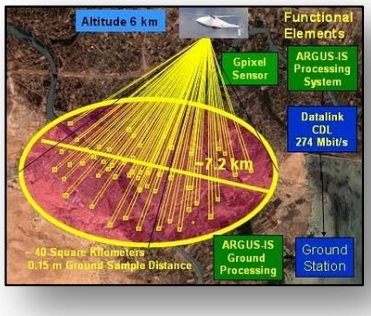
GigaPixel Surveillance in our future

By Christopher Hills CPP, CRMP

I have been asked if I really believe that GigaPixel technology will be used for security surveillance, after all we're talking about a digital image bitmap composed of one billion pixels (picture elements), 1000 times the information captured by a 1 megapixel camera. That is an extremely large image containing so much information that the human eye cannot see everything in the image. Special software has been developed to dive into the image. For me researching this new media started when a colleague sent me a link to the 70 Billion Pixels Budapest site. Not only was I amazed but I was hooked. I have since started a site to aggregate and journal GigaPixel technology called GigaPixel360.com.

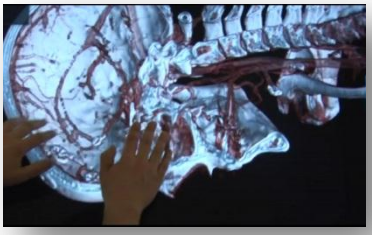
The more I learn about GigaPixel images and the growing market around the technology the more I am sure that surveillance will be impacted dramatically. Like most technology improvements over time, GigaPixel imaging technology advances in the areas of camera technology, storage and bandwidth are expensive. A few years ago the same was true of computers, cell phones and other technology advances we enjoy today at an economy we could have only imagined at the time.

The capabilities of many digital electronic devices are strongly linked to Moore's law: processing speed, memory capacity, sensors and even the number and size of pixels in digital imaging. Moore's law basically sets up the premise that in the future we will have the ability to capture GigaPixel video allowing security analytics we can only imagine (I could write another article on just the analytic advances that GigaPixel imaging makes possible). Today GigaPixel camera surveillance technology innovation is being driven by Military applications. Recently, the Pentagon has ordered a 1.8 GigaPixel surveillance video camera system designed as a payload for the A-160T Hummingbird robot helicopter now being quietly delivered to Special Forces. The camera is scheduled for flight testing at the start of this year giving them an unprecedented ability to track everything on the ground in real time.



Surveillance is only one of the many markets being affected by GigaPixel technology. One such market is healthcare organizations which are embracing GigaPixel technology at an unprecedented rate. Allan Korn, MD, CMO and Senior Vice President for Clinical Affairs for BlueCross BlueShield stated "We assume that every megabyte of an individual GigaPixel that we generate in the healthcare industry somehow needs to be aggregated and reported to everybody in a useful way," while participating in a recent Price Waterhouse Cooper healthcare report.

On another front, according to NASA Ames, University of California, Santa Cruz and Carnegie Mellon University, an increasing number of scientific disciplines (biological, medical, and material science) require high spatial resolution imagery but suffer from an insufficient lateral field of view. A mosaic of microscopic images, forming a GigaPixel image, solves this problem by capturing the entire subject while maintaining a high spatial resolution. Other areas utilizing this new technology are Geo Science, Museum Art, Documenting Fossils, Building Interiors, Dangers From Space and Crime Scene investigations to name a few. GigaPixel images can be hooked together to create tourist sites, or provide a visual framework for mapping applications, they are also an obvious platform for advertising. The list of possible areas of interest, organizations and markets for this rapidly increasing technology are never ending.



The big problem, as I am sure you have already considered, is how are we going store all of this information and move it over the internet? This can be a costly problem considering one company's recent experience. GigaPan offers free GigaPixel storage and in conjunction with Carnegie Mellon and NASA recently came out with a white paper depicting the rapid rise in GigaPixel images being uploaded to their service. The outcome is a dramatic increase starting in 2008 with around 1500 images and increasing to around 45,000 images by mid-2010. According to GigaPan, Carnegie Mellon and NASA that is equivalent to approximately 25 terapixels. That is a massive amount of digital information needing to be stored and accessed.

