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# CS4FN

Computer Science for Fun

Issue 10

## Computing goes mobile

Bonding with robot friends

Torchwood: in need of backup

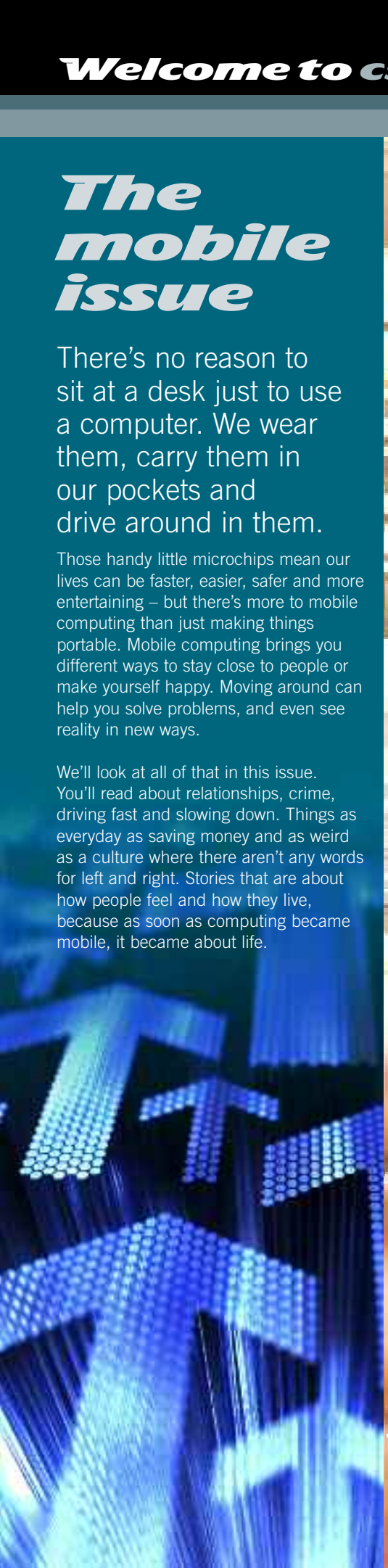
How to win love by not playing cool

# The mobile issue

There's no reason to sit at a desk just to use a computer. We wear them, carry them in our pockets and drive around in them.

Those handy little microchips mean our lives can be faster, easier, safer and more entertaining – but there's more to mobile computing than just making things portable. Mobile computing brings you different ways to stay close to people or make yourself happy. Moving around can help you solve problems, and even see reality in new ways.

We'll look at all of that in this issue. You'll read about relationships, crime, driving fast and slowing down. Things as everyday as saving money and as weird as a culture where there aren't any words for left and right. Stories that are about how people feel and how they live, because as soon as computing became mobile, it became about life.



# Read the book, scan the t-shirt

Books are starting to do something old in a new way. A new wave of authors are sending their books to readers via mobile phones, in instalments. Like the creator of Sherlock Holmes, Sir Arthur Conan Doyle did via The Strand magazine, releasing your work in bits can create a real sense of occasion, tension, and so raise your public profile. But today's mobile phones let this self-promotion go one step further using the clever idea of the QR code.

