

Timesys University

Track One

Building a connected home automation device with the Digi ConnectCore™ Wi-i.MX51 using LinuxLink

Session 2

How to build a control application using Qt Embedded for Linux to design a UI experience

Audio streaming is available for this event.
Turn on your speakers to listen.

Tools You Can Use

■ Q&A

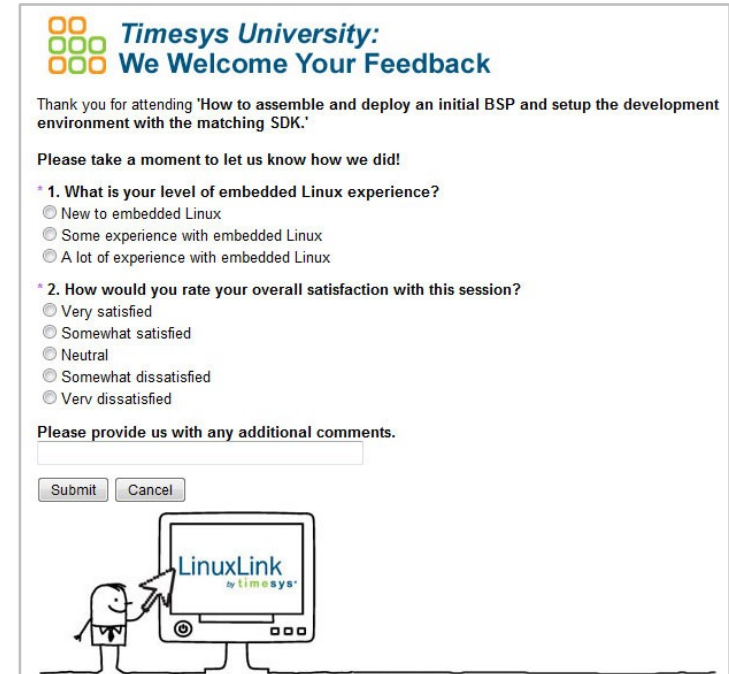
- Click on Q&A panel (?) or chat icon in the bottom right corner
- Type in your question in the space provided
- Click on “Submit”




Tools You Can Use

■ Polling

- The poll will appear on your screen
- Select your answer for each question
- Click on “Submit”



 **Timesys University:**
We Welcome Your Feedback

Thank you for attending 'How to assemble and deploy an initial BSP and setup the development environment with the matching SDK.'

Please take a moment to let us know how we did!


* 1. What is your level of embedded Linux experience?

- New to embedded Linux
- Some experience with embedded Linux
- A lot of experience with embedded Linux

* 2. How would you rate your overall satisfaction with this session?

- Very satisfied
- Somewhat satisfied
- Neutral
- Somewhat dissatisfied
- Verv dissatisfied

Please provide us with any additional comments.



Session Information

- **You can download the slides for today's session at** http://www.timesys.com/embedded-linux/training/timesys-university/digi_wi-imx51
- **You can view a recording of today's session at** http://www.timesys.com/embedded-linux/training/timesys-university/digi_wi-imx51
- **Today's speakers:**



Maciej Halasz
Director, Product Management
Timesys



Bob Blumenscheid
Product Marketing Manager
Digi International

Building a Connected Home Automation Device

- **Session 1 – Recording available**

How to assemble and deploy an initial BSP and setup development environment with the matching SDK

http://www.timesys.com/embedded-linux/training/timesys-university/digi_wi-imx51

- **Session 2 – Today**

How to build a control application using Qt Embedded for Linux to design a UI experience

- **Session 3 – March 17 @ 1pm EST**

How to integrate a WIFI and Bluetooth functionality with the control application

- **Session 4 – March 24 @ 1pm EST**

How to optimize, test and integrate the solution for quick deployment

Today's Agenda

- **Recap of what we have done so far**
- **Introduction to the ConnectCore Wi-i.MX51**
- **Qt development tools installation/setup**
- **Home Automation Application – GUI development**
 - Add labels, control lights
 - Add code for a custom widget
 - Test your application locally
- **Setup GPIO lines to control two GPIO connected LEDs (lights in a kitchen and a living room)**
- **Linux kernel and GPIO features**
- **Summary**

Session 1 Recap



What We Have Accomplished So Far

- **Learned about ConnectCore Wi-i.MX51 LinuxLink – needed for all exercises**
- **Reflected product requirements in Linux BSP and SDK**
- **Built a custom BSP with LinuxLink Web Edition**
 - Experiment on day one with a pre-built starting point
- **Setup a development environment**
 - System level development and optimizations
 - Development of a value-add software (applications)
- **Deployed the system on the target via NFS for future development**
 - Transferred images
 - Configured bootloader

