AUTOMATION MONITORING APPLICATIONS FOR iOS AND ANDROID MOBILE DEVICES

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Abstract:
Many people will be able to leave their laptop at the office and handle essentially all of their mobile computing and communications tasks with a pocket-sized device. The level of capability in contemporary smartphones and tablets is remarkable and continues to grow. In this paper is presented a method of developing remote applications for smartphones/tablets running iOS or Android operating systems designated to monitor and control industrial automations.

Key words: smartphone, tablet, remote, monitoring, controlling, wireless, network.

1.Introduction

Imagine monitoring the status of a unit under test from home while drinking coffee in the morning, or changing test parameters of a running application while at the airport. The new version of Data Dashboard for LabVIEW allows users to do all this and more. By controlling our LabVIEW applications remotely, we will save time, energy, and money.

Released in the fall of 2011, Data Dashboard for LabVIEW allows the use of iOS and Android mobile devices to view measurement data from NI LabVIEW programs on desktop or embedded systems. Using this application, we can create dashboards to display the values of network-published shared variables and deployed LabVIEW Web services on indicators, such as charts, gauges, textboxes, and LEDs. Data Dashboard 2.0 is available for the Apple iOS in the Apple App Store and for Android in Google Play, with the latest update to the app for iOS released in November 2012.

"*These new apps combine the portability of mobile devices with the power of LabVIEW, helping engineers increase their productivity and meet the latest application challenges,*" says Ray Almgren, NI vp of product marketing core platforms.

Before now, engineers needed domain experts to create native mobile apps to remotely control and monitor their systems from their iPads. Using the new version of the Data Dashboard for LabVIEW, we can now enjoy these productivity gains without a personal app developer. The Data Dashboard for LabVIEW can connect to existing LabVIEW applications that use network-published shared variables, LabVIEW web services, or data written to the NI Technical Data Cloud.

The newest version of Data Dashboard for LabVIEW for iPads offers the following advantages:

- custom free-form layout instead of the previous version's grid layout;

- ability to lock and share dashboards with others via email or the NI Technical Data Cloud;
- customizable color themes for controls and indicators and ability to choose background image;
- ability to have multiple dashboards with multiple pages;
- new controls and indicators like the list box, xy graph, switch, slider, and drop down;
- ability to use secure web services to interface with LabVIEW applications.

While the above features will only be available only on iPad devices, a subset of Data Dashboard for LabVIEW functionality on the iPhone (called Data Dashboard Mobile for LabVIEW) as well as selected Android phones and tablets can be accessed. Some features currently available on these platforms include the following:

- fixed-layout dashboards;
- data access via network-published shared variables or web services;
- indicators including graphs, strings, and numeric readouts;
- access to built-in device sensors (for example, accelerometers).

2. Smartphones and Tablets for Measurement and Control

Every day we see more and more people with an iPhone, Android-based phone, or other smartphone. According to Gartner Research, worldwide smartphone sales reached 472 million units in 2011, which is a 58 percent increase over 2010. Smartphones are growing in popularity and changing the way we live our lives. We no longer memorize phone numbers because we carry a phonebook in our pockets. We rarely ask for driving directions because smartphones include GPS with maps. We are connected 24/7 through email, text messaging, and now even video chat. Smartphones provide instant access to information wherever we go.

