3. Digital Image Processing

The following hypothetical claims are modeled after the technology in Research Corporation Technologies Inc. v. Microsoft Corp., *627 F.3d 859 (Fed. Cir. 2010) (*RCT*). The patent at issue was U.S. Patent No. 5,111,310. Hypothetical claims 1-3 are directed to an abstract idea and have additional elements that amount to significantly more than the abstract idea because they show an improvement in the functioning of the computer itself and also show an improvement to another technology/technical field, either of which can show eligibility.*

Background

A digital image generally consists of a discrete set of pixels arranged in columns and rows. In a gray scale image, the value of each pixel varies among shades of gray ranging from black at the weakest intensity to white at the strongest intensity. In contrast, a binary image includes pixels that can only have two values, black or white. Some printing devices such as facsimile machines and newspaper printers cannot reproduce gray scale images because they only print in black or white. Therefore, in order to convert a gray scale image into a binary image, halftoning techniques are used. Halftoning creates the illusion of various shades of gray in an image while only using the pixel colors black and white. Certain halftoning techniques involve the pixel-by-pixel comparison of the gray scale image to a two-dimensional array of threshold numbers, also known as a "mask." In digital implementation, the gray scale image to be halftoned is read into memory, and a computer processor compares each pixel of the image to a threshold number at the corresponding position of the mask stored in the computer's memory. Based on that comparison, a binary value representing black or white is output and these outputs are stored together in a binary array known as the dot profile. The dot profile is then converted to a binary display that is the halftoned image (the image for display).

In the instant application, the inventor has improved upon previous halftoning techniques by developing an improved mask called a "blue noise" mask. The blue noise mask requires less memory than previous masks and results in a faster computation time while improving image quality. The blue noise mask is produced through an iterative mathematical operation that begins with generating a dot profile with blue noise properties from an image at a 50% gray level using a blue noise filter. Subsequently, additional dot profiles are generated at differing gray levels. As pixels of the dot profile change across the gray levels, these changes are encoded in a cumulative array. Once all the dot profiles are built, the cumulative array becomes the blue noise mask.

Claims

1. A computer-implemented method for halftoning a gray scale image, comprising the steps of:

generating, with a processor, a blue noise mask by encoding changes in pixel values across a plurality of blue noise filtered dot profiles at varying gray levels;

storing the blue noise mask in a first memory location;

receiving a gray scale image and storing the gray scale image in a second memory location;

comparing, with a processor on a pixel-by-pixel basis, each pixel of the gray scale image to a threshold number in the corresponding position of the blue noise mask to produce a binary image array; and converting the binary image array to a halftoned image.

2. A non-transitory computer-readable medium with instructions stored thereon, that when executed by a processor, perform the steps comprising:

generating a blue noise mask by encoding changes in pixel values across a plurality of blue noise filtered dot profiles at varying gray levels;

storing the blue noise mask in a first memory location;

receiving a gray scale image and storing the gray scale image in a second memory location;

comparing, on a pixel-by-pixel basis, each pixel of the gray scale image to a threshold number in the corresponding position of the blue noise mask to produce a binary image array; and

converting the binary image array to a halftoned image.

3. A system for halftoning a gray scale image, comprising:

a processor that generates a blue noise mask by encoding changes in pixel values across a plurality of blue noise filtered dot profiles at varying gray levels;

a first memory for storing the blue noise mask; and

a second memory for storing a received gray scale image;

wherein the processor further compares, on a pixel-by-pixel basis, each pixel of the gray scale image to a threshold number in the corresponding position of the blue noise mask to produce a binary image array and converts the binary image array to a halftoned image.

<u>Analysis</u>

<u>Claim 1: Eligible.</u>

The method claim recites a series of acts for generating a blue noise mask and using that blue noise mask to halftone a gray scale image. Thus, the claim is directed to a process, which is one of the statutory categories of invention (*Step 1: YES*).

The claim is then analyzed to determine whether it is directed to any judicial exception. The claim recites the step of generating a blue noise mask, which as defined in the background is produced through an iterative mathematical operation. The courts have found that mathematical relationships fall within the judicial exceptions, often labelled as "abstract ideas." Since the mathematical operation of generating a blue noise mask is recited in the claim, the claim is "directed to" a judicial exception (*Step 2A: YES*).

Next, the claim as a whole is analyzed to determine if there are additional limitations recited in the claim such that the claim amounts to significantly more than the mathematical operation. There are several additional limitations recited in the claim besides the mathematical operation of generating a blue noise mask. First, the claim recites using a processor to generate the blue noise mask. The claim also recites the steps of storing the blue noise mask in a first memory location and receiving a gray scale image and storing the gray scale image in a second memory location. Thus, the claim uses a processor and memory to perform these steps of calculating a mathematical operation and receiving and storing data. The addition of general purpose computer components alone to perform such steps is not sufficient to transform a judicial exception into a patentable invention. The computer components are recited at a high level of generality and perform the basic functions of a computer (in this case, performing a mathematical operation and receiving and storing data) that would be needed to apply the abstract idea via computer. Merely using generic computer components to perform the above identified basic computer functions to practice or apply the judicial exception does not constitute a meaningful limitation that would amount to significantly more than the judicial exception, even though such operations could be performed faster than without a computer.

