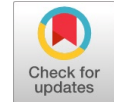


# Determining the Probability of Recovering Data from Damaged USB Flash Drive



Kalpna Shinde, Vini Kale, C.N.Kayte, Shobha Bawiskar

**Abstract:** Habit of storing digital data is becoming a common practice. To cope this need lots off secondary memory devices are commercially available in cheap prices. Important factor is significance of data, its dependability in human daily life. Hence looking at this scenario the cyber crime rates are at hike. Mostly after committing the crime intentionally or unintentionally criminals try to destroy the digital evidence by doing damage to e- device. Basic aim is to check whether damaged secondary can recover the data or not. For this purpose various damaged setup are done and by using software’s results are analyzed.

**Keywords:** Pen Drive(PD), Pen Drive Models, Data Recovery , Damaged PD

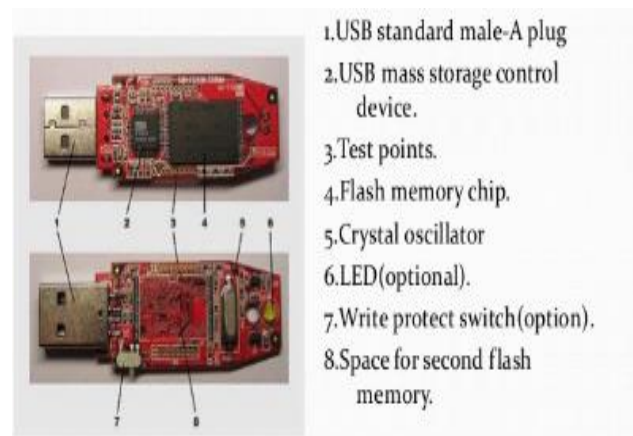
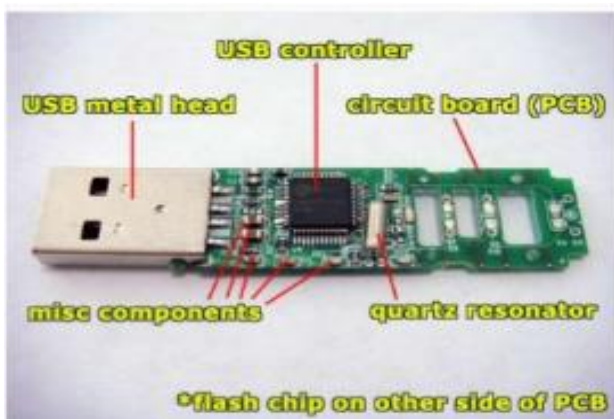
## I. INTRODUCTION

Secondary storage media are widely used as it is portable, small/micro in size, light weighted and easily carried from one place to another, Consumes less power compared to other devices.[21] Universal USB, less expensive. . The USB which stands for Universal Serial Bus is already a

customary in business for attaching peripheral devices to different types of computer [17, 18]. In this article A pen drive, or a USB flash drive is used for digital investigation. In market currently available pen drives with storage capacities ranging from 4GB and 32GB, 64 GB,... can be used to store multimedia content like graphics-heavy documents, photos, music files and video clips of various file formats. [19, 20,]As of March 2016, flash drives with anywhere from 8 to 256 GB were frequently sold, while 512 GB and 1 TB units were less frequent [13,14].As of 2018, 2TB flash drives were the largest available in terms of storage capacity.[15]. The extensive market for USB flash drives which is projected to exceed 555 million units by the year 2020 had shown the increasing importance of the technology in consumer applications [16]

## II. PEN DRIVE

Design and implementation1. USB standard male-A plug 2.USB mass storage control device. 3. Test points. 4. Flash memory chip. 5. Crystal oscillator 6.LED (optional). 7. Write protect switch (option). 8. Space for second flash memory[22,23]



Manuscript published on 30 July 2019.

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## I. PEN DRIVE MODELS:

Now a day’s storage devices, recording devices, spy camera are present in disguised manner. It’s just unbelievable that such devices exists can be used for or against any persons either to save or destroy human property.(may be tangible or intangible). Cyber Crime is technology based crime committed by technocrats.[12]





## Determining the Probability of Recovering Data from Damaged USB Flash Drive

As this research article is focused on pen drives few disguised pen drive models are shown below.

