# Forgetick:

## Reminding to Forget in Digital Culture

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Abstract—Ever since we can remember, humans forget. Forgetting has always been the norm and remembering the exception. Today this balance is shifting. In digital culture forgetting has become the exception and remembering the default. Though forgetting is not a human bug, it is a feature. That what is considered as memory failures are actually functions that are surprisingly vital to our everyday life. Opposed to the great technological advances that have been made on digital remembering, hardly any innovations were made on digital forgetting. What mechanisms of human forgetting are useful when applied in a digital context? The aim of this study is to make a contribution to the idea of introducing forgetfulness to digital memory. A USB memory stick that is able to forget is presented as test-bed environment for exploring forgetfulness in a standard Operating System. And we will define a theoretical framework which offers a set of principles for digital forgetting. How can we remind ourselves to forget in digital culture?

Keywords—Technology, Digital Culture, Interaction Design, Information Life-cycle Management, Privacy, Techno Regulation

## I. INTRODUCTION

Forgetting has been around since humans can remember. We are able to extend our memory by making a conscious effort to materialize our thoughts. We increasingly extended our options to memorize externally; from ancient wall paintings in a cave to storytelling, writing, the printing press, photography, songs and endless other ways. Still, forgetting has always been the norm – and remembering the exception. Today this balance is shifting, as observed by Viktor Mayer-Schönberger in his inspiring book *Delete* [1]. In digital culture, forgetting has become the exception and remembering the default. Forgetting has become troublesome for people: nowadays digital remembering is just easier. The result is a world that is set to remember, and has little incentive to forget.

Vast storage of digital memories has become possible due to cheaper hardware, easy retrieval and global access of digital information [2]. This has a major impact on how our society works today and how it might unfold in the future [3]. Technology has enabled innovation, collaboration, entertainment and democratic participation. But the same inventions are changing centuriesold assumptions about privacy, identity, free expression, personal control and ownership as more and more details concerning our lives are captured and stored as digital data [4]. This makes it imperative for us to debate and redefine these values as well as the relations between individuals and corporations and state [5]. Digital technology and global communication networks are moreover overriding our natural ability to forget.

Forgetting is not a human bug, it is a feature. Forgetting plays a central role in human decision making, enabling us to abstract and generalize our thinking by filtering out the details [6]. Forgetting allows one to live in the present, rather than to remain stuck in outdated assumptions. Forgetting enables us to forgive and to evolve within our environment. Forgetting is a form of freedom [7]. In our everyday lives, forgetting actually proves to be a very valuable asset.

Our relation to information is clearly evolving in the digital age. Stephens [8] takes a closer look at engaging with digital information and defines the following basic phases:

- 1) Creation and Receipt of information
- 2) Distribution of information
- 3) Use of information
- 4) Maintenance of information
- 5) Disposal of information

The final step in Stephens *Information Lifecycle*, the *disposal of information*, seems to rarely take place these days — and is certainly not encouraged by developments as the world wide web, cloud computing, data-aggregation corporations and ever expanding storage capacities.

Opposed to the great technological advances that have been made on digital remembering, hardly any innovations have been made on digital forgetting. In this study we research the relevance and potential of digital forgetting. The main research questions are:

- What are useful principles of human forgetting?
- How can these useful principles be translated to the digital domain?

As a methodology for this exploratory study a USB memory stick is developed which is able to forget. Also, a theoretical framework that offers a set of principles for digital forgetting is defined.

This USB stick is a test-bed that serves as initial platform to explore forgetfulness in the digital culture. It encounters the fundamental challenges that are involved with digital forgetfulness in a file system of a standard Operating System. Secondly, this test-bed poses a statement to open the discussion on self-governance of information in digital culture. The USB stick that is able to forget is presented as instrument for autonomy within the digital domain. Thirdly, it provides an environment for further studies on digital forgetting.

As such, conducting user-interface experiments is beyond the scope and intentions of this study. The study is not about the color of the buttons, but about the relevance and potential of forgetfulness in digital culture. Therefore a theoretical framework is defined as complementary contribution to the practical USB stick test-bed. This framework offers a set of principles on introducing forgetfulness to digital culture, to be used as guidelines and inspiration for future studies. The combination of these contributions in the practical and the theoretical domain aim at providing food for thought as starting points for discussion on moral, technical and legal grounds of digital forgetting. The paper is structured as follows. In section II, the importance of forgetting and its role in information processing is reviewed from different perspectives to give substance to the concept of digital forgetting. Section III discusses the design choices and development challenges of the world's first USB stick that is able to forget. In section IV, a set of principles for digital forgetting is defined that serve as guidelines for further implementations of forgetting in the digital domain. In section V considerations on digital forgetting are briefly discussed. The final section VI concludes the study.

## II. BACKGROUND

In this section the importance of forgetting and the role it plays in various field is reviewed. To start, the perspective of Sociology gives insight in *why* humans forget. Then perspectives from Psychology explain *how* this process functions. Implementing forgetfulness in digital culture is a means of regulating personal information and therefore involves the fields of Law and Regulations and the role of Technology – the *what* of forgetting. The section concludes with a set of examples that illustrate how new services that reflect implementations of digital forgetting are arising.

