

# SMARTPHONE MEASUREMENT ENGINEERING AND QUALITY ASSURANCE – A BREAKTHROUGH OF GREEN GAME CHANGERS

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**Abstract** – Smartphones have an enormous conceptual and structural influence on measurement engineering & quality control in science & education, instrumentation & application. Smartphones are matured. In 2009 worldwide 174 million Smartphones has been delivered. Measurement & control with Smartphones are ready for new opportunities for measurement engineering and quality control. Smartphones became convenient, reliable and affordable computers with cameras. Their cloud computing is the innovative technical infrastructure for knowledge acquisition, transfer and application. Their apps are innovative software modules for direct specialized applications. Smartphones, clouds and apps are reducing the complexity of conventional solutions in measurement engineering and quality control and facilitate 24/7/365-applications for everyone. Aim of the paper is to describe selected success stories for the fantastical capabilities of the modern game changers to flatten the boundaries for their fast acceptance at work and at home for measurement and quality control. Special attention is given to green vision for mobile object identification, contactless industrial quality control, personalized health care, remote facility and transport management, safety critical surveillance and all tasks which are too complex for the human eye or too monotonous for the human brain.

**Keywords** mobile, measurement, quality management

## 0. INTRODUCTION

Smartphones have an enormous conceptual and structural influence on measurement engineering and quality control in science & education, instrumentation & application. Smartphones are matured. They became convenient, reliable and affordable. In 2009 worldwide 174 million Smartphones has been delivered. Measurement and quality control with Smartphones are ready for the future. In only 10 years the German vision industry tripled its global sales volume over one Billion Euro/Year. Machine vision is used for mobile object identification, contactless industrial quality control, personalized health care, remote facility and transport management, safety critical surveillance and all tasks which are too complex for the human eye or too monotonous for the human brain. Aim of the paper is to open the eyes for a new standpoint concerning intelligent quality measurements. Smartphones are the innovative nano computers with an artificial eye and a browser. They become

the fundamental instrumentation for mobile measurement and quality control in the near future.

## 1. SMARTPHONES FOR SCIENCE

The fundamental task of science is to discover new relationships for example in measurement and quality control and to generalize the new knowledge for practical applications. This can be most convenient accomplished by Smartphones with

- open access to general knowledge,
- open access to special knowledge,
- fast publication of full-text documentations,
- simple storing of multimedia documentations
- high visibility of facts and specialists including videos,
- safe archiving in clouds and last but not least
- unlimited individual exchange of opinions by video conferencing in professional and social networks.

A practical example is the IOPscience express for iPhone, iPod Touch or iPad. The philosophy and the practical realization are demonstrated by an online tour in “all” languages (Fig. 1-1).



Fig. 1-1 Screenshot of the Online Tour  
<http://iopscience.iop.org/onetour> 26.06.2011

## 2. SMARTPHONES FOR EDUCATION

The fundamental task of education is to transfer generalized knowledge to final users for their qualification. The enhancing complexity of for example measurement problems and the fast development of innovative measurement and control facts and equipment demand a permanent re-qualification of users at work and at home. This can be most convenient accomplished by Smartphones with browser-based access to

- ebooks (Fig. 2-1)
- etutorials (Fig. 2-2)
- webcasts
- webinars (Fig. 2-3)
- web internships
- web conferences
- web academies.



Fig. 2-1 Smart Hybrid & Mobile Book Reading for Education

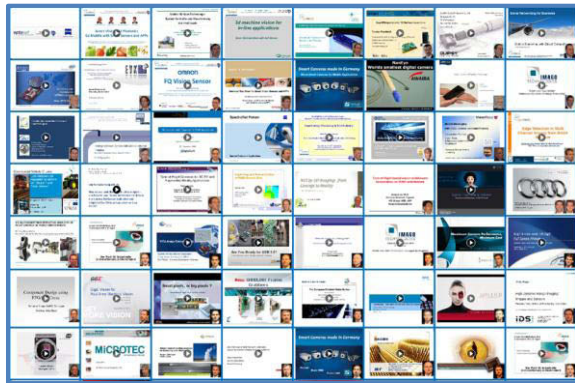


Fig. 2-2 eTutorials with eVideos  
<http://www.spectronet.de> 26.06.2011



Fig. 2-3 Screenshot of the Registration for a Webinar  
<http://pennwellreg.stream57.com/smart> 26.06.2011

## 3. SMARTPHONES FOR MEASUREMENT INSTRUMENTATION

The first example shows Smartphone applications for home and industrial measurements (Fig. 3-1).



Fig. 3-1 Smartphone Measurement Applications for Fundamental Physical Measurands

The second example shows Smartphone applications for medical inspections (Fig. 3-2).

