Determining the Scope of Recovery from Physically Damaged Micro SD Card

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Abstract: Today's use of secondary devices like cloud storage, Hard Disk, Pen Drive, SD, CDs, DVDs is constantly growing. Data might be deleted , loss or device is formatted accidentally or intentionally by various means. It's a myth that "once secondary storage devices are damaged then there is no access to data too". This article gives the detail investigation that from damaged devices too data can be recovered.

Keywords: Cyber crime, Data Loss, MICRO SD CARD, Recovery software's.

I. INTRODUCTION

Cyber Crime is technology based crime committed by technocrats.[1] The electronic crime scene that possess digital and electronic devices creates new challenges for the investigator [2].Dependency of data on storage devices is at hike. As per the studies Flash memory market revenues worldwide from 2013 to 2021 (in billion U.S. dollars) Release date October 2017 [3] as shown in Fig 1.
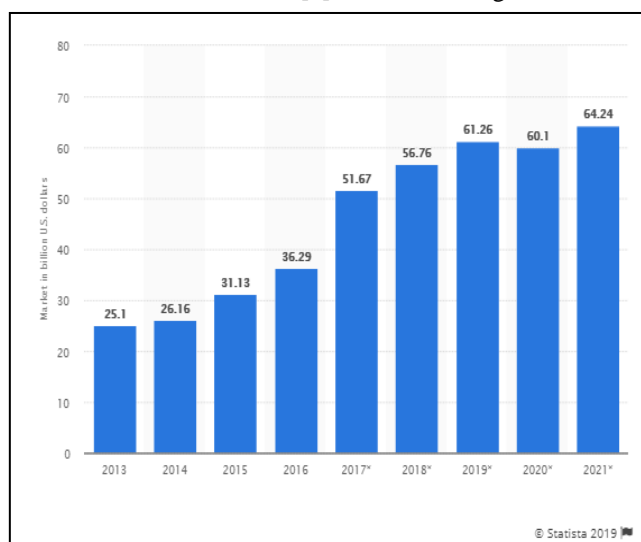

Fig 1- Flash memory market size worldwide 2013-2021

Criminals are doing smart crimes via cyber as a media and/or as a tool, and after committing crimes the criminal mindset is to destroying the digital evidence. Any data once saved in e-storage device is always recoverable in case if data is loosed.

Data loss is an error condition in information systems in which information is destroyed by failures or neglect in storage, transmission, or processing. Information systems implement backup and disaster recovery equipment and processes to prevent data loss or restore lost data.[4]

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Most commonly data loss causes due to following reasons:

- Accidental deletion of files or folders
- File system formatting
- Logical damage of a file system
- Loss of information about partition
- Storage failure
- physical damage to devices [5]

This article will be focused on physical damages to storage device like memory card 16 GB and looking for the chances to recover the data 99.99%. as one percent chances are there to get negative results in exceptional cases . Data Recovery refers to a situation of recovering specific information which becomes inaccessible due to logical or physical damages of the targeted storage device.[6,8]

MICRO SD CARD

The Secure Digital Card is a flash-based memory card that is specifically designed to meet the security, capacity, performance and environmental requirements inherent in newly emerging audio and video consumer electronic devices. The SD Card includes a copyright protection mechanism that complies with the security of the SDMI standard, and is faster and capable of higher Memory capacity. SD Card Capacities 16 MB , 32 MB, 64 MB , 128 MB , 256 MB , 512 MB , 1024 MB etc[7]

II. EXPERIMENTAL SETUP

Aims: To Recover (deleted or formatted) data from MICRO SD CARD.

Background: In this research article secondary storage device like MICRO SD CARD of 16GB is used for experimental work. 25 MICRO SD CARDs are used first it was formatted then on each one GB data inserted which includes all types of multimedia files. Then physically MICRO SD CARDs was damaged via various methods like heating, freezing …etc.

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

Secondary Device used: 25 SanDisk's Cruzer Blade[TM] USB Flash Drive of 16 GB (MICRO SD CARD).

Hypothesis: Data cannot be recovered from physically damaged MICRO SD CARD memory card

2. Procedure applied on Samples collected to physically damage the samples: details shown in Table 2.1 to 2.5
2.1 Method 1: Buried in Mud Method – in this devices were buried in mud with varying conditions as shown in Table 2.1

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Table 2.1 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, in this devices were deep in water varying conditions as shown in Table 2.2

Table 2.2 Use of aqueous media

Sample No	Water amount	Water Type	Environment temperature min approximately	Time depth Factor	Detected	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-, in this devices were kept in hot oven with various temperature as well as burned used Bunsen burner varying conditions as shown in Table 2.3

Table 2.3 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-, in this devices were freezed varying conditions as shown in Table 2.4