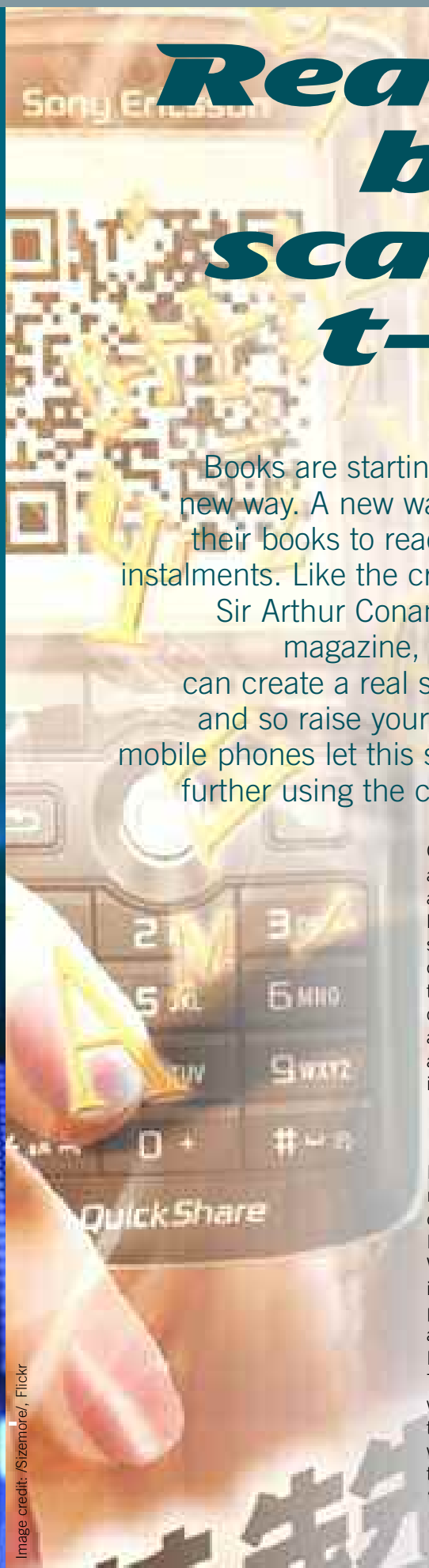



Image credit: /Sizemore/, Flickr

Originally developed for tracking car parts, a QR (short for Quick Response) code is a two-dimensional barcode. Most of us have seen one-dimensional barcodes in the shops; these are the tiger striped labels that can be scanned by a laser at the checkout to total our bill. But what can be done in one dimension can be done in two as well, and adding the dimension of height as well as length can increase the amount of information available.

## Read all about it

In Japan most mobile camera phones can now automatically read QR codes. The codes are printed in magazines, on signs, buses, business cards and even t-shirts. When you scan the code the information in it can take your phone direct to the product's website. For example in 2008 author Alexander Besher's sci-fi book Manga Man was promoted in Japan with T-shirts emblazoned with QR codes that when read took your mobile to the website to download a chapter. So in the future what you wear could become a doorway to the web. As Holmes might say, "Elementary my dear, what's on?"

# Real snail mail

The pace of modern life is getting faster and faster. Everything is done in a rush: fast food, news as it happens, instant messaging. It seems like everything has to be done immediately.

Why not slooooooow down? What's the rush? Technology ought not to leave us frazzled. With a bit of ingenuity, technology (with help from some snails) can help you put things back in perspective. Just because food can be fast doesn't mean it's great food. Just because we can send our modern-day communications at the speed of light doesn't mean we have to.

Forget email. You've heard of snail mail – well, maybe even that is too fast. Add some unpredictable delay, just for the fun of it. Send your message by Real Snail Mail. That's mail sent on the back of an actual snail. It is now possible, thanks to a team of researchers at Bournemouth University.

When you send an email, ever thought how it actually gets from here to there? Your computer isn't directly connected to your friend's computer. Instead your email has to hop about like a frenzied hare, jumping from one computer to the next, making its lunatic, frenzied way to its destination. A nanosecond here, a millisecond there. Up to that satellite and back down again, and quick as a flash it's on the other side of the world. Got to keep moving, keep hopping, fast as it can. Even if it's not the shortest route, that's fine as long as it is the fastest.

Send your message by Real Snail Mail and one of those frantic hops will slow things right down. Your message whizzes up to the satellite, then back down at the speed of light. Down to a snail tank. Your message then waits...waits for a snail to wander by. When a snail passes your message hops on to its back and the snail slows it all down. There is a drop-off point at the other end of the tank. When (or perhaps we should say if) your snail gets there, the message hops on and continues its journey to the destination. Until that time, it is forced to take it easy and just enjoy the ride.

It's all done in the name of the slow art movement. Art evolves as new media and new technology come along. The Bournemouth team have been looking at what can be done with extra small computers called RFID tags. They have a radio antenna so they can communicate wirelessly, and a simple chip that carries a unique identifier. That makes them small enough to ride on the back of those snails. When the snail arrives at the other side of the tank, that unique identifier tells the system which snail message has arrived, so it knows what message to send. Having had its slowed-down holiday it then whizzes on to the addressee, along with an overview of its journey.

So next time you have a not-really-urgent-if-you-think-about-it message to send, why not let a gang of *Helix aspersa* snails deliver it for you? Fred, Agatha, Sean, Penelope, Francis, Beatrice, Walter and Reginald can help add some tranquility to that otherwise frenzied life.

Find out how you can send your own Real Snail Mail message on our website at **www.cs4fn.org/magazine/**


## Transmission Impossible

Impossible as it seems, you have the ability to control the future actions of others. You take a freely shuffled pack of playing cards, letting your volunteers freely select pairs of cards – it might be a red pair, a black pair or a mixed pair. When the experiment is over, you show that what they believed were free choices were in fact controlled by you. You predicted exactly what they would do! To prove these reality-altering skills aren't just luck, you repeat the experiment, and again show your inhuman ability to correctly manipulate a person's free choice.