Project Requirements (Digi CC Wi-i.MX51)

- **Graphics**
- **Touchscreen**
- **Applications**
 - Screen calibration
 - Home automation application

- **Serial port communication**

- **Audio (optional)**
 - ALSA Mixer
 - Sound playback

- **GPIO controlled LEDs**

- **SD/MMC Card**
 - Filesystem

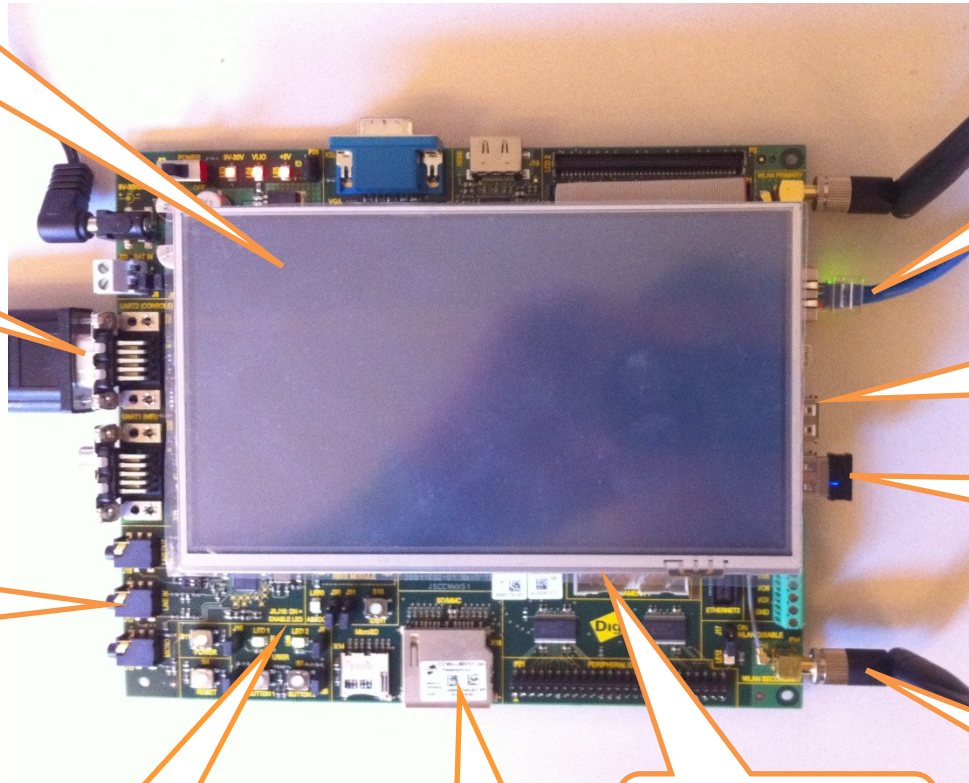
- **NAND Flash**
 - Boot from
 - Additional storage

- **Ethernet**
 - Secure Connection
 - Transfer (FTP/SCP)
 - Console (Telnet/SSH)

