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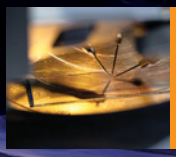
Electronics WORLD

THE ESSENTIAL ELECTRONICS ENGINEERING MAGAZINE

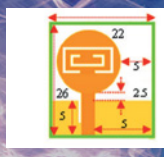
Developments In Design:

Digi-Key's Design Tools Accelerate Prototype-to-Production

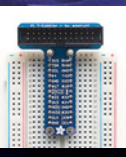
Digi-Key CORPORATION



Technology
SGTs for rollup electronic screens



Special Report
RF design



Special Report
Designing with Android and Raspberry Pi

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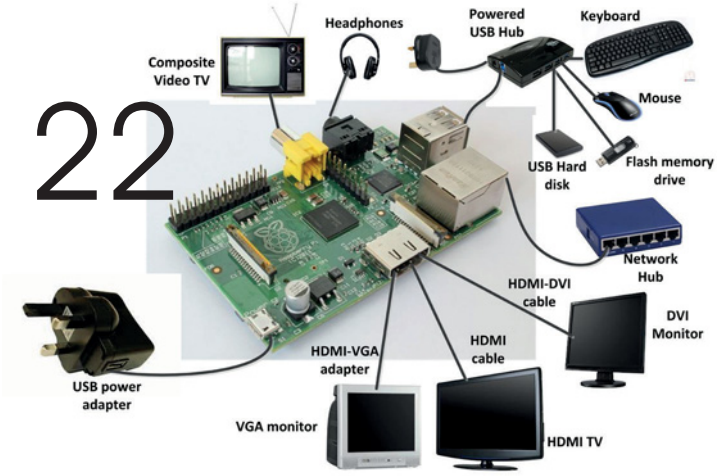
REGULARS



FEATURES

CAN I ORDER **AS FEW OR AS MANY** AS I NEED?

YES

WILL THEY DELIVER MY ORDER **ON TIME**?

NO

YES

DO THEY HAVE **GREAT CUSTOMER SUPPORT**?

YES

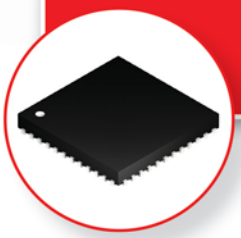
DO THEY STOCK A **WIDE RANGE** FROM LEADING BRANDS?

NO

Don't settle for second best.

YES

WHO'S BEST TO **DEPEND** ON FOR THE PARTS I NEED?



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SMALL TECH-FIRMS STILL STRUGGLE TO SHOW GROWTH

Officially, the recent economic downturn ended several months ago. The UK's economy is getting back on track, albeit at a stuttering pace. For many larger companies, this is good news after taking a proverbial battering, but for many smaller companies in the technology sector, the fact remains that obstacles are still in the way of growth.

A recent whitepaper compiled by UK-based conference-call service provider Conference Genie revealed several negative factors at play for smaller tech companies and SMEs in general throughout the UK. One of those is getting a handle on social media, specifically not knowing how to handle it as effectively as possible for marketing purposes, even though it can be a cost-effective marketing tool.

Being Connected

Of all the social media channels available to tech firms for marketing, Facebook was the most difficult to work with, said 39.78% of survey respondents.

Facebook can be surprisingly easy to use to good effect, as it allows for blog posts, images and interaction with customers without limit on information. However, for businesses, it can seem like a 'one size fits all' solution, whereas other channels like Twitter and Pinterest can be more direct.

Facebook can also require more work, but for sharing photos and reaching out to customers it's a very useful tool and, crucially, for many cash-strapped tech companies, it's free of charge.

Talent Hunt

Although social media is hard to get right, harder still is recruiting talented staff with all the relevant qualifications and know-how to get ahead in the technology sector. Studying for degrees in computing and engineering, for example, isn't that appealing to many students, and while there aren't that many vacancies for graduates to fill, this could change in the medium to long term.

An astonishing 43.01% of study participants said their biggest challenge was finding talented workers. Electronics engineering requires a significant amount of skill to get right, the reason many businesses in this sector have been frustrated in their attempts to recruit the staff.

To remedy the recruitment problem, it's up to businesses to ensure they get the right staff for their needs. This means making job advertisements more specific and, if needs be, offering training on the job to ensure that any new recruit gets up to speed with electronics engineering.

Studying for degrees in computing and engineering isn't that appealing to many students, and while there aren't that many vacancies for graduates to fill, this could change in the medium to long term

Levies?

A more peripheral yet common issue raised by the research were tax and interest rates, something that 22% of respondents spoke about at length. Under the coalition government, tentative steps have been taken to reduce the amount of corporate taxes paid by businesses. But for many the interest rates have remained at their current level for over seven years.

As the perceived economic recovery gathers pace, the likelihood of a rise in the Bank of England's base interest rate grows. Initially it is expected to go up by 0.25% to 0.75%, but this could have a profound impact on the wider business world. Access to capital could change, while those with loans may have to pay more interest.

Should this materialize, the chances are those with money to pay back will be hit the hardest. On the flip side, an interest rate rise may be beneficial to those firms with money in the bank, as they could stand to have a little extra finance to work with at the end of every month or year, although this would likely be a negligible amount.

The Stats Have It

Some 26.88% of the businesses surveyed in our industry said that staff performance analysis was the most important factor in boosting productivity. Next on the list of concerns was the need to analyze business performance, as mentioned by 22.58% of respondents. Both can use up a lot of resources, but are necessary to gauge the progress of any company.

To do so effectively, analysis should use a time-management system to keep a record of what each employee is doing. Something similar could work for business analysis, but needs inputs on a daily basis.

Another sticking point was retaining the unique selling proposition (USP); one in five spoke about it. In a competitive industry like technology, having a USP is hugely important.

Getting a handle on all these issues can make it easier for tech firms to navigate the choppy waters of running a successful business.

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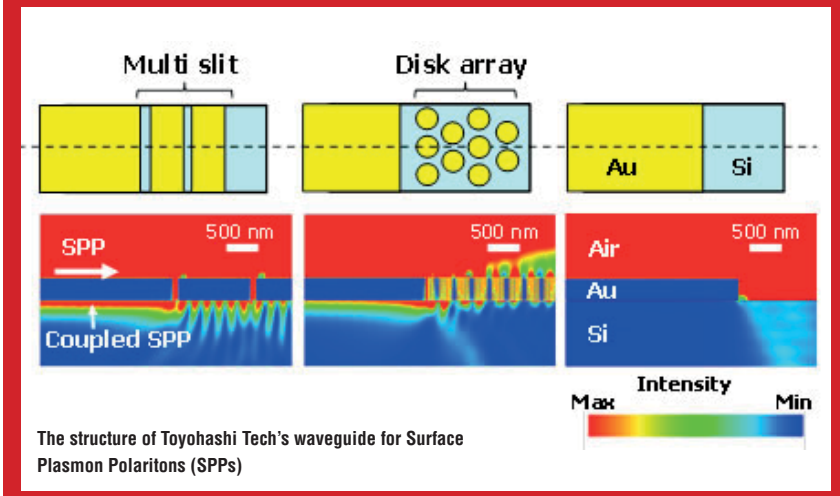
WAVEGUIDING STRUCTURE FOR SURFACE PLASMON POLARITONS WILL ENABLE LOW-POWER ELECTRONICS

Toyohashi Tech researchers in Japan have developed a simple, low-loss waveguide for Surface Plasmon Polaritons (SPPs) applicable for nanoscale photonic integrated circuits (ICs) on silicon, promising to enable lower power consumption in electronics.

SPPs are waves that propagate along the surface of a conductor, involving both charge motion in the conductor ("surface plasmon") as well as electromagnetic waves in the air or dielectric ("polariton"). They are shorter in wavelength than incident light (photons) and as such they can have tighter spatial confinement and higher local field intensity. An SPP will propagate along the interface until its energy is lost either to absorption or scattering.

Recently, there has been an increased interest in SPPs as signal carriers in nanoscale ICs to reduce power consumption. However, low-loss SPP waveguides with detectors had not been developed for application to nanoscale ICs until Mitsuo Fukuda and his team at Toyohashi Tech created their waveguide.



The structure of Toyohashi Tech's waveguide for Surface Plasmon Polaritons (SPPs)

The researchers deposited a thin metal-film on a silicon substrate terminated with a diffraction structure (a multi-slit or a metal disk array) at the end to guide the SPPs on the surface (air-metal interface) to the opposite side of the metal (metal-silicon interface). A Schottky barrier is formed at the metal-silicon interface, and the free electrons in the metal are excited by the guided SPPs to cross over it, resulting in observable photocurrent.

The waveguide developed in this research enabled the efficient propagation of SSPs in 1550nm-wavelength bands (transparent to silicon) along the Au film surface, and the photocurrents were much larger than for waveguides without the diffraction structure – 26 times for the grating structure and 10 times for the disk array.

This waveguide device is expected to contribute to nanoscale photonic ICs on silicon.

TECH SECTOR LOSES POTENTIAL SALES DUE TO LACK OF EFFECTIVE COMMUNICATION, SAYS EXPERT

There is new and ever more capable technology at our disposal, but, as a leading sales training organisation warns, the first to miss the opportunities to bring this to the mass market are often tech salespeople.

Doug Tucker, Managing Director of Sales Commando believes that those at the front line of technology sales have all but forgotten the proven sales techniques that are the true drivers behind long-term product success.

"Technology is developing at an unprecedented rate – in terms of R&D it is booming – and this should be great news for the consumer, tech firms and the economy. Yet my work within the sector highlights its salespeople typically simply list technical facts to potential clients and believe that that's an effective sales method. Believe me, it isn't!"

Tucker calls for technical sales staff to go back and rediscover fundamental selling techniques if they want to make the most of new and emerging technology opportunities.

"The odd thing I notice from a sales point-of-view is that technology is getting more complicated, rather than – as we're led to believe – more simplified. [With it] consumers are becoming rabbits in headlights, trapped with the dazzle that is technology specification. It is the responsibility of technology salespeople to understand what a consumer wants, remove the dazzle and attend to that need, which surprisingly may not be the leading edge of technology."

Tucker says proven sales techniques "aren't rocket science" but need to be adhered to, and the first and most basic rule is the need to listen.

"The easy way out of a difficult technology sales situation is by creating the magpie effect – whatever is shiniest and newest – backed up by a string of senseless jargonistic descriptions. But this usually only garners frustration and disillusionment amongst customers," he said. "Great selling is down to the ability to listen to the customer and being able to communicate effectively – every time. The technology sector is evolving rapidly and will, hopefully, introduce us to products that will change our lives for the better and forever. But for this to happen, tech firms need to learn how to bring their customers along with them, not alienate them at the first hurdle."

NEW RESEARCH COULD MAKE ROLL-UP ELECTRONICS DEVICES A REALITY

Philips scientists in partnership with researchers from the University of Surrey have developed a device called Source Gated Transistor, or SGT, which could see flexible electronics such as roll-up tablet computers widely available in the near future.

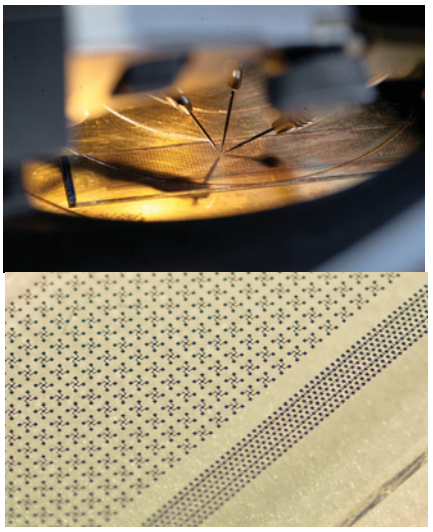
SGTs can be used in analogue as well as digital circuits to control currents, decreasing the odds of circuit malfunction and improving energy efficiency. Such properties make them suitable for next-generation electronic devices, enabling digital technologies to be incorporated into flexible plastics or textiles for wearable electronics.

Applications for such devices are endless, including ultra-lightweight and flexible gadgets that can be rolled up to save space; smart plasters, thinner than a human hair, that can wirelessly monitor the wearer's health; low-cost electronic shopping tags for instant checkout; disaster prediction sensors, used on buildings in regions at high risk of natural disasters; and so on.

In addition, the teams showed that SGTs are simple to manufacture, making flexible electronics even more accessible. They can be applied to mainstream materials such as silicon (the predominant manufacturing technology), but also to newer materials such as graphene, making this research so crucial.

"These [SGT] technologies involve thin plastic sheets of electronic circuits, similar to sheets of paper, but embedded with smart technologies. Until now they could only be produced reliably in small quantities and that confined them to the research lab. However, we have shown we can achieve characteristics needed to make them viable, without increasing the complexity or cost of the design," said lead researcher Dr Radu Sporea, Advanced Technology Institute (ATI), University of Surrey.

"By making these incredible devices less complex and implicitly very affordable, we could see the next generation of gadgets become mainstream much quicker than we thought," he said.



New kid on the block: Source Gated Transistors (SGTs) are not complex and are affordable, enabling next-generation flexible gadgets to become mainstream much quicker

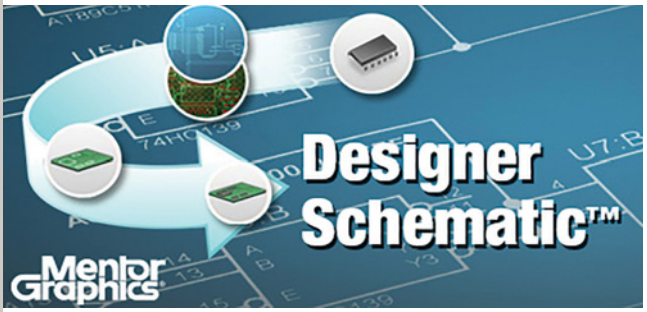
DEVELOPMENTS IN DESIGN: HOW DIGI-KEY'S SPECTRUM OF DESIGN TOOLS ACCELERATES THE PRODUCT LIFECYCLE – FROM PROTOTYPE TO PRODUCTION

In the world of electronic product design since computer aided design became the norm, accessibility has historically provided the most difficult obstacle for designers to overcome when first entering the world of board-level design. Even the most entry-level Computer Aided Design (CAD) tools will set you back a few hundred dollars. This steep barrier to entry for hobbyists and budding engineers serves to stifle the potential "next big thing" that might be designed by these creative individuals.

However, in the spirit of supporting the design process from Prototype to Production®, Digi-Key has teamed up with design software leaders Mentor Graphics (Mentor) and Aspen Labs (Aspen) to offer a broad "design tool spectrum", boasting a wide range of printed circuit board (PCB) design tools targeted at providing top of the line functionality at a drastically reduced price point.

Starting at the top end, and based on the wildly successful DxDesigner and PADS design solutions, Mentor's Designer® product suite offers professional-grade software at a very affordable price point. Engineers will gain the benefit of a first-class design tool suite as well as increased freedom in product design, untethered from approved parts lists and PCB design houses. This increased design flexibility will allow engineers to expand their part libraries through more choices and design their application to the required specifications at a potentially lower price point or higher performance or both – attributes that result from the adoption of newer technology devices. Also, because of a compatible tool suite, engineers will be able to focus on their area of specialty, eliminate redundancy, and shorten the entire product development lifecycle by allowing others to collaborate on a design and increase the odds of achieving first pass success. This in turn will significantly reduce time to market and overall project development costs.

The largest electronics design firms use Mentor design



solutions, and the stellar reputation of the solutions within the industry is well deserved. Integrating this industry-leading technology with Digi-Key's one-million-plus stocking parts and library of reference materials is truly a recipe for success. Engineers can leverage these features to create innovative PCB designs using parts from Digi-Key, sourced directly from the manufacturer, and smoothly transition these designs to PCB layout design services providers and PCB fabrication and assembly houses.

Rounding out the Digi-Key "design tool spectrum", and targeted at the hobbyist, maker, and entrepreneurial engineering communities, Aspen Labs has developed a system of free design tools for Digi-Key that enable engineers to easily create practical schematic designs.

The Aspen-developed toolset consists of three tools: Scheme-it®, PartSim, and PCBWeb. Beginning with Scheme-it, an online schematic and block diagramming tool that gives everyone the ability to design and share electronic circuit diagrams, the suite includes a comprehensive electronic symbol library and an integrated Digi-Key component catalog that allow for a wide range of circuit designs. Additionally, an integrated Bill of Materials (BOM) tool is provided to keep track of parts used in a design. Using this feature accelerates compiling a final parts list when the design is completed and allows the designer to quickly order all the parts needed to prototype their design. Furthermore, once a schematic drawing is complete, users can export it to an image file or share it via email with others, making design collaboration quick and easy. Scheme-it works natively in all major web browsers without requiring the use of any plugins.

PartSim is next in the trifecta of Aspen Labs tools. The tool

provides users with a fully featured, browser-based simulation tool, which includes a full SPICE (Simulation Program with Integrated Circuit Emphasis) simulation engine, web-based schematic capture tool, and a graphical waveform viewer. Further, users have the ability to browse examples of circuit designs to see the tool in action or to get an idea that can be used in their design with little or no modification.

> We have seen a tremendous uptick in customer demand for powerful, affordable design tools," said Randall Restle, Director of Applications Engineering at Digi-Key.

The Aspen Labs tool ladder ends with PCBWeb, a comprehensive application for designing printed circuit boards. The tool offers a myriad of features, such as schematic capture, supporting multi-sheet designs; PCB layout, supporting multi-layer boards with Design Rule Checker (DRC); and a library of components, including the ability to create custom symbols and footprints. These features are wrapped into a neat package, tightly integrating Digi-Key's industry-leading breadth of product availability by including these products directly into the tool. This again reduces the guesswork and part research time required for the project and accelerates design time.

All modules of the Aspen suite are available at no cost to the customer, providing a truly unique design environment for designers looking to move their designs from "the back of the napkin" to a fully vetted and tested circuit board, ready for implementation into their prototype.

With Digi-Key's implementation of a broad "design tool spectrum" through Mentor Graphics and Aspen Labs software, engineers have access to the latest design tools linked to Digi-Key's dynamically updated parts database. This allows designers to find the latest versions of parts as they are added to Digi-Key's extensive inventory to use in their applications. This ability is not possible with design tools that are associated with static parts lists from predetermined software libraries which are only updated when software updates are loaded. Since Digi-Key's design tools are directly linked to its parts database, there is no risk of designing in a discontinued or obsolete part. The engineer has the freedom to choose from well proven parts or from the latest technology available for their application. The choice is theirs.

"We have seen a tremendous uptick in customer demand for powerful, affordable design tools. The Internet has enabled more functionality and features within them, and we are happy to be involved in this while also drastically lowering the cost of design entry," said Randall Restle, Director of Applications Engineering for Digi-Key. "Overall, with the expansion of the Aspen tool suite and the introduction of the Mentor tools to our 'Design Tool Spectrum', we feel that we have made great strides in addressing this need and fostering creativity with our customers. We are excited to partner with these innovative companies to offer a truly unique set of design tools, available on demand."

Randall Restle, Director of Applications Engineering – Digi-Key

The realm of design tools is wide, varied, and often expensive. However, Digi-Key continues to be committed to providing the best service possible to its customers by providing powerful, top-level tools at a reasonable price point. Whether you require the well-proven, reliable technology of the Mentor tool, or your budget for tools is limited and you simply need to knock out a design now and then, as is well accommodated by the Aspen-designed tools, Digi-Key's suite of design solutions has the tool to meet your needs.

To learn more about Digi-Key, please contact UK/Ireland Sales Director Ian Wallace at ian.wallace@digikey.com or UK North Business Development Manager Ben Brookes at ben.brookes@digikey.com, or visit www.digikey.co.uk

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Machines Don't Lie

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When engineers start talking to each other, and after exhausting the more obvious topics, such as the latest interesting piece of technology, or the intricacies of someone's outlandish hobby, sooner or later the conversation rolls around to the same, inevitable subject: "Why is it that we do this 'engineering' thing, anyway"?