<p><a href="https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=s9yIXMGYD9q7rQHTtrnABw&amp;q=images+of+smart+toy+pen+drive+&amp;oq=images+of+smart+toy+pen+drive+&amp;gs_l=img.3...9508.9508..10000...0.0..0.148.148.0j1.....0....1..gws-wiz-img.IOMhl-e9HT8#imgrc=4e9pT38M_LYKGM:[5]">https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=s9yIXMGYD9q7rQHTtrnABw&amp;q=images+of+smart+toy+pen+drive+&amp;oq=images+of+smart+toy+pen+drive+&amp;gs_l=img.3...9508.9508..10000...0.0..0.148.148.0j1.....0....1..gws-wiz-img.IOMhl-e9HT8#imgrc=4e9pT38M_LYKGM:[5]</a></p>	<p><a href="https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3..11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-img.RNbWXgRt-eI#imgrc=vW9w3N0V6az4CM:[6]">https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3..11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-img.RNbWXgRt-eI#imgrc=vW9w3N0V6az4CM:[6]</a></p>	<p><a href="https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3...4164.4164..4496...0.0..0.0.0.....0....1..gws-wiz-img.GpD7xMICc2E#imgrc=uGg_4WVwMi_R1M:[7]">https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3...4164.4164..4496...0.0..0.0.0.....0....1..gws-wiz-img.GpD7xMICc2E#imgrc=uGg_4WVwMi_R1M:[7]</a></p>	<p><a href="https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3...11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-img.RNbWXgRt-eI#imgrc=vW9w3N0V6az4CM:[8]">https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3...11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-img.RNbWXgRt-eI#imgrc=vW9w3N0V6az4CM:[8]</a></p>	<p><a href="https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3...4164.4164..4496...0.0..0.0.0.....0....1..gws-wiz-img.GpD7xMICc2E#imgrc=_2MGQbESmY_QvM:[9]">https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=Z9eIXKuIGZa9rQHw7eABA&amp;q=images+of+smart+toy+pen+drive++bracelets&amp;oq=images+of+smart+toy+pen+drive++bracelets&amp;gs_l=img.3...4164.4164..4496...0.0..0.0.0.....0....1..gws-wiz-img.GpD7xMICc2E#imgrc=_2MGQbESmY_QvM:[9]</a></p>	<p><a href="https://www.wantitall.co.za/pchardware/8gb-usb2-0-memory-stick-creative-metal-wrench-usb-flash-drive-kepmem-funny-gift-pen-drive__b06xv88cj7[10]">https://www.wantitall.co.za/pchardware/8gb-usb2-0-memory-stick-creative-metal-wrench-usb-flash-drive-kepmem-funny-gift-pen-drive__b06xv88cj7[10]</a></p>
					
<p><b>Credit card style memory flash USB drive</b></p>	<p><b>High Quality Usb Flash Drive Real Capacity Pen Drive 16GB-128GB</b></p>	<p><b>China USB Flash Drive Cartoon Boy Toy Pen Drive Building Blocks Pendrive 4GB 8GB 16GB 32GB 64GB</b></p>	<p><b>Usb Bracelets</b></p>	<p><b>16gb car model usb 2.0 flash drive memory smart design storage u ...</b></p>	<p><b>8GB USB2.0 Memory Stick-Creative Metal Wrench USB Flash</b></p>

<p>https://subusb.com/</p>	<p>https://subusb.com/</p>	<p>https://subusb.com/</p>	<p>https://subusb.com/</p>	<p>https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=d-KIXP2NGciU9QOnh6gg&amp;q=images+of+funny++pen+drive&amp;oq=images+of+funny++pen+drive&amp;gs_l=img.3..012.8681.11251..11932...0.0..0.1648.2511.0j1j1j0j1j8-1.....0....1.gws-wiz-img.Rvz7Hb-IbVs#imgrc=BsSkwoUzaKpOnM:</p>	<p>https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&amp;biw=1200&amp;bih=733&amp;tbm=isch&amp;sa=1&amp;ei=d-KIXP2NGciU9QOnh6gg&amp;q=images+of+funny++pen+drive&amp;oq=images+of+funny++pen+drive&amp;gs_l=img.3..012.8681.11251..11932...0.0..0.1648.2511.0j1j1j0j1j8-1.....0....1.gws-wiz-img.Rvz7Hb-IbVs#imgdii=QhazkcvlnJunM:&amp;imgrc=gggpmMJRY5t7YvM:</p>
					
<p>4-1 pen drive</p>	<p>Diary pen drives</p>	<p>Fancy Heart shape pen drive</p>	<p>Wooden USB pen drive</p>	<p>IRTI - funny picture #8035 - tags: usb te</p>	<p>Funny And Cool USB Sticks</p>
					
