Chapter 16
Stigmergic Hyperlink: A New Social Web Object

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ABSTRACT

Inspired by patterns of behavior generated in social networks, a prototype of a new object was designed and developed for the World Wide Web – the stigmergic hyperlink or “stigh”. In a system of stighs, like a Web page, the objects that users do use grow “healthier”, while the unused “weaken”, eventually to the extreme of their “death”, being autopoietically replaced by new destinations. At the single Web page scale, these systems perform like recommendation systems and embody an “ecological” treatment to unappreciated links. On the much wider scale of generalized usage, because each stigh has a method to retrieve information about its destination, Web agents in general and search engines in particular, would have the option to delegate the crawling and/or the parsing of the destination. This would be an interesting social change: after becoming not only consumers, but also content producers, Web users would, just by hosting (automatic) stighs, become information service providers too.

INTRODUCTION

Regular Web hyperlinks have limitations like unidirectional linkage, unverified destination, and issues related to relevance, reputation and trust (Leuf, 2006), some addressed by technologies like XLink (W3C, 2001). The stigmergic hyperlinks (stighs) we designed embody an alternative for some specific applications and propose some interesting paradigmatic changes.

“Stigmergy” means the mark of the work (Grassé, 1959), and it is a form of indirect communication, effective for some distributed control problems (Marco Dorigo, 2004).

Stighs are “stigmergic” because they communicate indirectly and, as collective, display
emergent behaviors (that are not the result of centralized control mechanisms).

Stigths are also “hyperlinks” because they can look and feel like regular hypertext hyperlinks (Wardrip-Fruin, 2004). The main difference is that stigths have a “life” attribute that increases when they are used and decays at a natural pace, eventually down to a “death” level. This dynamic drives interesting emergent systemic behaviors.

We elaborate on the stigh’s architecture in the context of pervasive stigmergy, also in human-human relations and use other author’s taxonomy (Parunak, 2005) to frame our proposed object and look at it from a social epistemology perspective (Marsh & Onof, 2007), that includes Word Wide Web cases.

We discuss applications for stigths at two scale levels: the single Web page and the “generalized usage” scenario. For the Web page scale applications, we provide a demo at http://stigh.org that can exhibit the behaviors that support decentralizing the finding of useful Web resources across a community of users and the automatic replacement of undesired destinations. These applications have similarities with recommendation systems (Linden, Smith, & York, 2003).

Regarding the generalized usage scenario, we discuss decentralizing search and stigths and the Deep Web. Decentralizing search would increase the “calculative capacity” (Callon & Muniesa, 2003) of Web authors and that would be a noticeable social change – this could be achieved if search engines could, at least partially, outsource some of their tasks, like crawling and/or parsing (Brin & Page, 1997), delegating on stigths or equivalent objects. The same delegation could be an approach to the Deep Web – the Web that the search engines ignore (Bergman, 2001) – because it is hard to generalize how to crawl it. Instead of generalizing, specialized stigths could handle particular cases.

The structure of this paper is as follows: first we explain the stigmeric hyperlink from a high level perspective, including the architecture of the individual agent and its environment, one possible taxonomical classification, and a social epistemology perspective of stigmergy and stigths. We then discuss possible applications from the single Web page scale to the generalized usage scenario. In order to better understand the internals of stigmeric hyperlinks, there is a detailed engineering section. After one illustrated example of stigths in action, we state some technological considerations and, finally, future work.

**STIGMERGIC HYPERLINK(S)**

**The Stigh**

Social insects are one inspiration for this new type of hypertext object we call the **stigmeric hyperlink** – stigh, for short.

Social insects, such as ants and termites are capable of complex behaviors like traveling long paths to/from food, and building structures. As individuals they wouldn’t be able to do it but as a collective body they indirectly communicate and forms of organization emerge. Stigmergy is this indirect communication via modifications on the environment and it can be a solution for distributed control problems (Marco Dorigo, 2004).

Stigmergy – from the Greek **stigma** (mark) and **ergon** (work) – means “the mark of work”, in the sense that agents/workers acting/working on their local environment “mark” it in a way that probabilistically other agents/workers will acknowledge. This will reinforce the work process without the need for direct communication. The expression was introduced by the French biologist Pierre-Paul Grassé (Grassé, 1959).

Grassé observed that termites, when building a nest, modify their local environment by aggregating mud balls, marked with pheromones. These balls are more likely to be placed where other pheromone-marked mud balls already are, than elsewhere – the nest is built from this con-