobile burns. When compared to the other procedures, cyanoacrylate-BY40 and black magnetic powder yielded higher counts of discernible prints by enhancing.	Powder and fuming method(semi-destructive)	[35]
Superglue was found to be the most efficient enhancing strategy, followed by BY40. Because during firefighting, the nonporous surface may become wet. After being subjected to higher temperatures, silver vacuum deposition has been shown to generate fingerprints. Heat is radiated from the surface, and the air is directed downward.	Superglue for enhancing	[36]

Following some early success, more experiments were carried out employing dirt/greasy and latent markings on various items among the same sorts of fire chambers. Visible and latent fingerprints were recovered from the varieties of burnt surfaces (porous-non porous). fingerprint visualization was done with torches, fuming method and powder methods [38]. According to this study, after burning, thermal sheets become black, making it impossible to see fingerprints. The use of heat or steam to generate white fingerprints on darker backgrounds is one solution to this problem. The different chemical methods were also found useful for the enhancement of fingerprints. The focus of this research is on development using heat and steam [39]. The different chemical methods are used for the Visualisation of the fingerprint, but its enhancement on

paper is difficult where the different thermal methods are used.

According to research, Fire scenes can generate fingerprints if soot layers are removed before employing current fingerprinting procedures. After the dried latex was peeled and seen by ninhydrin, an experiment was done applying liquid latex to sooted surfaces to test its capacity to remove soot and generate fingerprints [40]. According to this study, Brushing, a 2 percent NaOH solution, and tape lifting were all used to remove the soot [41]. The goal of this study was to see if fingerprints could be formed after being exposed to an arson/fire scene simulation. High temperatures, soot deposition, and water treatment were applied to fingerprints on nonporous surfaces. When subjected to a maximum temperature of 800 degrees Celsius, a new fluorescent Zinc carbonate-based fluorescent tiny particle reagent

proved capable of producing latent fingerprints [42]. The most beneficial soot removal is Liquid Latex appears to be the most common method; however, there have been other variations. Depending on the circumstances of the situation, adjustments may be necessary. Up to a certain point, cyanoacrylate fuming is advantageous to nonporous objects appropriate up to 500°C exposure. Vacuum Metal Deposition is appropriate up to 900°C. Physical Developer and 30 Small Particle Reagent are both appropriate for items that have come into contact with water [43]. This literature examines the many approaches for recovering DNA and fingerprints from arson incidents. Recent advances in science and technology have resulted in the development of procedures to facilitate and

enhance the recovery of evidence that has been exposed to the harsh conditions of a fire and can be recovered after the soot and ash have been removed. Different soot removal procedures are used at the forefront of all fire investigations when evidence recovery is paramount in order to expose and improve D.N.A. and fingerprints by all standardized tests [44]. An Azo/CS/PVA film with a high humidity responsiveness allows it to collect perspiration in the fingertips, deform fast, and recover quickly after being removed from the fingers. Under UV, solar, and LED illumination, it also has good light response direction controllability [45]. the study shows that chitosan and P.V.A. were effective for fingerprint collection or recognition.

Fingerprint development from different arson cases surfaces.	Method used	References
Visible and Latent fingerprints (in grease, dirt, and blood) had been exposed to the fire conditions. And fingerprint visualization was done with torches, fuming method and powder methods.	Torches, fuming method and powder (Destructive and semi-destructive method)	[37]
1. The use of heat or steam to generate white fingerprints on darker backgrounds of thermal paper. 2. use acetone to remove the upper layer of thermal paper.	Heat or steam for development (Semi-destructive method)	[38]
The potential of liquid latex to remove soot and generate fingerprints after the dried latex was peeled was tested by applying it to sooted surfaces.	Semi-destructive method	[39]
Brushing, a 2 percent NaOH solution, and tape lifting were all used to remove the soot, some prints were visible, while another fuming is required.	Non-destructive and semi-destructive method	[40]
Fingerprints on different surfaces were exposed to extreme temperatures; soot deposition was removed subsequently with water. A fluorescent tiny particle reagent based on zinc carbonate proved capable of producing latent fingerprints.	Non-destructive method	[41]
Cyanoacrylate (superglue) fuming is advantageous to rough surfaces appropriate up to 500-degree Celsius exposure. Vacuum Deposition is appropriate up to 900-degree Celsius. Physical Developer are appropriate for surfaces that have come into the exposure of water. The most beneficial soot remover is Liquid Latex appears to be the most common method of removal.	Semi-destructive method	[42]
Different soot removal procedures are used at the forefront	Destructive, non-destructive	[43]

of all fire investigations when evidence recovery is paramount in order to expose and improve D.N.A. and fingerprints by standardized tests.	methods	
Fingerprint recognition by chemical or stabilizer which used in charred document	Method used	References
An Azo/CS/PVA film with a high humidity responsiveness allows it to collect perspiration in the fingertips, deform fast, and recover quickly after being removed from the fingers. Under UV, solar, and LED illumination, it also has good light response direction controllability.	Destructive method	[45]

