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A STUDY ON INDENTED HANDWRITING THROUGH ESDA TECHNIQUE

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Abstract
In addition to other types of microscopes such as magnifying lenses, compound microscopes, stereo microscopes, and comparison microscopes that are utilised for document examination. Some equipment, such as the Electrostatic Detection Apparatus (ESDA), It also employed for document analysis. These tools and technique are only used for intended document analysis. ESDA is a forensic instrument that identifies indented script on paper.
An ESDA (electrostatic detecting device) is a powerful technology used to decode depressions or imprints in sheets during disputed paper testing. It is a non-destructive technique. It is a sensitive approach that may detect indentations, impressions, or subsurface patterns created on sheets many levels under the uppermost sheet. It is also sensitive to old handwriting, resulting in indentations. It is a technique for displaying indented text, which may be found during disputed content examination in the event of scribbled notes and abduction letters. In this research focuses on the ESDA technique to developed indented handwriting and also focuses on the study of pen pressure through ESDA technique.
Key words: ESDA, Indented writing, Indentation, Toner, Impression.

Indented writing

It is sometimes referred to as second-page writing. It is the script tool's imprint on sheets of paper, one of which contains the original script. This is typical when utilizing pads of sheet or in other record-keeping situations. When health and other records are accused of being tampered with, tented writing can be utilised to identify persons in anonymous note situations and can be a valuable investigative tool. An imprint conveyed to the pages below commonly reveals a textual addition to a file or folder. Following pages' indented text may vary from what shows on the document's surface. (*Indented Writing*, 2021).
Indented text recovered and preserved from previous pages can frequently suggest text it's out of position, missing, or added after the event. We've all actually read mystery novels or watched TV and movie plots in which the recovery of indented text serves as a clue. To "interpret" indented writing from suspect pages, the media rubbed delicate lead pencils or paper over the document's surface. The indentations would be seen in relief. (*What Is Meant by Indentation?*, 2017)
Although humorous, the possibility that this method may be used to taint or delete possibly vital evidence must serve as a warning against amateur examinations. Indented writing is often recovered using one of 2 techniques: photographic images using an oblique (glancing) light source or

utilizing ESDA, which refers to the Electro-Static Detection Apparatus.