<p>Credit card style memory flash USB drive</p>	<p>High Quality Usb Flash Drive Real Capacity Pen Drive 16GB~128GB</p>	<p>China USB Flash Drive Cartoon Boy Toy Pen Drive Building Blocks Pendrive 4GB 8GB 16GB 32GB 64GB</p>	<p>Usb Bracelets</p>	<p>16gb car model usb 2.0 flash drive memory smart design storage u ...</p>	<p>8GB USB2.0 Memory Stick-Creative Metal Wrench USB Flash</p>

## Determining the Probability of Recovering Data from Damaged USB Flash Drive

					
4-1 pen drive	Diary pen drives	Fancy Heart shape pen drive	Wooden USB pen drive	IRTI - funny picture #8035 - tags: usb te	Funny And Cool USB Sticks

Data loss, data deletion, device formatting or physical damage to PD may be accidentally or unintentionally happen. In this scenario role of data is important. Hence data recovery can be possible in above mentioned criteria's. this article majorly deals with physically damaging PD and then check for data recovery possibilities.

### A. Data Recovery

The information remaining on the storage can be recovered to a safe location. Recovery chances depend greatly on the specific data loss situation Data recovery software serves to get data back after its loss with the maximum result possible. Commonly, data recovery process is based on storage scan to find specific information (deleted files, lost file systems) and assemble structures of the damaged file system.

The process of retrieving and handling the data from damaged, failed, corrupted or inaccessible secondary storage device when it is unable to access it normally is known as file recovery process.[11]

### B. Recovery data process is done in three steps:

1. Recovery Software first detects the device PD
2. Scan the device (select either 2.1 or 2.2)
3. for this article 2.2 is selected  
2.1 Quick Scan - Searches for deleted files and folders using a basic algorithm for fast results.  
2.2 Deep Scan - Scans the storage device sector by sector to ensure recovery results.
4. Recover the data can be F= Fully recovered ,P=partially Recovered, NO=No Recovery..3.1Preview all files available for recovery.3.2 Choose what you want to recover to avoid unnecessary recovery.

### IV. EXPERIMENT:-

A. **Data Sample:** Multimedia content of one GB (1-GB data) with Maximum types of file extensions are collected as data sample.

B. **Device used:** 25 SanDisk's Cruzer Blade™ USB Flash Drive of 16 GB (PD).

### 2.1 Method 1: Buried in Mud Method

Sample No	Mud	Time Factor	Detectable	Recovery possibility
Sample 1	Dry	1hr	yes	yes
Sample 2	Dry	1-day= 24hrs	yes	yes
Sample 3	Semi wet	1hr	yes	yes
Sample 4	Semi Wet	5hrs	yes	yes
Sample 5	Liquid muddy	7-days=168 hrs	yes	yes

### 2.2 Method 2: Use of aqueous media like Water,

Sample No	Water amount	Water Type	Environment temperature min approximately	Time depth Factor	Detecte d	Recovery possibility
Sample 1	4 ltr in bucket	Normal Water	6-8	1 hr	yes	yes
Sample 2	4 ltr in bucket	Normal Water	8-11	12 hrs	yes	yes
Sample 3	500 ml in bottle	Drainage Water	8-14	12 hrs	yes	yes
Sample 4	500 ml in beaker	Hot 50 continuously boiled Water	11-14	1 hr	yes	yes
Sample 5	500 ml in beaker	Hot 100 continuously boiled Water	11-14	1 hr	No	No

### 2.3 Method 3: Heating Method

Sample No	Heating equipment used	Temperature in Celsius	Time Factor	Detectable	Recovery possibility
Sample 1	Hot Oven Method	50	1 hr	yes	yes
Sample 2	Hot Oven Method	80	1 hr	yes	yes
Sample 3	Hot Oven Method	160	1 hr	yes	yes
Sample 4	Bunsen Burner	heated	05 sec	yes	yes
Sample 5	Bunsen Burner	heated	60 min	Yes/no	no

### 2.4 Method 4: Freezing Method

Sample No	Freezer Temperature in degree Celsius	Time Factor	Detectable	Recovery possibility
Sample 1	-20	1	yes	yes
Sample 2	-20	24	yes	yes
Sample 3	-20	48	yes	yes
Sample 4	-20	72	yes	yes
Sample 5	-20	96	yes	yes

2.5 Method 5: Scratching Method

Sample No	No of Scratches with I-pin	Detectable	Recovery possibility
Sample 1	100	yes	yes
Sample 2	150	yes	yes
Sample 3	200	yes	yes
Sample 4	250	yes	yes
Sample 5	500	no	no