#### A. Sociology

We as humans within our selves are quite selective in what things we choose to remember and how. Forgetting therefore is not a deficiency in the human machine, but a mechanism to cope with and structure the events we encounter in our lives<sup>1</sup>. Forgetting helps us to shape our self identity as the essence of who we are and think we are in society. Sociologists like Anthony Giddens believe that we create a sort of auto-biography, a narrative of the self. So if we have some unfortunate life events that are difficult to fit into our story, often what we tend to do is to choose and pick events that we like to keep and we leave out (i.e. forget) the things that we don't like so much. This selection and shifting is important for our mental health, for us humans to live the long lives we do without going crazy [9].

## B. Psychology

The psychology of human forgetting and remembering holds many insights on how our natural information processing machine and storage device, the brain,

<sup>&</sup>lt;sup>1</sup>According to Vili Lehdonvirta in VPRO Tegenlicht episode *De Techmens* broadcasted 14 Oktober 2013 on Ned2, *http://tegenlicht.vpro.nl/afleveringen/2013-2014/TechMens.html* 

actually works. The Chairman of Harvard University's Department of Psychology Daniel L. Schacter explains that what is considered as memory failures are actually indications that memory is functioning as designed. In his book How the Mind Forgets and Remembers [6] he presents a framework that explains the common memory miscues we all encounter. Not only is explained how these failures of memory occur routinely in daily life but also why it is a good thing that they happen, and why it is surprisingly vital to a keen mind that they occur regularly. This framework presents the seven sins of memory, inspired by the ancient seven deadly sins which are Pride, Anger, Envy, Greed, Gluttony, Lust and Sloth. These sins have great potential to get us into trouble, yet each of the sins can be seen as an exaggeration of traits that are useful and sometimes necessary for survival. The seven malfunctions of memory are identified as listed below.

1) Transience: Transience is the weakening of memory over time. It is a basic feature of memory, and the culprit in many memory problems. One can quite easily sum up the activities of the day, but the activities of a day that was a month ago is way harder.

2) Absent-mindedness: Absent-mindedness involves a breakdown at the interface between attention and memory. For instance like forgetting about turning off the lights when leaving from home. The desired information isn't lost over time; it is never registered in memory to begin with.

3) *Blocking:* Blocking is about information that we know to have known, but we can not retrieve it. For instance, when meeting someone who appears to be familiar but you fail to reproduce the name of the person.

4) *Miss-attribution:* Miss-attribution is about assigning a memory to the wrong source. This happens for instance in the occasion you tell someone about a story that you thought to have read in a newspaper, but actually you were told about it by a friend.

5) Suggestibility: In suggestibility, memories are implanted as a result of leading questions while retrieving a memory. For instance when you are trying to remind a street name and your friend says, wasn't it something like this?

6) Bias: Bias reflects powerful influences of our current knowledge and beliefs on how we remember our past: rewriting the past based on present beliefs. An example would be to have a skewed memory of a specific

incident; you happen to remember a hitchhike tour to Paris different than your friend.

7) *Persistence:* Persistence occurs when we can not forget about intrusive recollections, although we wish to. A trauma would fall in this category, so does an addiction.

Just like the ancient seven deadly sins, the memory sins occur frequently in everyday life and can have serious consequences for all of us. Each of the seven sins is a by-product of otherwise desirable and adaptive features of the human mind. Forgetting can be frustrating, but it is often useful and even necessary to dismiss information that is no longer current. As such the sins can be seen as window on adaptive strengths of memory. What useful principles and mechanisms are embedded in the human capacity to forget and how can we translate this to our digital memory? Section IV further elaborates on this. First we move from human forgetting to aspects of forgetting in the digital domain.

#### C. Law

Humans forget in many ways, for many reasons. But computers don't forget at all. At least, they are not instructed to do so. Yet. Today, information is frozen in digital memory until further notice. If we think of reintroducing digital forgetting, we have to construct new rules for our computers to forget. This does not only include programming rule sets, but also new Laws<sup>2</sup> and Regulations<sup>3</sup> about when information can or can not be deleted. This subsection briefly reviews the recently proposed Right to Be Forgotten and Privacy in the digital domain.

1) Right to Be Forgotten: The internet has a long memory. But what if the pictures, data and personal information that it can pull up about you appear unfair, one-sided or just plain wrong? More and more people are claiming they have a right to decide which information about should be publicly available or not, and are even trying to delete themselves from the web. The issue of forgetting in the digital domain triggers legal, technolog-ical and moral debates.

<sup>&</sup>lt;sup>2</sup>A *law* describes what we can and can not do and is governed, organized and executed by the state. The law intends to prevent that parties brake the law, punishment will follow when the line is crossed.

 $<sup>{}^{3}</sup>A$  *regulation* is a much broader concept than law, it is any means to steer the behavior of people. Using the law is one of the ways in which one can regulate behavior, others means would be the design of architecture or to change the Interaction Design of a system.

On January 2012, the European Commissioner for *Justice, Fundamental Rights and Citizenship*, Viviane Reding, announced the European Commission's proposal<sup>4</sup> to create a new privacy right – the *Right To Be Forgotten*. A comprehensive reform of the EU's 1995 data protection rules to strengthen online privacy rights and boost Europe's digital economy. The core idea is that if an individual no longer wants his personal data to be processed or stored by a data controller, and if there is no legitimate reason for keeping it, the data should be removed from their system at legal request.