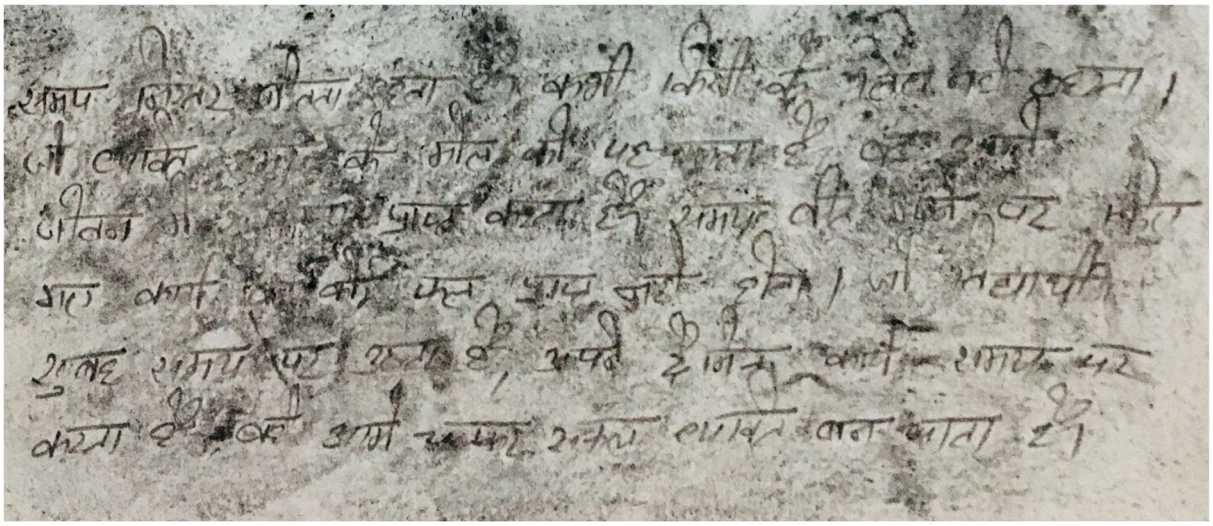

Figure 1 indented handwriting

In many languages, an indentation or indent is an empty space at the beginning of a line that indicates the beginning of a new paragraph. This concept has been used by several computer languages to indicate "paragraphs" or other logical chunks in the programme. "Indentation" refers to the "space" within a document between the "text" and the "left or right margin." In MS Word, there are "four sorts" of indents: The space between the "paragraph" and the "left margin" is shown by a left indent. Right indent: shows that there is space between the "paragraph" and the "right margin." First line indent: used to indicate the "first line" of a paragraph. Hanging indent: used to determine the location of the paragraph's text lines "below the initial line"(*What Is Meant by Indentation?*, 2017). ESDA is an abbreviation for Electrostatic Detection Apparatus.

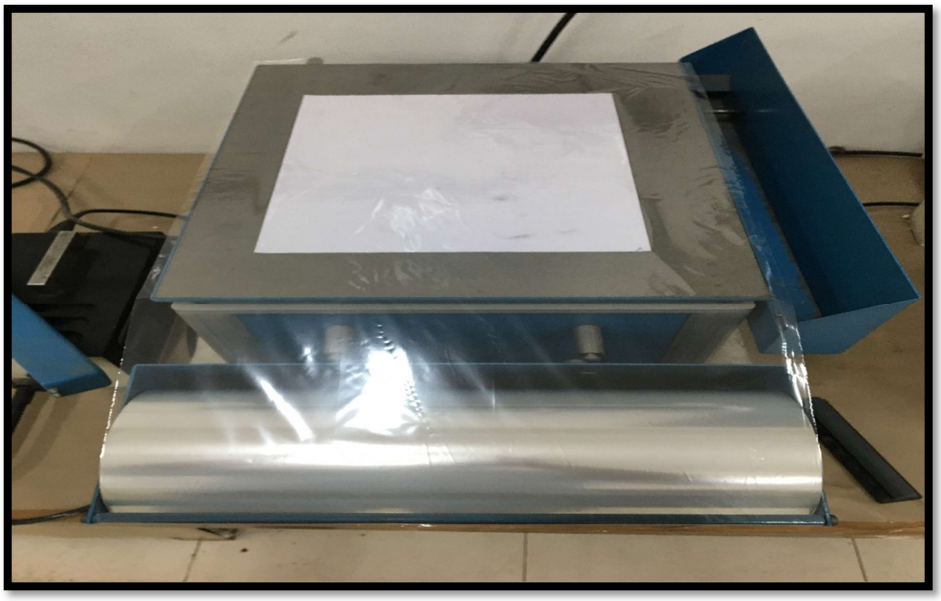

Figure 2 ESDA Instrument

It is a tool used in the inspection of questioned documents to expose any indentations or imprints that may be present on paper. Foster and Freeman manufactured ESDA. It is a sensitive technology that

can detect indentations on paper. ESDA stands for Electro-Static Detection Apparatus. This apparatus is used to produce a durable 'lift' from sheet, results in a visual map of indented impressions in that paper. It is quite sensitive, therefore indentations up to 7 sheets underneath the original written page may be visible.

Rather Seward offered a hypothesis in 1998 and 1999 to explain the detecting capabilities of an Electrostatic Detection Device (EDD) due to the surface charge effect caused by paper-to-paper friction, particularly if a writing tool is forced down into the topmost sheet of paper. Seward's concept, known as the charge transport model, is based on charge transfer via the Mylar-paper-platen system.

