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Sudoku Saves Photographers from Copyright Theft

Sep. 5, 2013 — A new watermarking technology based on a system akin to the permutation rules used to solve the numeral puzzles known as Sudoku has been developed by computer scientists in Malaysia. Writing in the *International Journal of Grid and Utility Computing* the team reports how their system could resist attempts to "crop" the watermark in more than nine times out of ten cases.

Images, photos and graphics on the web are easy pickings for plagiarists and those who might ignore copyright rules. Photographers and others often add a watermark to their images to reduce the risk of their images being lifted for use on others' sites without permission. However, those intent on leeching an image might simply crop the watermark in some cases.

With the proliferation of digital multimedia content on the internet, content owners and service providers require robust technology to protect their work. Digital watermarking is commonly used to embed specific information into the media to be protected, such as a company's logo or product serial number. Such information can later be extracted and used to detect forgery and unauthorized usage and to prove authenticity and provenance. Importantly, a digital watermark must not distort or disrupt display of the image when used in its rightful place and so needs to be imperceptible in use.

Now, Shamsul Khalid of the Universiti Tun Hussein Onn Malaysia, in Johor, and colleagues, explain how a valid 9x9 Sudoku solution -- comprising a pixelated second image -- is used to create the watermark so that it is evenly distributed within an image and so that it resists automated cropping and noise additions by bots and other tools that scrape images from websites and add them to an illicit database for unlicensed resale or distribution to other websites that require a range of unique images but do not wish to pay for the privilege.

The approach uses the permutations of rows and columns in Sudoku solutions to create and detect an invisible digital watermark that is overlaid on an image with a random distribution. If the image pirate crops part of the image, then the chances are that enough of the watermark will remain elsewhere in the image that the complete watermark might be retrievable provided that the precise and correct Sudoku solution is given.

The team's initial tests showed that with 81 9x9 Sudoku solutions they could defeat more than 94% of attempts at cropping. They are currently implementing 256 16x16 Sudoku, which they suggest will be even stronger. The best "anti-cropping" watermarks used previously achieved only 75% resistance. Moreover, the Sudoku approach does not require investigators or the authorities to have access to the original image. Based on the relationship between full and partially recovered watermarks, the Sudoku approach will be able to discern whether a pirated image has the copyright owner's watermark.