This proposal gained lots of supporters, and opponents. Jeff Rosen, Professor of Law in George Washington University, explains why he thinks it represents the biggest threat to free speech on the Internet in the coming decade as follows [10]. According to the regulation, he reviews, when someone demands the erasure of personal data, an Internet Service Provider shall carry out the erasure without delay, unless the retention of the data is necessary for exercising the right of freedom of expression, as defined by member states in their local laws. For a preview of just how chilling that effect might be, he continues, consider the fact that the right to be forgotten can be asserted not only against the publisher of content (such as Facebook or a newspaper) but against search engines like Google and Yahoo that link to the content. If someone else posts something about me, do I have a right to delete it? This, of course, raises the most serious concerns about free expression. Its hard to imagine that the Internet that results will be as free and open as it is now, Jeff concludes.

Peter Fleischer, Google's Global Privacy Counsel, made a statement posted in Google's '*Thoughts on the Right to be Forgotten*', on 16 February 2012 [11], which stated:

"Ultimately, <u>responsibility</u> for deleting content published online should lie with the person or entity who published it. Host providers store this information on behalf of the content provider and so have no original right to delete the data. Similarly, search engines index any publicly available information to make it searchable. They too have no direct relationship with the original content. We're supportive of the principles behind the right to be forgotten - and believe that it's possible to implement this concept in a way that not only enhances privacy online, but also fosters free expression for all."

The point made here on that *responsibility for deleting content published online should lie with the person or entity who published it,* very much appeals to the idea self-governance and individual control on personal data pursued in this study of digital forgetfulness.

By the end of 2013, the data protection rules was revisited and now specifically provides for the Right to Erasure in Article 17, previously termed the Right to Be Forgotten, which would require the data controller to take all reasonable steps to have individuals' data erased, including by third parties without delay, for the personal data that the controller has made public without legal justification [12]. Under Article 17, data subjects are granted the right to obtain from the controller the erasure of personal data relating to them and from third parties the erasure of any links to, or copy or replication of that data, where the data are no longer necessary in relation to the purposes for which they were collected, that individual withdraws consent or objects to the processing of his/her personal data, or where the processing of such data contravenes other parts of the Regulation. The implementation and implications of Article 17 are still subject to a hot debate on legal, technical and moral grounds.

2) *Privacy:* Since forgetting is a valuable function in our daily lives within the analogue domain, as such it prolongs its imprint into the digital dimension too. An envisioning of a future society where every single moment was recorded on camera, and nothing was ever forgotten anymore, was the main theme in the episode *The Entire History of You* of the British drama series *Black Mirror*<sup>5</sup>:

Set in an alternate reality where everyone has access to a system which records everything they do, see or hear. You need never forget a face, a holiday or a night out again... but is that always a good thing?

Though this episode shown in 2012 is no longer a peek into the future, it has already arrived through products

<sup>&</sup>lt;sup>4</sup>http://ec.europa.eu/justice/newsroom/data-protection/news/ 120125\_en.htm

<sup>&</sup>lt;sup>5</sup>Black Mirror Season 1, episode 3, broadcasted 18 Oktober 2012

like Autographer<sup>6</sup>, Narrative<sup>7</sup>, Google Glass<sup>8</sup>. Wearable devices for Lifelogging<sup>9</sup> that capture image, audio, video or other data at every moment, every hour, every day. Not only of the person using the device, but of everyone else nearby too. Big Brother is replaced by many Little Sisters<sup>10</sup>. Many new questions on themes of privacy, freedom and ownership arise – for the generation of today to answer. Who really owns all this data? Digital forgetfulness could be an aid to enhance self-governance over individual privacy.

But what exactly is privacy and when is it violated? A recent view on privacy is proposed by Helen Nissenbaum in the article Privacy as Contextual Integrity [13]. Nissenbaum posits a new construct, "contextual integrity", and states privacy is a social concept instead of an information concept. It is too narrow to regard information as either absolutely private or absolutely public. It is not about content of information, but about context. Information needs to stay within the context it was originally shared in. Privacy is about compartmentalizing personal information: to keep information in the intended context. People are willing to share information, but it needs to be contained in the right context. For instance: medical conditions are fine to share with a doctor, financial information is fine to share with a bank, beliefs fine to share with a priest. But people get upset when information is migrated out of context. If the cashier in the supermarket offers you a new medicine, because your doctor told the supermarket you have a hart condition: your privacy is violated. The concept of context could also be applied to the dimension of time. It might be very OK to have a drunken party picture online on your social media to re-celebrate a good party, but it might be compromising if this picture pop ups at some later time completely out of context. Forgetfulness can be implemented as a tool for self-governance of personal information and thereby contribute to individual privacy.