**Arson cases**

This study is based on data from the government's official open-access crime statistics release. It looks into arson crimes in India from 2009 to 2018, with a focus on the last ten years. In order to better policing and criminological studies in diverse patterns identified via study, national crime statistics must be reviewed. From a peak of 11836 in 2012 to a low of 8505 in 2010, the number of cases recorded varied. Arson as

a violent crime decreased overall and had a varied long-term trend from 1995 to 2018. The Indian Penal Code's Sections 435, 436, and 438 were used to prosecute persons with offences. Arson crime rates were determined to be between 0.7 and 0.9 % of all Indian Penal Code offences recorded annually in the country, suggesting that these crimes account for 0.3 to 0.4 proportion of most Indian Penal Code charges [46, 47].

Arson case which relates to cases of charred doc. and fingerprints.	Method used	References
Examines arson offences in India from 2009 to 2018, with an emphasis on the last decade. Arson crime rates were found to be between 0.7 and 0.9 percent of all I.P.C. offences reported in the country on an annual basis.	Case report	[46]
A senior fire officer said the fire started on the second level of the Delhi Commission for Women's headquarters (D.C.W.)." And fire burned the important papers.	Case study	[47]

This review study from (2016-2022) on non-destructive method video spectral comparator of different version shows its use in question document, biological and fingerprint visualization

**A non-destructive method for question document VSC**

The study's goal was to see how well non-destructive procedures, such as VSC and M.S.P. used in question document,

Ballpoint pen ink, which is often used in Indian question documents and fraud cases, might be distinguished using methods such as the Video-spectral-comparator technique and Micro-spectrophotometer. We looked at the most popular pens in India (Parker, and Reynolds, Cello griper, Lexis 2 kinds and locally manufactured pens) for overwriting, alteration, and modification of ballpoint pen ink [48-50]. A important part

of a forensic investigation is determining whether a stain recovered from a crime scene is blood or not. The purpose of this pilot research is to encourage the use of the Video Spectral Comparator as a non-destructive preliminary method for analysing the staining in question. The approach is based on the unique spectral features of blood and is not definitive. The findings were based on 25 healthy people participants' samples of blood taken on nonporous and porous surfaces, as well as

waste animal blood samples [51]. This shows that the non-destructive method using VSC is not only used in question documents is also used for the examination of stains (biology studies.) Using multiple light sources, the Video Spectral Comparator was utilized to examine both writing and latent fingerprints on burnt sheets [52]. it reveals from a study that VSC can also be used for chance print visualization.

Non-destructive method used for question document, biological studies and fingerprint examination	Method used	References
A document examiner can use the VSC2000 to assess inks, discover hidden security features, and detect document alterations. The VSC2000 allows users to customize filter and light combinations at the touch of a button.	Non-destructive method	[48]
Ink analysis was used on the different pieces of paper by VSC (real (2011)) and Songer (2014)). The VSC equipment, according to Chourasiya.et. al. (2017), may be used to check papers for deterioration and inks.	VSC (Non-destructive) method	[49]
The VSC technique and Micro spectrophotometer were able to differentiate ballpoint pen ink used in Indian fraud.	VSC and MS (Non-destructive method)	[50]
The (VSC) Video Spectral Comparator is a non-destructive preliminary method for analysing stains from porous and nonporous substrates.	Non-destructive method	[51]
Under infrared light of VSC fingerprint on charred document are visualised.	VSC (Non-destructive method)	[52]

## CONCLUSION

The present review demonstrates the enhancement of latent fingerprints from charred documents. Charred documents are one of the vital pieces of evidence found in cases like fraud, arson, white-collar crimes and forgery. Charred documents contain important information which might help the investigator to link the culprit. These documents are very difficult in collection, preservation, decipherment and

visualization. Documents become fragile after burning, so damaging becomes one of the consequences for the examiner to overcome. The deciphering method depends mostly on paper type and pen composition or its type. Any impression on charred document firstly it's stabilized by which it gets strength, then the collection is done by a different method, and further decipherment method comes up with new technologies from destructive(chemical) to

the non-destructive (instrumental) method. Here, fingerprints are evidence which normally found at any crime scene. Its pre hypothesis is based on traces of evidence which are mostly seen on any surface. Fingerprint contains sweat glands which makes a latent print to be visualized by physical or chemical method. Fingerprint from arson cases nonporous or semi-porous surfaces can be developed by soot removal method, lift method or by a physical and chemical method. where PVA (polyvinyl acetate), which is used as a stabilizer in the charred documents, can also use for fingerprint development by reacting with chitosan and PVA. An Instrumental method used for question document examination like video spectral comparators is also used for stain detection and fingerprint visualization from burnt surfaces found from crime scene. Hence, a more advanced method should be developed to relate the charred document to chance prints, as prints are easy to find evidence of in any case.

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