Observation

Method: Water Deep Method

	No of samples	Type s of files in	No. files before recover	Scanning status	No files after recover	Noise And type of noise & Reason of noise	Data loss	Time required for deep scanning	Type of recovery F/P/NO recovery	Recovered Data
<b>Recuva[1]</b>	1 HR in clean water	Webp, dll, exe, m4a, mp3, jpg, png, pptx, docx, pdf, mkv, mp4	269	Successful	300	Types of noise: Wed, To, TED, OY, OUT, CESa, ITH, IO N, ING, ILE, IA, I<, HFA, H<(E, H<, Fix, File, EAD, ATE, AT A, AND, AFL, %f', s", SD  Reason: due to damaged PD noise get added.	N	2.40 HR	F	33GB
	12 HR in clean water		269	Successful	300		N	1.25HR	F	33GB
	12 HR dirty water		269	Successful	300		N	2.10HR	F	33GB
	1.15 HR in water at 60 degree		269	Successful	299		N	1.5 HR	F	33GB
	1 HR boiling water	269	<b>NOT DETECTED</b>						N	00
<b>7datarec[2]</b>	1 HR in clean water	Webp, dll, exe, m4a, mp3, jpg, png, pptx, docx, pdf, mkv, mp4	269	Successful	505	Repeated data get recovered.  Noise:#.OUT file	No	2.15 HR	F	1.70GB
	12 HR in clean water		269	Successful	505		No	1.56 HR	F	1.70GB
	12 HR dirty water		269	Successful	505		No	2.16HR	F	1.70GB
	1.15 HR in water at 60 degree		269	Successful	500		No	2.45 HR	F	1.70GB
	1 HR boiling water	269	<b>NOT DETECTED</b>						N	00
<b>Photorec</b>	1 HR in clean water		269	Successful	274		No	1.67 HRS	F	997MB

<b>ec[3]</b>	12 HR in clean water	Webp, dll, exe, m4a, mp3, jpg, png, pptx, docx, pdf, mkv, mp4	269	Successful	274	NO noise observed.	No	1.30 HRS	F	997MB
	12 HR dirty water		269	Successful	274		No	1.55 HRS	F	997MB
	1.15 HR in water at 60 degree		269	Successful	274		No	1.57 HRS	F	997MB
	1 HR boiling water		269	<b>NOT DETECTED</b>				N	00	
<b>Stellar [4]</b>	1 HR in clean water	Webp, dll, exe, m4a, mp3, jpg, png, pptx, docx, pdf, mkv, mp4	269	Successful	270	-----	No	2.58 hrs	F	1GB
	12 HR in clean water		269	Successful	270	No	1.45 hrs	F	1GB	
	12 HR dirty water		269	Successful	270	No	3.15 hrs	F	1GB	
	1.15 HR in water at 60 degree		269	Successful	270	No	2.45 hrs	F	1GB	
	1 HR boiling water		269	<b>NOT DETECTED</b>				N	00	

**Method: Buried Method**

	No of samples	Types of files in	No files before recover	Scanning status	No files after recover	Noise And type of noise & Reason of noise	Data loss	Time required for deep scanning	Type of recovery F/P/NO recovery	Recovered Data
<b>recuva</b>	1 HR Land	Webp, dll, exe, m4a, mp3, jpg, png, pptx, docx, pdf, mkv, mp4	269	Successful	303	Types of noise: Wed, To, TED, OY, OUT, CESa, ITH, ION, ING, ILE, IA, I<, HFA, H<(E, H<, Fix, File, EAD, AT E, ATA, AND, AFL, %P, s, SD  Reason: due to damaged PD noise get added.	No	2.54hr	F	33GB
	24 Land		269	Successful	300		No	1.45 hrs	F	33GB
	1 HR Mud		269	Successful	300		No	1.43 hrs	F	33GB
	5 HR mud		269	Successful	300		No	1.43 hrs	F	33GB
	25 HR mud		269	Successful	287		No	1.45 hrs	F	29.5GB
<b>7datarcc</b>	1 HR Land	Webp,	269	Successful	505	Repeated data get recovered.	No	2.10 hrs	F	1.70GB
	24 Land		269	Successful	505		No	1,56 hrs	F	1.70GB