This technology is based on the premise that the paper sandwiched between a grounded platen and a Mylar charging film acts as a capacitor, with the capacitance changing depending to the different compression of the paper. This resulted in theories such as "Thickness Variation Theory" and "Surface Variation Theory."

A document is a set of knowledge or evidence that is written or printed and acts as an official document. Questioned Documents is one which bears a signature, handwriting, letterpress printing, or other indications whose authenticity or legality is in doubt. Indentations are generated when two or more pieces of paper are stacked on top of one another while writing. The underlying pages contain the hidden impression that ESDA is capable of developing. Construction The ESDA machine consists of a thin foundation upon which paper is to be kept, a cellophane, that is a polyethylene film fixed on the paper by a suction, a static electricity device, and a toner (*Introduction to Questioned Document*, 2022).

The toner is similar to the one used in electrically photographic printing machines. Principle. The ESDA works on the assumption that indented regions of paper have a lower negatively charged than nearby areas. This draws the toner used in the Electrostatic Detection Device to these areas, revealing any indentations. Using this method, indented impressions have been recovered from up to 7 sheets of material beneath the original text. Imprint from papers as old as sixty years may be clearly seen. The ESDA method detects and records hidden writing impressions on paper's surface (Horan & Horan, 1988).

Almost any substance, including conductors, may be charged triboelectrically. Type of material, touch and separating velocity, moisture, and a range of other characteristics all influence the amount of charge. So because surface charges differ based on whether or not valley is present, the EDD can detect indentations. Toner particles with opposing charges are attracted to creases on the surface. (*Secondary Impressions of Writing Detected by ESDA - ScienceDirect*, n.d.).

The ESDA method involves spreading a Mylar film (equivalent to Plastic wrap) all across sheet to be examined. After that, the Mylar film is electrostatically charged using a "bow". (a large thin rod containing a small electrical wire charged to 7 kV). When the material is smooth, the charge is usually constant. The electrostatic charge differs from the backgrounds where the paper fibres have been broken by indentation-induced paper-paper contact. This leads to the creation of a latent image. To observe this four-dimensional image, black tone akin to those used in printers is applied to the Cellophane surface. When electrostatic charge builds, toner attaches (i.e. in the surface of indentations) (*Secondary Impressions of Writing Detected by ESDA - ScienceDirect*, n.d.).

As a consequence, the picture has a greyish toner background with black toner traces in indented impression zones. By placing a translucent "sticky coated film" over the toner, the image is permanently affixed as a "lift." Toner may be sprayed to the Mylar sheet in three ways: by cascade tiny glass beads filled with toner and over area, by blowing a spray of toner powders and over surface, or by using a device akin to a makeup brush. A variety of factors impact the efficiency of ESDA lifts.

