OS Independent Mobile Solutions for Manufacturing Execution Systems

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ABSTRACT

From the suppliers' perspective it is best to provide the user of a plant with a mobile solution in the form of perfectly matching Apps for the rolled-out manufacturing execution system. Due to the extremely short innovation cycle in the mobile phone development and not least because of the first iPhone generation launch in 2007 the mobile phone market completely changed over the past four years. Today, a large percentage of the sold devices can be classified as smart phones. The paper describes an easy and reliable way to develop OS independent mobile solutions for all common smartphones based on standard technologies.

Keywords: HTML 5, PhoneGap, Mobile, Manufacturing Execution System, SOAP, Web service, Android.

1. INTRODUCTION

For a long time, mobile devices have become widely used with control systems. The solutions include proprietary pager-based systems just as SMS messages sent by traditional mobile phones. But in these cases, the maximum number of characters available and the possibilities of graphically displaying the transferable information are limited. Interaction with the control system or taking direct measures is hardly – or only in a very simple way – possible.

Due to the extremely short innovation cycle in the sector of mobile phone development and not least because of the first iPhone generation launch in 2007 the mobile phone market completely changed over the past four years. Today, a large percentage of the sold devices can be classified as smart phones (s. Fig. 1). The original primary function of calling is only playing a minor role. Initially, only private users enjoyed these innovative mobile possibilities, but meanwhile these technologies have reached business users as well. The "mobile" office is used by the most different industries and it is hardly imaginable working without it any longer.

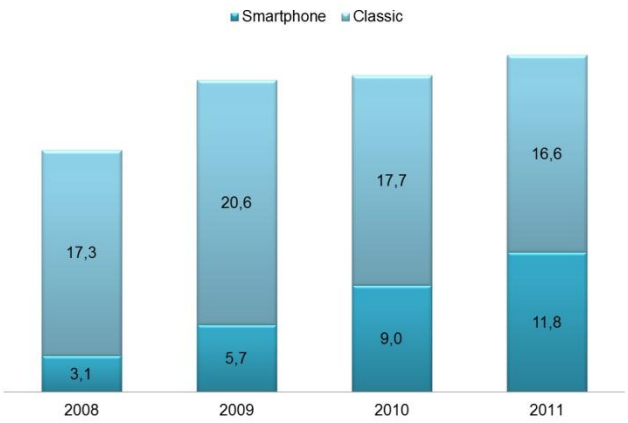

Figure 1: Distribution of smart phones in Germany in million pieces – Source: BITKOM

While the Apple App Store offers 425.000 apps for download, there are still only a few appropriate solutions that are applicable for industrial use, especially for production. The same is true for the still young but large "Market Place" for Android Devices. This is due to the specific features of the available control systems and the respective requirements these Apps have to be tailored to. In contrast to the consumer market of mainly private applications, it is therefore rather difficult to provide a universal solution.

2. GENERAL TREND

Although, the market offers already some toolbox solutions that provide an integration of existing and new alarm systems for the building control, SCADA-Systems, MES or any other data server to a complete system, these solutions still don't provide the functional range to meet the requirements of an installation. From the suppliers' perspective it is therefore best to provide the user with a mobile solution in the form of perfectly matching Apps for the rolled-out control system. The next hurdle is to select the right hardware-platform. A few years ago, Blackberry was the standard in the Smartphone sector, but various other platforms become increasingly established on the market, particularly iOS and Android. Now, the challenge is to create solutions that can be applied equally for the most important devices, so that the end customer can select his favorite hardware.

This general trend should be used by the automation engineering for innovative solutions. The evaluation of a complex or highly automotive production process requires, inter alia, significant key data. Only a performance measurement system that is able to process and provide data in real time enables an efficient control of the production for the management. For collecting, calculating and filing key data, stand-alone systems or functional modules are applied in integrated production systems, such as a MES (Manufacturing Execution System).

3. DATA ENTRY DURING THE PROCESS

In the heterogeneous IT landscapes of production, online interfaces to the production controls can usually be implemented only at considerable expense and are thus somewhat of an exception. Yet in comparison with manual data entry using what are known as MDA – Machine Data Acquisition or PDA – Production Data Acquisition terminals, the significance and quality of online data are considerably higher. Reliable key performance indicators therefore require online interfaces. The interfaces should be standardized as much as possible to make accessibility more feasible.

The level of detail and the quality of the data entered have a decisive influence on the quality of the indicators. For example, the availability per plant/machine mentioned above can be displayed with a “collective alarm” for each machine. But if you want to break down this factor into the components “technical”, “organizational”, and “system related”, you need three “alarms” for the process. This increase in detail immediately leads to imprecision that opens the way to different interpretations: what happens when several different “classes” of alarms appear simultaneously? To solve this problem, an open class and priority concept is needed that can be adapted to the circumstances of production.

4. KPI PROCESSING

The calculation of the key data has to be flexibly adaptable to the requirements of different production areas. A flexible visualization tool for the collected raw data and calculated key data is required. Data that is not distributed attractively will not be used in the end. Currently, there's a trend to simplify the reporting using as little key data as possible via "Dashboards" or "Signal solutions". This might be enough for an initial assessment of the situation, but it doesn't provide any further analyses and thus no derivation of measures, too. That is the reason why the reporting of key data should provide the possibility for "Drill-down" (how is the value made up and which partial aspect has been essential) and also the history of the key data (trend value or statistical outlier).