There's another game changer on the horizon—tablets. Forrester Research predicts that by 2013 tablets will outsell desktop computers in the US. Tablets are somewhere between a smartphone and a laptop. They are web-connected with touch-screen interfaces like smartphones, but they feature the screen real estate of laptops. The first to release and start gaining adoption, was the Apple iPad; however, other big players like Google, Microsoft, Samsung, HP, Amazon, and RIM have announced devices and OSs of their own. Like smartphones, tablets are poised to disrupt the traditional ways we complete common tasks. With the iPad, for example, we can intuitively download and read books, stream television shows, or read magazines and newspapers. As the technology continues to evolve and prices drop, it's only a matter of time before tablets become more widely adopted.
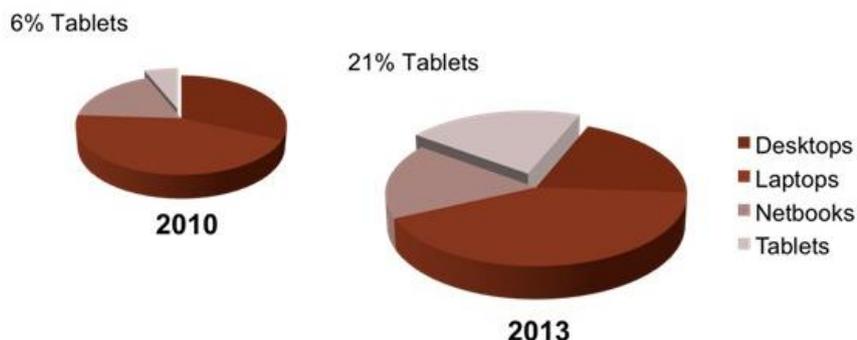

Figure 1. Researchers predict tablets will outsell desktop computers in the US by 2013.

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As more of us adopt smartphones, wireless carriers are building an infrastructure to provide Internet access to these devices from virtually anywhere. This infrastructure not only offers us access to email, sports scores, and news, it also gives engineers a vehicle for accessing measurement data from anywhere. Engineers can carry a smartphone or tablet and essentially have, right in their pockets, a human-machine interface (HMI) for remotely viewing and controlling systems. They can monitor data for trends, view historical data over periods of time, instantly receive alarms based on measurements, or remotely control an application or test sequence.

Because of their network connectivity, smartphones and tablets are great tools for remotely viewing measurements; however, their small size and processing power also make them effective for portable measurements. For portable measurements today, engineers can choose from several options such as handheld meters and portable data loggers with integrated displays. But these typically have fixed functionally that is defined by the vendor. Smartphones and tablets can offer a more flexible solution. In the future, engineers may be able to directly connect a data acquisition (DAQ) device and write software specifically for their application needs.

Figure 2. Smartphones and tablets have the potential to replace traditional handheld meters for portable measurements.

This idea of tethering a DAQ device to an off-the-shelf computing device is not a completely new concept for portable measurements. Previous attempts, such as miniature laptops, used conventional power-hungry processors and therefore provided unusable short battery life. Personal digital assistants (PDAs) offered longer battery life and were useful for some applications, but their underpowered processors limited their functionality.

These devices have evolved into today's smartphones and tablets. They now pack more processing power than standard desktop PCs did 10 years ago and can be used to write more powerful processing routines for inline analysis directly on a device. The processors consume less power than standard PC processors so the devices are useful for longer periods of time. They include gigabytes of data storage, providing ample room to save logged data. Touch-screen technology offers an intuitive way of interacting with the user interface, which can be designed to mimic application-specific knobs, buttons, and

controls. The features in mobile computing devices have evolved to create a viable platform for portable measurements that exceeds the capabilities of traditional methods.

Building an application for a smartphone or tablet is not a trivial task. National Instruments has recognized that many of its customers have limited or no expertise programming for mobile platforms. To help engineers take advantage of these devices, NI has created several tools for remotely viewing measurements and connecting to data acquisition hardware.

3. Remotely Monitor and Control Automations with the Data Dashboard for LabVIEW app

With the Data Dashboard for LabVIEW app, engineers can create a custom, portable view of NI LabVIEW software applications. The app displays the values of network-published shared variables and/or Web services on charts, gauges, text indicators, and LEDs. Users can create custom layouts of one, two, four, or six indicators and quickly swipe between multiple layouts.

Figure 3. The Data Dashboard for LabVIEW displays the values of network-published shared variables and/or Web services.

To view an application from the Data Dashboard for LabVIEW, engineers must firsts create a desktop or embedded application that publishes data to the network. This can be done in one of two ways:

1. The simplest way is to add network-published shared variables to a LabVIEW VI. Using the shared variable, data is shared between loops on a single diagram or between VIs across the network. It is configured at edit time using property dialogs and no configuration code is required in the application.