How on earth do you do it? Find out on our website, **www.cs4fn.org/magazine/**

What moves around and smells? Find out more in the magazine+ section of **www.cs4fn.org**

# Future friends who get around

We can all do with a little help at times. Relying on someone else for their companionship is a fairly basic human need, but perhaps in the future our companions will be artificial. A large European Union-funded research project called LIREC (that stands for Living with Robots and Interactive Companions) is setting out to discover how we can create a new computer technology that helps us form long-term relationships between humans and synthetic companions in real social settings.

## Out of the laboratory

LIREC's artificial companions won't be studied in a laboratory though. They'll be going into homes and offices as the new generation of artificial companions, in the form of robots or as graphical characters on screen. They will be socially aware, which means they will have some idea of how to act properly in particular situations, like any good and trusted companion would. The companions will be tested in three main environments: a real house where real people live with helper robots, an office in a university where robots assist in the day-to-day work, and as playmates for kids, playing games like chess. The researchers in LIREC hope the people will start to form relationships with the robots. They may start to see them as a useful part of the world around them – not able to do everything a human can, but still a valuable part of their social circle.

## Important memories

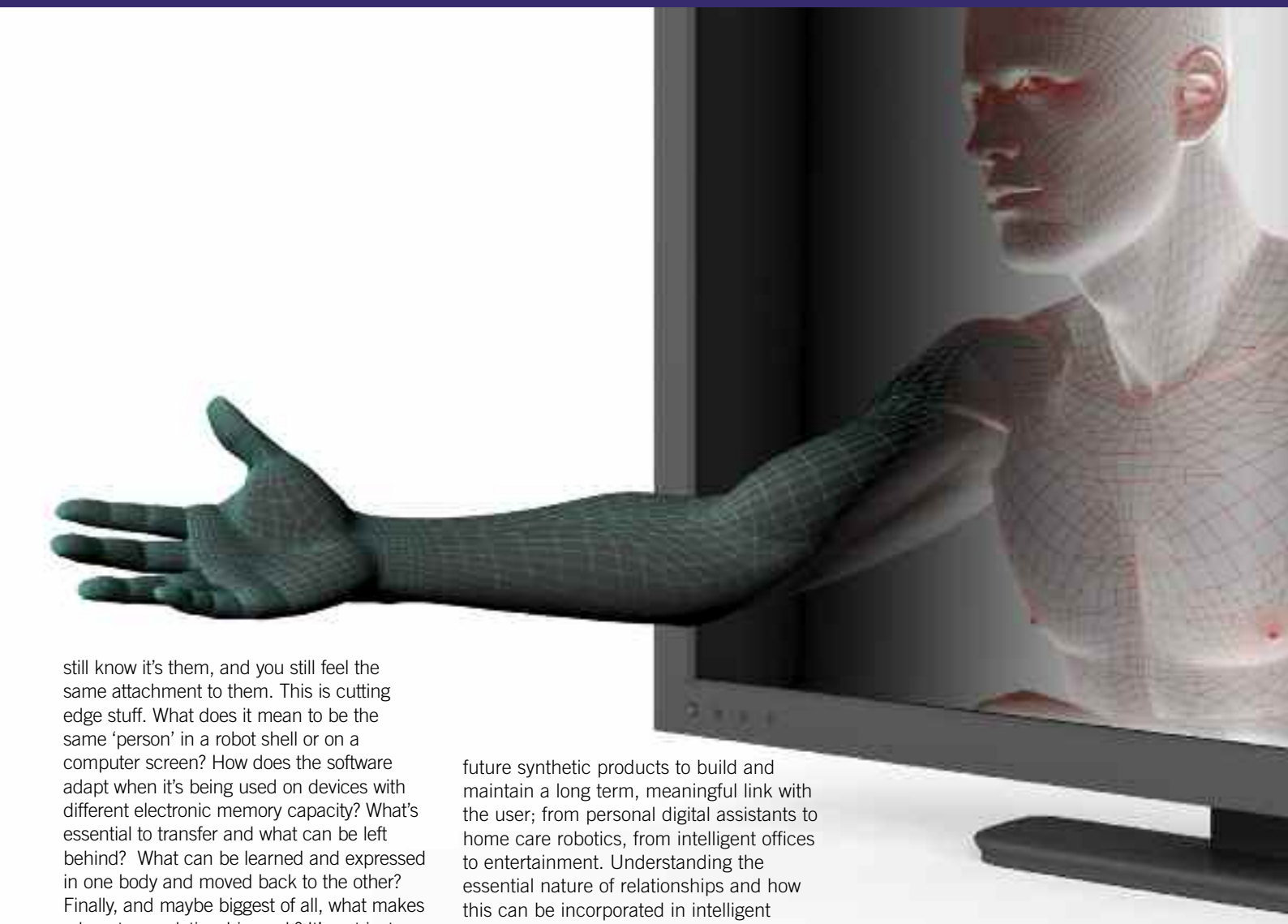
At the heart of these companions will be state-of-the-art artificial intelligence, but this needs to be socially smart software. Imagine your artificial companion knows what you did last night. That's fine – your pals know that too. You have to share some information to build up a bond with someone. Now suppose a stranger (or your parents) ask the companion what you've been up to. You would expect that a friend would be careful about exactly what they would reveal in each case. That's called tact: knowing what to say, when and to whom. We humans do it all the time. This ability to thoughtfully filter information is part of the social glue that keeps us together. The artificial companions need to be able to do this too, so the software needs to be able to understand what is appropriate in different situations, and act accordingly. It's a very challenging problem. Have a go at listing how you would decide who should know what about a range of different topics. It's tough. One way to help design the software is to look at the way human memory works, how information gets connected and modified, and whether you remember or forget a particular incident. At the core of it, it seems that people don't work like a search engine. We can't instantly recall everything that's happened to us, but that leads to a fascinating question. Would we want total recall from an artificial companion's memory, or is forgetting stuff what we would expect?