The claim also recites the additional steps of comparing the blue noise mask to a gray scale image to transform the gray scale image to a binary image array and converting the binary image array into a halftoned image. These additional steps tie the mathematical operation (the blue noise mask) to the processor's ability to process digital images. These steps add meaningful limitations to the abstract idea of generating the blue noise mask and therefore add significantly more to the abstract idea than mere computer implementation. The claim, when taken as a whole, does not simply describe the generation of a blue noise mask via a mathematical operation and receiving and storing data, but combines the steps of generating a blue noise mask with the steps for comparing the image to the blue noise mask and converting the resulting binary image array to a halftoned image. By this, the claim goes beyond the mere concept of simply retrieving and combining data using a computer.

Finally, viewing the claim elements as an ordered combination, the steps recited in addition to the blue noise mask improve the functioning of the claimed computer itself. In particular, as discussed above, the claimed process with the improved blue noise mask allows the computer to use to less memory than required for prior masks, results in faster computation time without sacrificing the quality of the resulting image as occurred in prior processes, and produces an improved digital image. These are also improvements in the technology of digital image processing. Unlike the invention in <u>Alice Corp.</u>, the instant claim is not merely limiting the abstract idea to a computer environment by simply performing the idea via a computer (*i.e.*, not merely performing routine data receipt and storage or mathematical operations on a computer), but rather is an innovation in computer technology, namely digital image processing, which in this case reflects both an improvement in the functioning of the computer and an improvement in another technology. Taking all the additional claim elements individually, and in combination, the claim as a whole amounts to significantly more than the abstract idea of generating a blue noise mask (*Step 2B: YES*). The claim recites patent eligible subject matter.

<u>Claim 2: Eligible.</u>

The claim recites a non-transitory computer-readable medium with stored instructions. The term "non-transitory" ensures the claim does not encompass signals and other transitory forms of signal transmission. Therefore, the claim is directed to a manufacture (an article produced from materials), which is a statutory category of invention (*Step 1: YES*).

The claim recites the same steps as claim 1. Therefore, the claim is directed to the same abstract idea identified in claim 1 which is the mathematical operation of generating a blue noise mask

(*Step 2A: YES*). Similarly, the claim recites the same additional elements of comparing the blue noise mask to a gray scale image to transform the gray scale image to a binary image array and converting the binary image array into a halftoned image. These additional elements add significantly more to the abstract idea as evidenced by the improved functioning of the computer in halftoning a gray scale image and the improved digital image processing. For the same reasons set forth above, taking all the additional claim elements individually, and in combination, the claim as a whole amounts to significantly more than the abstract idea of generating a blue noise mask (*Step 2B: YES*). The claim recites patent eligible subject matter.

Claim 3: Eligible.

The claim recites a system comprising a processor, a first memory and a second memory. The claim is directed to statutory category of invention, *i.e.* a machine (a combination of devices) (*Step 1: YES*).

The claim recites the same abstract idea as identified with regard to claim 1, which is the mathematical operation of generating a blue noise mask, and thus is directed to the abstract idea (*Step 2A: YES*). Similarly, the claim recites the same additional elements that compare the blue noise mask to a gray scale image to transform the gray scale image to a binary image array and convert the binary image array into a halftoned image that add significantly more to the abstract idea. For the same reasons set forth above, taking all the additional claim elements individually, and in combination, the claim as a whole amounts to significantly more than the abstract idea of generating a blue noise mask (*Step 2B: YES*). The claim recites patent eligible subject matter.

4. Global Positioning System

The following hypothetical claims are modeled after the technology in SiRF Technology Inc. v. International Trade Commission, 601 F.3d 1319 (Fed. Cir. 2010) (SiRF Tech). The patent at issue was U.S. Patent No. 6,417,801. Hypothetical claims 1 and 2 are directed to an abstract idea and have additional elements that amount to significantly more than the abstract idea because they show an improvement to another technology or technical field.

Background

Global Positioning Systems (GPS) use signals from multiple satellites to calculate the position of a mobile GPS receiver on Earth. Each satellite transmits a signal containing unique pseudo-random noise (PN) codes, satellite positioning data and absolute time information. A mobile GPS receiver generally determines its position using the PN codes, satellite positioning data and the absolute time information from multiple satellite signals. In areas where signal levels are low, it is possible for the mobile GPS receiver to detect the PN codes, but is difficult to obtain the satellite positioning data and absolute time information from the satellite signals.

This application describes systems and methods in which a server wirelessly coupled to a mobile GPS receiver uses a mathematical model to solve for the mobile receiver position without receiving satellite positioning data or absolute time information from a satellite. These systems and methods improve GPS techniques by enabling the mobile GPS receiver to determine its position more accurately and improve its signal-acquisition sensitivity to operate even in weak-signal environments. In particular, the mobile GPS receiver is a mobile device that includes a