I cannot count the number of times I have heard this subject debated. Sometimes it leads to the ironic or sarcastic "Why would anyone... ?" etc, while at other times it is closer to a recruiting sergeant's earnest arguments: "How can we convince the next generation to... ". In this case, however, what interests me is the direct, literal, philosophical interpretation of the question: "What is it that makes engineering worth doing?"

As is often the case with such analysis, an examination of the incorrect or spurious replies to the question can assist in refining an answer:

- **"Engineering is a rewarding career".**
  With thirty years at the bench behind me, I can hardly argue that engineering is a bad career to follow, but if I were choosing a path based only on the likely financial or other rewards, it would not be high on my list. Certainly, wages in the first decade compare well with, for example, industrial management or accountancy, but the more senior level pay-scales fall far short of these other fields. In addition, the workload (considered in unpaid-overtime-hours) does not fall with seniority.
- **"It is an easy stepping-stone to higher management".**
  This is far from guaranteed. While there are successful businessmen who began their careers in engineering, and a few famous engineer-entrepreneurs, they are greatly outnumbered by individuals who have followed a financial or pure-management path. Far more common are unhappy, low-to-middle-grade technical managers who are no longer engineers, but have stalled in their management career path as well.
- **"Engineers are held in high social regarding".**
  Perhaps in the 1850s, or the 1940s. Maybe still in Germany, Korea or parts of the US, but not in present-day Britain. Engineers labour under a plethora of unhelpful, negative cultural stereotypes, starting with the "socially inept solitary nerd" and then work down, and a status in society – often lamented in the technical press, equating to a cable television installation technician, or a white-goods repair man.
- **"As an engineer you will achieve 'Great Things".**
  You might get lucky! You might be the one who stumbles over the next fundamental discovery or who has the next Big Idea, but it isn't very likely. You are more likely to be either a tiny cog in a corporate machine, or an overworked, frustrated, lone worker in a small recession-struck manufacturer. Most of what you do will either be sub-technician-level, day-to-day, "make the company keep running" work, or your innovations will be either claimed or stamped on (frequently both) by your superior managers.

It may seem, from the above, that I am denigrating engineering as a career. Nothing could be further from the truth. I have followed that same path myself for decades and cannot imagine doing anything else.

I strongly advocate engineering, both as an abstract endeavour and as a career, but not from the point of view of any external benefit or social influence. I advocate engineering because it is an exercise of absolutes, without dependence on external values or opinions. It pits the skills of the practitioner against the absolute laws of nature, rather than the inconsistent, mercurial opinions of other people.

If you design and build a device – anything from a single-transistor amplifier to a cruise-liner – it exists as an independent entity. Its existence and its physical, measurable, functional parameters are absolutes. Even software has an absolute existence, both as a binary pattern of memory location values and an observable function when "running" on its processor.

These absolutes are what, in my opinion, define the nature of engineering. The creative design process consists of bringing into being mechanisms – in the broadest sense of the word – which fulfill previously decided, or "specified", requirements. Once designed, these "mechanisms" then possess a sort of independence, in that they continue to execute their designated functions independent of the will or opinion of either their "creator" or the world in general. A work of art, a theatrical performance, or a political decision can be highly valued or cast aside as worthless, based on nothing but the whim of an audience, or even a single critic. A bridge, on the other hand, will span a river until it (mechanically) fails. The opinions of the people walking over it are irrelevant. They may think it is an ugly bridge, or a beautiful bridge. They may admire or criticize its design, but it still remains a bridge. ●

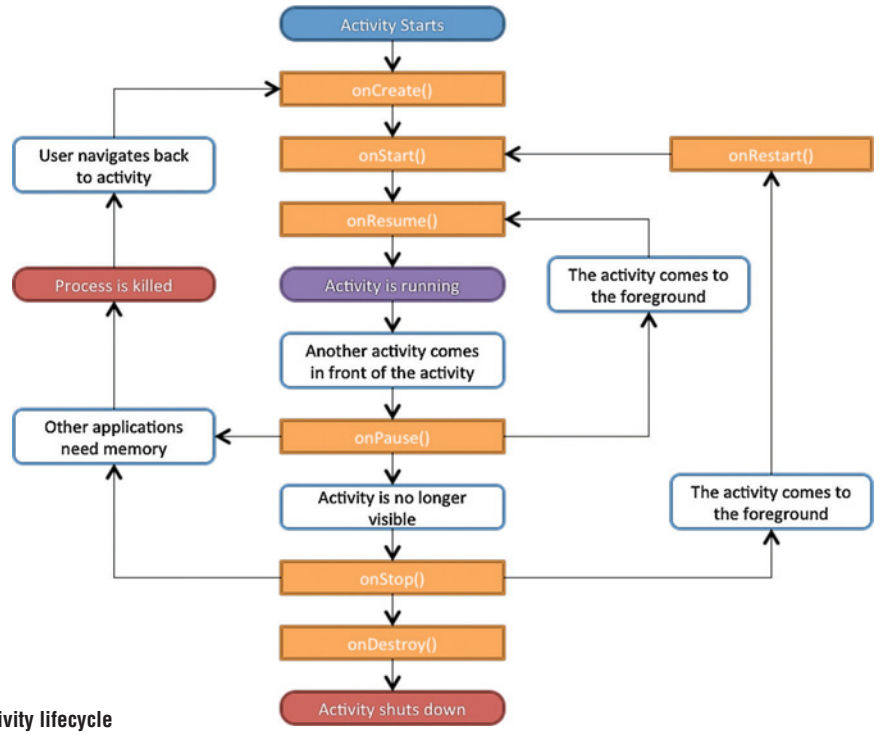


Figure 1: Android activity lifecycle

INTERFACING ACCESSORIES ON ANDROID

ACCESSORY INTERFACES SIMPLIFY THE DEVELOPMENT OF EMBEDDED ANDROID APPS, EXPLAINS **DAVID FLOWERS** OF MICROCHIP TECHNOLOGY

Whilst mobile phones and tablet computers began life as embedded platforms, they now run on operating systems similar to those of standard PCs. They have become multi-threaded and even multi-core devices, capable of simultaneously running multiple applications, maintaining multiple types of connectivity and providing the user interface. For the consumer this delivers higher functionalities, whilst for the application developer it delivers both opportunities and challenges. The opportunities include enabling mobile devices to interface with other electronic devices, such as personal fitness equipment and medical health devices, whereas the challenges lie in such new mobile apps demanding a very different set of design skills, especially for developers more familiar with creating applications on smaller processors.

Understanding Threading

A sound knowledge of threading is important for all developers of mobile apps because it is central to the mobile device's ability to run multiple operations simultaneously. Threading is the division of a programme execution within a process which creates two sets of code that can run simultaneously. Whilst one set of code waits for an event to occur before it can continue, the other threads must be able to carry on running. Without proper threading, the app's user-interface would lock up and become non-responsive as tasks such as connecting to the Web, or via Bluetooth or USB for example, would block the thread for an unspecified amount of time.

Threading also introduces the problem of concurrency into programme development. When two or more threads are running simultaneously, it is possible to have very complex data-access issues when data needs to pass between two threads, or when the same data needs to be read or modified by both threads. Since each thread's execution time is unknown, it is possible to be modifying the variable in one thread at the same time as a second thread is trying to read it. Java provides the answer to this with the use of a synchronised keyword: this allows developers to create sections that lock onto a shared object, so that if a thread is inside the synchronised section no other thread can enter that section until the first thread has left it.

In Code 1, the synchronised functions are used to ensure that variables 'a' and 'b' are both modified together, resulting in the same sum. Without synchronisation, it would be possible for one thread to call the updateVariables() function 'b' in the code just after 'a' has been incremented but before 'b' has been decremented, when a

second thread calls the getSum() routine, resulting in a sum that is different for that brief moment of time.

Code 2 shows how a synchronised section can be used instead of a synchronised function to achieve the same effect. Using a synchronised section allows other variables and functions within the parent object to continue to be used, since the lock is only placed on variable 'a' instead of the entire parent object. As synchronisation statements are slightly more complex and susceptible to errors, care must be taken to use the appropriate method for each function.

> The challenges lie in new mobile apps demanding a very different set of design skills, especially for developers more familiar with creating applications on smaller processors

Java also enables data or events to be passed safely between threads using handlers and messages. A handler is similar to a mailbox; messages can be placed in a handler, which then presents the first message to the thread, as soon as the associated thread is no longer busy. This method can be used to pass information about events or data between threads.

Overriding Lifecycle Changes

Android activities or apps go through lifecycle transitions that occur when changes on the phone or tablet could affect the application. When developing applications targeted for the Android OS, it is important to understand the activity lifecycle because even simple user interactions, such as rotating the screen, sliding out a keyboard or receiving a call, can cause lifecycle changes in an application. Many of the system resources an activity can request also specify that they must be freed in certain lifecycle states. For example, broadcast receivers are used to detect certain events that happen on the USB bus, such as when the device is detached. The broadcast receiver, however, needs to be unregistered when the application pauses, and re-registered when the application resumes.

The Android OS provides a way to override the default behaviour of each of these events, so that developers can add any functionality required at these lifecycle transitions. To override a lifecycle function, simply use the state name as a function with the @Override keyword before it.

When overriding a lifecycle function, always use the super-keyword to call the parent functionality being overridden. This ensures that the other steps normally occurring in that lifecycle change will still happen. Failure to do this can result in the application crashing or failing to build. It is also important to realise that, sometimes, it matters where the parent functionality is called within the function. For lifecycle changes on the creation side of the cycle – onCreate(), onStart(), onResume() – the super-function is typically called at the start of the function. For the lifecycle changes on the destruction side of the cycle – onPause(), onStop(), OnDestroy()– it is usually important to have the super-call near or at the end of the function.

One method of working around the issue of having to handle various lifecycle changes is to move some of the handling of objects that need to survive these transitions to a service. Using a service for the data-connectivity objects can also allow multiple activities to share the same data connection.

Wireless Communication

The three main connectivity interfaces are USB, Bluetooth and Wi-Fi. These methods are dependent on the version of the OS, as well as the hardware features available on the device.

Wi-Fi is probably one of the easiest and best-documented interfaces available for app development. If the target accessory includes an HTTP server, the browser on the phone or tablet can be used to

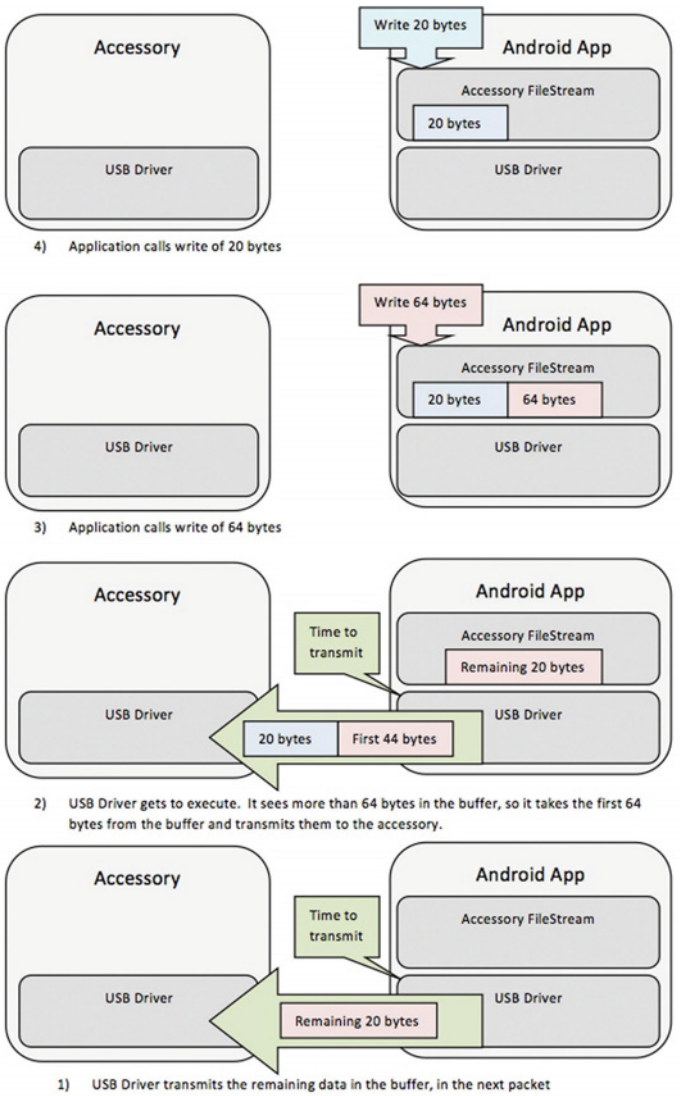


Figure 2: Data packing and fragmentation

```
private Integer a = 0, b = 0;

public synchronized void updateVariables() {
        a += 1;
        b -= 1;
}

public synchronized Integer getSum() {
        return a + b;
}
```

Code 1: Synchronised functions

```
private Integer a = 0, b = 0;

public void updateVariables() {
        synchronized(a) {
                a += 1;
                b -= 1;
        }
}

public Integer getSum() {
        synchronized(a) {
                return a + b;
        }
}
```

Code 2: Synchronised keywords

```
public class PushbuttonMessage {
        private boolean pressed = false;
        public PushbuttonMessage (boolean state) {
                pressed = state;
        }

        public boolean isPressed() {
                return pressed;
        }
}
```

Code 3: Create a class to be used as a message

```
private final static int BUTTON_EVENT = 1;

PushbuttonMessage pbMsg = new PushbuttonMessage(false);

/* Get a new message with the "what" of BUTTON_EVENT, and the button message
 that was just created */
Message msg = handler.obtainMessage(BUTTON_EVENT, pbMsg);
msg.sendToTarget();
```

Code 4: Create a message and send it to a handler

eliminate the need for a custom application. There are also different telnet/ftp applications available that also avoid custom development. If a custom application is required, Java offers network application programming interfaces (APIs) and there is ample reference material on how to use them. There is however one Android OS-specific item that needs to be added to the application before the app is able to use the networking API. In the AndroidManafest.xml file, the activity accessing the network API needs to be given permission to do so by adding the line in code 7 (see the facing page).

One major limitation when using an Android device's Wi-Fi for accessory interfacing is that Android does not currently support ad-hoc networking, so a network infrastructure is required before the Wi-Fi accessory can operate. This may be realistic for some applications, such as a thermostat in a house that will always have Wi-Fi connectivity to the home router, but unrealistic for nearly all mobile accessories.

```
private final static int BUTTON_EVENT = 1;

private Handler handler = new Handler() {
        @Override
        public void handleMessage(Message msg) {
                switch(msg.what) {
                case BUTTON_EVENT:
                        /* Now that we know we have a button message, we know that the
                         object associated with the message is a PushbuttonMessage.
                         Create a PushbuttonMessage and cast the object to it so that
                         we can access its members */
                        PushbuttonMessage pbMessage = (PushbuttonMessage) msg.obj;
                        if(pbMessage.isPressed() == true) {
                                //do something here
                        }
                }
        }
};
```

Code 5: Implement a handler to receive and decode a message

```
@Override
public void onResume() {
        super.onResume();

        //your stuff here
}
```

Code 6: Override the onResume() function

```
<uses-permission android:name="android.permission.INTERNET" />
```

Code 7: Add permission for an app to use the Internet

```
UsbManager = (UsbManager)getSystemService(Context.USB_SERVICE);

UsbInterface intf = device.getInterface(0);

UsbDeviceConnection connection = manager.openDevice(device);

connection.claimInterface(intf, true);

UsbEndpoint endpointOUT = intf.getEndpoint(0);

connection.bulkTransfer(endpointOUT, buffer, buffer.length, timeout_ms);
```

Code 8: Connect via the USB Host API and despatch a packet

Different Android OS versions offer support for different Bluetooth devices. Android v2.x versions support the Serial Port Profile (SPP), although not all devices with these OS versions are capable of using the feature. The SPP is useful for creating custom applications that do not have a pre-defined data format. For more specialised accessories, v3.x introduced support for the headset and Advanced Audio Distribution Profile (A2DP), whereas Android OS version 4.x introduced support for the Health Device Profile (HDP).

USB Connectivity

One of the most recent methods for downloading data from an Android device is USB. Before version 2.3.4 of the Android OS, the USB port was used exclusively by the device manufacturer, so was not available to application developers. This changed with the v2.3.4 and v3.1 Android OS updates, allowing developers of Android accessories to use the USB port.

Android version 3.1 then introduced a USB Host API, allowing developers to use standard USB peripherals plugged into a suitable

```
<uses-library android:name="android.hardware.usb.host" />
```

Code 9: Enable an app by permitting access to the USB Host API

```
<intent-filter>
        <action android:name="android.hardware.usb.action.USB_DEVICE_ATTACHED" />
</intent-filter>
<meta-data android:name="android.hardware.usb.action.USB_DEVICE_ATTACHED"
 android:resource="@xml/device_filter" />
```

Code 10: Auto-launch an app when a device is attached in USB Host mode

Android device. The OS also has built-in support for some USB device classes, such as Human Interface Device (HID) and Mass Storage Devices (MSD). These built-in drivers allow these USB peripherals to be used seamlessly, just as they are used on a standard computer. For peripherals without built-in support, the USB Host API allows app developers to connect and communicate directly to the USB endpoints through a simple, low-level API set.

In order to gain permission for the USB Host API, the app needs to declare use of the library in the AndroidManafest.xml file of code 9 above.

Setting up a device filter enables an application to auto-launch when a specific peripheral is plugged into the USB port. In the AndroidManafest.xml file, an intent filter must be created and associated with the USB_DEVICE_ATTACHED event, and that must be associated to a filter file such as "xml/device_filter.xml".

The device_filter.xml file contains information about the devices that should cause the app to launch. This can be either by the Vendor ID (VID) and Product ID (PID) pair, or by the class, subclass and protocol set.

It is also possible for application developers to be less specific by not including every attribute in the tag. In the absence of a product-ID attribute for example, any matching vendor-ID device can cause the app to launch.

OpenAccessory USB

To enable USB capability in Android devices without hardware support for the USB host, Google added the OpenAccessory framework onto the standard USB drivers in the Android devices. This enables accessory developers to use standard USB port functionality for custom USB traffic. The OpenAccessory protocol achieves this by first exchanging a few custom, vendor-class, device-level control transfers to the USB port, as developed by the manufacturer of the device. These commands switch the USB drivers into an accessory mode and cause the USB peripheral to detach from the bus and reattach in accessory mode, with Google's vendor ID and one of two specific product IDs. In this mode, there is a vendor-class interface that can be accessed by an application.

The interface OpenAccessory presents to the application is like the FileStream format. Data is written and read from the stream, similar to the way in which a file is read and written. This differs from most firmware implementations of USB peripherals, in which the interface is based on the USB packet size. The issues which result from this difference need to be understood by the app developer and the accessory firmware developer.

The Android device's USB driver receives a file stream and, therefore, it does not recognise or understand the potential logical breaks in the data for specific commands. The data from two separate calls to the write function of the app can bring packets together into the same USB packet. The firmware needs to be aware that a received USB packet could contain information from two separate calls to the write function from the app.

A single call from the app to the write function may also be fragmented across multiple USB packets. The USB driver on the Android device will break the data into packets and send them to the accessory, and the accessory must be able to reassemble data into the appropriate format.