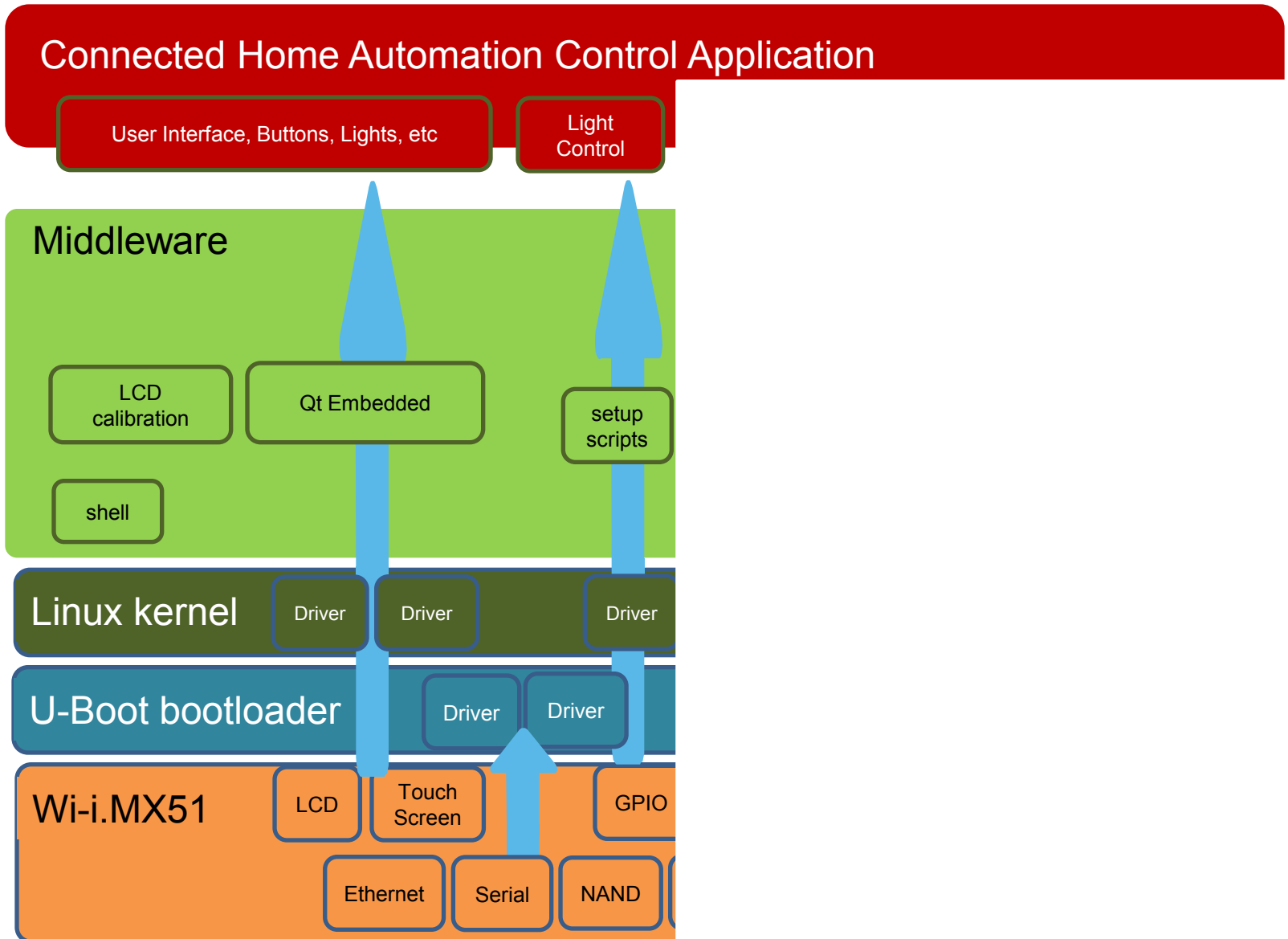
- **USB**
 - Storage (USB stick)
 - Extensions

- **Bluetooth**
 - Sensor connections

- **WiFi**
 - Data upload to a server



Home Automation Device (Blueprint)



Introduction to the Digi ConnectCore™ Wi-i.MX51



Giveaway

- **If you attend at least 3 out of 4 sessions in our Track 1, we will automatically enter you into a drawing for a prize.**
- **The winner will receive a complete ConnectCore Wi-i.MX51 Development Kit.**
- **Together with Digi International, we also offer the above mentioned kit at a discount price of \$249+S&H**
- **If interested in buying a kit, send an email to sales@timesys.com with “CC-Wi-i.MX51 Kit SPECIAL OFFER” in subject line.**



Qt Development Tools Installation/Setup



Qt Development Tools



Options

- TimeStorm with Qt linuxlink.timesys.com
- QtCreator qt.nokia.com

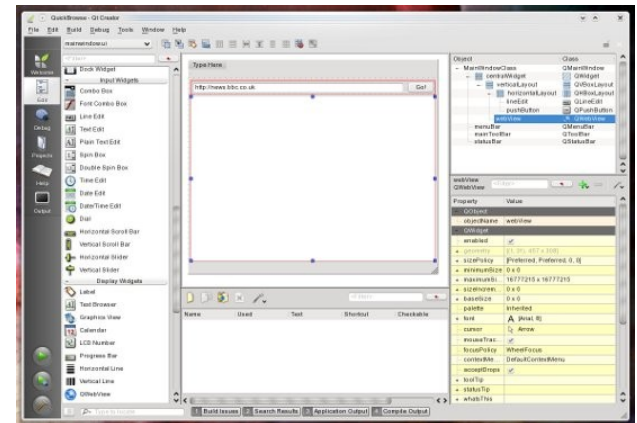
Installation

- Download from your LinuxLink account
- Uncompress with


```
tar xzvf timestorm.tar.gz
```
- Generate a license file