### Determining the Probability of Recovering Data from Damaged USB Flash Drive

	1 HR Mud	dll,exe ,m4a,	269	Successful	500	Noise:#.OUT file	No	2.19 hrs	F	1.70GB
	5 HR mud	mp3,j pg,png	269	Successful	500		No	2.hrs	F	1.70GB
	25 HR mud	.pptx,d ocs,pd f,mkv, mp4	269	Successful	500		No	2.40 hrs	F	1.70GB
<b>photorec</b>	1 HR Land	Webp, dll,exe ,m4a, mp3,j pg,png .pptx,d ocs,pd f,mkv, mp4	269	Successful	274	----- -----	No	1.56 hrs	F	997MB
	24 Land		269	Successful	274		No	1.50 hrs	F	997MB
	1 HR Mud		269	Successful	274		No	1.57 hrs	F	997MB
	5 HR mud		269	Successful	274		No	2.14 hrs	F	997MB
	25 HR mud		269	Successful	274		No	1.45 hrs	F	997MB
<b>Stellar</b>	1 HR Land	Webp, dll,exe ,m4a, mp3,j pg,png .pptx,d ocs,pd f,mkv, mp4	269	Successful	270	----- -	No	2.16 hrs	F	1.0 GB
	24 Land		269	Successful	270		No	2.15 hrs	F	1.0 GB
	1 HR Mud		269	Successful	270		No	2.30 hrs	F	1.0 GB
	5 HR mud		269	Successful	272		No	1.58 hrs	F	1.0 GB
	25 HR mud		269	Successful	270		No	2.10 hrs	F	1.0 GB

#### Method: Heating method

	.No of samples	Types of files in	No files before recover	Scanning status	No files after recover	Noise And type of noise & Reason of noise	Data loss	Time required for deep scanning	Type of recovery F/P/NO recovery	Recovered Data
<b>recuva</b>	At 80 degree in hot air oven	Webp, dll,exe ,m4a, mp3,j pg,png .pptx,d ocs,pd f,mkv, mp4	269	Successful	288	Types of noise: Wed,To,TED,OY,OUT,CESa,ITH,ION,ING,ILE,IA,I<,HFA,H<(E,H<,Fix,File ,EAD,ATE,ATA,AND,AFL,%f',s'',SD  Reason: due to damaged PD noise get added.	No	3.56 hr	F	29.5GB
	At 110 degree in hot air oven		269	Successful	285		No	3.45 hrs	F	29.5GB



	At 160 degree in hot air oven		269	Not Detected					N	00
	5 sec. on flame		269	Successful	285	Types of noise: Wed, To, TED, OY, O UT, CESa, ITH, ION, ING, ILE, IA, I<, HF A, H<(E, H<, Fix, File ,EAD, ATE, ATA, A ND, AFL, %f', s", SD	No	1.13 hrs	F	29.5GB
	1min. on flame		269	Not Detected					N	00
							No			
<b>7datarec</b>	At 80 degree in hot air oven	Webp, dll, exe ,m4a, mp3, jpg, png ,pptx, doc, pdf, mkv, mp4	269	Successful	500	Repeated data get recovered.	No	2.10 hrs	F	166GB
	At 110 degree in hot air oven		269	Successful	496		Noise:#.OUT file	No	1,56 hrs	F
	At 160 degree in hot air oven		269	Not Detected					N	00
	5 sec. on flame		269	Successful	498	Repeated data get recovered. Noise:#.OUT file	No	2.hrs	F	166GB
	1min. on flame		269	Not Detected					N	00
<b>photorec</b>	At 80 degree in hot air oven	Webp, dll, exe ,m4a, mp3, jpg, png ,pptx, doc, pdf, mkv, mp4	269	Successful	278	-----	No	1.56 hrs	F	921MB
	At 110 degree in hot air oven		269	Successful	278	-----	No	1.50 hrs	F	921MB
	At 160 degree in hot air oven		269	Not Detected					N	00
	5 sec. on flame		269	Successful	278	-----	No	2.14 hrs	F	921MB
	1min. on flame		269	Not Detected					N	00

## Determining the Probability of Recovering Data from Damaged USB Flash Drive

<b>Stellar</b>	At 80 degree in hot air oven	Webp, dll, exe, m4a, mp3, jpg, png, pptx, doc, pdf, mkv, mp4	269	Successful	269	----- --	No	2.16 hrs	F	1.0GB
	At 110 degree in hot air oven		269	Successful	268		No	2.15 hrs	F	1.0GB
	At 160 degree in hot air oven		269	Not Detected				N	00	
	5 sec. on flame		269	Successful	267	----- --	No	1.58 hrs	F	1.0GB
	60 Sec on flame		269	Not Detected				N	00	