Packing and fragmentation can also occur together. For example, the OpenAccessory framework currently uses 64-byte packets. If the app calls the write function twice, back to back, the first call sends 20 bytes of data and the second call sends 64 bytes. It is possible, therefore, for the two sections of data to be packed together into an 84-byte block of data, depending on when the USB driver takes the data from the stream and sends it over the bus. The USB driver then needs to break this stream of data into USB-sized packets, by sending the first 64 bytes of data, followed by a packet of 20 bytes. The first packet, however, contains the 20 bytes of data from the first write and 44 bytes from the second write. The second packet of 20 is the remaining data from the second write.

The final challenge is to understand how USB bulk transfers are formed. According to the USB specification, USB bulk transfers are complete when the exact amount of expected data is sent and a packet smaller than the endpoint size, or a zero-length packet, is sent.

To complete a transfer of a block of data that is an exact multiple of the endpoint size, currently 64 bytes, accessory developers must follow this with a zero-length packet. Failure to send zero-length packets, when required, can result in the data remaining in the Android USB driver without being transferred to the OpenAccessory FileStream, and therefore never being transferred to the app.

The OpenAccessory framework also requires permission in the AndroidManifest.xml file, as per code 12 on the facing page.

The device can auto-launch an app based on string information passed during the steps required to enter accessory mode. This is done through xml files that are similar to the USB Host API, see code 13 on the facing page.

The OpenAccessory framework's most significant drawback is that it is an optional add-on library in the Android OS. Some manufacturers, therefore, have chosen not to include it, so it is not possible to assume that every device with a suitable OS version will

support this functionality. Support may also be included in one version of the product, but withdrawn on subsequent versions.

The release of the Android 4.1 Jelly Bean introduced version 2 of the Android Open Accessory (AOA) protocol which gives accessory developers two new features: the addition of support for digital audio output and HID controls from accessory mode.

Digital Audio

Support for digital audio output allows easy creation of audio docks with Android devices. Whilst an audio dock was possible with AOA version 1, it required the designer to create a custom protocol and use a custom application. Any standard application would still output audio via the headset or speakers. With AOA version 2 all core audio on the Android device is routed to the USB port, allowing the audio to work with any app or feature on the device. AOA version 2 also allows the audio interface to be accessed with or without launching the app when docked. Not sending the manufacturer or model string to the Android device, before it enters accessory mode, is sufficient to allow the accessory to be docked without being launched.

Interface Controls

HID controls, from accessory mode, were previously only available in USB Host mode. With AOA version 2, accessories can send HID reports to the associated Android device and to the OS to control the user input. This is useful for audio dock controls, as well as for the implementation of control devices such as mice, keyboards and joysticks. ●

UNDERSTANDING ACCESSORY INTERFACES

Understanding the capabilities and limitations of accessory interfaces is crucial for transforming a hardware design into an effective Android accessory. Skills such as threading, wireless communication, using Android as a USB host and digital audio will probably all have to be mastered. Development resources for each of these challenges, including free firmware and example Android accessories, can be found on the Microchip websites:
www.microchip.com/android; /USB; /wifi; and /bluetooth.

```
<?xml version="1.0" encoding="utf-8"?>
<resources>
        <usb-device vendor-id="1240" product-id="516"/>
        <usb-device class="256" subclass="256" protocol="5"/>
</resources>
```

Code 11: Set-up a filter for a device to launch an app in USB Host mode

```
<uses-library android:name="com.android.usb.accessory" />
```

Code 12: Enable an app to access the OpenAccessory framework

```
<intent-filter>

        <action android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED" />

</intent-filter>

<meta-data android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED"

 android:resource="@xml/accessory_filter" />
```

Code 13: Launch an application in OpenAccessory mode

```
<?xml version="1.0" encoding="utf-8"?>

<resources>

<usb-accessory manufacturer="Microchip Technology Inc." model="Basic Accessory Demo"
version="1.0" />

</resources>
```

Code 14: Use a filter to determine which devices will launch the app

SYSTEM DESIGN IN THE REAL WORLD

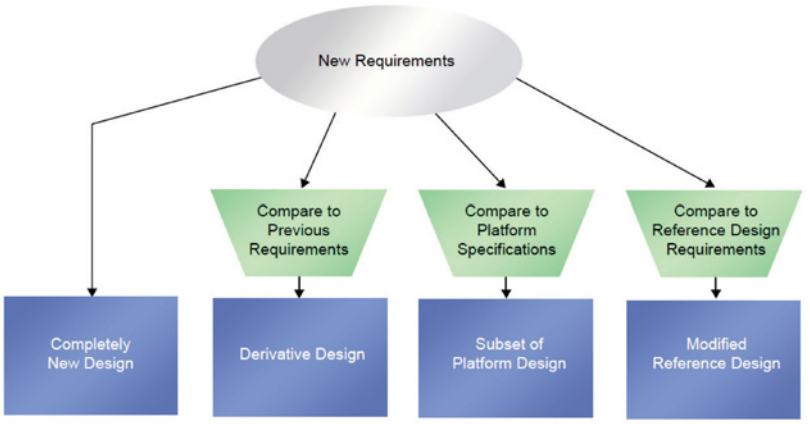


Figure 1: Categories of derivative designs

WHAT ACTUALLY HAPPENS WHEN SYSTEM REQUIREMENTS CHANGE? **RON WILSON** FROM ALTERA CORPORATION PROVIDES SOME ANSWERS

Debate rages over the correct methodology for system-on-a-chip (SoC) based system design. Is it the traditional register transfer level (RTL) flow; or is it high-level synthesis of a C-language behavioural model? What about intellectual property (IP) reuse methodology that minimizes any kind of code generation?

Every expert has an opinion on how design teams ought to move from requirements definition to manufacturing. Each view is based in preference, past experience, or – in the case of Electronic Design Automation (EDA) vendors themselves – product availability. But in many real-world situations, all of these views may be irrelevant.

The reason is simple: most system designs – 55%, according to a study by the website embedded.com – are not new designs; they are modifications of some existing design. This means that the actual design process depends not on the dictates of some methodology expert, but on the nature of the changes in requirements and on the data available to the design team. The results may be anything from a formally-driven revision process to a mad scramble to contain an epidemic of unanticipated changes. Far too often, the result is in fact – if not in name – a redesign of the entire system: not because of the extent of the changes, but because of the lack of both reuse planning and a methodology that can manage change.

In this article we will ask methodology experts and practicing designers to describe a consistent way of discussing what actually happens when system requirements change. Then we will apply that framework to several real-world design situations and use it to suggest what the design process should be and how to make it better.

Categories

Derivative designs occur in at least three distinct situations (Figure 1). The most obvious is when the new project is defined by a list of requirement changes to an existing design: new functions, new peripherals, or new performance figures, for example.

However, there are at least two other categories as well, one of which is the use of a platform design, such as Google's Android platform. Frank Schirrmeister, group director of product marketing for the System Development Suite at Cadence, points in particular to the Texas Instruments Open Multimedia Applications Platform (OMAP) as an example. He observes that the OMAP platform defines a superset containing almost any conceivable system in the application area. Design teams generate a particular instance by pulling unused blocks out of the platform and, in some cases, re-optimizing the resulting design.

The third situation is related: use of a reference design. This process is in fact an example of derivative design, but in important ways it is different from either modifying an existing design from in-house or applying a platform.

Of these three cases, only the first is likely to be classified as a derivative design. Platform-based and reference-based designs are often considered new designs. All three share common characteristics; they begin with a completed design, and then require comparison of the new design requirements against existing specifications. They proceed to identify and then implement necessary changes to the existing design.

Step One: What Has Changed?

Each of these design processes begins with a new set of requirements. The first step in each process is to identify discrepancies between the new requirements and the existing design. In theory, this is a rigorous process. We can identify these differences by comparing the original and the revised requirements documents. But in many cases the design team will not have access to an original, current or accurate requirements document for the existing design.

The next step in our theoretical process is to categorize each requirement change as behavioural, structural, or parametric. Behavioural changes, or changes in the function of the system, are the most common, according to the embedded.com study, comprising over half of derivative designs. Curiously, they are also the least supported by today's automated design tools, and often end up getting tracked with a spreadsheet.

Structural changes, in contrast, dictate specific alterations to the system hardware or software: changing an operating system, adding or removing hardware blocks, or changing interconnect between blocks, for example. In some applications, such as communications infrastructure, changes to the system I/O are frequent. Altera design operations specialist Kevin Weldon says: "It used to be that we were mostly involved in working with customers to achieve their target operating frequency. But now, we are seeing more changes in I/O. Customers want to make sure there are no I/O show-stoppers."

Parametric changes dictate changes in measurable quantities: response time, bandwidth, supply current, or bill-of-materials cost, for example. These changes can be the easiest to state, but the most difficult to trace through from the requirements document to the implications for specific hardware and software blocks.

Finding Dependencies

In an ideal world, the earlier design – the one from which we will derive the new system – would exist in several mutually-consistent views. We would have not only a formal requirements document, but also a behavioural model, perhaps in both more abstract C code and as a transaction-level version. We would have a block-level architectural model of the hardware and software, and RTL and software code for the actual implementation.

> "Most system designs – 55%, according to a study by the website embedded.com – are not new designs; they are modifications of some existing design

In such a world the next step would be obvious: We would address changes in behavioural requirements by modifying our behavioural models. Changes in structural requirements would trigger adjustments to IP or interconnect, or to software functions. Parametric changes would cause revisions of the implementation-level code.

In each case we would have traceability and design-dependency files to determine how the adjustments we had made would influence other parts of the design (Figure 2), so that, for example, if we changed the definition of a data structure or the bandwidth of a signal in one part of the design, we would be notified of all the other areas in the design that could be impacted

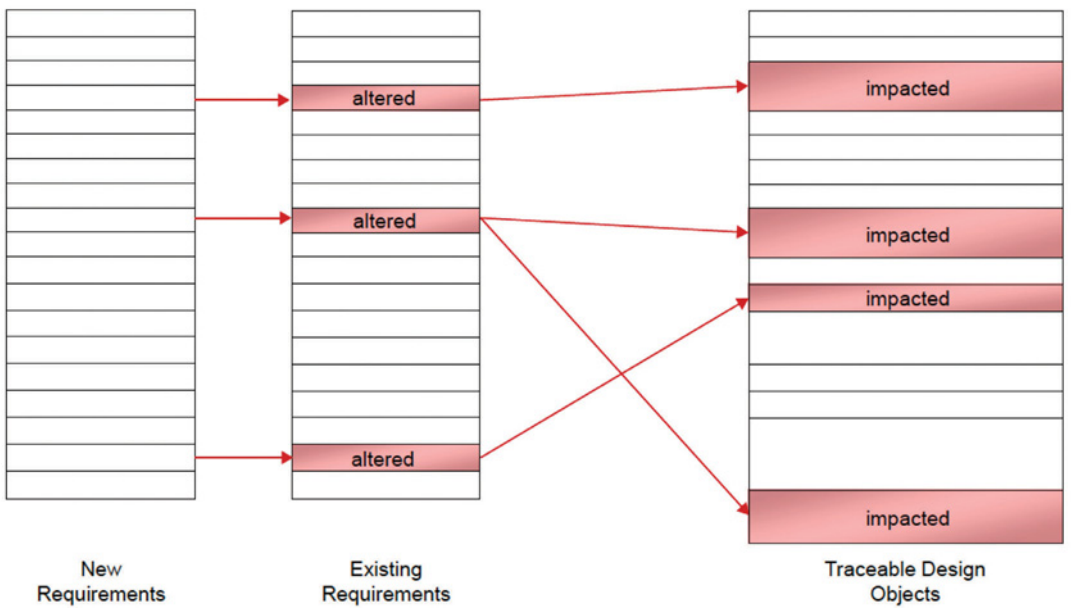


Figure 2: Traceability simplifies the conversion of requirement

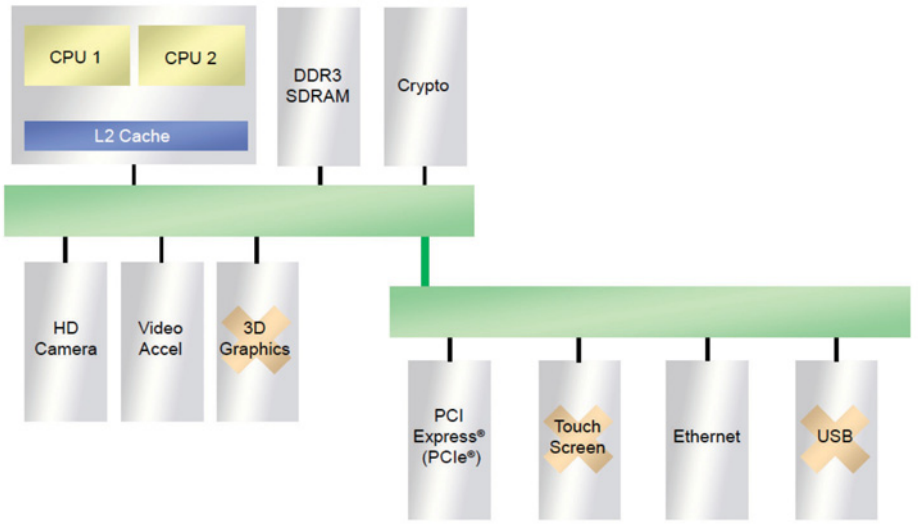


Figure 3: Removing parts to adapt a platform design for specific requirements

by the changes. The tools would help us keep all the documents – from requirements to implementation – coherent.

After each adjustment we would re-simulate at the appropriate level of abstraction to verify that the modified design now meets the new requirements, and then we would propagate the changes down to successively lower levels of abstraction and re-optimize until we had a new, verified implementation.

Schirrmeister points out that this idealized process relies heavily on two additional sets of data, neither of which is guaranteed to be available. The first is use scenarios. With accurate use scenarios we can limit verification of the modified design to modes and inputs that actually mean something to users. Without use models, we face proving that the new design meets the existing and the changed requirements across all physically possible states.

The second item is an adequate testbench, both for the full system and for key subsystems. In a real way, the testbench embodies requirements in a way that a human-language document cannot. And as many design teams have learned to their sorrow, having to recreate a system testbench can be a project on the same scale as the system design itself – or worse, if adequate data on key components such as third-party SoCs are not available.

In The Real World

There is one community of designers for whom our idealized example may not sound so unrealistic. Design teams in automotive, transportation, civil aviation and the like live with standards such as ISO 26262 or DO 178B, which demand that each element in the design and the testbench be traceable to its governing element in the requirements document. These design teams can identify exactly which parts of the design will require testing, and possibly alteration, in order to comply with a changed requirement, and they can say which modules will have to change in the testbench. That is a big head-start.

But in much of the design world, formal requirements traceability is pure fantasy. Traceability on such projects exists only in the memories of the design team members. Even if the original designers could still say what led them to implement a particular block in a particular way, they may have left the company or the industry before anyone gets to ask the question. We must ask how our ideal scenario plays out for these real-world situations.

On A Platform

Consider a design team using a platform. The platform, usually provided by the SoC vendor – Android being the obvious exception – is a superset system design. Everything you are likely to try with this architecture is in the specifications. The concept is then simple: Just create the requirements, identify which pieces of the platform are not needed and leave them out (Figure 3). Then optimize the remaining implementation as necessary to meet parametric constraints.

However, this concept presents some challenges. First, there may not be a requirements document, so the team may have to guess the platform-creator's intent and match that against the new requirements. When the differences are structural, this may be trivially easy. Android includes provision for cameras and microphones, for example; if not needed, they can be left out.

Functional requirements may be more challenging. Obviously a camera might be needed to capture MPEG4 video, but are four ARM cores and a DDR3 SDRAM interface really necessary? What if you want to capture and compress video while the user is Web-browsing? The absence of use models and functional requirements can force you into extensive system-level simulation just to find out which blocks are actually involved in the operations you need to support.

"You have to ask what the new requirements really mean," says Schirrmeister. "I worked on one project that required letterbox format on a video processor. That sounded like a simple added

output format. What we didn't realize initially was that the way the system worked, letterbox format gave us only a fraction of the normal time to decode each frame, so it had major performance implications in other parts of the design. The real art is in understanding the implications of changes in requirements."

Parametric requirements can be especially challenging. You may have to run a system simulation with the chip models at RTL to know if the platform can reach the desired specification at all. Again, several levels of simulation models, accurate use models and an extensive testbench are all vital components of a real design platform.

Altering Last Time's Design

Starting with a platform and working down, design teams can be fairly sure they can meet requirements by just taking blocks out of the platform and optimizing it. But what if you are starting with your previous design, or, even more challenging, with a third-party reference design? The principles don't change, but in the real world, a design team is unlikely to have traceable requirements, good system- or block-level simulation models, or fully-adequate testbenches for the existing design. Method must rely on art.

The challenges begin with identifying the changes. "It is often not a very orderly process," admits Altera design specialist Stacy Martin. "The team looks over the specifications, tries to spot feature or interface gaps, and goes to work on them."

Then it gets tricky. The changes may be well within the capacity of the existing implementation, creating opportunities for optimization, or they may exceed the range of the existing design. Either way, in the absence of a trusted requirements document, designers will have to either accurately estimate performance from system-level models or resort to simulation to find out what the existing design can do. In effect, the team has to analyze the existing implementation in order to regenerate the requirements to which that implementation was designed. Without accurate use models and a good testbench, the team will put a lot of energy into understanding the gap they are trying to fill, before any re-design begins.

These challenges can be daunting. "Design teams try to reuse as much of a system as they can," says Martin. "But after your best effort to reuse, sometimes it is just better to start from scratch."

In the real world there is, in fact, a distinct methodology for derivative designs. It is only a shadow of the ideal we presented here – a shadow dependent upon designers' skill and art in identifying the implications of changed requirements. The more energy the original designers put into reusability – maintaining accurate versions of the design at the requirements, behavioural, structural and implementation levels; locking down use models; and constructing adaptable testbenches – the more closely real-world derivative design can approach its ideal form. ●

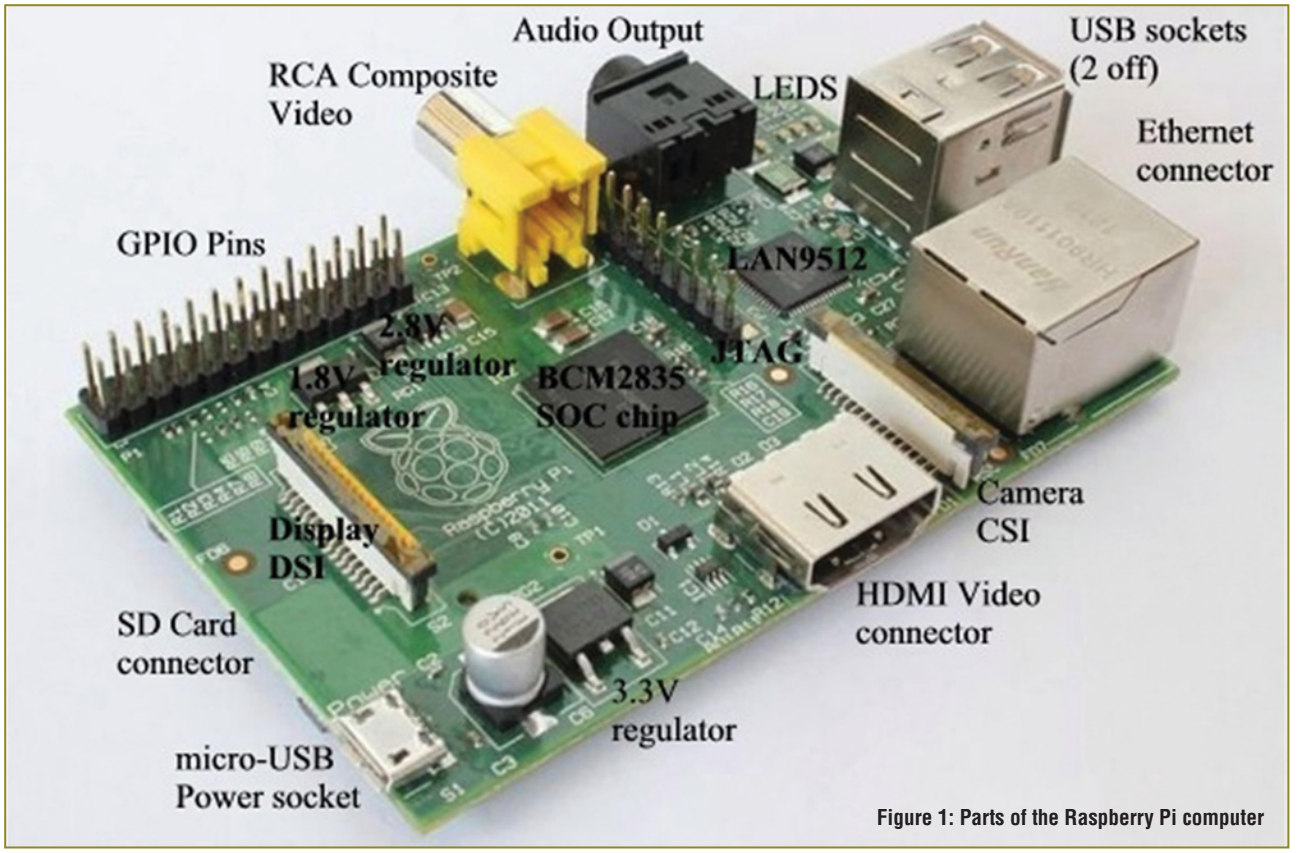


Figure 1: Parts of the Raspberry Pi computer

USING THE RASPBERRY PI COMPUTER IN AUTOMATION APPLICATIONS

PROFESSOR DOGAN IBRAHIM OF THE NEAR EAST UNIVERSITY IN CYPRUS DESCRIBES THE BASIC FEATURES OF THE RASPBERRY PI COMPUTER AND GIVES AN EXAMPLE OF ITS USE IN A SIMPLE MULTI-TASKING APPLICATION

The Raspberry Pi is a small credit-card-sized single-board computer and development board, developed with the aim of teaching the basics of computers in schools. With a price tag of less than £30, the Raspberry Pi is a very low-cost yet very powerful single-board computer based on the popular Linux operating system.