2. For more sensitive IT environments, engineers can add Web services to the application to invoke a method on a remote target using standard HTTP protocols. In this configuration, the Data Dashboard sends a request to the LabVIEW application, which processes the request and replies with a response. With the LabVIEW Web server, VIs can be deployed as Web services.

Before linking the dashboard controls and indicators we need to have variables to connect to. To deploy network-published shared variables we will need to create a project in LabVIEW. In the Project Explorer window we have to right-click on My Computer and select New>>Variable.

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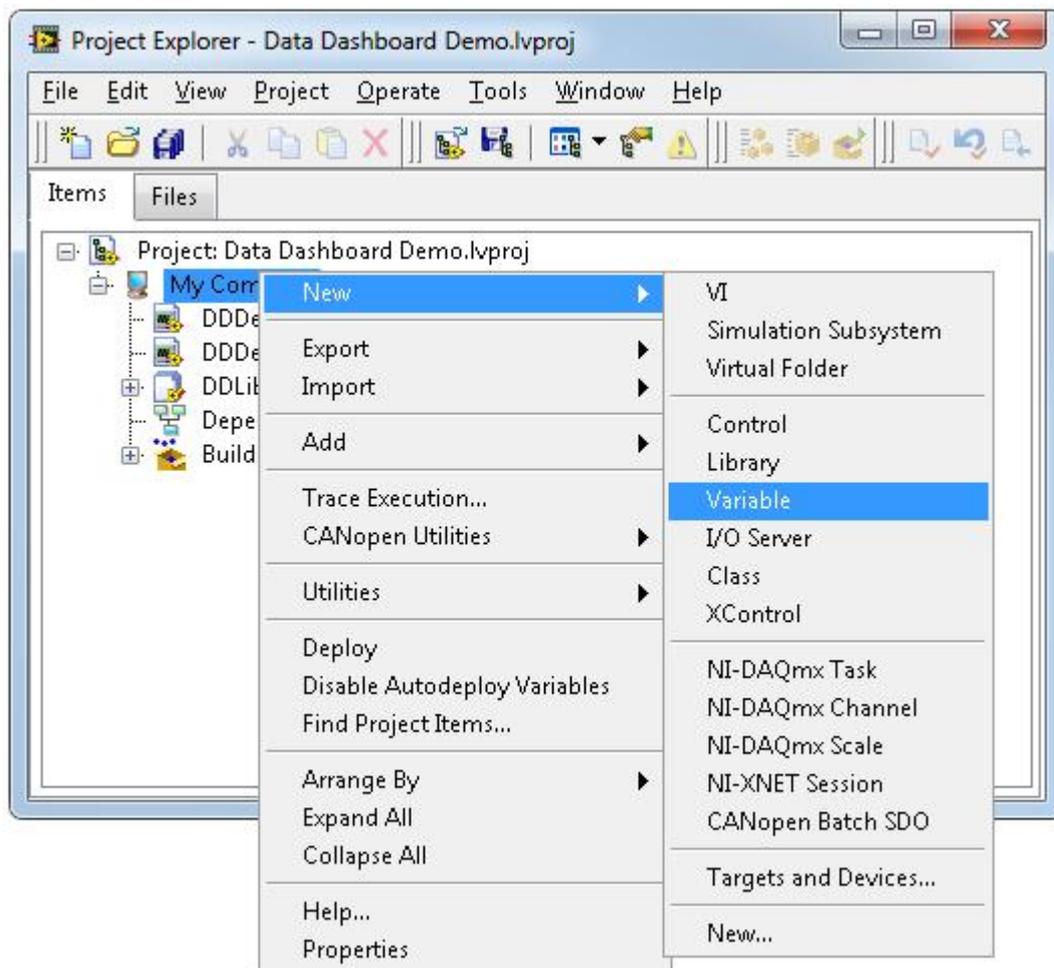# iOS AND ANDROID MOBILE DEVICES

Figure 4. Creating the network-published shared variables in LabVIEW.