### Method: Freezing Method

	No of samples	Types of files in	No of files before recover	Scanning status	No files after recover	Noise And type of noise & Reason of noise	Data loss	Time required for deep scanning	Type of recovery F/P/NO recovery	Recovered Data
<b>recuva</b>	1 hr Freeze	Webp, dll, exe, m4a, mp3, jpg, png, pptx, doc, pdf, mkv, mp4	269	successful	288	Types of noise: Wed, To, TED, OY, OUT, CESa, ITH, ION, ING, ILE, IA, I<, HFA, H<(E, H<, Fix, File, EAD, AT E, ATA, AND, AFL, %f", s", SD  Reason: due to damaged PD noise get added.	No	1.56 hrs	F	29.5GB
	24 hr freeze		269	Successful	286		Yes	1.50 hrs	P	29.5GB
	48 hr freeze		269	Successful	285		Yes	1.57 hrs	P	29.5GB
	72 hr freeze		269	Successful	285		Yes	2.14 hrs	P	29.5GB
	96 hr freeze		269	Successful	267		Yes	1.45 hrs	P	6.62GB
<b>7datarec</b>	1 HR Freeze	Webp, dll, exe, m4a, mp3, jpg, png, pptx, doc, pdf, mkv, mp4	269	Successful	501	Repeated data get recovered.  Noise: #.OUT file	No	2.15 hrs	F	1.67GB
	24 HR freeze		269	Successful	499		No	1.56 hrs	F	1.67GB
	48 hr freeze		269	Successful	498		No	1.59 hrs	F	1.67GB
	72 hr freeze		269	Successful	498		No	2.19hrs	F	1.67GB
	96 hr freeze		269	Successful	505		No	2.10 hrs	F	1.67GB
<b>photorec</b>	1 HR Freeze	Webp, dll, exe, m4a, mp3, jpg	269	Successful	278	-----	No	1.56 hrs	F	921MB
	24 HR freeze		269	Successful	277		No	1.50 hrs	F	921MB

	48 hr freeze	pg.png, pptx, doc, pdf, mkv, mp4	269	Successful	277	-----	No	1.57 hrs	F	921MB
	72 hr freeze		269	Successful	277		No	2.14 hrs	F	921MB
	96 hr freeze		269	Successful	269		Yes	1.45 hrs	P	921MB
<b>Stellar</b>	1 HR Freeze	Webp, dll, exe, m4a, mp3, j, pg.png, pptx, doc, pdf, mkv, mp4	269	Successful	264	-----	Yes	2.16 hrs	F	996MB
	24 HR freeze		269	Successful	262	-----	Yes	2.15 hrs	F	997MB
	48 hr freeze		269	Successful	263		Yes	2.30 hrs	F	0.97GB
	72 hr freeze		269	Successful	263		Yes	1.58 hrs	F	999MB
	96 hr freeze		269	Successful	265		Yes	2.10 hrs	F	0.99GB

**Method: Scratch Method**

	No of samples	Types of files in	No files before recover	Scanning status	No files after recover	Noise And type of noise & Reason of noise	Data loss	Time required for deep scanning	Type of recovery F/P/NO recovery	Recovered Data
<b>recuva</b>	100	Webp, dll, exe, m4a, mp3, j, pg.png, pptx, doc, pdf, mkv, mp4	269	successful	271	Types of noise: Wed, To, TED, OY, OUT, CESa, ITH, ION, ING, ILE, IA, I<, HFA, H<(E, H<, Fix, File, EAD, AT E, ATA, AND, AFL, %P?, s", SD  Reason: due to damaged PD noise get added.	Yes	1.56 hrs	P	6.63GB
	150		269	successful	287		No	1.50 hrs	F	29.5GB
	200		269	Successful	268		Yes	1.57 hrs	P	6.62GB
	250		269	Not Detected			N	00		
	500		269	Not Detected			N	00		
<b>7datarec</b>	100	Webp, dll, exe, m4a, mp3, j, pg.png, pptx, doc, pdf, mkv, mp4	269	successful	498	Repeated data get recovered.  Noise: #.OUT file	No	2.15 hrs	F	1.66GB
	150		269	successful	496		No	1.56 hrs	F	1.65GB
	200		269	Successful	497		No	1.59 hrs	F	1.65GB
	250		269	Not Detected			N	00		
	500		269	Not Detected			N	00		
<b>Photorec</b>	100	Webp, dll, exe, m4a, mp3, j	269	successful	279	-----	No	1.56 hrs	F	921MB
	150		269	successful	277	-----	No	1.56 hrs	F	921MB