#### D. Technology

The analogue and the digital world were previously considered as two distinct domains, however nowadays these domains have merged into one world<sup>11</sup>. Actions in the digital world have their impact in the analogue world and vice versa. A crime online can have similar consequences as a bank robbery on the corner of the street. What is forgotten in the analogue world, whether it is outdated information taken out of context or compromising pictures on social media, might forever continue to exist in digital memory. Therefore, digital information should somehow be regulated. There are four major views<sup>12</sup> on how to regulate information on the internet:

1) Cyber Libertarians: Regulating the internet is impossible and undesirable, self-regulation is the only acceptable form of regulation. [14]

2) Techno Regulators: Regulating the internet is possible through the use of technologies and adaption of the architectures, regulating the internet is desirable. Fundamental rights and constitutional values should apply to the internet too. [15]

*3) Territorials:* Regulating the internet is possible through applying national law. Regulating the internet is necessary, the national rule of law must be upheld also on the internet. [16]

4) Walled Garden: The internet is turning into a collection of *smaller internets*: countries and companies create a lock-in effect through limiting functionality of apps and gadgets in their domains. [17]

The first view is a bit outdated, the internet has become so important to the workings of our society that it can not remain an anarchy<sup>13</sup>. The fourth perspective is still a bit to new too take into consideration. The second and third perspective attract most attention in the debate around regulating information technologies.

The perspective of Techno Regulators is dominant in today's debate and is elaborated on by Lawrence Lessig in his book *Code 2.0* [15]. He states the architecture of the internet is a kind of law in itself: it determines what

<sup>&</sup>lt;sup>6</sup>Wearable camera that uses an array of built-in sensors to take pictures automatically triggered by changes in its environment, *http://www.autographer.com/* 

<sup>&</sup>lt;sup>7</sup>Tiny, automatic camera and app that gives you a searchable and shareable photographic memory, *http://getnarrative.com/* 

<sup>&</sup>lt;sup>8</sup>Wearable computer with an optical head-mounted display (OHMD) that is being developed by Google, with a mission of producing a mass-market ubiquitous computer, *http://www.google.com/glass/start/* 

<sup>&</sup>lt;sup>9</sup>Lifeloggers (also known as lifebloggers or lifegloggers) typically wear computers in order to capture their entire lives, or large portions of their lives.

<sup>&</sup>lt;sup>10</sup>As mentioned in Volkskrant, 3 February 2012, *De toekomst van beveiliging niet een Big Brother maar vele Little Sisters* 

<sup>&</sup>lt;sup>11</sup>As explained by Nick Bostrom in VPRO Tegenlicht episode *De Techmens* broadcasted 14 Oktober 2013 on Ned2, *http://tegenlicht.vpro.nl/talksinhoud/nick-bostrom.html* 

<sup>&</sup>lt;sup>12</sup>These four major views were discussed in a lecture on Cyberspace & Cyberlaw by Leiden University professor Bibi van den Berg of the Leiden Law School Institute for the Interdisciplinary Study of the Law on November 6th 2013

<sup>&</sup>lt;sup>13</sup>Idem footnote 12

people can and cannot do. Lessig argues that as how the world is now, code writers are increasingly lawmakers. They determine what the defaults of the internet will be. Whether privacy will be protected, anonymity is allowed and access is guaranteed: they define what the internet is. Code codifies values, and yet, oddly, most people speak as if code were just a question of engineering. Or as if code is best left to the market, or best left unaddressed by a government. Lessig suggests lawmakers need to be involved in the design and development of the internet, in order to embed our fundamental rights and constitutional values in the architecture. Like a locked door is not a command "do not enter" backed up with the threat of punishment by the state, a locked door is a physical constraint on the liberty of someone to enter some space. Another example of Techno Regulation in traffic control: instead of using a maximum-speed road-sign and speed-camera's, mounting a speed-bump in the road. In cyberspace, code is the main means of regulation. Digital forgetting lives by means of code and system architecture. Different than implementing a law such as the right to be forgotten, a technology could be implemented that provides to choose for digital forgetting in file systems.

## E. Applications

New services have popped up recently that already incorporate elements of digital forgetfulness. These elements can be attributed and labeled to the sins of memory as listed in section II-B. Below the applications are briefly explained and the forgetful quality is labeled:

- DUCKDUCKGO.COM:
  - absent-mindedness

Internet search engine that does not profile its users and avoid a filter-bubble<sup>14</sup>. This search engine does never store search queries linked to an identifiable account.

• SNAPCHAT.COM:

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transience, blocking
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Users can send pictures and media and set a time limit for how long recipients can view it, after which it will be hidden from the recipients device and deleted from Snapchat's servers. • GLIMPSE MESSENGER.COM: *absent-mindedness, blocking* Translated the functionality of a voice conversation to the texting medium: one reads the words as they come in, and after you read each word, it disappears.

• GET CONFIDE.COM:

*absent-mindedness, blocking* Messages disappear after they are read, ensuring communication remains private, confidential and off the record.

• FORGOTIFY.COM:

*transience, absent-mindedness* Music platform that offers user to listen to the 20% of music on Spotify (4 billion songs) that

never have been listened. Once a track is playedback, it is removed from the Forgotify play-list.

THEWAYBACKMACHINE.NET:
 persistence
 The Number of Content of Cont

The Wayback Machine is a digital archive of the World Wide Web and other information on the Internet, the service enables users to see archived versions of web pages across time.

• TOR PROJECT.ORG:

miss-attribution, suggestibility

Tor directs Internet traffic through a volunteer network of relays to conceal a user's location or usage from anyone conducting network surveillance or traffic analysis.