With the connection of a few external devices such as a monitor, keyboard, mouse and so on, the Raspberry Pi can be used to carry out most tasks found on laptops and PCs. For example, it can be used as an office computer to create and edit documents, spreadsheets, graphics applications, database applications and presentation slides. It can be used to access the Internet and to browse web pages, send and receive e-mails, or play sophisticated games. It can be used to learn computer programming and the commands of the Linux operating system. Additionally, the Raspberry Pi computer can be interfaced to the external world and projects can be developed to monitor and control external devices. For example, it can be used in industrial, commercial and domestic automatic control applications such as controlling the speed of a motor, temperature control, liquid level control, robotics, teaching automatic control and others.

This article describes the basic features of the Raspberry Pi computer and outlines how it can be used in automatic control applications. A very simple example is given to demonstrate the multi-tasking capabilities of the Python programming language that comes with the Raspberry Pi computer.

Raspberry Pi Parts

The Raspberry Pi has two models: A and B. Model B is slightly more expensive as it has larger memory, an additional USB port and an Ethernet port. We will look at the features and use of the more popular Model B only.

The Raspberry Pi computer is designed around the Broadcom BCM2835 System-on-a-chip (SoC), which includes the ARM1176JZF-S 700MHz CPU (ARM v6 instruction set), VideoCore IV GPU, DSP engine, 512MB SDRAM and a single USB port. The computer has no built-in hard disk or solid-state

disk, but uses an SD card to store the operating system and for data and program storage.

Figure 1 shows the Raspberry Pi computer elements, consisting of:

Ethernet connector: The RJ-45 Ethernet connector allows an Ethernet hub or switch to be connected to this port.

USB sockets: Just above the Ethernet socket there is a pair of USB sockets stacked on top of each other. Various USB-compatible devices, such as keyboard, mouse, flash memory drive, external hard disk and others, can be connected to these sockets. In some applications, two USB ports may not be enough and it may be necessary to use external USB hubs to increase the number of ports.

> One of the powerful features of the Raspberry Pi in automation is its GPIO ports; a total of 17 general purpose bi-directional I/O ports are provided

LEDs: Just above the USB sockets, at the top right-hand corner of the board there are five miniature LEDs used mainly for status display purposes.

Audio output socket: The 3.5mm audio output socket provides a stereo analogue signal for connecting headphones or speakers. It is recommended to use powered speakers.

RCA Composite Video socket: This socket is provided if it is required to connect the Raspberry Pi to an old-type TV to use it as a monitor.

GPIO pins: GPIO (General Purpose Input Output) is where the power of the Raspberry Pi comes when used in automatic control applications. The GPIO provides bi-directional I/O pins for interfacing external sensors, components and devices to the Raspberry Pi in control and monitoring applications. For example, the speed of a motor can be controlled using these pins. The board supports 17 x GPIO ports, UART, I2C bus interface, SPI bus interface and I2S audio bus interfaces.

SD card connector: This standard-size SD card connector is positioned underneath the board. The SD card must be at least 2GB in capacity and it stores the computer's operating system which is booted when power is applied to the board. It is recommended to use higher capacity SD cards (8GB or 16GB) so that pictures and video files can be stored on the card.

Micro-USB power socket: This socket is used to supply power to the Raspberry Pi. Any type micro-USB power supply with 5V output and a capacity of around 1A (the board actually requires 700mA, 3.5W power) can be used for powering the board.

HDMI connector: This connector is used to connect an HDMI-compatible monitor (or TV) to the Raspberry Pi. Most modern flatscreen TVs are HDMI compatible. A DVI-based PC monitor can be connected to the Raspberry Pi using an HDMI-to-DVI converter device or cable. The video resolution is from 640×350 to 1920×1200.

Camera CSI: This interface allows the connection of a compatible video camera to the board.

Display DSI: This interface allows compatible 'raw' LCD displays to be connected to the board.

Figure 2: Setting up the Raspberry Pi

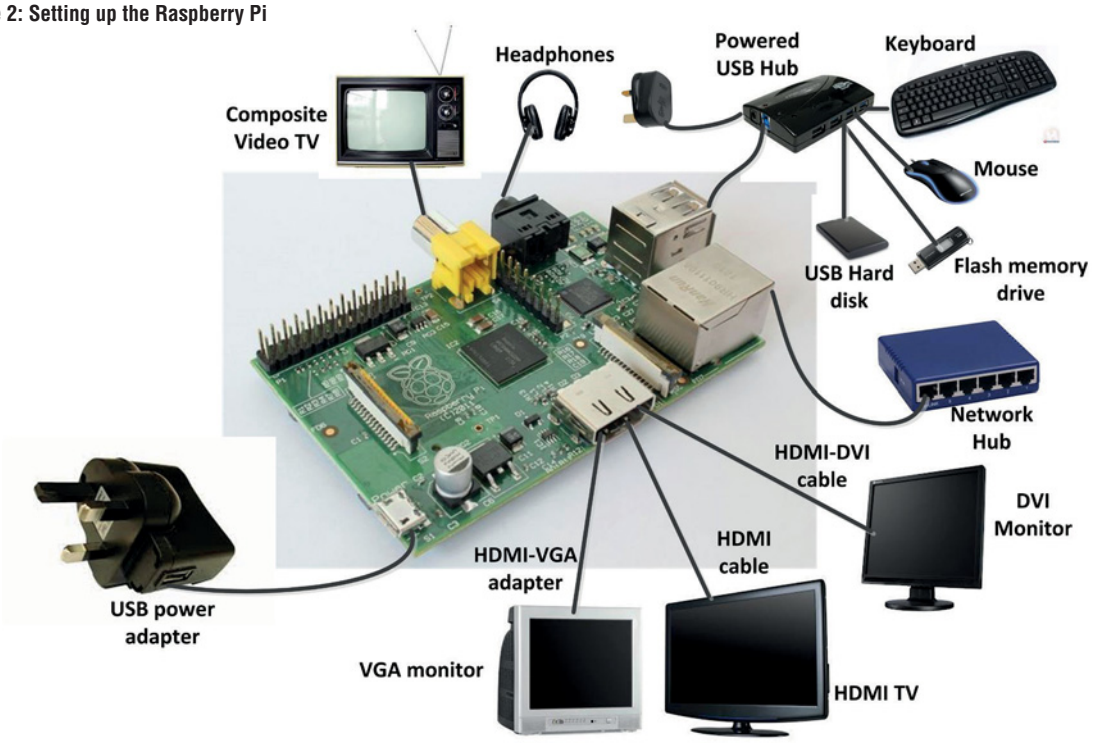


Figure 3: PiFace I/O board

Figure 4: RasPiComm I/O board (www.modmypi.com)

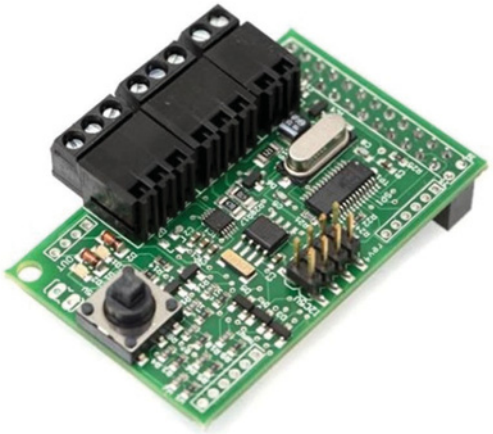
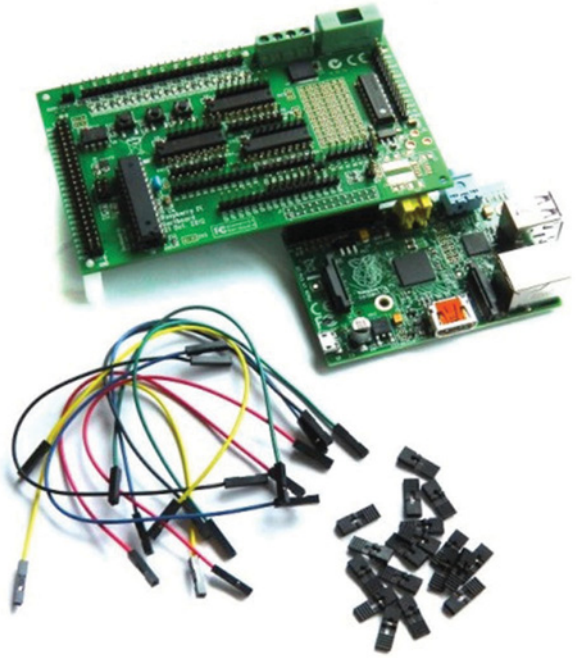


Figure 5: The Gertboard (www.modmypi.com)



LAN9512 chip: This chip provides the two USB 2.0 ports and the 10/100Mbit Ethernet controller functions.

Power regulators: In addition, the board contains several power regulators to step-down the 5V supply power in order to power on-board devices. For example, the SD card operates with 3.3V.

External hard disk drives and flash memory drives can be connected to the Raspberry Pi through its USB ports. Additionally, a USB-based Wi-Fi adapter can be connected for wireless Internet applications.

Setting Up The Raspberry Pi

Figure 2 shows various devices that can be attached to the Raspberry Pi.

In many applications a keyboard with a built-in mouse and an HDMI-compatible monitor are used. It is also possible to use the Raspberry Pi remotely over the Internet, which is an attractive feature, allowing a user to be located far from the actual Raspberry Pi hardware.

The Linux operating system is loaded onto the SD card. One of several versions of this operating system can be selected during the installation process. Programs can be written for the Raspberry Pi using the popular Python programming language, or more conventional languages such as Basic, C, Java and Perl.

One of the powerful features of the Raspberry Pi in automation is its GPIO ports a total of 17 general purpose bi-directional I/O ports are provided. In addition, the board supports useful communication protocols such as UART, I2C and SPI. The port count can be expanded if desired by using external port expander chips (e.g. MCP23S17) attached to the GPIO. In addition, sensors, actuators, display devices (e.g. LCDs, 7-segment displays etc), ADC and DAC modules and other communication devices (e.g. Bluetooth, IrDA etc) can be attached to the GPIO.

Many companies offer GPIO compatible sensors, expansion modules, or development kits, simplifying project development considerably. Some example Raspberry Pi compatible boards are discussed below:

PiFace

The PiFace (Figure 3) is a digital I/O board, developed at Manchester University. The board sits on top of the Raspberry Pi board and is connected to the GPIO connector. PiFace communicates with the Raspberry Pi using the I2C bus protocol, providing eight inputs and eight outputs. Only two pins of the GPIO connector are used. PiFace includes two relays, eight LEDs and push-button switches. The relays can be used to switch high-current loads. Screw terminals are provided to make connections to external devices.

RasPiComm

This small board (Figure 4) also sits on top of the Raspberry Pi GPIO connector. It offers RS232/485 ports, a real-time clock, I2C connector, joystick, digital outputs and screw terminals for external connections.

Figure 6: Starter kit for Raspberry Pi (www.amazon.co.uk)

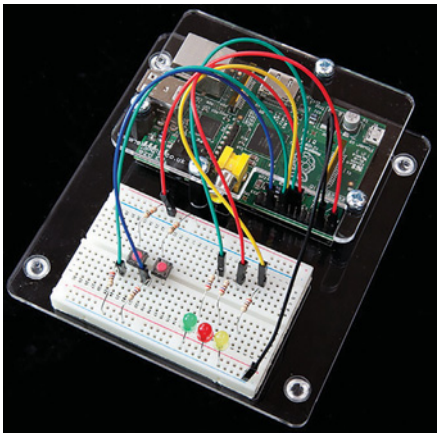
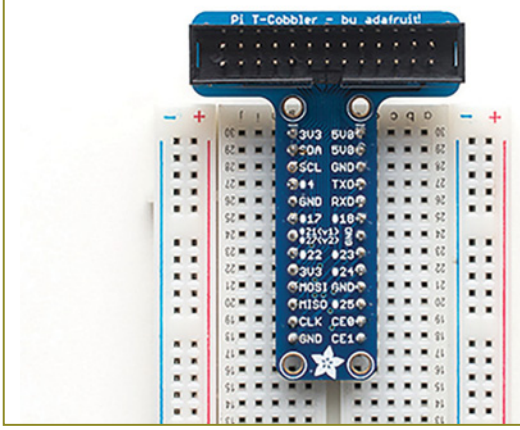


Figure 7: Pi T-Cobbler (www.adafruit.com)



Gertboard

This is an extension board (Figure 5) that plugs into the GPIO connector. Gertboard provides an 8-bit D/A converter, 10-bit A/D converter, on-board ATmega328 MCU, 6 x open-collector outputs, 12 x LED indicators and 3 x push-button switches.

Starter Kit For The Raspberry Pi

The starter kit for the Raspberry Pi is shown in Figure 6. Connections between the GPIO and the breadboard are made with jumper wires. The kit contains a breadboard, Raspberry Pi cover, jumper wires, LEDs and push-buttons.

Pi T-Cobbler

This is a small T-shaped connector (Figure 7) that plugs onto a standard breadboard. The GPIO signals are brought to the connector using a ribbon cable. This connector is useful during small project development. The signal names are marked on the connector for ease of use.

```
#------------------------------------------------------------
#
# SIMPLE MULTI-TASKING EXAMPLE
# ============================
#
# This is a very simple multi-tasking example using the Python
# programming language with the Raspberry Pi. Here, 3 LEDs called
# LEDA, LEDB and LEDC are connected to GPIO ports 17,18 and 23
# respectively. The program flashes the LEDs independently with
# the following sequence:
#
# LEDA: every second
# LEDB: every 500 ms
# LEDC: every 250 ms
#
# Program: Multitasking.py
# Date : February, 2014
# Author : Dogan Ibrahim
#------------------------------------------------------------
# import modules used in the program
#
import RPi.GPIO as GPIO          # import GPIO module
import time                                 # import time module
import thread                            # import module thread

LEDA = 17                                   # LEDA on GPIO17
LEDB = 18                                   # LEDB on GPIO18
LEDC = 23                                   # LEDC on GPIO23
ON = 1
OFF = 0

GPIO.setmode(GPIO.BCM)           # set BCM pin numbering
#
# Configure I/O ports as outputs
#
GPIO.setup(LEDA, GPIO.OUT)               # configure GPIO17 as output
GPIO.setup(LEDB, GPIO.OUT)               # configure GPIO18 as output
GPIO.setup(LEDC, GPIO.OUT)               # configure GPIO27 as output


def Flash_LEDA():
      while True:                                # do forever
            GPIO.output(LEDA, ON)                # turn ON LEDA
            time.sleep(1)                  # wait 1 second
            GPIO.output(LEDA, OFF)               # turn OFF LEDA
            time.sleep(1)                  # wait 1 second


def Flash_LEDB():
      while True:                                # do forever
            GPIO.output(LEDB, ON)                # turn ON LEDB
            time.sleep(0.5)                      # wait 500ms
            GPIO.output(LEDB, OFF)               # turn OFF LEDB
            time.sleep(0.5)                      # wait 500ms


def Flash_LEDC():
      while True:                                # do forever
            GPIO.output(LEDC, ON)                # turn ON LEDC
            time.sleep(0.25)                     # wait 250ms
            GPIO.output(LEDC, OFF)               # turn OFF LEDC
            time.sleep(0.25)                     # wait 250ms
#
# Start the tasks independently
#
thread.start_new_thread(Flash_LEDA, ()) # flash LEDA
thread.start_new_thread(Flash_LEDB, ()) # flash LEDB
thread.start_new_thread(Flash_LEDC, ()) # flash LEDC

while True:
 pass
```

Figure 8: A simple multi-tasking Python program

Raspberry Pi In Automation

The Raspberry Pi computer can be used in various low-cost and low-speed automation applications because of its important features.

There are many real-time automation applications that are required to run in multi-tasking or in multi-processing environments. Most microcontroller development systems and languages do not have operating systems and, therefore, don't directly support such desirable environments. Programmers of such systems tend to create simple and very basic multi-tasking applications using the interrupt facilities of the target microcontrollers, or they purchase multi-tasking library modules at additional costs. Linux on the other hand is a very popular, powerful, secure and highly reliable operating system, possessing all the features required in automation with its pre-emptive multi-tasking features.

Unlike the Windows operating system, Linux has always been a secure operating system, free from virus attacks. It is open-source, enabling users to customize or modify the code however they wish to. There is plenty of help available on the Internet on using the Linux operating system.

In addition, the Python programming language includes a very large number of libraries that make it an ideal programming language for large complex projects with multi-tasking and multi-processing features. The language also supports the Tkinter GUI (Graphical User Interface) module, enabling programmers to develop complex user-friendly GUI-based automation applications with text boxes, push-buttons, list boxes, scroll buttons and more.

Example Project

A very simple example project is shown here to illustrate how easy it is to carry out multi-tasking on the Raspberry Pi computer using the Python programming language. We've connected three LEDs to the Raspberry Pi computer and each one is flashed at a different rate. LEDA, LEDB and LEDC are connected to GPIO ports GPIO17, GPIO18 and GPIO23 respectively through current limiting resistors.

The Python program listing is shown in Figure 8. Notice that three separate tasks have been created in the form of functions and are executed independent of each other. Python supports threads where functions declared in programs can be executed in separate threads. This is done using the thread.start_new_thread call as shown in Figure 8.

The idea given here can be extended to complex multi-tasking control and monitoring applications. ●

FIND OUT MORE

Learn more about this subject in the book '*Raspberry Pi: Hardware Projects*' by Dr Dogan Ibrahim.

CAN I FIND OUT HOW DEVICES ARE
CONNECTED AND MANAGED?

YES

WILL I FIND OUT ABOUT
DATA SECURITY?