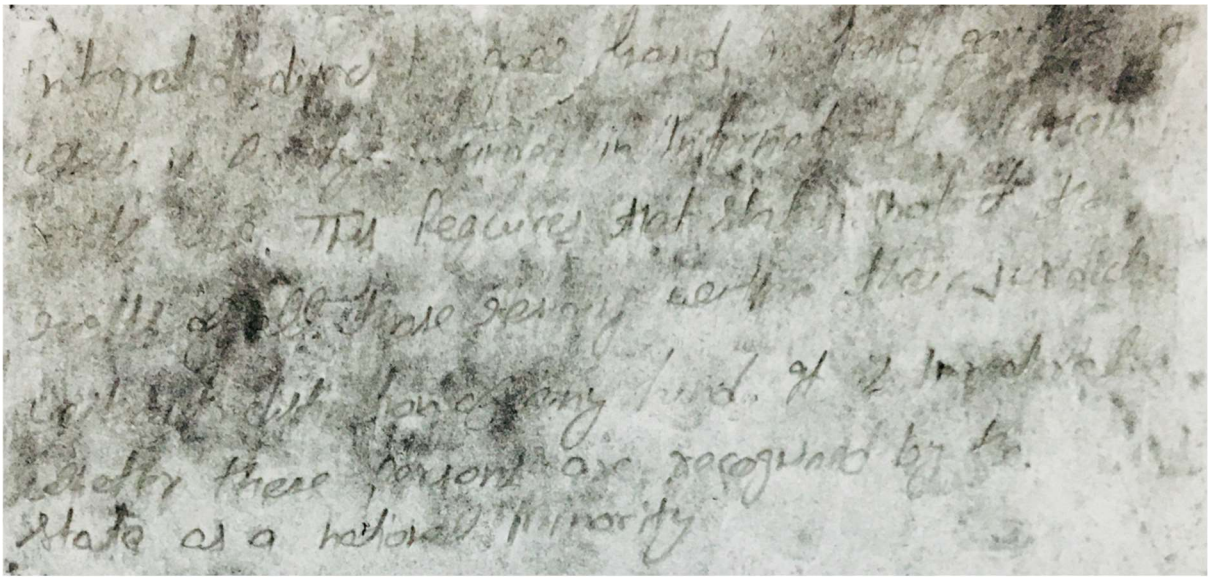

Figure 3 Illustration of developed indented English writings

The type of material or paper used, the pen or pencil used, the quantity of pieces of paper between both the text and the page holding the impressions, and the moisture at the moment of imprints are all factors. The sheet placed between the grounding plates and the Mylar charges sheet acts as a capacitor, with the charges in capacitance induced by the various compensation of the paper. The suspect indented page is wrapped in polythene, which is then pressed against the material by a vacuum generated by a porous metal frame. This is used to keep the paper and its cellophane covering in place on the plate. The original document is protected by the cellophane covering. Following that, the paper and cellophane are continuously charged with large electrical static electricity.

ESDA is being used to display forgeries that have been traced. A disputed paper, such as a ransom note, might be established as the origin of the indentation seen on some other piece of sheet. When a second letter is not accessible or cannot be discovered, decipherable indentations can provide important information. Documents with no clear identifying marks may give critical impressions evidence if they were below other papers when they were written.

Among the advantages are Because ESDA is non-destructive, the paper under scrutiny remains in its original state and is still available for additional study. Because it is extremely sensitive, indentations can be visible up to 7 pages below the sheet where the original writing was made. One disadvantage is It is not suitable for studying loose material such as newspaper or glossy paper including such magazine covers. Any fluid that comes into touch with a piece of paper will completely erase the ESDA impressions.

Noblett, M., "Optimum Conditions for Document Examination To use an ESDA (Electrostatic Detection Apparatus) Device to Visualize Indented Writings" (1982). As per this research, preconditioning a piece of paper in a moisture chamber set to 40 to 60% provided the most data from

indented handwriting. It also suggested that the use of aerosol toner provided more information than the use of cascade toner. This study also discovered that employing an electrostatic detecting device (ESDA) to examine indented writing had no detrimental influence on later latent fingerprint creation. " Steven J. Strach says, "ESDA identifies secondary writing impressions" (1995). Experiments have been conducted that show conclusively that, in certain circumstances, "imprints of text" may be identified by ESDA (Electro - static Detection- Apparatus) on sheet that has comes in contact with reverse of paper with heavily embossed writing. Such indirect "secondary" impressions are caused by the laterally relative movement of the two sheets of paper. Secondary impressions are frequently distinguished from normal main impressions (formed by the "process of writing") by a variety of characteristics, the most notable of which being the second impression pictures' hazy, fragmentary, and, at times, scattered look (Strach et al., 1995).

Some Factors Affecting the Accuracy of ESDA Results," Riebeling, 1993. The effect of moisture on ESDA photos was thoroughly investigated. The findings demonstrated that the accuracy of the ESDA images produced is dictated not by moisture content of the material at the moment of an indentation, but by variations in the moisture content which may arise between both the creases and the sheet being examined with the ESDA. A technique for making standard impressions was devised to evaluate the effect of water content on the quality of the image generated by the ESDA. This method is now used to ensure the quality of ESDA examinations (*Some Parameters Affecting the Quality of ESDA Results*, 1994).