• TAILS.BOUM.ORG: miss-attribution, suggestibility

Live Operating System that uses the Internet anonymously and circumvent censorship; all connections to the Internet are forced through the Tor network; leave no trace on the computer unless you ask it explicitly; use state-of-the-art cryptographic tools to encrypt files, emails and instant messaging.

• DARKMAIL.INFO:

absent-mindedness, miss-attribution

A new email protocol, Email 3.0, that embeds the meta-data header in the encryption – something that is impossible in the current email architecture.

This collection of recent application examples show that the concept of digital forgetting is a very active theme.

<sup>&</sup>lt;sup>14</sup>A filter bubble is a result state in which a website algorithm selectively guesses what information a user would like to see based on information about the user and, as a result, users become separated from information that disagrees with their viewpoints, effectively isolating them in their own cultural or ideological bubbles.

#### III. TEST-BED: USB STICK THAT IS ABLE TO FORGET

Forgetting shows to be a valuable asset to humans and involves a range of perspectives as discussed in the previous section II. How can mechanisms of human forgetting be translated to the digital domain? A test-bed was developed for digital forgetting within a standard Operating System, in parallel with the definition of principles for digital forgetting as elaborated on in section IV. This test-bed was made to encounter challenges concerned with digital forgetting and to create an initial platform to open new grounds on forgetting in the digital domain. As such, conducting user-interface experiments is beyond the scope and intentions of this study. This test-bed forms the fundamental bridge between theory and practice and gives direction to the debate on digital forgetting.

This USB stick that is able to forget is presented as instrument for autonomy within the digital domain. It poses a statement to open the discussion on self-governance of information in digital culture. By making such a tangible device for individuals to directly experiment with digital forgetting in an every day life setting, it tends to invoke feedback and provides solid ground for debate on the subject of digital forgetting.

This section elaborates on the design and development of this exploratory study. The name of the project was coined *Forgetick*, an agglomeration of forgetting and USB stick. A Forgetick USB stick is shown in Figure 1. Figure 2 shows a screenshot of the Forgetick website. A screenshot of the application is depicted in Figure 3.

## A. Starting Point

The lifetime of digital files is identified as key element in the translation of forgetting in the human memory to forgetting in a digital memory, a suggestion elaborated on by Viktor Mayer-Schonberger in his book Delete: The Virtue of Forgetting in the Digital Age [1]. On food products, the expiring date that is printed on the package reminds us about its shelf life. What if we would apply expiring dates to the files in a file system, like the milk in our refrigerator? The milk company knows about the time-span the milk is good to serve, likewise the author of a document file could set a date for the lifetime of the document. In this study an actual working prototype of a USB memory stick that is able to forget is presented. The USB stick runs a portable application that self governs the existence of the files that it contains, based on an expiring date for file items. The lifetime is set by the



Fig. 1. A Forgetick USB stick



Fig. 2. Screenshot of www.forgetick.nl

user as a relative time-span into the future. For instance the lifetime of a file item can be set to three weeks from now, the application then calculates the absolute timing at which the file item is to be removed. Through engagement with the forgetting USB stick, the user is incited to consider the intention and lifespan of digital information. Forgetick remembers how to forget in the digital domain.

#### B. Design Criteria

Digital information is discrete instead of analogue. In digital remembering, information is stored to the digital domain in a controlled and precise manner. Digital forgetting therefor would also be controlled and precise. The translation of human forgetting to digital forgetting is a creative process, which guided the design choices made.

Jame	Days	Weeks	Months	Years	Forever
IR – Pocket Symphony	0000000	0000	00000000000	0000000000	00
01 Space Maker.mp3	0000000	0000	000000000000	000000000	00
02 Once Upon a Time.mp3	0000000	0000	000000000000	000000000	00
03 One Hell of a Party.mp3	0000000	0000	000000000000	000000000	00
04 Napalm Love.mp3	0000000	0000	000000000000	000000000	00
05 Mayfair Song.mp3	0000000	0000	000000000000	0000000000	00
06 Left Bank.mp3	0000000	0000	000000000000	0000000000	00
07 Photograph.mp3	0000000	0000	000000000000	000000000	00
08 Mer du Japon.mp3	0000000	0000	00000000000	000000000	$\odot$
09 Lost Message.mp3	0000000	0000	00000000000	0000000000	00
10 Somewhere Between Waking and Sleeping.mp3	0000000	0000	00000000000	0000000000	00
11 Redhead Girl.mp3	0000000	0000	00000000000	000000000	00
12 Night Sight.mp3	0000000	0000	00000000000	0000000000	00
e Huilende Rappers	0000000	0000	00000000000	000000000	00
lk ben een Gangster.mp3	000000	0000	00000000000	000000000	00
Piraterij.mp3	0000000	0000	00000000000	000000000	00
Sukkel tje.mp3	0000000	0000	00000000000	000000000	00

Fig. 3. Screenshot of the application Forgetick, running on Mac OSX 10.8

The following design criteria were set out as cornerstones of the Forgetick application:

- 1) easy and intuitive in use
- 2) one click does the trick
- 3) information overview at a glance
- 4) live status feedback
- 5) designed for integration in standard OS

#### C. Interaction Design and User Experience

1) Opening the application: The application works on Mac OSX 10.6+ and can be downloaded from the public website http://www.forgetick.nl/. Once the application Forgetick is downloaded and installed on either a USB stick or a machine's Applications folder, the app is opened by double clicking the Forgetick.app icon. The application chooses to work from a Forgetick USB stick by default, but can alternatively function from the Desktop. If there is no Forgetick USB stick mounted at start up then it automatically creates a folder named Forgetick on the Desktop and works from there. After initial start up, the next time you mount a Forgetick USB stick, a computer will automatically launch the application.