## Determining the Probability of Recovering Data from Damaged USB Flash Drive

	200	pg,png ,pptx,d ocs,pd f,mkv, mp4	269	Successf ul	277		No	1.50 hrs	F	921MB
	250		269	Not Detected				N	00	
	500		269	Not Detected				N	00	
<b>Stellar</b>	100	Webp, dll,exe	269	successf ul	267	-----	NO	1.45 hrs	F	1.0GB
	150	,m4a, mp3,j	269	successf ul	265		NO	2.15 hrs	F	0.99GB
	200	pg,png ,pptx,d	269	successf ul	267		NO	2.30 hrs	F	0.99GB
	250	ocs,pd	269	Not Detected				N	00	
	500	f,mkv, mp4	269	Not Detected				N	00	

### V. RESULT AND CONCLUSION:

Physical damaged was done by applying Various Methods like Buried in soil, Deeping in aqueous media like water, Heating, Freezing Scratching to the PD with various criteria and conditions and then during recovery of data is recovered in successful recovery, Partially Successful Recovery and unsuccessful Recovery. Unsuccessful recovery was happened at very extreme conditions when applied. It is concluded that stellar phoenix as it was licensed software gives 100% result with little noise insertion. While other three software are observed maximum noise is inserted because of which file properties like file size changed, memory space changed. One disadvantage was that more memory size to store so many amounts of data is required