"How far may an ESDA image be kept once it has been written?" ESDA has been used as a development technique for many years, according to George J. Horanin (1988). It is a valuable tool for document investigators since it generates indented images on paper. The paper discusses the outcomes of study using various date paper to establish how long may images be made with ESDA after writing? According to the research, the latent picture of some writings can survive for further than fifty years. Furthermore, the article describes a real-life situation in which images were made decades after the paper was completed, therefore dating the development of critical sections.

N.NicDaéidin, "Examining the effects of paper kind, pen category, writing force, and degree of the junction on white & dark dominance in ESDA imprints of sequenced strokes" (2008). An illustration of the probability value in action. Forensic work using questioned papers may necessitate impression sequencing on occasion. Although examining ESDA trace of junctions may offer some results, there is currently no system in place to measure the intensity of the observations obtained in any one event. Using a range of paper and pen types, this study analyses junction points and statistically evaluates the data to evaluate the value of the findings obtained. (Daéid et al., 2008).

"Preserving electrostatic detecting apparatus (ESDA) photos," Om Prakash Jasujain (1991). A fresh approach. ESDA pictures are traditionally created on insulating polymer film and retained by covering them with protective, clear adhesive tape and/or photographically documenting the image. The current research looks at a simple approach for fixing or "fusing" ESDA pictures on polymer film to create a permanent record. The quality of this ESDA picture appears to be stable throughout time(*Preserving ESDA Images*, 1991).

Moore, D. (1998) The Impact of the ESDA (Electrostatic Detection Apparatus) on Hidden Prints on Paper for than a decade, document examiners have used the ESDA (electrostatic detection

apparatus) to identify and observe indentations on paper. However, many of the identical documents that go through the ESDA procedure may include latent print information that is vital to the effective defence of a case. As a corollary, both the disputed document analyst and the hidden print scientist have a genuine interest in paper evidence preservation. It is well knowledge and understanding that preparing a paper document with ninhydrin for latent prints can successfully eliminate any indentations.

The goal of this study was to determine whether the ESDA method had any detrimental impacts on hidden imprints on paper records. Four distinct elements were adjusted and evaluated throughout the testing phase. The findings are addressed, as are the activities that may be necessary to adequately secure both hidden imprint and indent evidence.

Applications of ESDA (Electrostatic Detection Apparatus)

Examination of a Questioned Document

Check Forgery-: In this type of forgery, the danger of a cheque book falling into the hands of bad persons exists. The individual might counterfeit the signature on the check and extract the funds. In this situation, we can inspect the second cheque for any indentations.

Traced Forgery-: Traced forging is accomplished by tracing the signature or handwriting that has been impressed on the second sheet. To counterfeit someone's signature or handwriting, the forger will follow the pattern of indentation of signature or handwriting. In this situation, ESDA can be used to decode the detected forgeries.

Note of Ransom: - The existence of the indentations can be determined by interpreting them on another piece of paper (the culprit's notebook) if written.

Anonymous letter: - It may contain impressions of writings relating to the offender's daily activities, which might eventually lead an investigator to a specific suspect.

Conclusion:

ESDA is a dominant technique to identify Indented handwriting without disturbing the sample and its surface. Its specifically charge the indented area with electrostatic road and with the help of Mylar film and black toner developed the indented handwriting. This technique mainly depends on the pen pressure that is apply while writing. If the sufficient pressure is not applying while writing it is impossible to developed handwriting. Many researches show that the indented handwriting very helpful to study the different pen pressure across the indented surface. But some researcher found that the very deep indentation failed to developed charge on surface, due to this those surface areas cannot have developed the indented handwriting. Now from the previous study we can say that ESDA is useful to developed indented handwriting but fail to determine pen pressure.

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