## With friends like these?

LIREC is also about understanding how these artificial companions can fit into the real world, and what they should and shouldn't do. Until now artificial companions have had fairly limited abilities to create long-term, meaningful social interactions with humans in real social settings. They have tended to suffer from the novelty effect; they are fun for a bit then get boring. But as LIREC sets out to create artificial companions that can hold a long-term relationship in people's lives, the researchers also need to consider issues like personal privacy and ethics. What safeguards should be built into the companions? Are there no-go areas? This research is as important as creating the software and hardware.

## Moving on, getting mobile

Today's robots are clever but still limited in what they can do, so LIREC will push things one stage further. LIREC's artificial companions will migrate. The same companion that's in the robot body at one moment will be able to move into a mobile device, like a phone, at another. The software will be able to adapt to its new environment, but hopefully you will still be able to recognise it's the same 'individual' you knew in the robot body. When you're talking to a friend on the phone you can't see their face or body language, but you



still know it's them, and you still feel the same attachment to them. This is cutting edge stuff. What does it mean to be the same 'person' in a robot shell or on a computer screen? How does the software adapt when it's being used on devices with different electronic memory capacity? What's essential to transfer and what can be left behind? What can be learned and expressed in one body and moved back to the other? Finally, and maybe biggest of all, what makes a long-term relationship work? It's not just about technology, LIREC is also asking deep questions about human relationships.

## The future

You have probably heard the term 'user friendly' when applied to technology. That means a technology is developed focusing on the needs of the human user, and advances in this field have changed the face of consumer electronics. The ease of using an iPod has been one of its main selling points. LIREC hopes to go a stage further and develop 'artificial companionship'. The technology will allow future synthetic products to build and maintain a long term, meaningful link with the user; from personal digital assistants to home care robotics, from intelligent offices to entertainment. Understanding the essential nature of relationships and how this can be incorporated in intelligent software could change future applications as much as the adoption of user-friendly technology already has.

## Get attached to this story!

There's an expanded version of this story in the magazine+ section of our website, **www.cs4fn.org**.

You can also read more at **www.lirec.eu**, and we will feature exclusive articles on LIREC as the project develops.

# How to win love by not playing cool

You know that feeling of awkwardness when you're talking to someone you fancy? That special mix of exhilaration and horror as you sweat, smile and stammer your way through an encounter with your beloved? It might be tempting to think that if you could just be cool and not give anything away, you'd be on your way to snagging the girl or boy of your dreams. Actually, as Vanessa Carpenter has found out, maybe what we need is more potential embarrassment, not less.

Vanessa works as an artist and designer for a group called Illutron and GeekPhysical in Copenhagen, Denmark. The projects she's done with her colleagues Mads Høbye and Dzl Møbius all use computers as a way to get people to socialise. One of the best ways to break the ice is to give people a chance to open up with one another. To share a moment that's a little bit personal. Maybe even a little bit…embarrassing.