YES

WILL I FIND OUT HOW THE
INTERNET OF THINGS
AFFECTS MY ROLE?

YES

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BLENDING FTTX AND DAS NETWORKS

IN THIS ARTICLE, **TONY LEFEBVRE**, DIRECTOR OF PRODUCT MANAGEMENT FOR OUTDOOR DAS PRODUCTS AT TE CONNECTIVITY, DESCRIBES WAYS TO LEVERAGE FTTX FOR DAS DEPLOYMENTS IN URBAN AREAS AND DISCUSSES ADVANCED DAS TECHNOLOGIES THAT REDUCE COSTS AND SPEED TIME-TO-MARKET

Wireline carriers face the challenge of supporting extensive copper and fibre networks in an era of declining wireline revenues. Customers are transitioning to wireless devices and services, and wireless service providers need far more points of presence in order to serve their need for higher data rates and greater coverage. By combining fibre-to-the-x (FTTx) networks with the latest DAS and fibre optimisation technologies, wireless carriers can reduce time-to-market and total cost of ownership while serving their customers better. It's a scenario that benefits both wireless and wireline carriers.

DAS And FTTx Opportunities

Wireline carriers are in an ideal position to provide infrastructure for wireless providers. By incorporating distributed antenna systems (DAS) with their FTTx or PON (passive optical network), wireline carriers can host wireless operator traffic and participate in the rapidly growing wireless revenue stream. Wireline carriers have invested billions in bringing fibre to the node and fibre to the premises in cities and suburban neighbourhoods. But the payback from these investments is being stretched out because of the competitive landscape and the convergence of technologies, resulting in wireless-subscriber churn.

As wireless service providers roll out 4G networks, the need for capacity and high-data-rate services continues to increase, resulting in each cell-site's coverage getting even smaller. When considering that the only way to deliver high performing, ubiquitous 4G services is to increase the capacity in the network by 300-500%, it is not a surprise that service providers' limited spectral assets are under strain, which calls for greater levels of frequency re-use. Furthermore, it is just not practical or cost-effective to add that many traditional cell sites to the network in order to achieve the required level of sectorization, leaving wireless service providers with only one option – to look for alternative small-cell solutions to fill in the gaps.

A primary solution for creating small cells is DAS. By deploying remote antennas connected via fibre, the service provider can extend the wireless signal from a base station over distances of up to several miles. However, deploying the fibre to support DAS is

tangential to the wireless service provider's business. Indeed, wireless carriers can speed time-to-market by using existing fibre assets in the environment, as well as minimize zoning and construction time by deploying smaller-cell site solutions, such as DAS, that can be blended into the environment by using public right-of-ways.

Wireline carriers can solve this problem. By using their fibre networks to support DAS, they can lease capacity on their fibre infrastructure or act as a neutral host for wireless carriers' DAS deployments. This creates an incremental and sustainable revenue stream, which not only improves the wireless service provider's business model for building out FTTx, but also it enables it to bring its service to market quickly, simply and reliably.

Linking DAS and FTTx

There is no doubt that by using small-cell architecture such as DAS an efficient way of distributing spectrum from a common RF source is achieved. Base station (BTS) signals are connected to a DAS host, which then distributes this signal to multiple remote antenna locations via a fibre network.

Carriers can take advantage of this model easily by offering *a la carte* services to the wireless service provider that: (1) provide access to fibre or offer optical efficiencies; and (2) provide leased physical space for the network infrastructure and gear.

DAS overlays nicely onto a FTTx network. The fibre origination in a FTTx network is typically in a serving office with great access to necessary facilities to host or "hotel" BTS resources. Inside the serving office, access to electrical, backhaul, HVAC and, importantly, fibre to the remote nodes creates an environment where the wireline operator can lease space, eliminating the need for the wireless operator to develop a new site to locate the BTS resources. The wireline operator then has the fibre from this serving office running deep into the network, returning its FTTx investment.

> Wireline carriers face the challenge of supporting extensive copper and fibre networks in an era of declining wireline revenues

By either leasing spare dark fibres or offering wavelength services, the wireline carrier can realize recurring revenues leasing these fibres to the wireless operators for their use to distribute the BTS capacity to remote DAS nodes. DAS nodes can be housed on lamp posts, telephone poles, in street cabinets or other street furniture. In this scenario the wireline carrier has the opportunity to further monetize its investment while the wireless operator has a cost-effective and time-to-market efficient solution to deliver wireless services.

Carrier Benefits

By utilizing FTTx networks to overlay a DAS solution, wireless and wireline carriers gain several key advantages:

- Maximised usage of the FTTx fibre plant;
- Faster payback on FTTx investments;
- Participation in the wireless market revenue stream;
- The capability to market both wireline and wireless services to a common customer base;
- Bundled enhanced wireline and wireless service on one bill;
- The ability to add a provider without disrupting the community, i.e. new construction;
- Minimizing time-to-service with easy-to-zone, non-aesthetically disruptive solutions, overlaid on the existing infrastructure and real estate.

While the return on investment (ROI) period often varies based on the type of fibre network architecture deployed, when taking into account the level of leased services offered, for example dark fibre or neutral host, and the number of wireless service providers participating, a return can be seen in as little as six months.

When used as an overlay in FTTx networks, DAS enables wireless signals to be distributed in a manner perfectly suited to deliver 2G, 3G and 4G services. Furthermore, the systems are easily upgraded to support future frequencies within a common hardware platform, making it an investment that continues to return revenues for many years.

Challenges

There's the practical matter of pulling DAS fibres in an urban or suburban area. Mobile operators envision pulling miles of fibre with thousands of costly splices to deploy DAS in these locations with costs running into the millions, but recent DAS and fibre innovations are making it easier to transport DAS traffic around urban and suburban areas without breaking the bank.

The main challenges in using DAS in urban and suburban areas are cost, efficiency and capacity.

- **Cost** – Much of the cost of deploying a DAS in an urban area doesn't come from the cost of DAS equipment, but the cost of installation. Traditional analogue DAS systems require one fibre-pair between each head-end and remote antenna. This one-to-one requirement in an area that may need dozens of remote antennas means that a lot of fibre must be deployed.
- **Efficiency** – Traditional analogue DAS requires the use of a separate BTS for each remote radio-head. In an 18-sector deployment for example, the mobile operator must deploy 18 RF sources for that DAS.
- **Capacity** – Analogue DAS requires an inordinate amount of traffic engineering before deployment because the signal attenuates more with increasing distance from the head-end. To achieve the required capacity for a large deployment, an analogue system will require more radio heads than a digital system.

Solutions

Advanced fibre and DAS solutions mitigate the challenges of deployment. The best DAS products feature all-digital transport, which enables a single head-end to simulcast a signal to many remote antennas or radio heads and to deliver the same high-capacity signal at each antenna. In addition, these head-ends can aggregate the capacity from two or more base stations, so the

mobile operator can increase capacity by simply adding another BTS (no additional head-ends, antennas or radio heads are required). Finally, advanced fibre solutions offer optional fibre-saving technologies such as CWDM and DWDM, which reduce the amount of fibre needed by 80% or more.

- **All-digital transport** – Digital DAS solutions transport RF signals in digital format from the head-end to the radio head or remote antenna unit. This means that the signal does not attenuate between the head-end and antenna, and that the head-end can simulcast the digital signal to all of the remote antennas in the system.
- **Capacity aggregation** – Modern DAS solutions can simulcast the capacity from the connected base-station(s) to all of the remote antennas or radio heads in the system. Capacity aggregation saves on base stations and head-end units and simplifies network design and management.
- **Fibre-saving technologies** – There are several fibre-saving technologies that can be used to minimize the amount of fibre that needs to be pulled and spliced. The first option is to use CWDM and DWDM to expand the data-carrying capacity of individual fibres and fibre pairs by multiplexing 8 (CWDM) or 80 (DWDM) wavelengths on a single fibre.

  Another option is to use a serial link combiner (SLC) to slash the amount of fibre needed in a DAS network. A serial link combiner can support up to 225MHz of spectrum over a single fibre pair. The SLC combines up to three 3.072Gbps fibre links to a single 9.8304Gbps (10Gbps) single-mode or multi-mode fibre pair.

  Another alternative is to use 12-fibre Micro-cable with Push-On (MPO) connectors to eliminate the need for field splicing of fibre. Fibre-splicing specialists are expensive, so reducing the number of splices saves time and money.
- **CPRI Interfaces** – Traditional DAS deployments require an RF connection between the carrier BTS and the DAS head-end. Because a BTS puts out far more power than a DAS head-end can accept, the deployment requires racks of RF attenuators that exacerbate the need for space, power and cooling resources and make it more difficult and costly to deploy the head-end. Digital CPRIs (Common Public Radio Interfaces) are emerging now that integrate base stations directly with DAS head-ends without racks of attenuators, making the deployment smaller and more cost-effective.

As we can see, there are plenty of ways to reduce fibre counts and installation costs tied to mobile network builds in urban and suburban areas. By taking advantage of advances in optical networking, service providers can deliver optimum capacity and coverage at a reasonable cost. By leveraging FTTx networks, wireless service providers can speed time to market, reduce costs and improve service to their customers. ●

BENEFITS OF OVERLAYING A DAS ON AN FTTX NETWORK

By overlaying a DAS on an FTTx Network, a carrier can acheive the following:

- **Monetize spare or dark fibres that may be reserved for spares or the expansion of a wireline network.**
- **Use optical splitters that link the wireless signal from the base station to the FTTx network for distribution to remote units.**
- **Offer wavelength services where dark fibres are not available. Use CWDM or DWDM to split out wavelengths for use in the DAS, minimizing fibre usage.**
- **Offer a simple demarcation point between the networks via an MST solution.**
- **Speed time-to-market by using existing fibre assets and take advantage of zoning approvals already completed.**
- **Utilize the space within a central office, basement, enclosure or hut to house wireless carrier base stations that will provide signals for the DAS.**
- **Utilize common backhaul, power and HVAC to minimise cost and environmental impact.**

Wireless carriers benefit from using DAS solutions as it improves wireless coverage and capacity by placing the signal sources much closer to the user, resulting in better voice quality and the ability to offer higher data-rate services.

BEYOND LITHIUM-ION: FUTURE BATTERY CONCEPTS

By Landa Culbertson, Mouser Electronics

Mobile technology hinges upon the availability of batteries to support it. This is something most of us know all too well, as we charge up our mobile devices every night. Lightweight, cost-effective, rechargeable, and providing higher energy density by far compared to the next commercial battery chemistry, Lithium (Li)-ion is the workhorse and standard for powering today's mobile devices. Developed in the 1970's, Li-ion battery technology is unfortunately nearing its theoretical limits though, and the lag in its ability to keep pace with advancements in mobile technology is plainly evidenced not only by our nightly charging ritual, but also by the latest product introductions to circumvent the issue and provide improved run-time, including wireless charging and mobile battery cases. The hunt has been ongoing for a better battery since the beginning, but there is urgency now, with battery limitations gating not only consumer electronics, but also the electric car industry and related clean energy initiatives. In November 2013, the U.S. Department of Energy even kicked off a $120M effort to develop a game-changing battery technology in five years that would extend battery life by 5X today's capabilities. The push has spawned a flurry of activity and here are a few of the future battery concepts you will be hearing more and more about.

Tin Nanocrystal Li-Ion Batteries

Batteries convert chemical energy into electrical energy by sharing a common carrier electron. Today's Li-ion batteries generate power by sending Li ions from the negative electrode (anode) to the positive electrode (cathode), and the reverse during charging. The electrodes are typically made of cobalt, graphite, manganese, or nickel and do not absorb all of the Li ions. Tin is a more ideal electrode, but tin crystals can become up to three times bigger when absorbing ions, and shrink when releasing the ions, much like a sponge. To handle the volumetric change, scientists at the Laboratory of Inorganic Chemistry at ETH Zurich and Empa are developing a nanomaterial made of tiny tin crystals which can effectively absorb and release the Li ions, thus doubling the energy capacity of the battery.

Metal-Air Batteries

The metal electrodes of batteries in the metal-air category react with oxygen in the air, instead of a liquid, to produce an electrical current. The most promising materials for the electrode appear to be Li and sodium, but aluminum and zinc have also been researched. In fact, zinc-air batteries, such as Renata's ZA675DP6 are already available on the market for use in hearing aids.

Although development of the Li-air battery is still in its infancy, the technology holds the most promise, with 5 to 10X higher theoretical specific energy than Li-ion batteries, and is particularly attractive to the electric car industry. The high specific energy of Li-air batteries translates to 1000 miles of range, compared to the existing average of 125 miles on Li-ion batteries.

Sodium-air batteries have a lower theoretical energy capacity than Li-air, but are more stable and easier to build, while still more efficient than today's Li-ion batteries. Tests on sodium-air batteries have also shown that they may present a higher practical energy storage capacity than Li-air.

Liquid Metal Batteries

MIT-founded and Bill-Gates backed start-up, Ambri, has developed a battery that uses a molten salt electrolyte sandwiched between two layers of liquid metal. The difference in composition between the liquid-metal electrodes—one low-density negative and the other high-density positive, creates a voltage. Ambri, also the recipient of a $6.9M grant from the U.S Department of Energy's high risk early stage ARPA-E program, is targeting the technology towards storage applications in the power grid to make the energy system more efficient.

More New Battery Concepts

Other new battery concepts including Li-sulpher, which has energy density that is 3 to 5X that of today's Li-ion batteries, and sugar-powered biobatteries which offer green technology in addition to high energy density are among many new battery concepts in development for the next generation of electrochemical batteries. It's a race to see which battery technology will succeed Li-ion, but no matter what, the consumer is sure to benefit.

uk.mouser.com

IMPLEMENTATION OF EFFICIENT GEOLOCATION USING SWARM RADIO

GUNTER FISCHER, **THOMAS FÖRSTE** AND **FRANK SCHLICHTING** FROM NANOTRON TECHNOLOGIES

INTRODUCE COLLISION AVOIDANCE (CAS) TECHNOLOGY, ILLUSTRATING THE BENEFITS OF AN EXTENDED SWARM APPROACH TO COMMUNICATION AND GEOLOCATION

The swarm concept is used in wireless sensor networks so that group members can interact with each other; adding location awareness to the mix means each can assess and measure the distance between them.

Combining communication and location awareness enables a whole new category of geolocation applications, including collision avoidance (CAS).

Vehicle	To Vehicle	To Asset	To Person	
Safety Zone B = 20 m	3B 60 m	1.5B 30 m	2B 40 m	Multiples of braking distance B. Absolute distance in meters.
Maximum Speed Safe Time	50 km/h 2.2 sec	- 2.2 sec	10 km/h 2.4 sec	

Table 1: Travel time through various safety zones on a straight collision course

The Swarm Platform Technology

Low-power swarm radios – autonomous 2.4GHz Chirp Spread Spectrum wireless nodes – are the basic swarm building blocks (Figure 1). They are able to broadcast and exchange messages while monitoring distances to other individuals in the swarm, which are the key capabilities that allow for coordinated swarm behaviour.

Each individual in a wireless swarm consists of a swarm radio controlled by a host through its application interface (API).

There are several categories of API commands (Figure 2). The RangeTo <node ID> command, for instance, returns the distance to another node.

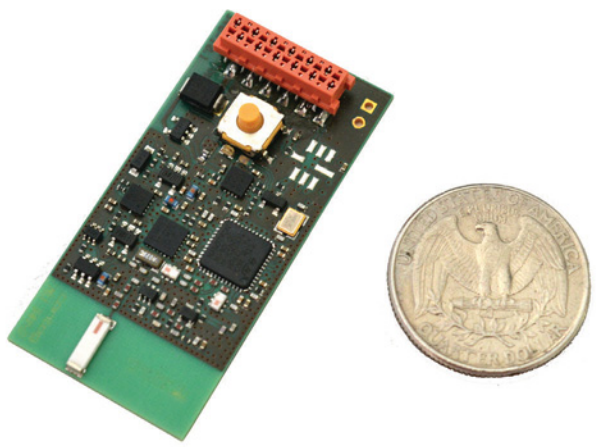

Figure 1: Low-power swarm radios; swarm radio mini from Nanotron

The quality of location awareness depends on two basic criteria: accuracy and latency. Accuracy is the difference between measured and true distance, usually characterized by a fixed offset and the spread of results, as shown in Figure 3. Latency specifies the time required to obtain a range result. It has a strong impact on the real-time character of the application. Short messages and quick responses help to minimize latency thus maximizing throughput. A typical swarm radio requires 1.8ms of air time for executing an SDS-TWR cycle (which is Nanotron's patented Symmetrical Double-Sided Two Way Ranging). To broadcast its ID it only requires 350µs.

The maximum obtainable range of swarm radios determines how far apart individuals in the swarm are able to interact, which also depends on the application environment. Under ideal line-of-sight conditions, range might exceed 500m; however, in reality, it is often much shorter due to obstacles, reflections, interference from other radio signals, antenna misalignments and so on.

Figure 4 shows a real-world example a swarm radio inside a car and another carried by a person. The range could be extended by placing the first antenna on the outside of the car and/or having the second one placed on a hard-hat instead of a belt, for example.

Collision Avoidance Solution (CAS)

One area where there is a need for automatic collision avoidance is mining. To prevent accidents, a reliable alarm is required whenever vehicles come too close to people, assets

or other vehicles. Swarm geolocation technology is well suited to implementing Collision Avoidance Solutions (CAS).

A simplified setup with vehicles, assets and people – a total of three node types – is used to illustrate the essential outline of the application. In the worst case scenario two objects move towards each other at maximum speed (Table 1). The system needs to react faster than the time necessary for the objects to traverse the respective safety zone for the shortest path collision course. In our example the shortest time is 2.2s, and as such the latency of the CAS system must be kept short and the whole group of nodes needs to complete the full location awareness cycle faster than 2.2s. For reliable operation it might be worth accelerating the sequence to execute it several times within this interval.