### REFERENCES:-

- Recuva software <https://recuva.en.softonic.com/downloadStellarPhoneix>
- 7 Data Recovery Software <https://7datarecovery.com/#forwardPhotrec> data recovery
- Photorec 7.0 Data Recovery** - <https://downloads.tomsguide.com/PhotoRec,0301-32874.html>
- Stellar Phoneix** : <https://www.stellarinfo.com/>
- [https://www.google.com/search?rlz=1C1CHBD\\_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=s9yIXMGYD9q7rQHTrnABw&q=images+of+smart+toy+pen+drive+&og=images+of+smart+toy+pen+drive+&gs\\_l=img.3...9508.9508..10000...0.0..0.148.148.0j1.....0....1..gws-wiz-IMG:hl-e9HT8#imgrc=4e9pT38M\\_LYKGM:\[\]](https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=s9yIXMGYD9q7rQHTrnABw&q=images+of+smart+toy+pen+drive+&og=images+of+smart+toy+pen+drive+&gs_l=img.3...9508.9508..10000...0.0..0.148.148.0j1.....0....1..gws-wiz-IMG:hl-e9HT8#imgrc=4e9pT38M_LYKGM:[])
- [https://www.google.com/search?rlz=1C1CHBD\\_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive++bracelets&og=images+of+smart+toy+pen+drive++bracelets&gs\\_l=img.3...11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-IMG:RNbWXgRt-el#imgrc=vW9w3N0V6az4CM:](https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive++bracelets&og=images+of+smart+toy+pen+drive++bracelets&gs_l=img.3...11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-IMG:RNbWXgRt-el#imgrc=vW9w3N0V6az4CM:)
- [https://www.google.com/search?rlz=1C1CHBD\\_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive+&og=images+of+smart+toy+pen+drive+&gs\\_l=img.3...4164.4164..4496...0.0..0.0.....0....1..gws-wiz-IMG:GpD7xMICc2E#imgrc=uGg\\_4WVwMi\\_R1M:](https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive+&og=images+of+smart+toy+pen+drive+&gs_l=img.3...4164.4164..4496...0.0..0.0.....0....1..gws-wiz-IMG:GpD7xMICc2E#imgrc=uGg_4WVwMi_R1M:)
- [https://www.google.com/search?rlz=1C1CHBD\\_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive++bracelets&og=images+of+smart+toy+pen+drive++bracelets&gs\\_l=img.3...11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-IMG:RNbWXgRt-el#imgrc=vW9w3N0V6az4CM:](https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive++bracelets&og=images+of+smart+toy+pen+drive++bracelets&gs_l=img.3...11277.16608..16992...0.0..0.1263.2965.0j9j0j1j7-1.....0....1..gws-wiz-IMG:RNbWXgRt-el#imgrc=vW9w3N0V6az4CM:)
- [https://www.google.com/search?rlz=1C1CHBD\\_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive+&og=images+of+smart+toy+pen+drive+&gs\\_l=img.3...4164.4164..4496...0.0..0.0.....0....1..gws-wiz-IMG:GpD7xMICc2E#imgrc=\\_2MGQbESmY\\_QvM:](https://www.google.com/search?rlz=1C1CHBD_enIN764IN764&biw=1200&bih=733&tbn=isch&sa=1&ei=Z9eIXKuIGZa9rQHiw7eABA&q=images+of+smart+toy+pen+drive+&og=images+of+smart+toy+pen+drive+&gs_l=img.3...4164.4164..4496...0.0..0.0.....0....1..gws-wiz-IMG:GpD7xMICc2E#imgrc=_2MGQbESmY_QvM:)
- [https://www.wantitall.co.za/pchardware/8gb-usb2-0-memory-stick-creative-metal-wrench-usb-flash-drive-kepmem-funny-gift-pen-drive\\_b06xv88cj7](https://www.wantitall.co.za/pchardware/8gb-usb2-0-memory-stick-creative-metal-wrench-usb-flash-drive-kepmem-funny-gift-pen-drive_b06xv88cj7)
- Sneha Pandhare , Dr.Shobha Bawiskar,” Recovery Of Data From Damaged Disks”.(Online-Oral Presentation), International Conference on “Innovations in Engineering, Technology and Sciences”- (ICIETS2018) with catlog “CFP18Q63-PRJ:978-1-5386-7321-8” held on September 21-22 ,2018, NIE Institute of Technology, Mysore, Karnataka, (Bangalore)India, will be published in IEEE Xplore Digital Library
- Alpna, Dr. Sona Malhotra ,” Cyber Crime-Its Types, Analysis and Prevention Techniques” International Journal of Advanced Research in Computer Science and Software Engineering Research Volume 6, Issue 5, May 2016 ISSN: 2277 128X ,page no 145. Paper Available online at: [www.ijarcsse.com](http://www.ijarcsse.com)
- Madison, Alex (2016-07-09). "Keychain Not Included: The Five Highest-Capacity USB Flash Drives for Your Digital Life". Digital Trends. Retrieved 17 October 2016.
- Jump up to: a b Athow, Desire (2016-07-04). "The best USB flash drives 2016". Tech Radar. Retrieved 17 October 2016.
- "The Largest Flash Drives | Digital Trends". Digital Trends. 2018-07-23. Retrieved 2018-10-09.
- G. I. A. Incorporated, "USB Flash Drive Market Trends," Global Industry Analyst Inc., 20 March 2017.[Online].Available:[http://www.strategyr.com/MarketResearch/USB\\_Flash\\_Drives\\_Market\\_Trends.asp](http://www.strategyr.com/MarketResearch/USB_Flash_Drives_Market_Trends.asp). [Accessed 20 March 2017
- Parthasarathy, M., & Parthasarathy, S. (2017). Performance Analysis of USB Flash Memory Devices on Linux vs. Windows XP.
- JUANCHO D. ESPINELI, 2 JASMIN NIQUIDULA, "INFORMATION THEORY IN USB FLASH MEMORY DEVICE ANALYSIS" Proceedings of Academics World 63 rd International Conference, Manila, Philippines, 28th -29th April 2017, [http://www.worldresearchlibrary.org/up\\_proc/pdf/834-14997520531-6.pdf](http://www.worldresearchlibrary.org/up_proc/pdf/834-14997520531-6.pdf)
- International Journal of Engineering Research and Development. ISSN: 2278-067X. 2012; 1(6): 25-34.
- 20 B Naresh Kumar Reddy, N Venktram, Sireesha, “An Efficient Data Transmission by using Modern USB Flash Drive” International Journal of Electrical and Computer Engineering (IJECE) Vol. 4, No. 5, October 2014, pp. 730~740 ISSN: 2088-8708

21. Oka Mahendra,Djohar Syamsi,Ade Ramdan,Marcella Astrid,"Design and implementation of data storage system using USB flash drive in a microcontroller based data logger" , DOI 10.1109/ICACOMIT.2015.7440175,Electronic ISBN: 978-1-4673-7408-8 CD-ROM ISBN: 978-1-4673-7407-1,https://ieeexplore.ieee.org/abstract/document/7440175.
22. PNY USB Flash Drive – CES 2006 – LetsGoDigital. Ces-show.com. Retrieved on 2011-05-18.
23. BlueTrek Bizz – an expandable USB and a Bluetooth headset in one Archived 2014-08-29 at the Wayback Machine. TechChee.com (2008-05-20). Retrieved on 2011-05-18.

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