Table 2.4 Freezing Method

ample 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 , in this devices were scratched with i-Pin for number of times as shown in Table 2.5

Table 2.5 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

After that MICRO SD CARDs were checked for its detection, once it is detected three freeware software's and one licesenced software was used

3 The procedure to recovery data is as follows:

Step no.1 Select the appropriate software
1. Software Tool No1 - Recuva Freeware[9],
2. Software Tool No 2 - Photorec 7.0 Data Recovery Freeware[11],
3. Software Tool No 3 - 7-Data Recovery[10],
4. Software Tool No 4 - Stellar Phoenix Licensed[12]

Step no.2 Select the secondary device like MICRO SD CARD

Step no.3 If device are detected goto step no 4 else goto to step no. 5

Step no 4

Step no.4.1 Scan the device

Step no.4.2 Content will be shown in either unsuccessful recovery, partially successful recovery or completely successful recovery

Step no.4.3 Select specific files or devices that want to be recovered.

Step no.4.4 Select the location where the recovered data have to be saves

Step no. 4.5 End

Step no.5 Try for device detection if detected goto to step no 4 else goto step no 6

Step no.6 End

Observation: - shown in Table 3.1 to 3.5

Table 3.1 Buried in Mud Method

Method 3.1: Buried in Mud Methods

Sample No	Condition	Software Tool No1 Recuva Freeware			Software Tool No 2 Photorec 7.0 Data Recovery Freeware			Software Tool No 3 7-Data Recovery			Software Tool No 4 Stellar Phoenix Licensed		
		DST	FSE (269)	R	ST	FSE (269)	R	ST	FSE (269)	R	DST	FSE	R
Sample 1	Buried in dry Mud for 1-hr	3.56 HRS	41	9.67MB	1.56 HRS	274	989MB	2.10 HRS	506	1.66GB	2.16 HRS	270	1.0GB
Sample 2	Buried in dry Mud for 1-day=24 hrs	3.45 HRS		14.5GB	1.50 HRS	274	989MB	1.56HRS	506	1.66GB	2.15 HRS	270	1.0GB
Sample 3	Buried in Semi wet Mud for 1-hr	2.13 HRS	295	30.6GB	1.57 HRS	274	989MB	2.19 HRS	506	1.66GB	2.30 HRS	270	1.0GB
Sample 4	Buried in Semi wet Mud for 5-hr	1.13 HRS	9	6.4GB	2.14HRS	264	989MB	2.HRS	506	1.66GB	1.58 HRS	272	1.0GB
Sample 5	Buried in Liquid muddy for 7-days=168 hrs	1.45 HRS	18	4.67GB	1.45 HRS	80	989MB	2.40 HRS	506	1.66GB	2.10 HRS	270	1.0GB

Deep Scan Time=DST, Total No of Files extracted out of 1GB= FS, Recovery status =R

Table 3.2 Use of aqueous media

Method 3.2: Use of aqueous medium like Water (H$_2$O)

Sample No	Condition	Software Tool No1 Recuva Freeware			Software Tool No 2 Photorec 7.0 Data Recovery Freeware			Software Tool No 3 7-Data Recovery			Software Tool No 4 Stellar Phoenix Licensed		
		DST	FSE (269)	R	DST	FSE (269)	R	DST	FSE (269)	R	DST	FSE (269)	R
Sample 1	4 ltr in bucket	3.45 HRS	264	50.5GB	1.67 HRS	263	957MB	2.15 HRS	285	704MB	2.58 HRS	270	1.0GB
Sample 2	4 ltr in bucket	3.25HRS	264	50.5GB	1.30 HRS	257	950MB	1.56 HRS	270	690MB	1.45 HRS	270	1.0GB
Sample 3	500 ml in bottle	3.15HRS	48	20.8GB	1.55 HRS	258	953MB	2.16HRS	500	1.66GB	3.15 HRS	270	1.0GB

| Sample 4 | 500 ml in beaker | 3.5 HRS | 144 | 19.8GB | 1.57 HRS | 274 | 986MB | 2.45 HRS | 506 | 1.66GB | 2.45 HRS | 270 | 1.0GB |
| Sample 5 | 500 ml in beaker | ND | 0 | 0 | ND | 0 | 0% | ND | 0 | 0 | ND | 0 | 0 |

Deep Scan Time=DST, Total No of Files extracted out of 1GB= FS, Recovery status =%R, Not Detected=ND