2) Copy files into Forgetick: The native OSX Finder can be used to copy files to either the USB stick or the generated Forgetick Desktop folder. Alternatively one can drag and drop files on the Forgetick application window, file items will then be *moved* to the root of the Forgetick path. When the file copy process is completed, the new file items will show up in the file list inside the Forgetick application. The application adds the lifetime information to its archive and manages the files accordingly. Folders are shown in bold font, files in regular font. The file list can be navigated by scrolling the mouse wheel.

3) Lifetime control: Behind each file item a set of dots is shown, these dots form a lifetime timeline. The timeline contains 7 days, 4 weeks, 12 months, 10 years and forever. When a dot it hovered, its sequential number within the time period is shown. To set the lifetime for a file item, one can click a dot. To adjust the lifetime of a file again, another dot can be selected. When the mouse is dragged over a group of file item dots,

multiple adjustments can be quickly made. The lifetime of a directory is applied recursively to files with an lifetime that is longer. The lifetime of parent directories is updated to match the maximum lifetime of a file item that it contains. The lifetime sticks to the file item even when it is renamed, moved or duplicated using the native OSX Finder.

4) Digital forgetting: The Forgetick application automatically keeps a record of the lifetimes one has set for files and folders. These lifetimes can be modified at any time. The application automatically updates the marked dot representing the lifetime of a file item over time. For instance, if one sets the lifetime for file Testfile.txt to 3 weeks and a week later one takes another look in the application: the dot will have been moved to the left one step to accurately show the current lifetime. Which in this example would be a marked dot representing 2 weeks. If a file item is overdue, it will be moved to the native OSX Trash. File items that have a lifetime less than 24 hours will be shown in red font. When starting up the application, expired files are removed within one minutes after start up. Within this last minute, the lifetime can still be modified to a new lifetime.

## D. Technical Design

Currently Operating Systems provide file information such as *Date Created* and *Date Modified* - however a *Date Expiring* is not yet part of the file system. Therefore the Forgetick application adds this expiring date dimension through a standalone application. The application was developed using the open-source C++ toolkit openFrameworks<sup>15</sup> as development environment. It implements a directory watcher, which keeps track of file changes in the Forgetick path and compares these with file records stored in a SQLite database.

A decision rule set was developed to handle the existence of files across directories, and works as previously discussed in section III-C3. The decision rule set determines actions in tricky situations, such as that the lifetime of a folder should be at least as long as the longest lifetime of files that it contains. Otherwise a folder would be removed while a file inside the folder was supposed to be kept longer. Therefore a folder adjusts to the lifetime of the files that it contains. On the other hand, it can be effective to apply a lifetime recursively in a folder instead of setting the same lifetime for each file inside the folder. The decision rule set that was developed deals with these kind of actions and situations.

The Forgetick app needs to stick the lifetime information to the file and keep it available even if the file is moved to a different folder path or when it is renamed. A database keeps a record of the checksum<sup>16</sup> and filesize for each file. Combining the filename, checksum and filesize a file item can be identified even when it is replaced or renamed across folders. This way it can track changes when the application is not even running: when it starts up it re-indexes the files and acts upon the intermediate directory changes since the last run.

Researching mechanisms of forgetfulness within a file system on a USB stick offers a stable testing environment to experiment with. Working with a portable application that is running from this external memory provides a consistent and controllable digital laboratory. The USB drive offers a delimited environment that is safe, since operations that involve file removal are executed within the boundaries of the USB drive and do not affect the file system of the host machine.

## E. Feedback

In this study forgetfulness is reintroduced to the digital domain to reconsider its relevance, importance and potential in today's culture. The USB stick testbed is presented as initial platform for experiment and experience, in parallel a set of principles is proposed for future studies and inspiration. This study furthermore tends to evoke a debate on moral, technical and legal grounds. It invites an audience to reflect how digital forgetting could be applicable and useful in one's every day life. General replies, reviews and feedback that came forward in informal discussions and talks about this study tend to center around the following themes:

1) Applications: In the first seconds exposed to the idea of forgetting in a digital context, it often strikes people as a counter intuitive concept. When thinking it over in a second instant it starts making sense and turns into a revelation. People are interested in the potential of how they could use digital forgetting and are curious to try out the Forgetick USB stick or Desktop application. Other people directly jump from the personal domain to the public domain (as discussed in section V-B) and wonder how digital forgetting would enhance control

<sup>&</sup>lt;sup>15</sup>See http://www.openframeworks.cc/

<sup>&</sup>lt;sup>16</sup>A checksum or hash sum is a small-size datum computed from an arbitrary block of digital data for the purpose of detecting errors that may have been introduced during its transmission or storage.

over their data in the realms of the internet. A question often posed is: could it work for information uploaded on social networks too?