In order to use it, we have to drag the shared variable created from the **Project Explorer** window onto the block diagram, and then to right-click on the shared variable and select **Access Mode**>>**Write** (or **Read**). We must deploy the shared variable before displaing its value in the Data Dashboard and for that, in the **Project Explorer** window, right-click the project library that contains the shared variable and select **Deploy**. Build and run the application to continuously update the shared variable.

In order to create a Web Service and a Web method to connect the data dashboard, we have to right-click **Build Specifications** in the **Project Explorer** window and select **New**>>**Web Service (RESTful)**. On the Information page, we have to select the name of the Web service and its destination directory. Use the default settings. On the **Source Files** page, use the **Add Item** arrow to move the created VI from the **Project Files** tree to the **Service VIs** tree.

Build the project, and then right-click on VI's build specification in the Project Explorer window and select Deploy to deploy the Web service application.

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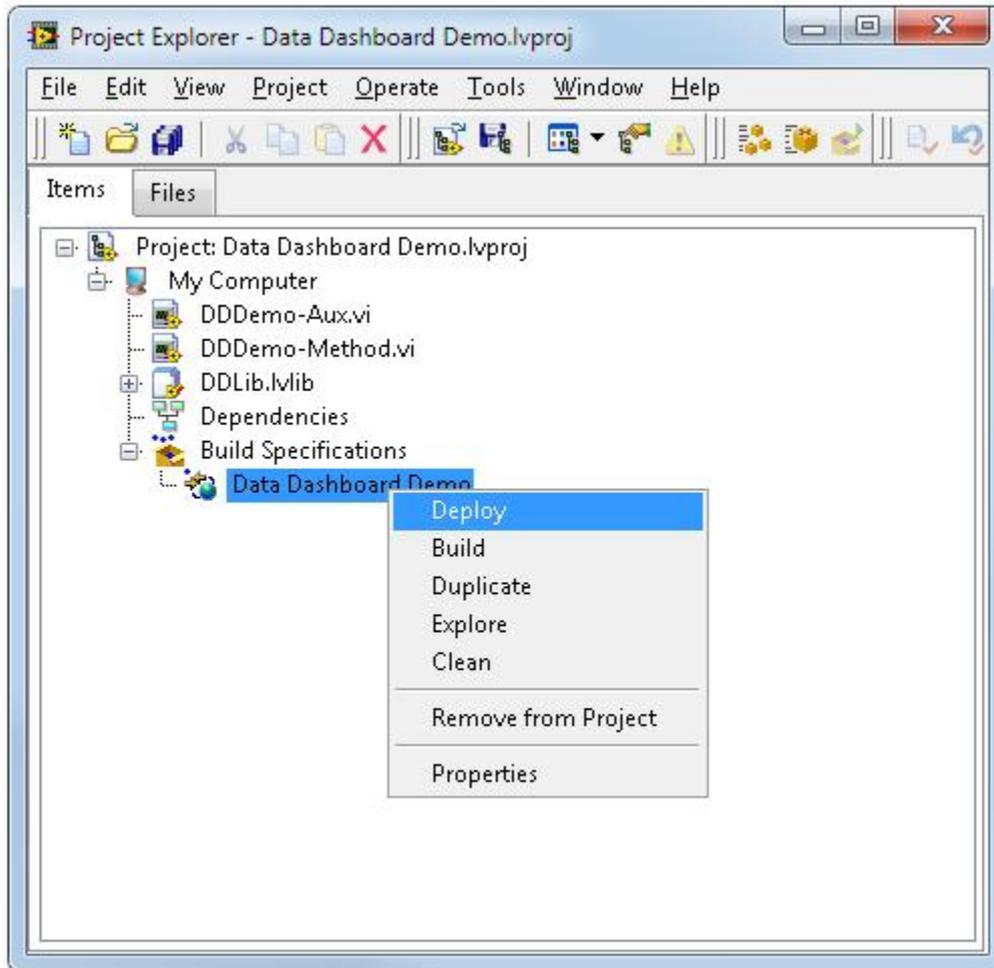# iOS AND ANDROID MOBILE DEVICES

Figure 5. Deploying a Web service application in LabVIEW.