Table 3.3 Heating Method

Method 3.3: Hot Oven Method

Sample No	Condition	Software Tool No1 Recuva Freeware			Software Tool No 2 Photorec 7.0 Data Recovery Freeware			Software Tool No 3 7-Data Recovery			Software Tool No 4 Stellar Phoenix Licensed		
		DST	FSE (269)	R	DST	FSE (269)	R	DST	FSE (269)	R	DST	FSE (269)	R
Sample 1	80	3.57 HRS	230	942MB	1.36 HRS	275	989MB	1.35 HRS	506	1.66GB	1.6 HRS	270	1.0GB
Sample 2	110	3.56 HRS	29	2.58GB	2 HRS	275	989MB	1.56 HRS	506	1.66GB	1.6 HRS	270	1.0GB
Sample 3	160	3.45 HRS	28	2.80GB	1.56 HRS	275	989MB	1.56 HRS	506	1.66GB	1.6 HRS	270	1.0GB
Sample 4	Heated 5 sec	ND	0	0	ND	0	0	SD-NDST	0	0	ND	0	0
Sample 5	Heated 60 sec	ND	0	0	ND	0	0	ND	0	0	ND	0	0

Deep Scan Time=DST, Total No of Files extracted out of 1GB= FS, Recovery status =R, Not Detected=ND, Successfully detected but No DST processed=SD-NDST

Table 3.4 Freezing Method

Method 3.4: Freezing Method

Sample No	Condition	Software Tool No1 Recuva Freeware			Software Tool No 2 Photorec 7.0 Data Recovery Freeware			Software Tool No 3 7-Data Recovery			Software Tool No 4 Stellar Phoenix Licensed		
		DST	FSE (269)	R	DST	FSE (269)	R	DST	FSE (269)	R	DST	FSE (269)	R
Sample 1	1 HR	2.15 HRS	295	30.6GB	3.56HRS	274	989MB	2.15 HRS	506	1.66GB	2.56	270	1.66GB
Sample 2	24 HRS	2.15 HRS	4	2.49GB	1.57 HRS	274	989MB	1.56 HRS	506	1.66GB	3.45	270	1.66GB
Sample 3	48 HRS	2.15 HRS	200	74.349.95 GB	2.56 HRS	274	989MB	1.59 HRS	506	1.66GB	3.10	270	1.66GB
Sample 4	72 HRS	2.15 HRS	59	8.26GB	3.00 HRS	274	921MB	2.19HRS	506	1.66GB	3.34	270	1.66GB

| Sample 5 | 96 HRS | 2.15 HRS | 258 | 13.9GB | 1.56 HRS | 274 | 989MB | 2.10 HRS | 506 | 1.66GB | 3.23 | 270 | 1.66GB |

Deep Scan Time=DST, Total No of Files extracted out of 1GB= FS, Recovery status =R

Table 3.5 Scratching Method

Method 3.5: Scratch Method

Sample No	Condition	Software Tool No1 Recuva Freeware			Software Tool No 2 Photorec 7.0 Data Recovery Freeware			Software Tool No 3 7-Data Recovery			Software Tool No 4 Stellar Phoenix Licensed		
		DST	FSE (269)	%R	DST	FSE (269)	%R	DST	FSE (269)	%R	DST	FSE (269)	%R
Sample 1	100	2.45HRS	295	30.6GB	2.14 HRS	274	989MB	2.45 HRS	506	1.66GB	1.56 HRS	270	1.0GB
Sample 2	150	3.23 HRS	295	30.6GB	2.56 HRS	274	989MB	3.56 HRS	506	1.66GB	2.34 HRS	270	1.0GB
Sample 3	200	3.12 HRS	295	30.6GB	3.00 HRS	274	989MB	3.12 HRS	506	1.66GB	3.45 HRS	270	1.0GB
Sample 4	250	3.56 HRS	295	30.6GB	2.34 HRS	274	989MB	3.23 HRS	506	1.66GB	4.00 HRS	270	1.0GB
Sample 5	500	ND	0	0	ND	0	0	ND	0	0	ND	0	0

Deep Scan Time=DST, Total No of Files extracted out of 1GB= FS, Recovery status = R, Not Detected=N

III. CONCLUSION

In Case of MICRO SD CARD memory card,

- Due To Damaged MICRO SD CARD
  Hypothesis proved to be wrong as evidences from experimental results data can be recovered from damaged MICRO SD CARD memory cards can be achieved.
- Comparisms between software's using various parameters were observed.
- Stellar phoenix as it was licensed software gives 100% result with little noise insertion. While other three software maximum noise is inserted like in form of (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 …etc)
- In freeware software Photorec 7.0 Data Recovery, 7-Data Recovery and then Recuva give good results respectively.
- Noise was inserted because of damage done to devices, because of which maximum data space is required to store the data. Redundant data was seen present mainly in Recuva.
- It is concluded that data can be recovered is possible in either Full recovery, partially recovery and in very rare cases at extreme conditions data is completely loss hence recovery is just impossible.

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