EXHIBIT F

Nokia Point & Find

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How Do Computers "See?" Image Recognition Expert Matthew Johnson Explains.

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When I use Nokia Point & Find on my N97, I'm always amazed by how my phone's camera can immediately recognize objects like barcodes and buildings, even without taking a picture of them. So today I caught up with Matthew Johnson, Lead Software Engineer at Nokia Point & Find, to find out how the technology works.

Q: Nokia Point & Find uses image recognition to identify objects in the world around you, using your phone's camera. Is this image recognition technology part of a bigger field of research?

A: It's one of the main tasks studied in the field of computer vision, which is itself part of the field of artificial intelligence. Computer vision research focuses on developing ways for computers to achieve the same complex tasks with visual data as the brain such as recognizing faces, navigating through a room, reading text and in the case of Point & Find matching parts of an image to parts of another image.

Q: Why have you decided to dedicate your life to researching computer vision?

A: My mother is a concert pianist and soloist, and my father is a computer scientist and mathematician. As a result, I have always been of two minds about my approach to the world, both artistic and scientific. By studying the way the brain understands visual information and trying to reproduce that process in computers, we learn a lot about how human beings comprehend the visual world, and that appeals to both sides of me.

Q: Does computer vision have anything to do with the way we see using our eyes?

A: Absolutely. The eye is a camera, with light focused on the retina. The retina has a bunch of cells which react to the incoming light in different ways. One kind sees the world in gray and are used in the dark and by your peripheral vision. Another kind separates light into different colors: red, green and blue. The cells in the retina encode the image the eye sees and sends it to the visual cortex, which is how we see. In a similar way, a digital camera encodes and sends image information to a computer vision program.

**Q: Is this similar to how digital cameras work?**

A: Digital cameras work a lot like the eye, capturing light in three different channels of red, green and blue. However, where the eye is an analog, or continuous, image capture device a digital camera is a digital device. The light is gathered by receptors, and each receptor creates a pixel in the final image.

Q: How does this translate to what the computer sees?

A: Computers can use these pixels to find out all kinds of information about an image. This information is usually represented by a histogram, which is a collection of counts for different properties. The histogram is the challenging part of the technology to get right. The computer uses histograms to compare different images, and when the histograms are similar it infers that the images that produced them must be similar, which helps it to recognize the object it is "looking" at. We have made significant strides in this area at Nokia Point & Find, which you can experience using the free P&F service in real life on Nokia smartphones.

Matthew Johnson earned his PhD in Computer Vision at the University of Cambridge and knows more about computer vision and imaging technology than I'll ever understand. If you ever want to learn more on the topic in further technical depth, I highly recommend checking out his technical publications.

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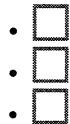
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About

Nokia Point & Find lets you access relevant information and services on the internet, simply by pointing your mobile phone camera at real life objects. The service combines the first mobile augmented reality browser on S60 devices with a web-based content management tool that allows anyone to create and publish augmented reality experiences.

Companies utilize Nokia Point & Find Management Portal to create a mobile experience combining location-based technology with image recognition, sensor-based orientation, text search, advanced barcode scanning, and common smartphone functions easily, quickly, without any coding required.

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