Chapter 19
Mobile Vision on Movement

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ABSTRACT

In the early days of photography, camera movement was a nuisance that could blur a picture. Once movement becomes measurable by micro-mechanical means, the effects can be compensated by optical, mechanical or digital technology to enhance picture quality. Alternatively movement can be quantified by processing image streams. This opens up for new functionality upon convergence of the camera and the mobile phone, for instance by 'actively extending the hand' for remote control and interactive signage.

INTRODUCTION

The history of technology is one of surprising crossovers, where a technique developed in one area causes subsequently a break-through in another area. For 'movement' the milestone is the invention of the accelerometer for the airbag: the cushion that inflates for large decelerations to protect vehicle passengers from physical damage. Inflating too early may cause an accident, while reacting too late makes it useless. Therefore the sensor needs to perform robust and dependable in real-time to provide the desired safety, while the mass-market requires it to be cheap and mass-producible. The large-scale introduction of this sensor has given credibility for use in other markets (Knivett, 2009).

The most remarkable crossover has happened when the accelerometer is applied to the digital camera. Typically handling causes a jitter of 10 to 20 vibrations per second. The effect is more apparent with the larger pixel sizes and is further magnified by auto-focus and zoom features (Or & Pundik, 2007). Once having the jitter extracted, it can be compensated by optical and mechanical techniques providing image stabilization. This can also be performed by digital techniques and from the movie industry came special hardware boxes to support such functionality. However, initial ex-

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periments to bring the stabilisation function as software into the camera have not been successful. The digital camera, equipped with digital communication channels, has created a new industry with associated printers, photo-finishing kiosks and a variety of on-line services.

The mobile phone quickly caught on and started to integrate the camera onto the mobile platform, called the camera phone. The product philosophy is based on 'convergence' of data, audio and video into a single device. Sharp and J-Phone have introduced the world-first camera-phone (J-SH04) in November 2000 in Japan. Four years later (October 2004) about 75% percent of mobile phones in Japan are camera phones and in 2005 the market penetration saturates around 75 to 85%, i.e. almost all mobile phones in Japan are camera phones. In the meantime the number of cell phones in general is skyrocketing and will break the 1 billion units barrier by 2010 according to the Gartner Group. Though the camera phone overshadows the digital camera in sales volume, its performance still trails because of additional requirements on cost, size and power consumption (Henning, 2008).

A similar development has been in Remote Control, for instance for the Home Amusement Centre. The early devices simply send keyboard pressings over an infra-red channel to the TV. Recently, it has become possible to point or even to copy movements into a cursor position on a screen. By measuring the pulses over the infra-red channel, the Doppler effect of the moving device can be quantified and used for calibration. Such techniques can also be used to free the computer mouse from its wire, and over this application the Gaming industry is entered. Games have been developed first as a PC application and gradually moved to use specialized peripherals. Also here the wiring between computer peripherals and the processor box has always been a cause for irritation. Cables get mixed up and the user is limited in its freedom, even more so with the advent of multi-user games.

(Casual) Gaming has been based on laser-based pointing devices with sensors located in/on the target object. This concept has brought a remarkable spin-off in museums, where one points to art to get a spoken explanation. Recently the accelerometer from the air-bag and the digital camera also made a cross-over to remote control. This way to move a device and let the movement known to a server to be included in a game or service is best known from the Wii technology. The path the accelerometer went from its invention in automotive safety to mass amusement is accompanied by a continuing improvement. According to a recent Gartner study (Savvas, 2008), the market demands further improvement in the mechanical motion sensor technology, gradually adapting the accelerometer better to the requirements of the application areas.

Initially the camera phone is just the addition of a vision sensor to a cell-phone, but with less resolution and at less performance. For the mobile telephone the emphasis has been on image compaction and stabilization by measuring the global motion through electronic means. Alternative to the use of the accelerometer, image stabilization can also been done by digital image processing. This removes the dependence on mechanical stress and temperature effects, making the accelerometer hard to test when the device becomes smaller. In the movie industry, separate boxes where the camera images are post-processed for stable 3D effects, have long been in use. It is not trivial to incorporate this functionality into the camera phone. But when this is done, all kind of pointing and interaction functions can be accommodated on a camera phone. This can be extended to support to capture user directives (Cravotta, 2007).

One may wonder, whether this development path is plausible as it assumes that a technology with limited effect in digital cameras will by nature become better when the market is extended to mobile telephones. For the mobile telephone the emphasis has been on image compaction and stabilization by measuring the global motion