Figure 5 shows the steps of the location awareness cycle and how they are supported by swarm radio:

- **Get IDs:** As a first step the swarm radio makes itself visible by broadcasting its own ID. SetBroadcastIntervall=01 for example sets the blink interval to 1s. After activating the broadcast by SetBroadcastNodeID=1, the swarm radio broadcasts its ID every second. Node IDs of other participants are automatically stored in the NodeID list when received. The host application can read the NodeID list by using the GetNodeIDList command. This way neighbours are identified to the CAS application.
- **Range to IDs:** As a second step, the swarm radio measures the distance to all neighbours. This is accomplished by subsequently executing the RangeTo <node ID> command. The resulting distance values are communicated back to the host application.
- **Evaluate distances:** In a third step, the CAS application needs to decide whether or not any of the measured distances

Ranging	Data Communication
RangeTo	EnableDataNotification
GetRangingResults	SendDataTo
BroadcastRangingResults	GetData
DeleteAllRangingResults	BroadcastData
SetPrivacyMode	EnableRangingData
	FillRangingData
Set-Up	**Node Identification**
SetNodeIDAdd	BroadcastNodeID
ReadNodeIDAdd	SetBroadcastIntervall
SetNodeType	GetNodeIDList
SaveSettings	
RestoreSettings	**Air Interface**
ReadSettings	SetCSMA
SetFactorySettings	

Figure 2: Overview of Nanotron's swarm API commands

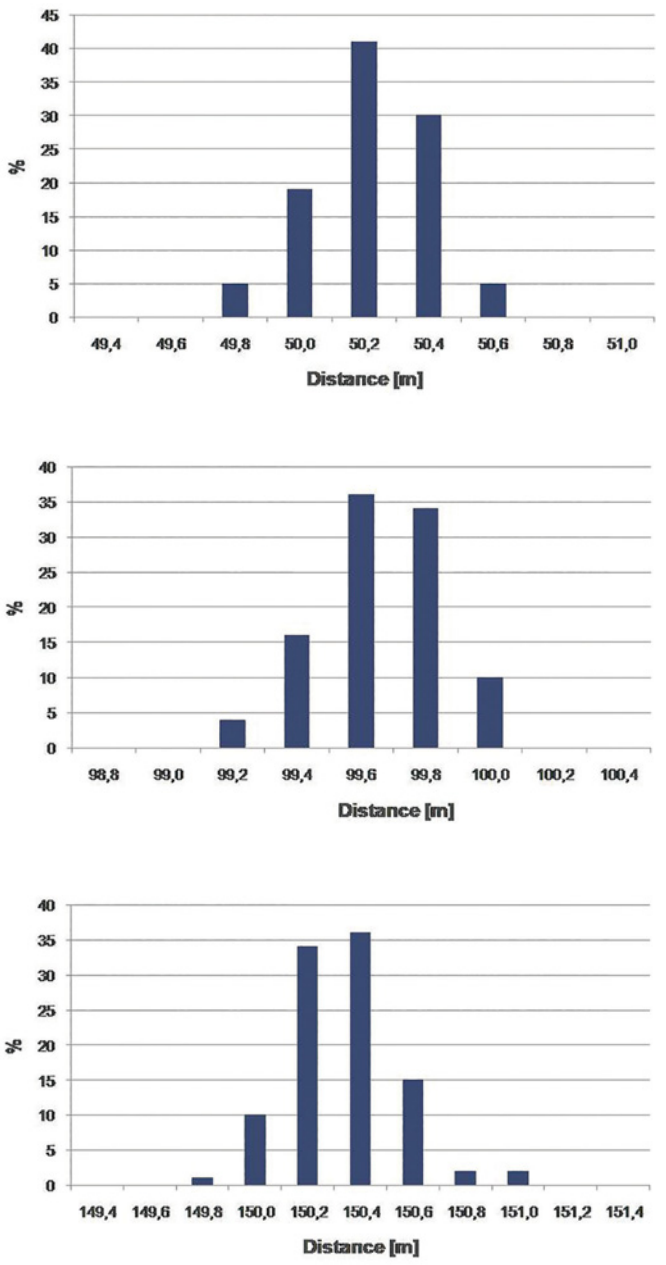

Figure 3: Ranging accuracy is characterized by offset and spread. The actual distances are 50, 100 and 150 meters, respectively

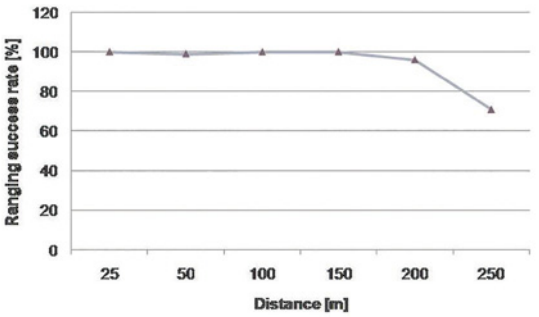

Figure 4: Range measured between a pedestrian with a swarm radio mini and another swarm radio mounted onto the dashboard of a passenger car

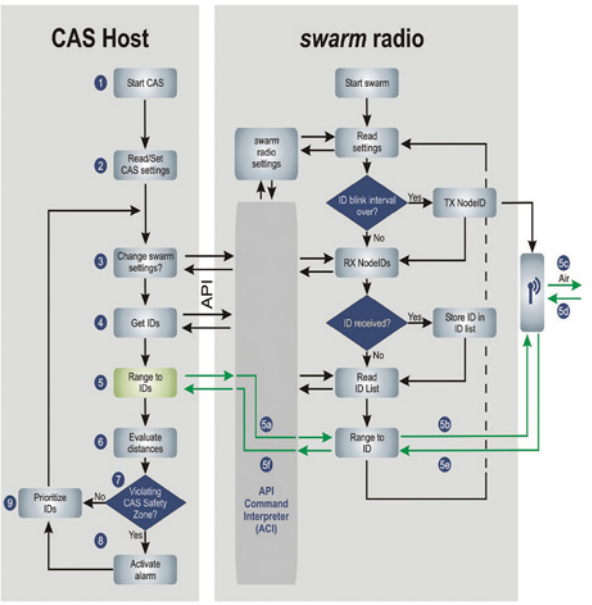

Figure 5: Collision avoidance application flow-chart. Example: RangeTo command

violates a safety zone requirement and needs to take action if it does. It may involve a simple audio alarm on approach or exercising the brakes of a truck to prevent an imminent collision.

As part of designing the CAS application it is now possible to estimate the time required to execute one location awareness cycle and trigger an alarm if required. The sequence in our example takes less than 30ms, so the time constraint mentioned earlier can be easily met.

All swarm radios share the same air interface. The CAS application works in an entirely asynchronous fashion and packet collisions may occur. Several location-awareness cycles instead of just one increase the probability of a successful sequence. At the same time, traffic through the air interface must not exceed channel capacity. Broadcasting the node ID together with a full ranging cycle takes about 2.2ms of air time. This is just 0.1% of the 2.2s cycle-time for the CAS application. As a rule of thumb, no more than 17% of the available airtime should be used – a good trade-off between success rate and throughput. This is important when scaling the application by adding more swarm radios.

Safety Zones

In real swarm applications safety zones could be designed to be dynamically adjusted to the actual speed of the moving object and the last measured distance on a potential collision course. This minimizes the number of alarms and maximizes the number of swarm radios that can be used by the system. ●

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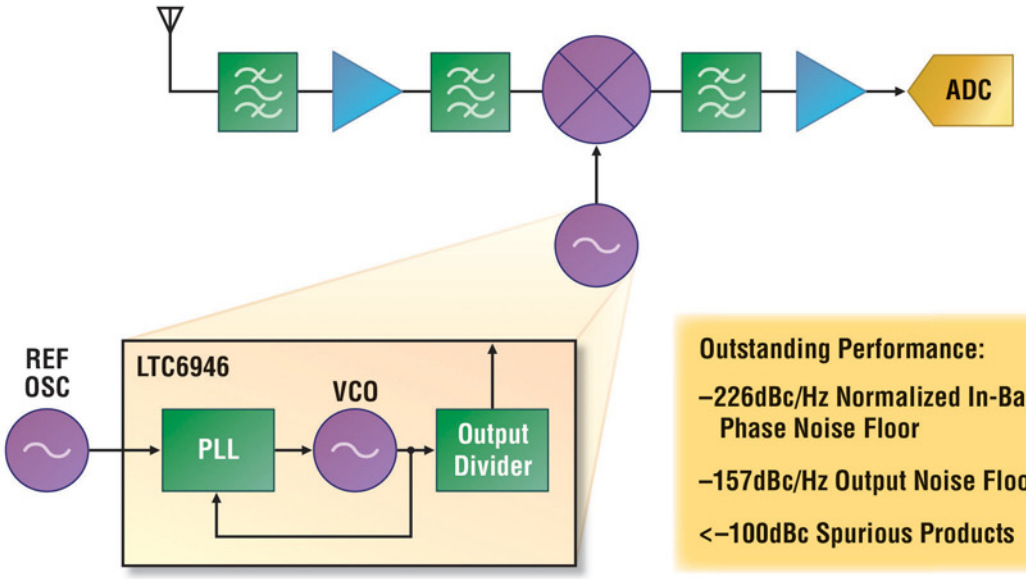

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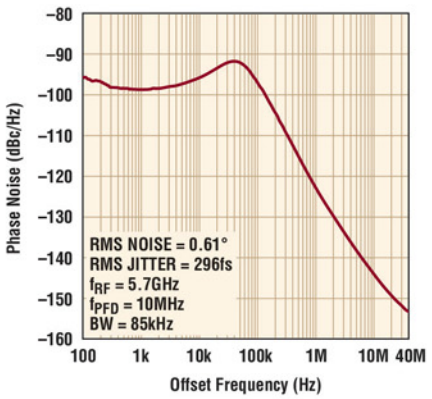

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5.5GHZ NOTCHED WLAN-BAND UWB ANTENNA USING SLOTTED RECTANGULAR SPLIT-RING RESONATORS

M. M. ISLAM, M. R. I. FARUQUE AND **M. ISLAM** FROM UNIVERSITI KEBANGSAAN MALAYSIA PRESENT A NEW DESIGN OF AN UWB ANTENNA, WITH OPTIMISED CIRCULAR RADIATING PATCH PRINTED ON LOW-DIELECTRIC FR4 MATERIAL

Theoretical physicist Sir John Pendry was the first to identify a practical way to create metamaterials, or materials engineered for specific applications. In the process, he also demonstrated the split-ring resonator (SRR) for the first time, which is an artificially made structure that produces the desired magnetic susceptibility (or magnetic response) in various types of metamaterials up to 200 terahertz.

A new opportunity now exists in short-distance wireless communications thanks to the US Federal Communications Commission (FCC), which allocated the 3.1-10.6GHz frequency band for unlicensed radio communication. IEEE 802.11a WLAN and HIPERLAN/2 are narrowband communications technologies in the 5.15-5.825GHz range, but they tend to suffer from interference, especially from ultrawide band (UWB) systems.

To overcome this problem, spatial filters can be used, which filter out the interfering bands. On the other hand, an electromagnetic bandgap (EBG) structure, split-ring resonator and parasitic elements can also be used for solving this problem.

UWM Efforts

A lot of research has centred on UWB antennas. A notched-band design was presented for UWB antennas in Reference 2, see box. Complementary split-ring resonators (CSSRs) were etched in the T-stub region of a coplanar waveguide (CPW) feed in this design antenna to generate a notch frequency band of 5-6GHz, where the antenna dimensions were 33mm × 35mm.

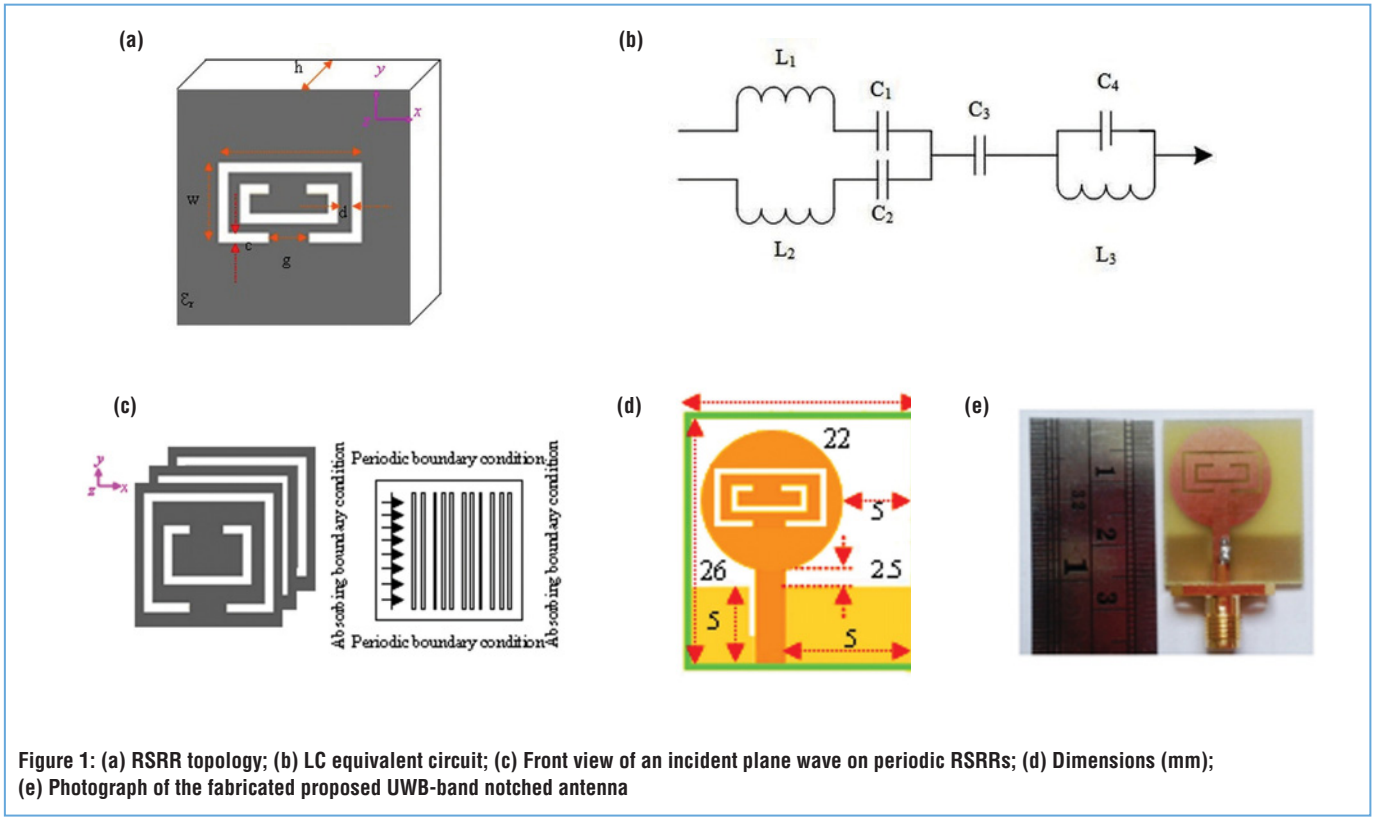

Figure 1: (a) RSRR topology; (b) LC equivalent circuit; (c) Front view of an incident plane wave on periodic RSRRs; (d) Dimensions (mm); (e) Photograph of the fabricated proposed UWB-band notched antenna

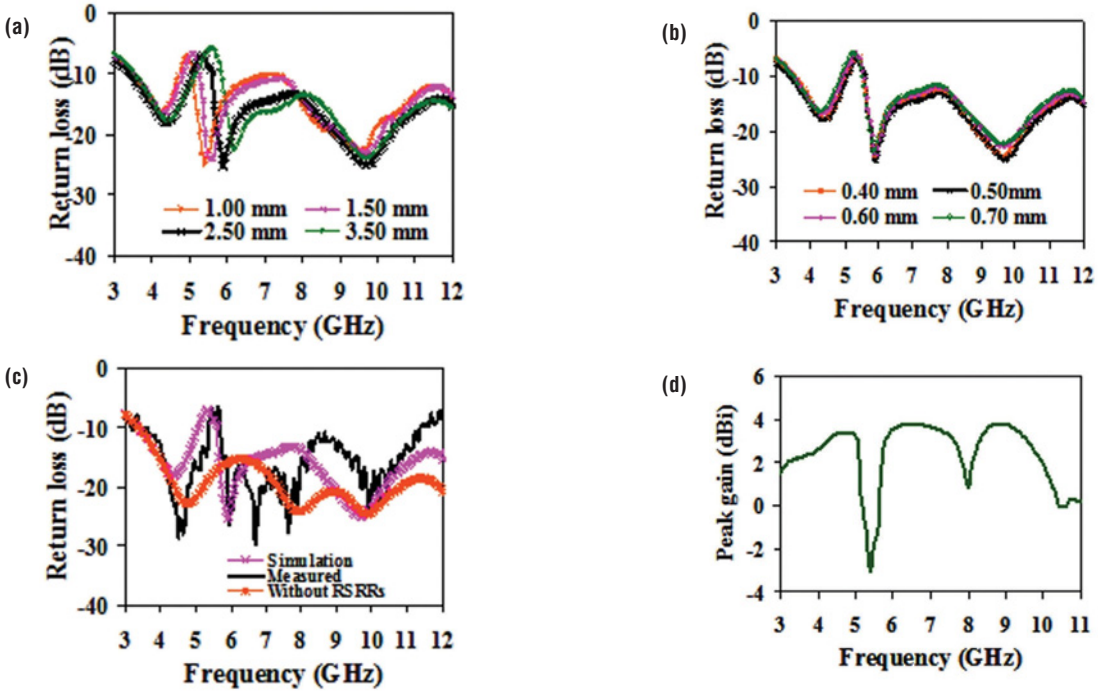

Figure 2: Figure 2: (a) Return losses of the proposed antenna with different values of g; (b) Different values of d; (c) Measured and simulated return loss; (d) Measured peak gain

In Reference 3, a monopole antenna was presented with single notched-band properties for UWB applications. An open-loop resonator is inserted to create a notched band, centred at 5GHz, at the centre of the reported fork-shaped antenna, 35 × 30mm² in size. A compact monopole antenna was presented with standard notched-band properties where the antenna dimensions were 30mm × 35mm (see Reference 4). In order to produce a notch frequency band from 5.12-6.08GHz, a vertical coupling strip was inserted at the centre of the radiating slot patch.

We've created a notched 5.5GHz WLAN-band UWB antenna with slotted rectangular split-ring resonators (RSRRs) with a nearly omni-directional radiation characteristic and smooth current distribution. This antenna is made of a circular radiating patch with slotted RSRRs and a partial ground plane containing a rectangular slot in its upper section, generating an ultra-wide bandwidth, ranging from 3.45GHz to over 12GHz. The antenna formation is smooth with simple design, and is easy to manufacture. Slotted RSRRs are inserted inside the circular patch to generate a notch frequency band for filtering out the 5.5GHz WLAN band.

Antenna Design

Figure 1a shows the structure of the RSRRs; the LC equivalent circuit is shown in Figure 1b. The RSRRs are made by engraving two square split-rings with cuts located on the reverse side of each ring in the circular patch. When an electromagnetic wave of polarization in the x axis propagates in the z direction, an electromagnetic force is created around the SRR [5]. The SRR then conducts as an LC circuit, as the total current flows in both rings. The resonant frequency can be found from Equation 1 [5]:

$$\omega_0 = \sqrt{\frac{2}{\pi r_0 L_0 C}} \quad (1)$$

where L is the total inductance of the SRR, r_0 is the average radius of the considered SRR, and C is the capacitance per unit length between rings.

Figure 1c shows the front view of an incident plane wave on periodic RSRRs. An absorbing boundary condition is applied to the propagation regions, and periodic boundary conditions are applied to reduce the computational domain. From the analysis it can be observed that both incident polarizations can generate a notched band. The notched band belongs to a region where permeability or permittivity is negative.

The antenna dimensions (in mm) and a photograph of the fabricated proposed UWB band notched antenna are shown in Figures 1d and 1e. The antenna is printed on a low-cost 1.6mm-thick FR4 substrate with a dielectric constant of 4.6 and loss tangent of 0.02. It is made of a circular patch with a radius R, and partial ground with a rectangular slot to gain the ultra wide bandwidth. The circular radiating section is printed on the upper section of the substrate fed by a microstrip line, with the ground plane printed on its lower side. An SMA connector is attached to the port to gain the 50Ω input impedance. The overall antenna dimensions are 22mm × 26mm, with the slotted RSRRs' l = 12mm, w = 6.5mm, c = 0.5mm, d = 1.5mm, g = 2.5mm and h = 1.6mm.