Take a look at a few of Vanessa's projects and find out what awkwardness could do for your pulling power. Before you do, though, we should explain that when we say Vanessa works with computers, we're not talking about computers like the ones that sit on desks. She works in 'physical computing', building interactive gadgets that work within the real world. Designers in physical computing make computerised electronic gadgets with things like sensors, motors and displays. Here you'll see Vanessa's icebreaking designs at work in a toilet door, a corset and projected onto walls.

## The ladies' and men's room mixup

It started with nightclubs. To get ideas, Vanessa's group went to observe people in clubs and watched them struggle with a big problem. "They're with their friends and it's supposed to be this social place to meet someone, but it's almost impossible to approach someone," she explains. "It's really hard to do the pickup or even make new friends in a nightclub because everyone's suspicious." You have to talk to someone to get to know them, but there's never a good excuse – leading to billions of bad chat-up lines. In awkward situations, though, talking is essential to fix things. So how do you create an awkward situation in a nightclub?

What Vanessa's group did was to replace the usual signs on the toilet doors with electronic displays whose symbols could change. Sometimes guys would head for what they thought was the right loo, only to see a group of girls come out. Groups of people outside and inside the toilets talked to one another to try and figure out what was going on. Sometimes the people who had figured out the game would try and guide other groups to the right place, or cheekily enter the 'wrong' toilet on purpose. As long as there were some people who didn't know what was happening, the awkward situation produced lots of playful interaction between the girls and guys in the club.

## Your heart, but not on your sleeve

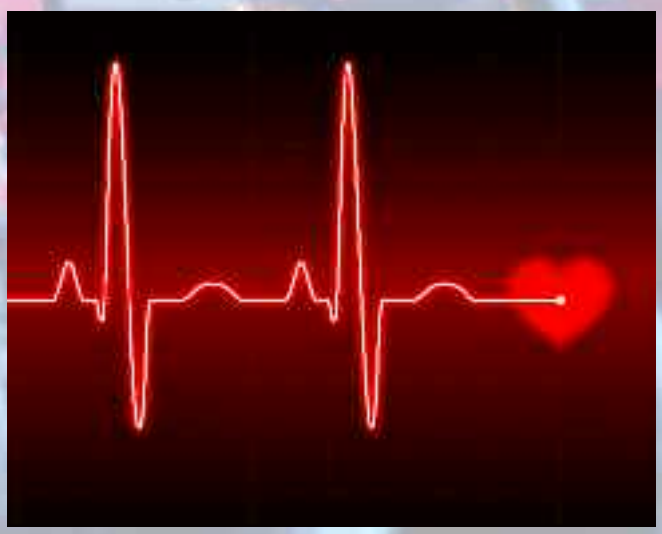
Pretend you're on a date. Your heart's pounding, you might be getting clammy hands, but you hope your date will never know. "So how do we get past that," Vanessa asks, "stop playing cool and start being honest here?" What she designed was a corset that tells the person wearing it when her heart rate rises, by getting tighter. Vanessa got a corset and put a heart rate monitor for runners inside it. Then she attached it to a circuit board that monitored the signal it got from the heart. When the wearer's heartbeat went above 75 beats a minute, the computer pumped air into pockets around the corset, which kept it tight until her heart rate went down again. That did two things: it told the wearer 'hey, your body thinks you're doing something interesting' and it gave them a sort of hugging feeling from the tightened corset.

Vanessa tested it by wearing it to a party, where, she says, "'what ended up happening was kind of beautiful". Because of the music and talking in the party no one could hear the pump working, so Vanessa could be the only one who knew when her heart rate was up. Except when she and a friend left to get some supplies, the friend could hear the corset filling up as well. "So then he was aware every time my heart rate went up," says Vanessa, laughing. "So that was really embarrassing, because it was every five minutes and it was like, 'oh dear'." But once again, the situation was saved by awkwardness. Embarrassment turned into flirting, and pretty soon Vanessa and her friend were a couple.

## Projecting your feelings

Sure, the corset worked when Vanessa was excited about being around someone, but it also inflated when she drank a Red Bull and went on the dance floor. So Vanessa and Illutron began working on a better system that works on more than just heart rate. Now they have one that looks at heart rate, body temperature, and even changes in your skin's electrical response. All those signals get sent to a laptop, and if you're at one of Vanessa's events, projected onto the wall.

You might think it would be embarrassing to have your body chemistry projected up onto a wall for everyone to see, but it turns out the effect can be exactly the opposite. At one party, Vanessa says, there were three shy guys sitting together, hiding from the crowd. She asked them if they'd mind putting on the monitors. They weren't sure at first but they agreed. Immediately, Vanessa says, their heart rates went through the roof, but after a few minutes they settled down…and suddenly they got confidence. "Then," says Vanessa, "three guys who were hiding in a corner are now going up to all the prettiest girls in the room and saying 'hey, that's my heart rate on the wall. Isn't that cool?' so now they have an excuse to talk to people." Once again, Vanessa and her group manage to fight awkwardness with awkwardness.