Run

- Export your QMAKESPEC variable point it to linux-timesys-g++ in the SDK
- Execute timestorm binary



Home Automation Application – GUI Development



Home Automation Application



- **Create a new Workspace**
- **Create a new Qt GUI Project**
 - UI Type - QMainWindow
 - No additional QT frameworks are necessary
- **Create the following components**
 - Remove menu bar and status bar
 - Use layouts
 - Add labels for Living Room and Kitchen lights and Garage door
 - Add Qwidget placeholders for buttons
 - Use Spacers
- **Custom Widget**
 - Develop or adapt an existing custom widget for a button



Home Automation Application (Cont'd)



- **Define/Connect signals**
 - Define a signal in a custom widget
 - Capture the signal in a service class
 - Implement the service routine

- **Change the stylesheet of the design**
 - Create a resource file
 - Add a new JPG with a background
 - Make your application use your stylesheet

Setup GPIO Lines to Control Two GPIO Connected LEDs



SYSFS and GPIO – What Are They?

■ What is SYSFS

- Virtual in-memory file system
- Exports information about devices and drivers from the kernel device model to userspace
- Used for configuration of **GPIO**

■ GPIO-SYSFS

- User interface to the in kernel gpio framework
- Same interface no matter what platform you're developing for
- Deals with pins strictly one at a time
- Available in all mainline kernels from 2.6.27 onwards

How to Control GPIO with SYSFS

■ Procedure

- Find the correct GPIO lines for the two onboard LEDs
 - Use hardware reference manuals
- Request the GPIO number from the kernel (73 and 74)

```
# echo 74 > /sys/class/gpio/export
```
- Once you've done this you'll see a folder

```
/sys/class/gpio/gpio74
```

In this folder you'll see the attributes needed to control the gpio.
We will use attribute value.

How to Control GPIO with SYSFS (Cont'd)

■ Procedure

- Set the direction for each GPIO by writing one of "in", "out", "high" or "low" to your gpio's direction attribute. "low" and "out" have the same effect, to change the pin to an output which is initially low. "high" changes the pin to an output which is initially high. "in" changes the pin to an input.

```
# echo out > /sys/class/gpio/gpio74/direction  
# cat /sys/class/gpio/gpio74/direction
```

- Control the GPIO state (LED on/off) by writing "0" or "1" to the value file

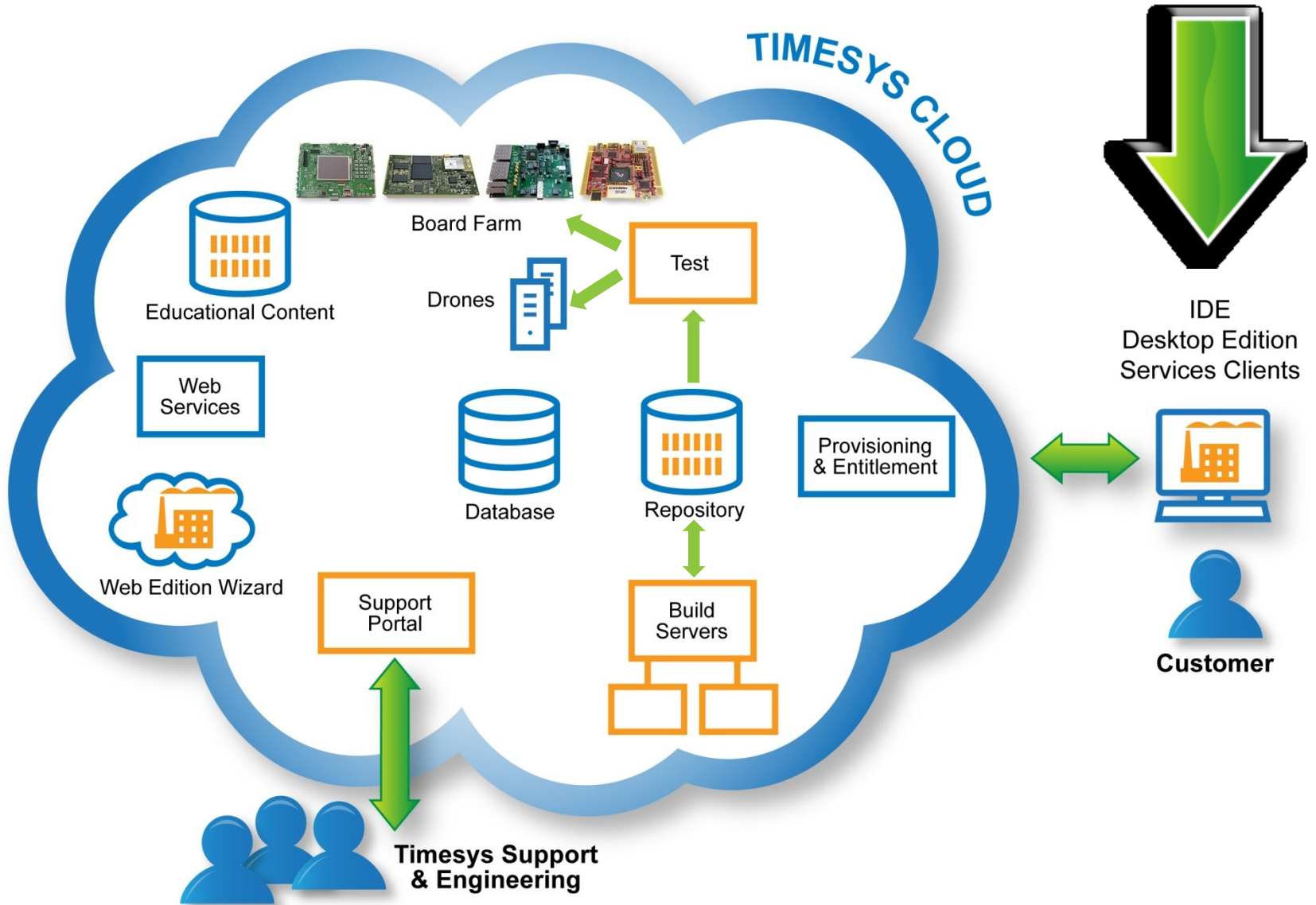
```
# echo 1 > /sys/class/gpio/gpio74/value
```