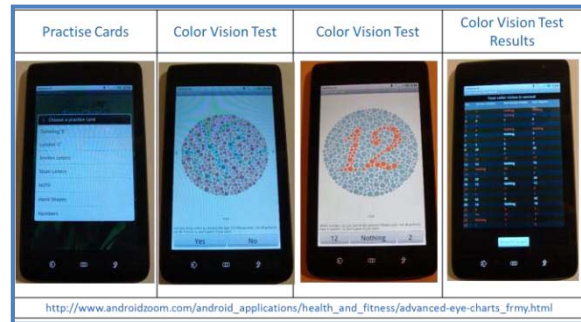


Fig. 3-2 Smartphone Test Applications of the Color Vision Capability of Human Operators

## 4. SMARTPHONES FOR QUALITY CONTROL

The first example shows Smartphone applications from wireless personal instructions with Skype to telecontrolling with quality management software for example from [www.caq.de](http://www.caq.de) (Fig. 4-1).



Fig. 4-1 Smartphone Applications for Quality Control and Quality Management

The second example shows that engineers at Sea Changer Inc., Largo, Florida designed a handheld wireless sensor colorBUG (Figure 4-2) that measures CIE color values and illuminance in concert with free software from the iTunes App Store and displayed on iPhone or iPod touch for quality control (Figure 4-2).

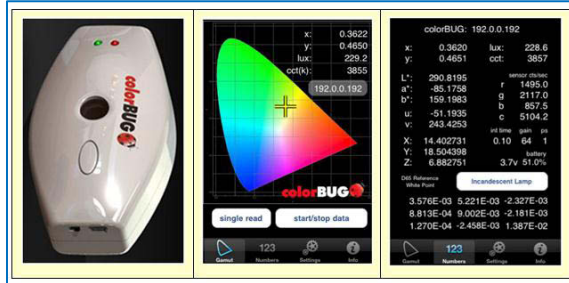


Fig 4-2 ColorBUG Sensor

<http://www.oceanoptics.com/products/colorbug.asp> and displays on iPhone 26.06.2011

### 5. CURRENT BOTTLENECKS

The fast development and harmonization of Smartphones and Smartpads raises the question: Is it desirable and possible also to harmonize for example the software for image processing. The question is not from about because Smartphones are equipped with lighting, camera and powerful computing capabilities. The huge number of software packs and apps hamper their selection and application. A short impression is given by a small selection of packs (Fig. 5-1) and a small selection of apps (Fig. 5-2).

	<a href="http://www.mvtec.com/download">http://www.mvtec.com/download</a>
	<a href="http://industrial.omron.de/de/misc/forms/download_xpectia_simulator.html?referrer=22985&amp;subject=Xpectia%20Simulator">http://industrial.omron.de/de/misc/forms/download_xpectia_simulator.html?referrer=22985&amp;subject=Xpectia%20Simulator</a>
	<a href="http://www.commonvisionblox.de/pages/cvb/releases.php">http://www.commonvisionblox.de/pages/cvb/releases.php</a>
	<a href="http://stz-ilmenau.de/downloads/index.php">http://stz-ilmenau.de/downloads/index.php</a>
	<a href="http://www.zbs-ilmenau.de/intern/vip/toolkitd.php">http://www.zbs-ilmenau.de/intern/vip/toolkitd.php</a>
	<a href="http://www.zeiss.de/axiovision">http://www.zeiss.de/axiovision</a>

Fig. 5-1 Small Selection of Software Packages for Image Processing

	<a href="https://market.android.com/details?id=com.devuni.flashlight&amp;feature=search_result">https://market.android.com/details?id=com.devuni.flashlight&amp;feature=search_result</a>
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	<a href="https://market.android.com/details?id=com.mobialia.colordetector&amp;feature=related_apps">https://market.android.com/details?id=com.mobialia.colordetector&amp;feature=related_apps</a>

Fig. 5-2 Small Selection of Software Apps for Image Processing

### 6. CONCLUSIONS

General aim of the paper was to show that the progress in measurement engineering and quality control is **not** linked with PCs and expensive measurement instruments only. In near future measurement engineering and quality control will be more convenient, reliable and affordable due to the worldwide existing Smartphones in many millions of hands. A strong push in future developments and products will be accomplished by the reduction of mass for products and services and by the launch of innovative smarter and greener products and services into old markets (Fig 6-1).

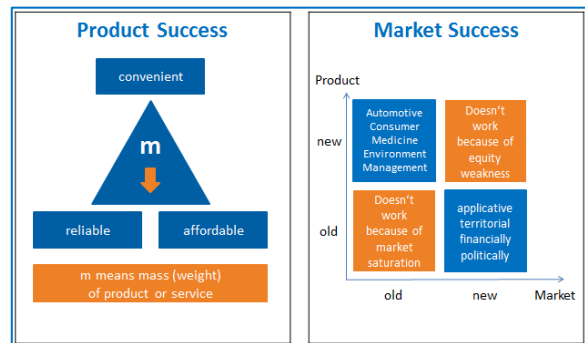


Fig. 6-1 Product Success and Market Success

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