# Turn right in Tenejapa

Suppose you are the successful designer of an in-car satellite navigation system. You've made lots of money selling it in the UK and the US and are now ready to take on the world. It should be easy, shouldn't it? The basic system already works. All you need to do now is get a team of translators to come up with the equivalent of the small number of phrases used by the device and add a language selection mechanism. Simple...

Not so simple, actually. As linguists have discovered, a third of known languages have no concept of left and right. Since language helps determine the way we think, that also suggests the people who speak those languages don't use the concepts. To them, "turn right" is meaningless. It has no translation.

Take Tzeltal. It is spoken by indigenous Mayans in southern Mexico. One dialect of Tzeltal, spoken by about 15,000 people in the aboriginal community of Tenejapa, has no notion of left or right. That's because the people who speak it live in an area roughly covering one slope of a mountainous region. Rather than "The cup is to the left of the teapot", they might say the equivalent of "The cup is on the uphill side of the teapot". Even when they're away from the mountainside they subconsciously keep track of where uphill would be.

How would you design a Tenejapan satnav? Have a look at the magazine+ section on **www.cs4fn.org** to find out.

# Torchwood: in need of backup

Disaster planning, that's the Torchwood game. They are there to save the Earth whenever it needs saving from aliens. Shame they blew it when it came to disaster planning for Torchwood itself!

### We are coming

Torchwood is the BBC's spin-off from Doctor Who. In the most recent series, the world is threatened by the brutal '456' whose arrival is heralded when every child in the world simultaneously stops and chants 'We are coming'. The Torchwood team of Captain Jack Harkness, Gwen Cooper and Ianto Jones spring into action. Unfortunately, early on a little accident (we won't say what so as not to spoil it) happens in their base. On the run and homeless, they have only their wits in place of the normal hi-tech surveillance gadgetry. It's so desperate at one point, they end up in an empty shell of a warehouse with only a sofa and the contents of their pockets with which to save the world.

### Move it!

It's a shame that it comes to this when a little bit of disaster planning would have made it all so much easier. A backup site is crucial, whether it's an earthquake or Martian hordes causing the disaster. Just because your city has been flattened by a meteorite doesn't mean your operations have to be disrupted.

Captain Jack knows all about disaster management of course. Kill him, and he jolts back to life and carries on as though nothing has happened. With some standard forward planning any organisation can do that too.

The fact that when the disaster happens the Torchwood team have to come up with solutions on the fly shows that they hadn't even thought about it. Tut tut! If they had done some planning, what would have been their alternatives?

### Cold war

The first alternative is to have a 'cold site' ready. This is what Torchwood defaulted to in their warehouse. Lucky Ianto remembered it! A cold site is just a backup location that can be moved into. It doesn't have software, data or even hardware ready, but at least everyone knows what to do and where to go. In time it can be up and running again. Given their remit of saving the Earth against war-hungry aliens, Torchwood needed something better.

### Getting warmer

At the other end of the disaster planning spectrum is the 'hot site'. It is a fully functioning copy of your main operations building. All the hardware is there, the software is there and so is the data. Everything that happens at the main site IT-wise is copied at the hot site too. Lose your main site to a nuclear bomb and you carry on almost seamlessly at the hot site. (It obviously has to be located somewhere else suitably far away, or it will be as radioactively hot as the original! You can also have 'warm sites' where you might just have the hardware installed, or the data backups are only weekly rather than continuously.

Which kind of backup site you choose depends on the organisation: what can it afford balanced against the costs of downtime. If it's critical to the survival of the planet, like Torchwood, then clearly you need to be at the warmer end of the backup scale!

### Back to life

It's a shame that Torchwood's IT management only focused on installing lots of fancy gadgets and ignored the more mundane side of things. If they had been a little more competent Jack and Co might have sorted out the '456' before it all got out of hand. Never mind. It all worked out OK in the end. Well, sort of.

**Roger Boyle** of the University of Leeds takes us exploring in the mist of a thought experiment.

# climbing

## You're in the Scottish highlands and you're climbing a peak, when the mist comes down. Can you still climb the peak?

Theoretically you can, so let's overlook the issues of hidden crevasses and lurking wolves. Even if the visibility is zero you are able to sense which way is 'up' or 'down'. If you persistently go up, you don't actually need to see the destination … you'll reach a summit, won't you? Actually, you can be quite smart about this and distinguish between 'gentle up' and 'steep up', perhaps by just moving one pace in each direction – then taking the steepest route may well get you there quicker. It would be pretty dangerous to try getting up a real mountain without being able to see, but what if you just imagine that any big problem is a mountain to climb? Then this thinking becomes really useful.