- Set links for your application

Linux Kernel and GPIO Features



LinuxLink Architecture



What We Have Accomplished



What We Have Accomplished

- **Learned about ConnectCore Wi-i.MX51 LinuxLink – needed for all exercises**
- **Installed the IDE development tools for Qt design**
- **Developed a GUI with the following:**
 - Layers, Custom Widgets, Spacers and Labels
 - Implemented signals-handlers
- **Learned about GPIO and SYSFS**
 - Setup two onboard LEDs for user access
- **Added code to our application to control the LEDs**

Next Session

■ March 17 @ 1pm EST

How to integrate a WIFI and Bluetooth functionality with the control application

- Add libraries to support WIIMOTE features
- Enable Bluetooth support in the Linux kernel
- Develop code to pair Bluetooth devices, to connect and read values from accelerometers
- Add support for the WIFI – RedPine driver
- Add code in the application to periodically log data and upload it to a remote server
- More fun to come...

Last Week's Homework – Share Your Experience

- 1. Outline your own requirements**
- 2. Assemble a BSP that matches your needs**
- 3. Setup your development environment**
- 4. Run your custom Linux images on your hardware**
 - Did you have any problems outlining your requirements and then translating them into a Linux blueprint?
 - How did the assembly of your custom BSP go?
 - Were you successful in getting your custom Linux images up and running on your boards?

Homework

1. **Design your own GUI with Qt Embedded**
2. **Adapt/design your own QWidget**
3. **Locate GPIO lines on the board you are using**
4. **Change the state of the GPIO lines from your GUI**

Let us know if you run into any challenges. We have setup a dedicated communication channel to share questions, comments and replies.

Please subscribe at <https://lists.timesys.com/listinfo/timesys-university>

While your questions will be answered by Timesys expert engineers, we encourage you to answer questions asked by others. Sharing experiences is always the best way to learn.

Glossary

LinuxLink (Web Edition) – Web-based version of LinuxLink

LinuxLink (Desktop Edition) – Local version with full customization and third-party tools integration

Workorder – Stores definition of your software – filenames, versions

Bootloader – Runs first, initializes necessary hardware, loads Linux

Linux kernel – Operating system that manages hardware access and other features for higher level software

Device Driver – Code that's part of a Linux kernel, defines how software accesses specific hardware

File System – All files (libraries/utilities/scripts/etc.) combined on a single storage, e.g. NAND flash

Middleware – Complete frameworks including APIs, utilities that provide specific functionality, e.g. QT

API (library) – Used by applications, provide functionality, abstract hardware access

Toolchain (cross) – The most important part of the development environment. Used to compile source code into binaries.

More Info

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Stay Online for Q&A!