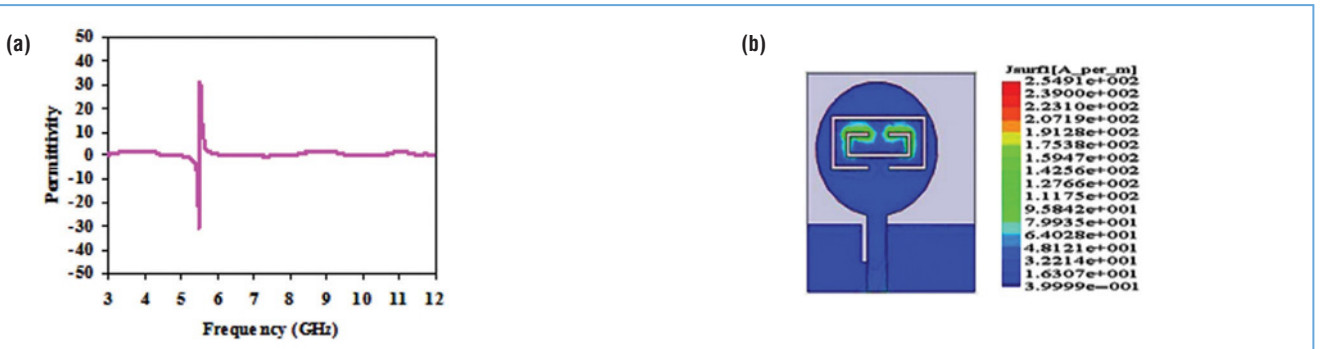

Figure 3: (a) Extracted negative permittivity of RSSRs; (b) Surface current at 5.5GHz

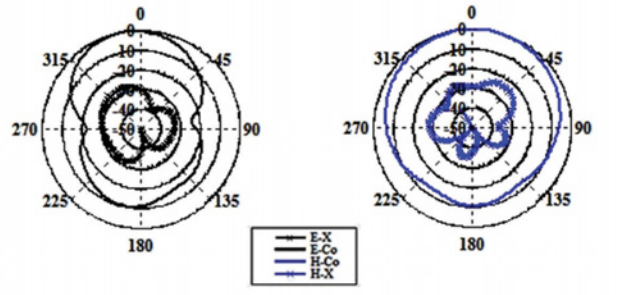

Figure 4: Measured radiation patterns on the E plane (black) and H plane (blue) at 5.5GHz

Results

Figure 2a shows the gap between the two edges of the slotted rings for different g values. The resonance of the eliminated band switches from a lower frequency up to a definite value as the value of g rises, with the optimized value being 2.5mm.

Figure 2b shows the proposed antenna's impedance properties for different values of d, which is the thickness of the RSRRs. It is found that at lower frequencies the resonance occurs when d is 0.40mm, whereas at higher frequencies it is observed when d is 0.60mm and 0.70mm. The notched 5.5GHz WLAN band is seen with 0.50mm, which is desired.

An Agilent E8362C vector network analyzer was used to measure the performance in a standard far-field testing environment. The simulated and measured return losses of this antenna are shown in Figure 2c with return loss without slotted RSRRs. The notched 5.5GHz WLAN band is realized in the return loss properties in a bandwidth of 495MHz. It covers an ultra wide frequency band from 3.45GHz to over 12GHz with an eliminated 5.5GHz WLAN band. The incompatibility between measurement and simulation is predominantly due to fabrication faults of the antenna.

Figure 2d indicates the measured peak gain of this antenna. The gain drops swiftly in the region of the eliminated 5.5GHz WLAN band, measured -3dBi. The antenna shows stable gain without the operating frequency of the notched band.

The extracted negative permittivity of the RSRRs is shown in Figure 3a. This single negative metamaterials characteristic shows as epsilon negative (ENG), which means that the permittivity characteristic is negative. The surface current distribution is plotted in Figure 3b. It can be seen that the concentrations of the surface current distribution are very stable around the slotted rectangular split-ring resonators and the feeding line. The flows of the current in the slotted RSRRs are inverse to the current flows in the outward edges of the radiating patch and ground. Consequently, the entire effective radiations are reduced significantly or cancelled out completely, and an eliminated WLAN band is generated at 5.5GHz by virtue of high attenuation.

Figure 4 illustrates the measured radiation patterns at 5.5GHz in the E and H planes. In order to demonstrate co-polarization and cross-polarization, two-dimensional (2D) radiation patterns were created at 5.5GHz; E_θ represents the co-polarization and E_φ the cross-polarization properties. The yz coordinates are taken into account as the E plane and xz coordinates as the H plane. The cross-polarization dimension is smaller than the co-polarization dimension on both the H plane and E plane at the resonance of 5.5GHz. It is observed that the proposed antenna exhibits better broadside radiation features and considerable front-to-back ratio with low cross-polarization, which leads to a symmetric and nearly omni-directional radiation pattern. At the eliminated 5.5GHz WLAN band, the gains are markedly restrained in all directions, which show the effect of slotted RSRRs. ●

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WHAT THE READERS SAY...

POSTGRADUATES PROBLEM

The engineering skills-shortage debate has been raised again as a result of a recent report published by Cranfield University in partnership with the Higher Education Academy (HEA).

Some 46 bodies, ranging from academia and trade groups to manufacturing, materials and design, came to the conclusion that "a revolutionary improvement in postgraduate education" is required.

This comes as no surprise. The last two years have seen rising student dissatisfaction lead to a 13.5% fall in the number of full-time postgraduates.

It's frustrating to see that, despite currently leading in innovation, the UK's universities are slowly slipping down the international rankings, facing "a collapse in their global position within a generation".

> The last two years have seen rising student dissatisfaction lead to a 13.5% fall in the number of full-time postgraduates

So what's being done? The Cranfield report calls for three things: an industry roadmap, a cross-sector taxonomy of postgraduate education and an overhaul of teaching methods to bridge the gap between student and industry needs.

Although this goes some way to combating the problem, more is needed. Having faced these challenges, Accutronics prescribes the use of an innovation strategy. Here, employers must innovate in both product and process development. One way of achieving this is by using government-funded Knowledge Transfer Partnerships (KTPs).

We face a second-wave of skills shortages if we fail to address the current situation. A serious remodelling of industry and academic collaboration is required if we are to lay the foundation for sustainable growth.

Rob Phillips,
Managing Director, Accutronics Ltd, UK

WOMEN IN ENGINEERING

I've read many articles focusing on the status of women in engineering roles which illustrate the unconscious beliefs and expectations we have as a society and our attitudes towards the gender issue. Although the figures for the male/female engineer ratio emphasize the chronic shortage of talent in manufacturing, trying to stop the conversation about gender differences can only deepen discrimination in our sector.

I believe that successful women in engineering should act as champions for their gender and accept the weight of their individual characteristics. By embracing what they are, women can achieve greatness and become role models for those entering the profession. However, if we decide to call a halt to the debate about gender differences in the workplace – believing that discrimination laws have fixed the problem for us – the result will be an even thicker and more impenetrable glass ceiling.

The media can do its bit by highlighting the most successful women in engineering and celebrating them as role models. We need to tell the story and include the ups and downs, challenges and successes each of these women has been through. It is my belief that it is up to each successful woman to pave the way and encourage the debate to open.

Michelle Gillam
Marketing Manager at REO (UK) LTD

IAN DARNEY'S GROUND LOOPS

Ian Darney's approval of ground loops in PCB design and elsewhere ('Design Guidelines,' July) brought me up short.

I submit that there are ground loops and there are ground *loops. His flavour are arguably beneficial, but if the task is to get an audio or video signal from here to there, ground loops are to be hunted down and killed without mercy, since a ground loop on an audio or video transmission line destroys the signal, resulting in hum (audio) or irreparable loss of sync (video). And where Darney rejects the single-point system ground in favour of more sophisticated approaches, in audio-video transmission single-point grounds, along with isolation transformers and fibre optics, are the favoured solutions.*

Most typically, audio/video ground loops are caused by differences in potential between reference grounds, which are most often simply AC power-line ground. Usually a few volts difference between the grounds of different power circuits doesn't matter, especially since they are almost always at different locations.

The tricky part is connecting those locations with audio or video lines, both with a nominal one-volt level; the wanted signal is simply swamped by the unwanted, creating a dreaded ground loop. Making matters worse, microphone outputs are no more than a few millivolts, requiring in addition shielding and well-adjusted differential inputs for the rejection of hum and other intereference.

Harry Joseph
NYC AV guy

THIS SERIES PRESENTS SOME SIMPLE ARDUINO PROJECTS. ARDUINO IS AN OPEN-SOURCE ELECTRONICS PROTOTYPING PLATFORM, BASED ON FLEXIBLE, EASY-TO-USE HARDWARE AND SOFTWARE

How To Make A Musical Instrument With Arduino

BY **JOHN NUSSEY**

The Arduino allows to go beyond playing a sound – you can create your own instrument, similar to the Theremin. The Theremin, named after its inventor Léon Theremin, was one of the first electronic musical instruments, developed in the 1920s. It worked by detecting the proximity of the player's hands to two radio antennae to change the signals: one hand for volume and the other for pitch.

The PitchFollower Sketch

The following sketch describes how to make a budget Theremin using a light sensor to control the pitch.

What's needed for the project:

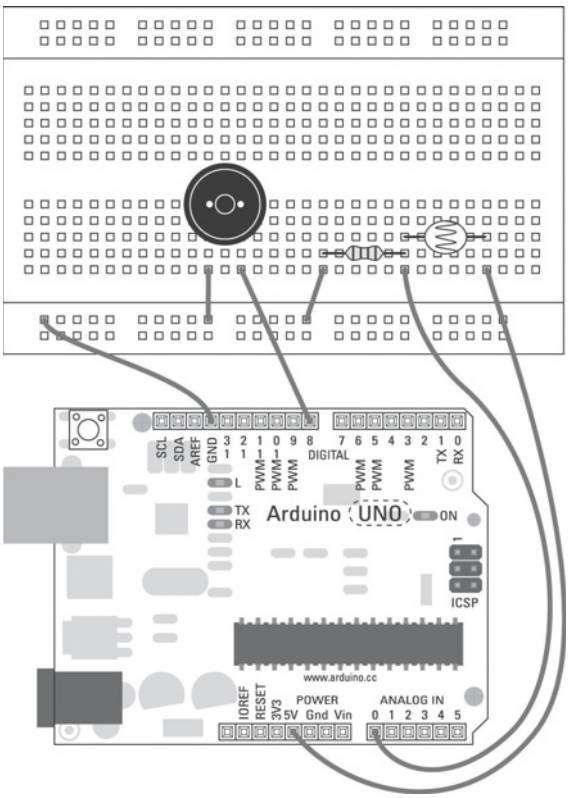


Figure 1: Pictorial diagram

- Arduino Uno;
- Piezo;
- Breadboard;
- Photoresistor (used as a light sensor);
- A 47kohm resistor;
- Jumper wires.

This circuit has two separate halves, the piezo and the light sensor circuit. The piezo is wired as in the toneMelody sketch, with one wire connected to digital pin 8 and the other to GND.

The light sensor is connected to analogue 0 on one side and 5V on the other; the 4.7K resistor is connected between analogue 0 and ground.

Complete the circuit, and open the sketch by choosing File → Examples → 02.Digital → tonePitchFollower.

```
/*
 Pitch follower
 Plays a pitch that changes based on a changing
analog input circuit:
 * 8-ohm speaker on digital pin 8
 * photoresistor on analog 0 to 5V
 * 4.7K resistor on analog 0 to ground
 created 21 Jan 2010
 modified 9 Apr 2012
 by Tom Igoe
This example code is in the public domain.
 http://arduino.cc/en/Tutorial/Tone2
 */
void setup() {
 // initialize serial communications (for debugging
only):
 Serial.begin(9600);
}
void loop() {
 // read the sensor:
 int sensorReading = analogRead(A0);
 // print the sensor reading so you know its range
 Serial.println(sensorReading);
 // map the pitch to the range of the analog input.
 // change the minimum and maximum input
numbers that follow
```

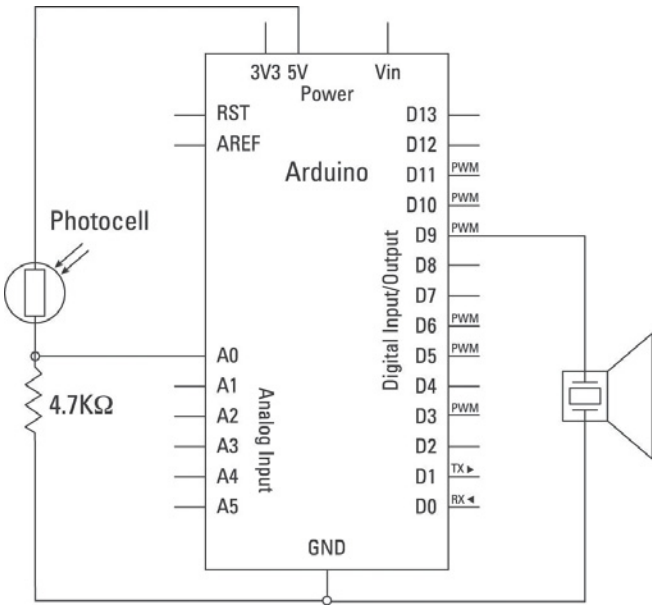
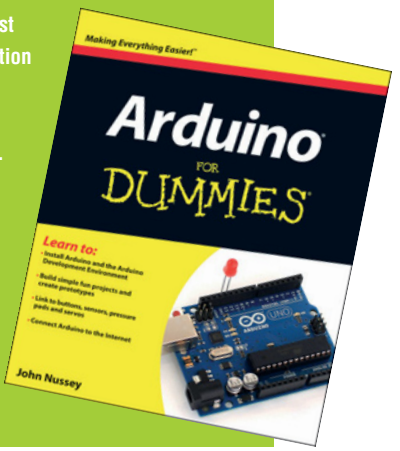


Figure 2: Schematic diagram

WIN THE 'ARDUINO FOR DUMMIES' BOOK BY JOHN NUSSEY

John Nussey is a creative technologist based in London. He teaches interaction design and prototyping at the Goldsmiths College and the Bartlett School of Architecture among others. We have a couple of copies of this book to give away. To enter please supply your name, address and email to the Editor at svetlanaj@sjpbusinessmedia.com. The winner will be drawn at random and announced at the end of the series.




```
// depending on the range your sensor's giving:
int thisPitch = map(sensorReading, 400, 1000, 100, 1000);
// play the pitch:
tone(8, thisPitch, 10);
delay(1); // delay in between reads for stability
}
```

After you have found the sketch, press the Compile button to check the code. Any syntax errors turn the Message box red when they are discovered, and there will be an error message stating what is wrong.

If the sketch compiles correctly, click Upload to upload the sketch to the board. When it is done uploading, there should be a light sensor that will change the pitch of the buzzer. If you don't hear any change, turn a desk lamp on over the breadboard to increase the difference when the light sensor is covered by a hand, for example. If nothing happens, double-check the wiring:

- Make sure the correct pin numbers for the inputs and outputs are being used.
- Check the photoresistor's light-sensitive surface is exposed.
- Check the connections on the breadboard. If the jumper wires or components are not connected using the correct rows on the breadboard, they will not work.

The PitchFollower Sketch Breakdown

This sketch directly converts the readings from the light sensor to a frequency rather than requiring a lookup table. This means that you can slide between notes as well as choose them individually.

In setup, the serial port is opened to allow the monitoring of the sensor readings as they come in.

```
void setup() {
// initialize serial communications (for debugging only):
Serial.begin(9600);
}
```

In the main loop, the light sensor is read from analog pin 0. This reading is also forwarded onto the serial monitor.

```
void loop() {
// read the sensor:
int sensorReading = analogRead(A0);
// print the sensor reading so you know its range
Serial.println(sensorReading);
```

To convert the sensor's range to the range of frequencies that the buzzer can cover, you use the map function.

```
// map the pitch to the range of the analog input.
// change the minimum and maximum input numbers below
// depending on the range your sensor's giving:
int thisPitch = map(sensorReading, 400, 1000, 100, 1000);
```

The tone function then outputs the note with the mapped sensor value for 10 milliseconds. This duration makes the sound audible, but the real duration will be determined by how long you hold your hand over the sensor.

```
// play the pitch:
tone(8, thisPitch, 10);
```

Finally, a tiny delay occurs at the end of the loop to improve the stability of the readings.

```
delay(1); // delay in between reads for stability
}
```

More on this and other Arduino projects can be found in the book 'Arduino For Dummies' by John Nussey.

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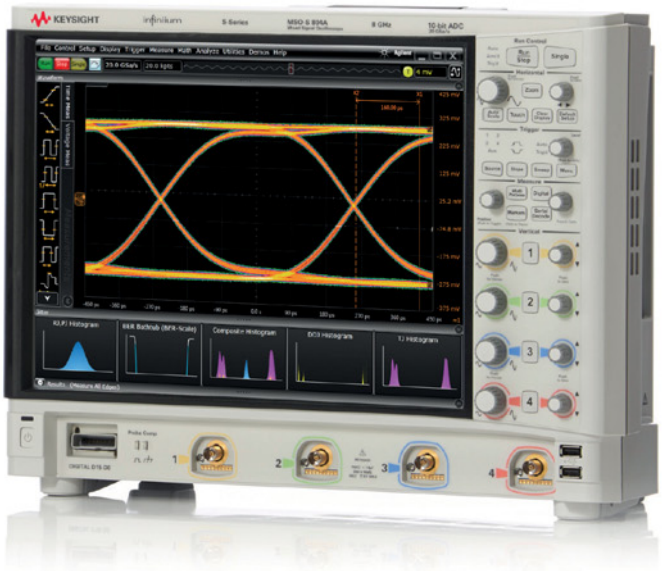

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European Microwave Week (EuMW) will be held in the extraordinary and beautiful 'Eternal City' of Rome, this year. Bringing industry, academia and commerce together, EuMW 2014 is a six-day event, including three cutting-edge conferences and an exciting trade and technology exhibition featuring leading players from across the globe.

The event focuses on the needs of engineers and researchers and offers an opportunity for both communities to discuss the latest trends and developments in applications of microwaves. Microwave devices, systems for telecommunications – both terrestrial and space-borne, transportation, medical, radar and new areas of application will be included in the programme. Particular emphasis will be placed on space-related technologies and applications.

THE EXHIBITION

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- 5,000 key visitors from around the globe;
- 1,700 – 2,000 conference delegates; and
- In excess of 250 international exhibitors, including Asia and the US as well as Europe.

Concentrating on the needs of engineers, the event will present the latest trends and developments that are widening the field of application of microwaves. Pivotal to the week is the European Microwave Exhibition, which offers the opportunity to see, first hand, the latest technological developments from global leaders in microwave technology, complemented by demonstrations and industrial workshops.

THE CONFERENCES

The 2014 week consists of three conferences and associated workshops:

- The European Microwave Integrated Circuits Conference (EuMIC) – the 9th European Microwave Integrated Circuits Conference (EuMIC) will be held as part of the European Microwave Week 2014. This conference targets RF microelectronics and is a vital part of the European Microwave Week which is the largest RF/microwave event in Europe.
- The European Microwave Conference (EuMC) – the 44th European Microwave Conference (EuMC) represents the main event.
- The European Radar Conference (EuRAD) – the 11th European Radar Conference (EuRAD) will be held as part of the European Microwave Week 2014. This radar conference is the major European forum for the current status and the future trends in radar technology, system design and applications.

The three conferences specifically target groundbreaking innovation in microwave research through a call for papers on the latest trends in the field, driven by industry roadmaps. The result is three superb conferences with the very best papers, carefully selected from close to 1,000 submissions from all over the world.

Special rates are available for EuMW delegates. For a detailed description of the conferences, workshops and short courses please visit www.eumweek.com.

EVENT TRENDS

A trend that has emerged over recent years is the development of Pavilions that provide an identity and a platform for smaller companies and distributors to band together, present a collective presence and demonstrate the diversity of their country's industry. This year the number of Pavilions has grown to include European representation from past, past and future EuMW host countries including Germany, France, Holland, Italy and Spain. Demonstrating that the week is truly international, the Chinese Pavilion will again be prominent, while manufacturers from the rest of Asia and the US continue to be well represented.

A number of companies will run the ever-popular Exhibitor Workshops where experts in their fields will offer attendees live demonstrations and hands-on experience. The educational/instructional theme will continue on the floor of Hall 9 with European Microwave Week Microwave Application Seminars (MicroApps), which, now in its fourth year, has become a recognised event in itself. The NI, Rohde & Schwarz and Horizon House sponsored seminars will take place in the MicroApps Auditorium for all three days of the exhibition.