Suppose now you have the apples and oranges franchise at Glastonbury Festival. You are given a wheelbarrow that can hold up to 300 apples or 250 oranges, and access to a warehouse with an infinite supply of both. You wheel the barrow through the happy crowds and sell apples at 15p each, oranges at 18p. Profit on an apple is 2.3p, and on an orange 4.1p. The lighter the barrow, the faster you move. The longer you're away from base, the more chance you run into a friend and decide to spend some of your earnings. And the longer you're away from base, the more chance the unscrupulous will pilfer some fruit. Pilferers are more likely to steal whatever is in shortest supply on the barrow. Phew – this scenario is getting complex quickly. The question is, what's the best number of apples and oranges to load every time you are at base in order to maximise the profit of each outing through the crowd? Of course you can't see into the future – future-gazing is a bit like peering into a thick fog. Clairvoyance aside, how can you solve the problem?

This sort of problem is very common in the real world of computing – it's called an 'optimisation' problem. If you load the barrow with M apples and N oranges (where M and N are just placeholders for the particular numbers we pick for an outing), you want the value of (M,N) that returns the highest profit. At the outset you have no idea of the best answer, so let's guess. Go on an outing with 100 apples and 120 oranges, and let's suppose the profit is some number that we will call: P(100,120). Time is on your hands, so now go on outings with (99,120) – that is 99 apples and 120 oranges, (101,120), (100,119) and (100,121) apple-orange loads. Maybe the profits exceed P(100,120) and maybe they don't. If you do find a more profitable load, this gives a good clue at how to best adjust the loading. If you make more profit with an extra orange (eg (100,121) ) then you should go for more oranges on future trips, trying a run like (100,122) next. You can then compare its profits to the earlier trips and keep taking a step in the direction of the most profits for each new outing.
Trying to find the answer to the barrow problem is like trying to find your way up that Highland mountain. We are somewhere in 'apple-orange land'. We feel around the closest territory sensing which direction is useful, or best. We go that way and then do some more sensing. Each step we take might be in a different direction left or right, but if our senses are right we'll

### Find out more

'Hill-climbing' occurs all over computing. One application is to solve the Travelling Salesman problem (see page 14) and it is used a lot in artificial intelligence applications too. Learn more about it on **www.cs4fn.org** where you can also follow the links to a video about it.

# hills

keep getting closer to the top of the mountain, where the answer lies. And one of the nice things about hill-climbing in computer science is that there's no chance of ending up being helicoptered away with a broken leg.

## Bigger hills to climb

Back in the Highlands, we all know that there are many peaks. Maybe you climb your peak in the mist and reach the top, but then the mist lifts and suddenly you can see the next hill is much higher than the one you're on top of. So to reach the highest hill, we would have needed to go down before going up – how could we have known that when the mist was down? This sort of thing happens in computing applications as well, and leads to much "cleverer" ways of deciding what the best direction of travel might be.

# I'm on the clock

Since Arthur Weasley is such a fan of muggle technology, we like to think he'd be charmed to recognise one of Microsoft's recent inventions. Designers at Microsoft Research in Cambridge have made what they call a 'Whereabouts Clock', which does the same job as the one the Weasley family has in the Harry Potter books.

Like the clock in the books, Microsoft's Whereabouts Clock shows where each member of a group of people is at a given moment. Its round face is divided into areas for work, home, school and 'out'. (Unlike the Weasleys' clock, there's no zone labelled 'mortal peril'. Probably a good thing.) When someone's location changes, an icon of their face moves from area to area on the clock, so when someone leaves school to go home, for example, their icon moves from 'school' to 'out', and finally to 'home' as they arrive.

## Calling the tower

The inner workings of the Weasleys' clock are simple: it's magic! So how did Microsoft get theirs to work, given that they have to rely on more everyday human technology? Their version relies on the fact that your mobile phone can tell the Whereabouts Clock where it is just by being plugged into your network. When users are initially setting up their clocks, they tell their phones when they're in the 'school' zone, say, and the phone looks to see what the closest network tower is to that location. Anytime it finds itself getting the strongest signal from that tower, the phone assumes it must be at school. Whenever the phone doesn't recognise the tower it's connecting to, it just shows the general 'out' zone on the clock.