After the application is developed and Web services or shared variables are deployed, building a dashboard is as simple as browsing to the server and choosing the signals to monitor. Numeric, Boolean, or string data types can be monitored and each data type features multiple indicator types including LEDs and charts. The Data Dashboard Mobile for LabVIEW app has the same functionality, but only has one indicator per dashboard instead of the multiple indicator layout more easily readable on a tablet.

To place indicators on the dashboard drag them from the pallet onto the page. The next step is to link the indicators to the data connections. Tap the **Chart** indicator and select the **Data Link** icon. This will open the Connect dialog. Select **Shared Variables** in the Connect dialog. Then, enter the Shared Variable server DNS or IP address. Tap **Connect** to connect to the Share Variable Engine. Tap the name of the library that contains the deployed shared variable, and then select your shared variable. The data type of each shared variable is listed below the variable name.

Data Dashboard 2.0 only allows you to select shared variables that are compatible with the data type of the selected indicator. You can customize the chart's appearance by selecting the properties menu shown below. Then run the dashboard by selecting **Play** in the upper right hand corner.

Figure 6. The Properties menu of a chart connected with a shared variable in Data Dashboard 2.0 on the iPad.

If we have placed down the indicators and deployed the Web Service, we can link our dashboard indicators to the Web methods. There are two ways to connect to a Web method, polling and calling. Polling a Web method calls the Web method continuously every .3 to 30 seconds as specified by the user. Calling a Web method only calls the Web method when the Call button is pressed. Tap the **Controls and Indicators** icon and select **LabVIEW Web Services**. Drag a **Poll Web Service** to the dashboard and select the **Web Link** icon. The Web Services connection dialog will open and you will be able to enter the server DNS or IP address, and Port of your Web Service. Tap **Connect**.

Figure 7. The Web Services dialog box in Data Dashboard 2.0 on the iPad.

Next, you will see a display of Web Services hosted on your target. Choose your Web Service and then, the Web Method you want to link to your poll. When the Web method connects successfully, you will see the Web Link icon turn green. You will now see an overlay that shows you which indicators on the dashboard that you can link to your variable. Tap the Chart to link your Web method variable to the chart indicator. You can also choose to create a new indicator from the overlay.

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With the Data Dashboard for LabVIEW app on the iPad, engineers can develop customized dashboards that can both monitor and control applications. With iPads making up the majority of industrial tablets used worldwide as of 2012, this functionality is first being brought to this platform with an eye on future hardware trends. With this new functionality, users can create complete free-form layouts for their dashboards, add custom background images and control/indicator color themes, connect securely to applications using secure LabVIEW web services, and sharing mechanisms for dashboards.
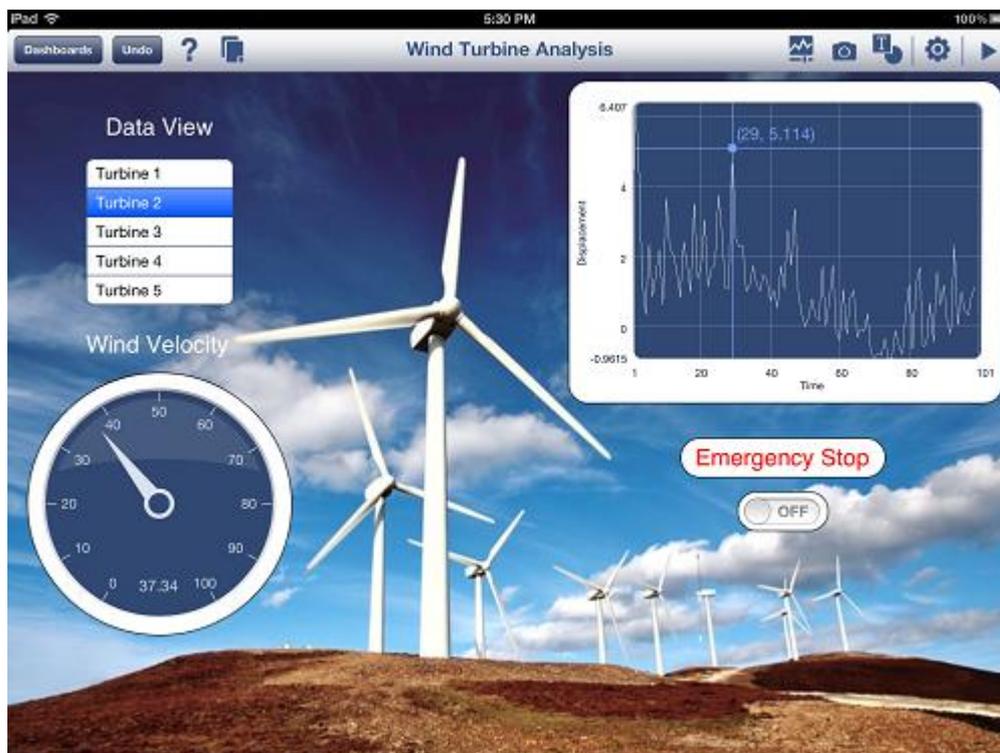