The exhibition hall will also be home to the conference Poster Sessions, Coffee Breaks and the Publisher's Corner. Once again CST is sponsoring a Cyber Café on the show floor for all delegates, exhibitors and visitors, as well as free Wi-Fi access in all conference areas.

REGISTRATION IS FREE

- International Companies – meet the industry's biggest names and network on a global scale.
- Cutting-edge Technology – exhibitors will show their latest product innovations, offer hands-on demonstrations and provide the opportunity to talk technical with the experts.
- Technical Workshops – get first-hand technical advice and guidance from some of the industry's leading innovators.

www.eumweek.com

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AUTOMOTIVE BUCK REGULATOR IC WITH WIDE INPUT VOLTAGE RANGE

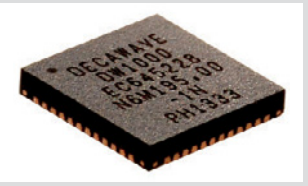
The new A8585 from Allegro MicroSystems Europe is an automotive buck regulator IC designed to provide the low quiescent current power-supply requirements for next-generation car audio and infotainment systems.

The new automotive AEC-Q100 qualified device incorporates all the control and protection circuitry required for a high-current regulator with ±1.0% output voltage accuracy. It operates over a wide input voltage range from 4V to 35V and offers a choice of pulse-width-modulated (PWM) or pulse-frequency-modulated (PFM) operating modes.

In PWM mode, the device employs current-mode control to provide simple compensation, excellent stability and fast transient response. In low IQ (quiescent current) mode, the A8585 employs pulse frequency modulation to draw less than 33µA from an input of 12V, while providing an output of 5.0V/40µA. The transition from PWM to PFM mode can be controlled by the user (A8585, A8585-1) or it can occur automatically (A8585-2, A8585-3).

www.allegromicro.com

DIGI-KEY AND DECAWAVE SIGN A GLOBAL AGREEMENT



Digi-Key Corporation has signed a global distribution agreement with Irish fabless semiconductor manufacturer DecaWave Limited, whose IR-UWB technology and ScenSor line offers industry-first measurement, indoor location and communications functionality.

DecaWave developed its ScenSor family of IR-UWB ICs to provide developers with the ability to locate tagged indoor objects to a precision of 10cm at a distance of up to 300m in line-of-sight mode and 40m in non-line-of-sight mode.

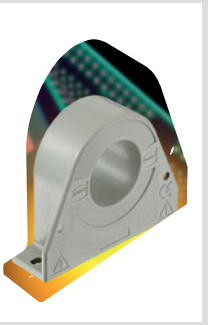
The DW1000 is a complete, single-chip CMOS Ultra-Wideband IC based on the IEEE802.15.4-2011 standard. Digi-Key also stocks the DWM1000, an RF module integrating the DW1000, antenna, balun and crystal.

Industry applications include agriculture, automotive, EPOS/retail, factory automation, healthcare, safety/security, smart buildings, smartphones, warehousing/logistics and wireless gateways.

www.digikey.co.uk

HALL-EFFECT CURRENT SENSORS COVER 100A TO 800A RANGE

Harting has introduced a range of Hall-effect current sensors with a current range from 100A to 800A. The new Hall-effect current sensors Eco (HCSE) family consists of four models, based on the open-loop measurement principle which provides a direct representation of the primary current with an accuracy of up to ±1%.



The HCSE sensors can measure direct or alternating currents, including signals with complex waveforms, over a frequency range from 0-50kHz. Because the devices use proven Hall-effect technology to sense the magnetic field created by the current flowing in a conductor, they provide non-contact, galvanically-isolated measurements with high immunity to interference from the magnetic fields of external current-carrying conductors.

The wide temperature range of -25° to +85°C allows use in thermally-critical applications. The sensors come in standard sizes and their compact, unified shape across the whole product range offers a high degree of freedom for integration into individual applications.

www.harting.com

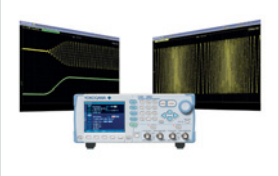
TWO NEW MODELS OF YOKOGAWA ARBITRARY/FUNCTION GENERATORS

The new Yokogawa FG400 Series is a range of arbitrary/function generators that combine intuitive operation with comprehensive sweep and modulation facilities. The instruments allow the creation of basic, application-specific and arbitrary waveforms, and feature isolated output channels used in the development of floating circuits in power electronics applications.

The range consists of two models: the single-channel FG410 and the two-channel FG420, both generating signals of up to 20V peak-to-peak over the frequency range from 0.01µHz to 30MHz. Operation is via front-panel pushbuttons and a 3.5-inch LCD screen which displays alphanumeric values alongside the generated waveforms.

The instruments incorporate a number of basic waveforms as standard, including sine, DC, ramp, square and pulse. Advanced functions include sweep (frequency, phase, amplitude, DC offset and duty), modulation (FM, FSK, PM, PSK, AM, DC offset and PWM) and burst (auto, trigger, gate and triggered gate).

tmi.yokogawa.com



NEW PV CONNECTOR MEETS THE HIGHEST CERTIFICATION STANDARDS

Amphenol Industrial Products Group now offers the H4 UTX, a PV connector that meets all three of the highest certification standards on the market, allowing it to be used globally. The new connector meets IEC50521 TUV 1500V-Class A (all access), UL6703 1000V (Americas) and JET 1500V (Japan), enabling it to be used by PV module manufacturers, installers, developers, electrical distributers as well as inspectors, combiner box companies and engineering procurement construction firms.

The H4 UTX is available in all AWGs from 14 AWG to 8 AWG, and is fully mateable with all existing H4 PV connectors. A larger version of the connector, known as the H4 UTX-XL, can accommodate 8 AWG PV wire, up to 2kV. This version can mate with the H4 UTX as well as all existing H4 connectors in all AWGs.

The H4 UTX uses Amphenol's proven RADSOK technology to achieve higher current ratings and lower contact resistance, resulting in lower power losses.

www.amphenol-industrial.com

NEW TIGHT STABILITY CLOCK OSCILLATOR IN DIFFERENT PACKAGE SIZES

IQD's new range of clock oscillators, which are at the forefront of modern clock oscillator design, deliver frequency stabilities as low as ±10ppm over the full industrial temperature range of -40 to 85 degrees C.

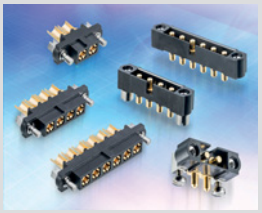
Two versions are available, offering different ceramic package sizes: the IQXO-445 series is housed in a 2.5 x 2.0mm package while the IQXO-430 series is housed in a 3.2 x 2.5mm package. Both series are available over a frequency range from 4-54MHz and offer extremely low current consumption of 3.1mA at 40MHz, coupled with a phase noise performance of -145dBc/Hz at 10kHz offset. IQXO-445 and IQXO-430 series come available with 4 or 6 pads and can be specified in supply voltages of 2.5, 3.0 or 3.3V.

Output is CMOS-compatible with up to 15pF load and both models include tri-state capability as standard and are intended for RoHS-compliant reflow soldering.

www.iqdfrequencyproducts.com

40A POWER CONTACTS HI-REL CONNECTORS NOW AVAILABLE OFF THE SHELF

Harwin has doubled the current rating of the power contacts available for use in its Datamate Mix-Tek mixed-technology connector series from 20A to 40A. In addition, up to 12 of the new high-current contacts can be used in one Datamate Mix-Tek housing, with devices specified for use at high temperatures up to +150degC (with derating).



To respond to industry demands, Harwin has made the most commonly-preferred variations of the Datamate Mix-Tek connector family immediately available as standard, off-the-shelf items. To the stocked profile, 2-10 pin varieties featuring the new 40A contacts have been added, and it also includes the popular 3A signal, 20A power and 50Ω coax parts.

The new contacts are plated with 0.76µm of gold for aerospace applications and for high durability. Contacts are compact and operate over a wide temperature range.

Key applications for the connectors include aircraft flap actuators, industrial machine control, avionics rotary and linear actuators and others.

www.harwin.co.uk

EMS PROVIDER AWS ELECTRONICS ENHANCES FAST TRACK SERVICES

Specialist contract electronics manufacturer AWS has set up a dedicated Fast Track service at its newly-expanded Newcastle-under-Lyme facility. The company guarantees quotes in under 48 hours and promises to assemble PCBs within five days of materials procurement. The service is available for low-run production volumes as well as prototyping.

By consolidating its manufacturing in two sites, Newcastle under Lyme in the UK and Namestovo in Slovakia, AWS Electronics has been able to invest in the latest manufacturing technology and has set up an SMT line and assembly area in the UK plant dedicated to Fast Track business. Technical engineering teams see projects through from start to finish, implementing the latest DFM and DFT techniques to assure build quality.

"Fast Track orders are handled by a separate project workflow team, so there is no disruption of scheduled production orders," said Paul Deehan, AWS Group CEO.

www.awselectronicsgroup.com

NEW DC-LINK FILM CAPACITORS WITH SNAP-IN TERMINALS FOR EASY PCB MOUNTING

AVX has launched its new FRC series medium-power DC-link film capacitors, which feature a wide range of capacitance and voltage values in addition to self-healing properties. Designed for use in DC filter circuits, power supplies, industrial inverters, UPS systems, motor drives, power converters and solar inverters, FRC series capacitors are comprised of dry, wound, metalized polypropylene film dielectric encased in a size A, self-extinguishing, cylindrical plastic case sealed with thermosetting resin and featuring four snap-in terminals that facilitate easy mounting to PCBs.

This series' capacitors are available in nine voltages from 400V-1500V; two tolerances (±5% and ±10%), two lead lengths (4mm and 8mm), and values from 4.7µF to 35µF. Housed in size A cylindrical cases measuring 54mm (L) x 36mm (OD) x 5.1mm (P1), the RoHS-compliant series is rated for operating temperatures from -40°C to +105°C and exhibits long lifetime performance of 100,000 hours at rated voltage and 70°C.

www.avx.com

NEW LINKSWITCH-3 ICS MEET 2016 DOE 6 EPS EFFICIENCY REGULATIONS

Power Integrations (PI) introduced its LinkSwitch-3 family of highly integrated monolithic switching ICs that deliver accurate primary-side regulation for chargers and adapters up to 10W. With its characteristics, the ICs are suitable for smartphones, tablets and other mobile devices, particularly those subject to 30mW no-load limitations, such as the upcoming, mandatory, US DoE EPS efficiency regulations and EU CoC Tier 2 guidelines.

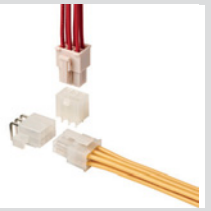
The LinkSwitch-3 ICs simplify CV/CC charger designs by eliminating the need for opto-couplers and secondary-side control circuitry; a 10W charger, for example, can be implemented using only 28 external components.

The new devices provide highly accurate output voltage and current regulation, compensating for transformer and internal parameter tolerances along voltage variation from the AC line. LinkSwitch-3 ICs incorporate a 725V power MOSFET, on/off-control state machine, high-voltage switched current source for self-biasing, frequency jittering to minimize EMI, plus cycle-by-cycle current limit and hysteretic thermal shutdown circuitry.

www.powerint.com

POWER CONNECTORS AS A COMPLETE SOLUTION FOR MULTIPLE APPLICATIONS

Now available at TTI Inc are the Molex Perfect Fit range, which comprises three series of robust, reliable power interconnects. Mega-Fit, Mini-Fit Jr and Micro-Fit 3.0 connectors offer a power solution for a wide range of applications across a broad range of markets, from defence to consumer.



The Mega-Fit 3.0 series interconnects offer up to 23A current-carrying capability, the highest on the market compared to existing mid-range power connectors. This power-dense design with high current terminals, tight pitch and row spacing provides more power per linear- and square-millimetre than most mid-range power products.

Molex Mini-Fit Jr connectors are optimised for high-current, high-density applications requiring design flexibility. Suitable for power applications up to 9A per circuit, they are available in single or dual row 2- to 24- circuit options.

Micro-Fit 3.0 low- to mid-range power distribution connectors boast the highest current-power distribution capability in the smallest-size device currently on the market.

www.ttieurope.com

MOUSER WILL RELEASE NEW MULTISIM BLUE POWERED BY NATIONAL INSTRUMENTS

Mouser Electronics announced the upcoming release of MultiSIM BLUE, the National Instruments (NI) Multisim Component Evaluator – Mouser Edition. In collaboration with NI, the new Mouser version of the free tool will add features and functionality to provide engineers with an industry-standard SPICE simulation environment of electronic circuits using Mouser Electronics' s distributed components.

This upcoming release of MultiSIM BLUE will include more than 100,000 electronic components with intuitive simulation features and SPICE analyses. Engineers can now visualize and evaluate linear performance, making this critical step of circuit design easier, faster and more productive.

With MultiSIM BLUE, engineers can easily create schematics, simulate circuits and build printed circuit board layouts, all with one powerful integrated tool. MultiSIM BLUE gives the ability to scheme and simulate, plus it handles PCB layout, Bill of Materials (BOM) and purchasing.

The advanced circuit design tool is included with a library of more than 100,000 authorized Mouser electronic components from the industry's leading manufacturers.

www.mouser.com/MultiSimBlue

EMBEDDED WIRELESS MODULES OFFER HIGH FLEXIBILITY FOR M2M APPLICATIONS

Now available from Solid State Supplies is a new series of embedded wireless modules for use in machine-to-machine (M2M) applications such as point-of-sale, smart grid, fleet management or tracking solutions. Providing compact form-factor, network scalability and future proofing due to the availability of ready-to-use firmware upgrades, the modules are ideal for industrial M2M designs.

Developed by Sierra Wireless, the AirPrime HL Series modules are the industry's smallest embedded wireless modules – measuring only 22 x 23mm – that are completely interchangeable across 2G, 3G and 4G technologies. The modules also include optional global satellite navigation (GPS and GLONASS) capability, providing manufacturers with the ability to offer products that can handle multiple network technologies across many geographic regions.

The HL Series has been designed for maximum flexibility in production: manufacturers have a choice of either soldering the modules on to boards for applications that require high-volume production; or they can use an innovative snap-in socket.

www.sssltd.com

NEW LOW CXR PHOTOMOS WITH OPTIMIZED ON-RESISTANCE

Panasonic's new Low CxR PhotoMOS relays offer the smallest housings and lowest on-resistance for maximum continuous load currents of up to 1A. They belong to the successful Low CxR series PhotoMOS, with an optimized (low) product of C and R.

Especially measurement applications require the lowest possible output capacitance C at the open contact and at the same time a low on-resistance R at the closed contact for high-frequency loads. Optimizing the capacitance and resistance component in the transistors makes this possible.

The most advanced MOSFET technology allows the combination of a very low contact resistance of 0.18-ohms (typical) with a low output capacitance of 37.5pF (typical) at the same time.

The new types are available in the well proven ultraminiature VSSOP and SSOP housings. The vertical VSSOP housing with its minimal space requirement of 1.8mm x 2.1mm is the smallest design currently available on the market.

www.panasonic-electric-works.co.uk

MICROCHIP INTRODUCES THE PIC32 BLUETOOTH STARTER KIT

Microchip has announced the new PIC32 Bluetooth Starter Kit, featuring a PIC32 microcontroller (MCU), HCI-based Bluetooth radio, Cree high-output multi-colour LED, three standard single-colour LEDs, an analogue 3-axis accelerometer, analogue temperature sensor and five push-buttons for user-defined inputs.

Additionally, the kit includes PICkit On Board (PKOB) which eliminates the need for an external debugger/programmer; USB connectivity; and GPIOs for rapid development of Bluetooth Serial Port Profile (SPP), USB and general-purpose applications. The starter kit also features a plug-in interface for an audio CODEC daughter card which is set to release at a later stage to support Bluetooth audio.

The Bluetooth Starter Kit includes a PIC32MX270F256D MCU for main processing that runs at 83DMIPS with 256kB Flash and 64kB RAM with a rich feature-set including USB, I2S/SPI, mTouch capacitive touch sensing and an 8-bit Parallel Master Port.

Target applications include consumer devices such as Bluetooth thermostats and wireless gaming controllers.

www.microchip.com/get/1AVL

KEITHLEY PROGRAMMABLE POWER SUPPLIES OFFER A STEP UP IN PRECISION, SPEED AND SENSITIVITY

Keithley Instruments introduced the Series 2280S precision measurement, low noise, programmable DC power supplies. Unlike conventional power supplies, these power supplies are also sensitive measurement instruments with the speed and dynamic range essential for measuring standby current loads and load current pulses that battery-powered wireless, medical and industrial devices produce. Typical applications include characterizing battery-powered medical devices, wireless sensors, RFID tags, intrinsically safe devices and consumer electronics, as well as new, low-power semiconductor devices.

Series 2280S supplies can output up to 192W of low-noise linear regulated DC power. The Model 2280S-32-6 can output up to 32V at up to 6A, and the Model 2280S-60-3 can output up to 60V at up to 3.2A. Although their sourcing and measurement performance is a step above that of conventional power supplies, Series 2280S supplies have conventional power supply pricing.

The power supplies address emerging trends in the design of electronic components and systems.

www.keithley.com

EUROQUARTZ LAUNCHES NEW WEBSITE

Frequency control specialist, Euroquartz has launched a new website at www.euroquartz.co.uk, offering engineers enhanced search facilities with comprehensive technical information on the company's wide range of frequency management products.

The new site is designed to work across multiple platforms – including mobile phones and tablets – and provides engineers and system designers with easy access to a wide range of technical information and data sheets for Euroquartz's ever-increasing product range. This includes quartz crystals, oscillators, temperature-compensated crystal oscillators (TCXOs), oven-controlled crystal oscillators (OCXOs), voltage-controlled crystal oscillators (VCXOs), filters and resonators.

As well as products for commercial and industrial applications, the independent UK-based manufacturer also offers components for aerospace and defence projects, manufactured to military specifications.

The new Euroquartz website also features information on the company's manufacturing facilities, quality control and distributors plus an extensive selection of technical notes covering crystal, oscillator and filter specification.

www.euroquartz.co.uk

TOTAL FREQUENCY CONTROL LEADS THE WAY

Since it was established in 1988 – primarily as a distributor of frequency control products, including quartz crystals, clock oscillators, inductors and wound coils – Total Frequency Control (TFC) is offering years of experience in this business.

The company expanded through the part-acquisition of Livingston-based RFX Limited in 2002, offering high-quality designs and manufacturing standard- and bespoke high-frequency precision OCXO, TCXO, VCXO and PLL systems and GPS-synchronized precision OCXO modules for commercial and military applications.

The partnership with RFX allowed the development of TFC's renowned GPS-disciplined OCXO which set a new benchmark for miniature frequency standards, allowing a fast return and a disciplined performance assured. It was initially developed for use in military, industrial and commercial applications for synchronization and timing. In 2009, it acquired the assets of Laptech Precision in Ontario, Canada, which provided an in-house supply of critical precision quartz components and further expanded the group's manufacturing capability.

www.tfc.co.uk

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2005 Redesigned GUI across Proteus Suite

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Shape based autorouter included 2009
VSM Studio IDE introduced 2010

2011 Design rule aware manual routing
2012 ARM® Cortex™-M3 MCU simulation
2013 New application framework

2014

NEW Project clips enable re-use of blocks of circuitry inside a project across multiple projects
NEW Dynamic teardrop control including per pad override
NEW Integrated Arduino™ toolchain with VSM Studio and common Arduino™ shields
NEW Library import tools (BSDL,PADS ASCII)
NEW New Project notes module for generic entry of notes and reports
NEW Major upgrade to BOM module to improve physical output and simplify styling
NEW Improved support for paste, solder, fanout and stitching vias during footprint creation

Labcenter Electronics www.labcenter.com

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