2) Metadata: How to know on beforehand what file items you might be needing at a later moment? How to foresee what information is valuable in the long term and can you be certain which information really is irrelevant in the future? There is a fear to accidentally overlook potential valuable information that might possibly come in handy in the future, as a result disposal of information is 'not done' and every bit of data is stored indefinitely. This fear indeed brings about the tension to keep or not to keep. This is exactly the point of this study: to critically reflect on the lifetime of information and to make a conscious decision about it.

3) Collective Mind: Another recurring theme is the collective mind. It continues into the question: who owns information when it is shared? Is ownership and responsibility of shared information vested in the original sender or the recipient? What if the recipient exposes the information to a third party? This applies to digital forgetfulness in social context and the public domain, a theme that is beyond the scope of this study and fuel for the ongoing debate on information ownership in moral and legal contexts.

4) Security: When labeling information with a life time, this can be seen as expressing a certain quality to information. In the light of privacy this qualification can be of concern, since for third uninvited parties it can be more easy to find valuable information in the piles of data files. That raises questions on security and involves encryption and data protection.

## IV. PRINCIPLES FOR DIGITAL FORGETFULNESS

Humans forget in many different ways in different dimensions. In the USB stick test-bed as reviewed in section III, the fundamental dimension of *time* was explored by making a first working prototype for forgetting in a digital file system of a standard Operating System. This USB stick lays out the field for many more dimensions of digital forgetting. In this section a theoretical framework of *principles for digital forgetting* is proposed, as a second contribution to the field of digital forgetting.

This section starts with presenting the proposed principles in subsection IV-A. Secondly a distinction is made between Time-based and Event-based digital forgetting in subsection IV-B. In subsection IV-C the principles are discussed in light of the Forgetick application.

#### A. Framework of Principles

This set of principles suggest other dimensions in which digital forgetting can be explored. These principles are based on literature reviews, the discussed backgrounds, experiences from the USB stick test-bed development and the seven sins of memory as identified by Daniel L. Schacter [6] that were reviewed in section II. These proposed principles are presented and explained below.

1) Principle of Lapse: Our mind makes information less accessible over time. This is highly functional, because when information has not been used for longer and longer periods of time, it becomes less and less likely that it will be needed in the future.

2) Principle of Adaptation: Forgetting reflects an optimal adaptation to the structure of the environment. The past history of using a particular bit of information predicts its current use. Library books that were checked out recently are more likely to be checked out again. The likelihood of receiving an email message from a correspondent is a function of the time elapsed since earlier messages.

*3) Principle of Scrolling:* On the cue 'table' we do not instantly remember all our encounters with this subject at once, but we are slowly scrolling deeper into memory. This is a data overload protection.

4) Principle of Filtering: Imagine all stimuli were registered in elaborate detail, regardless of the level or type of processing to which they were subject. The result would be an overwhelming clutter of useless details. Our mind judges swiftly based on our attention, some information we encounter is never registered at all. This non-registering concept is implemented by the search engine DuckDuckGo.com to enhance privacy. Searches in this engine are anonymous, data is never registered to an identifiable account.

5) *Principle of Prospect:* Already at the moment of experiencing an event you decide about its importance based on its attention impact. You decide about the quality of the memory, based on the likeliness to recollect it later and to be of value in the future.

6) *Principle of Access:* Blocking in the human mind is about access, one can not retrieve information that is known to be there. This concept is obviously very applicable to digital domains, since it is about access permissions.

 TABLE I.
 The principles are categorized as Time-based forgetting or Event-based digital forgetting, and are mapped against the Seven Sins of Memory by Daniel L. Schacter [6].

Principle	Time-based	Event-based	Transience	Absent-Mindedness	Blocking	Miss-Attribution	Suggestability	Bias	Persistance
1. Lapse	Х		х						
2. Adaptation	х		х						
3. Scrolling	Х		х						
4. Filtering		х		Х					
5. Prospect		Х		х					
6. Access		Х			Х				
7. Abstraction	Х					Х			
8. Overlooking	Х					Х			
9. Similarity		х					Х	x	
10. Fixation	Х	Х							Х

7) Principle of Abstraction: Abstracting information is fundamental to abilities such as categorization and comprehension, allowing us to generalize across events and organize our experiences. Sometimes we don't really need to retain the source of the information, but we only need to keep the gist of it. We can benefit from an experience even when we do not recall all of its particulars, we abstract the key elements.

8) *Principle of Overlooking:* An autistic person is burdened by a rote record of trivial facts while remaining insensitive to patterns and regularities in the environment which our memory systems normally exploit to our benefit. These patterns are overlooked.

9) Principle of Similarity: For events that are repeated, such as Christmas, it is more easy to recall the event since the basic structure of the event is similar every year. Therefor when reminding the event of Christmas of about four years ago, only the details would make a difference. Similarity is a feature that is implemented as recommendations in Amazon, or suggestions while you type your search query in the Google omnibox.

10)Principle of Fixation: Sometimes the mind can not forget about intrusive recollections, information is fixed in place due to the impact of an experience. Repetition might also be a reason, it is unlikely to forget your own name.