Figure 8. The Data Dashboard for LabVIEW app running on the iPad

In addition to reading data from network-published shared variables or web services, we have the ability to add dashboard controls to write data or commands over the network. New controls and indicators give us more flexibility to create the dashboard needed for the application. Once added to the dashboard, controls and indicators can be connected to data for monitoring and control.

With the enhanced Data Dashboard for LabVIEW app, we can send our favorite dashboards to colleagues via email or the NI cloud. We also have the option to lock our dashboards for read-only access once distributed. If our colleague receives a dashboard through email and has the same Data Dashboard for LabVIEW app installed, then it will automatically open the app when opened from email.

Figure 9. The controls and indicators available in Data Dashboard for LabVIEW app running on the iPad

The improved app will enable creating, editing, and saving multiple dashboards on a single device. In addition, we have the ability to add multiple pages to each dashboard we create. The dashboards are displayed on a "carousel" that can be swiped through and we can choose the one we would like to work on. Once opened, we can customize and change the dashboard or run it.

The new Data Dashboard for LabVIEW app will enable linking controls and indicators to secure LabVIEW web services. By using secure LabVIEW web services, dashboard users will have to login using IDs and passwords setup by the developer and have the digital API key to access the application. By configuring secure web services, developers can have groups of user IDs have access to only monitor data while other groups have the ability to control and montior the application. Properly configuring an API security key for a web service during the configuration process allows only requests coming with that particular key access to any data.

Data Dashboard does not support all Shared Variable data types, Web method request types, and Web method output data types. In unsupported cases Data Dashboard will choose to not display these items rather than not allow the user to connect. Data types supported by the Data Dashboard 1.0 are outline below.

Shared Variable Data Type	I8, U8, I16, U16, I32, U32, I64, U64, SGL, DBL, Boolean, and String
Web Method Indicator Data Type	I8, U8, I16, U16, I32, U32, I64, U64, SGL, DBL, Boolean, and String
Web Method Request Types	GET
Web Method Output Type/Format	Terminal/XML

4. Conclusion

We often consider smartphones and tablets recreational devices for playing games and streaming videos, but they can also be powerful engineering tools. Desktop PCs and laptops, for example, are commonly used for simple tasks like Internet browsing, word processing, and gaming. But they are also one of the most important tools engineers use for designing, validating, and producing products. Engineers use PCs to take measurements, store data, automate tests, perform analysis, create reports, and much more. The extreme portability and web connectivity of smartphones and tablets make them exciting recreational devices, but these features also present interesting use cases for measurement and control applications. Smartphones and tablets offer engineers a way to remotely measure and control systems and a new platform for portable measurements.

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