In the industrial environment with its high grade automotive technologies, OEE (Overall Equipment Efficiency = product of availability, performance and quality rate) has become a universal indicator. The parameter “availability” reflects the reliability of the machinery and plants and takes account of disturbing influences. The parameter “performance” provides information about idle time and cycle time overrun and the “quality rate” represents losses from quality issues. Thus, the OEE is an indicator that includes all relevant influence. Although it provides an initial indicator for a general assessment, it doesn’t allow a detailed causal research. For this, the single parameters and other key data –adjusted to a specific problem – normally are more appropriate. In many applications, especially the parameter "availability" is calculated and interpreted in different ways. A classification of the availability into "technical" (from the perspective of machinery / production plants), "system-dependent" (idle times caused by close-by plants/engines) and "organizational" elements is one example for such a detailing. Thus the OEE will include an “overall availability", which is the result of purging the overlaps of the three indicators mentioned above.

5. COMMUNICATION

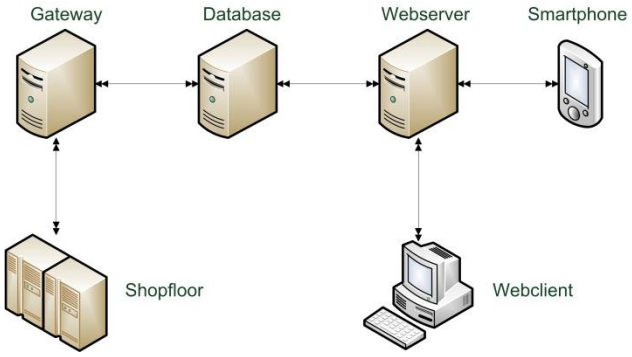

Figure 2: Continuous communication from the PLC to the mobile device

An online connection from the production control to the control system allows a timely high quality data acquisition. The data transfer to the mobile device has to take place without any major delays (s. Fig. 2). Connecting the controls of the shop floor takes place either via standards, such as OPC or via a direct socket-connection (TCP/IP). All process data and reports of the control level will be entered in the central data base of the MES via the gateway. The web server accesses to this one. Data processing for the web client in the production and for the smart phones is done via web application. If required (for reasons of greater security), it is possible to install an additional web server outside the firewall to connect the mobile devices. The entire MES communication is designed bi-directionally. Even all data that is transmitted to the shop floor will be previously entered into the database.

6. KPI APP

Using for example the iLegato KPI-App (s. Fig. 3) the employee has the possibility to access the subscribed key data of his production sector any time. Based on the OEE, it is possible to use additional key data of the node for assessment. Alerts und process values can easily be observed and if necessary actions initiated. The configuration is made comfortably in an easy way via the regular web client of the control system, executable on a standard web browser.

Figure 3: Native iPhone interface with iLegato KPI-App

In industrial production, a "shift" is used as a given period for collecting production key data. Normally, production requirements are specified in a shift rhythm (e.g. volume and products) and the production employees work in shifts, too.

Thus, a target/actual comparison will be possible, and the employees have a direct access to the key data of their shift. Via iLegato, the employee has the possibility to access to the entire archived key data of his subscribed node. To guarantee an unerring entry, the date selection is done via large icons. An additional option is to filter for "early shift" to –for example – accordingly restrict the display.

The advantage of calculating key data within specified periods is comparability and the provision of trends over a longer period. An immediate response to unsatisfactory results by the production management or by the maintenance department is only possible at the end of a period. The online determination of key data will remedy this shortcoming. Based on this data, the responsible employees are able to take corrective measures any time. At this point, the advantage of the mobile entirely becomes effective. Equivalent to the above description, it is possible to subscribe all online key data and to display it almost in real-time. The disadvantage is that the solution is implemented native in Objective-C (iOS).

7. HTML 5

The web is constantly evolving. New and innovative websites are being created every day, pushing the boundaries of HTML in every direction. HTML 4 has been around for nearly a decade now, and publishers seeking new techniques to provide enhanced functionality are being held back by the constraints of the language and browsers.

To give authors more flexibility and interoperability, and enable more interactive and exciting websites and applications, HTML 5 introduces and enhances a wide range of features including form controls, APIs, multimedia, structure, and semantics. The new technology introduces a whole set of new elements that make it much easier to structure pages.

HTML 5 provides mobile device users richer web applications and improved usability. The new features of HTML 5 standardize the use cases and technologies that are common in smartphone-optimized mobile web applications. In today's Mobile Web of WML or XHTML-MP or HTML 4 documents, these features are implemented using proprietary device and browser APIs. With HTML 5, advanced web application features are available in all mobile browsers supporting the markup language, using the same standard syntax and displaying the same standard behavior.

8. PHONEGAP

PhoneGap is an open-source mobile development framework developed by Nitobi Software. It enables software programmers to build applications for mobile devices (s. Fig. 4) using JavaScript, HTML5 and CSS3, instead of often less-known languages such as Objective-C (iOS). The resulting applications are hybrid, meaning that they are neither truly native (all layout rendering is done via the webview instead of Objective-C or Corona

apps) nor purely web based (many of the functions would be supported by HTML5). One disadvantage is that hybrid applications do not always have full access to the device application programming interface (API), it depends from the used OS.

Figure 4: PhoneGap interface with iLegato Monitor-App

PhoneGap currently supports development for the operating systems Apple iOS, Google Android, HP webOS, Microsoft Windows Phone, Nokia Symbian OS and RIM BlackBerry. Support for recent versions, such as BlackBerry 5 and 6 and Windows Phone 7, is being implemented now.

9. CONCLUSION

In addition to the condition monitoring of the machinery and plants via significant key data, the support for the maintenance department via the control system is very important. Applications for iPhone, Android devices and Blackberry are developed based on html 5 and the open source solution PhoneGap. In this way, it is possible to edit alarm messages of the subscribed node, and to take specific actions. The application is running in the background and – in case of a new alarm message -will give a note to the user via vibration alarm or acoustic signal.

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