In table I these principles are put in relation to the seven sins. The principles are furthermore categorized as time-based or event-based digital forgetting, which is further discussed the following subsection.

## B. Time-based or Event-based forgetting

In psychology, the term *prospective memory* is used to describe remembering to do things in the future. Such as picking up flowers when driving to a family gathering or making a call to reserve a table for two on Saturday night. Two distinctions are made in prospective memory by psychologists Gilles Einstein and Mark McDaniel [6]:

1) Event-based: This involves remembering to carry out a task when a specific event occurs. A cue triggers a recall of the intended action. For example if your friend Frank asks you to tell Harry to call him, whenever you happen to meet Harry at University.

2) *Time-based:* This involves remembering to carry out an action at a specific time in the future, a generated cue can help us remind to do something at a later time. For instance setting an alarm clock to get a dish out of the oven.

A time-based and event-based distinction could be made for digital forgetting too. Precise actions for digital forgetting can be triggered by event-based or time-based cues. For instance, deleting a movie from your USB stick that is stored there for over 1 year would be an example of time-based digital forgetting within the *Principle of Lapse*. It is unlikely that you will watch this movie anytime soon since it is already on there for months. In contrast, deleting a movie from your USB stick whenever it is completely watched would be an example of eventbased digital forgetting within the *Principle of Prospect* since it is unlikely you will watch this movie again soon.

## C. Forgetick Test-bed application review

When reviewing the Forgetick application that was developed for the USB stick test-bed, the following principles are implemented:

• Principle of Prospect

Within the Forgetick application, the user sets the lifetime for a file based on the intended or expected use in the future. This demands a conscious decision of the user and forces critical reflection regarding the lifetime of data.

• Principle of Lapse

The USB stick runs a portable application that self-governs the existence of the files that it contains, based on the lifetime set for the file item. This makes keeps the data collection organized, as a result the files are easier to navigate.

In further research and development the following principles could add interesting dimensions to the Forgetick application:

• Principle of Similarity

Files that are of similar file type could automatically be labeled with similar lifetimes. These lifetime standard could be made available as preferences for the user. For instance, mp3 files might be automatically set to be kept 6 months when transferred to the stick, while pdf files only need to be kept 2 weeks.

• Principle of Adaptation

For files that are used and reviewed often, the lifetime could automatically be extended since it is likely that the file is valuable and useful.

Beyond the application of digital forgetting on a USB stick, other implementations might be meaningful and useful. To give some examples:

• Principle of Abstraction

A text document might be summarized to its core message, abstracting the original text. Or the details in a picture might have been blurred out since they were not or less looked at.

• Principle of Overlooking

A great implementation to enhance Privacy on the internet would be a browser addon that breaks identifiable patterns in online behavior.

## V. DISCUSSION

This section briefly discusses what the implementation of digital forgetting implies, and how it could work across environments and social domains.

## A. Environments

Digital forgetfulness could be very well introduced to other digital file systems beyond the USB stick or Desktop. Such as a download folder or a backup drive. It might even go beyond local machines, digital forgetfulness can be applied to internet services such as an email inbox or file storage in the cloud.

## B. Social Domains

An whole new perspective that can be opened up beyond the USB stick is to broaden the application domain from private use to public use. Once information is shared it involves a whole range of other issues that are beyond the scope of this study such as copyright, security, surveillance and data protection. Applications of digital forgetfulness on social media, messenger services, online file sharing evoke many new questions to be further addressed in future studies.

## C. Implementation

Digital forgetting could possibly be implemented in standard Operating Systems and be available to a general audience via two different routes: embedding digital forgetting in a file system navigator such as Mac OSX Finder, or creating a new file type that supports digital forgetting.

1) Operating System: The first option would be to integrate the concept of an expiring date for file items right into an Operating System. Next to Date Created, Date Modified, the OS would have Date Expiring. This addition to the file system could become mandatory for Operating Systems, supported by a new Law on Data Regulation and Data Protection.

2) *File Type:* A second option would be to create a new file type that implements forgetfulness. The forgetting file type must incorporate encryption and security, and supportive software would be needed to opening the forgetting file type.

The practical USB stick test-bed and the theoretical principles for digital forgetting that are a result of this study intend to contribute to the reintroduction of digital forgetting in the digital domain.

#### VI. CONCLUSION

A shift in today's digital culture is ongoing: forgetting has become the exception and remembering the default. Instead of the other way around, as it has always been. Forgetting is not a human bug, it is a feature. This study aims at making a contribution to the idea of digital forgetting in our ever more digitized world. From the big abstract concept of *digital forgetting*, this study presents a very concrete test-bed application in the form of USB stick that is able to forget. The study presents a test-bed application that explores how digital forgetting could work in file systems on a fundamental level. This working prototype was developed to illuminate the debate on digital forgetting and go beyond just idea's and theory. It provides a starting point for further debate by opening the discussion on self-governance of personal information, privacy, techno regulation, the architecture of file systems and the future information management on the internet. Parallel to a working prototype that is a first implementation of digital forgetting in file systems on a standard Operating System, this study offers a second contribution: Principles for digital forgetting. This principles suggests to be inspired by natural processes when it comes to designing the mechanisms for digital forgetting. This set of principles is proposed as guidelines and inspiration to discover future applications of forgetfulness in digital culture.

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