So how do we deal with this amount of information? When "Pan-STARRS", a "Panoramic Survey Telescope & Rapid Response System" is fully operational, it will have four telescopes, each with a digital camera capable of 1.4-gigapixel resolution. With just one telescope in operation so far, the facility already generates 1.4 terabytes of image data per night. For the longer term, its architects are installing 1.1 petabytes (quadrillion bytes) of disk storage. Although Pan-STARRS won't use up all of that storage right away, it will still rank as one of the world's largest databases. "There are only a handful of databases that large in the world," said Ted Kummert, Corporate Vice President of the Data and Storage Platform Division at Microsoft commenting on Microsoft SQL's ability to scale to the huge GigaPixel information demand.

Microsoft is on the forefront of current technology developed for this media. They have developed an end to end program for producing and viewing GigaPixel Images. This means that when zoomed in you are presented with a standard perspective projection providing a sense of immersion, and when zoomed out you experience a curved projection so that you get a full overview of the scene. Microsoft also allows you to mash your GigaPixel into a 3D scene with Photosynth. Not only can you view your GigaPixel images via the internet with HD View, Silverlight Deep Zoom but you can now view them on your phone with Seadragon.

The first generation of GigaPixel surveillance could be used in same fashion as the military application mentioned above, command and control of assets within an area, the ability to move around a very large area, yet zoom up on the license plate of a car half mile away.

Hardware manufacturers, another market embracing this new technology, will be paramount to delivering this new deep information content to the end user. Dr. Thomas Ertl, Professor with the Visualization Institute of the University of Stuttgart, gives several examples of Gigapixel

visual (display) development drivers as medical volume visualization, visualization of molecular dynamics and terrain rendering to name a few. The University of Stuttgart is one of many educational institutions delving into Gigapixel technology and display systems. The LIVE lab at Virginia Techs "Gigapixel Project" focuses on information visualization using large, high resolution displays while Microsoft is empowering GigaPixel images through interfaces like the Kinect interface along with the release of Surface 2.0 which is making Gigapixel more accessible to the end user. Displays that allow multiple users to interact with massive amounts of data in real time is the goal of both learning institutions and corporations alike.

In terms of surveillance one early adopter may be municipalities employing the Gigapixel video technology in a fashion similar to the military, but rather stationary from a very high point in a city. Combining megapixel and regular camera(s) would allow deep dives into areas not covered by or not accessible to the Gigapixel video. Similar to Microsoft Bing's StreetView integration with flicker users which already supports integration of interior and exterior video, except these security video icons will be click tagged with geo information, camera location, camera type etc... So that the operator can seamlessly move into the cameras already placed in those locations or within vehicles on the move. In the surveillance market, systems have to have the ability to mine actionable information, meaning a system would need to ignore empty spaces, or rather recognize (learn) that buildings or spaces are constant and unchanging (which become non interest), send back low res active spaces (which become medium Interest) high res of interest (which become high interest) giving a new perspective to a car leaving a bank robbery for instance. In this scenario the operator of our Municipal surveillance system could be viewing the scene and in video pursuit before officers arrive on site. Because the buildings never move, the buildings in the background would show up high res; however it would not take any bandwidth as the buildings are not actually being sent as video as they are stationary objects and the system has marked those pixels as "background" images. The system would then utilize low res for the surrounding

medium interest areas (such as streets). In real time an operator could define a square around the area of interest while diving into that area of the city. The area of interest, in this case is our car leaving the bank robbery scene and the subsequent chase, which is being monitored by the system from above in real time utilizing a low bandwidth by sending only those areas of high interest.

It's not a matter of "if" GigaPixel surveillance is in our future, it's "when".