## On the face of it

Why make it look like a clock though? Well, it turns out the Weasleys were on to something, design-wise. A clock is actually a pretty good model to show people's whereabouts. For one thing, using a clock is simple. It's always on, you just look at it when you need it, and when you do you get the information you want at a glance. Also, clocks give information away to the right people – everyone who's allowed into a particular room can see it, so family and friends are allowed to see people's whereabouts. The fact that you have to be physically in the same room to see it means that if you're not trusted enough to get into the house, you won't get the information.

## Added extras

Just knowing where someone is doesn't necessarily tell you what people are doing. To add a little bit more detail to their first design, Microsoft allowed users to choose specific activities from a pre-determined list, so you could say "leaving now" if you were at work but would soon be on your way. The users found, though, that sometimes they wanted to say more about what they'd be doing later, like "will be in this afternoon". Other times, they wanted to let people know how to get in touch with them: "my email isn't working so call me". It's important to give your designs a testing phase like this, so you can find out what works best. Sometimes your users will come up with ideas you didn't even think of, and sometimes features you thought would be great don't end up getting used very much.

Overall, though, the testers of the Whereabouts Clock liked it. Some people said the clock made them feel like they always had a virtual presence even when they were out. Plus it doesn't take any effort at all – if you just want to show your basic location, you only need to keep your phone turned on. As for trying to find people by checking the clock, the users thought it worked really well, and many especially liked watching people's icons change location. There was a particular wonder about seeing a person's icon drift over the clock face to show that they'd arrived, and then moments later seeing the person walk into the room.

So we might soon be able to get a real Whereabouts Clock just like the Weasleys have. As long as we're producing stuff out of the Harry Potter books, can we get working on flying broomsticks soon please?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# Watching v

Sasha owns a new tour company and her first tours are to the Azores, a group of volcanic islands in the Atlantic Ocean, off the coast of Portugal. They are one of the best places in the world to see whales and dolphins, so lots of people are signing up to go.

Sasha's tour as advertised is to visit all nine islands in the Azores: São Miguel, Terceira, Faial, Pico, São Jorge, Santa Maria, Graciosa, Flores and Corvo. The holidaymakers go whale watching as well as visiting the attractions on each island, like swimming in the lava pools.

Sasha's first problem, though, is to sort out the itinerary. She has to work out the best order to visit the islands so her customers spend as little time as possible travelling, leaving more for watching whales and visiting volcanos. She also doesn't want the tour to go back to the same island twice – and she needs it to end up back at the starting island, São Miguel, for the return flight back home.

## Trouble in paradise

It sounds like it should be easy, but it's actually an example of a computer science problem that dates back at least to the 1800s. It's known as 'The Travelling Salesman Problem' because it is the same problem a salesman has who wants to visit a series of cities and get back to base at the end of the trip. It is surprisingly difficult. It's not that hard to come up with any old answer (just join the dots!), but it's much tougher to come up with the *best* answer.

Of course a computer scientist doesn't want to just solve one-off problems like Sasha's but to come up with a way of solving any variant of the problem. Sasha, of course, agrees – once she's sorted out the Azores itinerary, she then needs to solve similar problems, like the day trip round São Miguel. Her customers will visit the lakes, the tea factory, the hot spring-fed swimming pool in the botanic gardens and so on. Not only that, once Sasha's done with the Azores, she then needs to plan a wildlife tour of Florida. Knowing a quick way to do it would help her a lot.

## The long way round

No one has yet come up with a good way to solve the Travelling Salesmen problem though and it is generally believed to be impossible. You can find the best solution in theory of course: just try all the alternatives. Sasha could first work out how long it is if you go São Miguel, Terceira, Faial, Pico, São Jorge, Santa Maria, Graciosa, Flores, Corvo and back to São Miguel, then work out the time for a different order, swapping Corvo and Flores, say. Then she could try a different route, and keep on till she knew the length of

# vhales well

every variation. She would then just pick the best. Trouble is, that takes forever. Even this small problem with only 9 islands has over 20 000 solutions to check. Go up to a tour of 15 destinations and you have 43 billion calculations to do. Add a few more and it would take centuries for a fast computer running flat out to solve it. Bigger still and you find the computer would have to run for longer than the time left before the end of the universe. Hmmm. It's a problem then.

### Be greedy

The solution is not to be such a perfectionist and accept that a good solution will have to be good enough even though it may not be the absolute best. One way to get a good solution is called using a 'greedy' algorithm. You start at São Miguel and just go from there to the nearest island, from there to the nearest island not yet visited, and so on till you have done them all. That would probably work well for the Azores as they are in groups, so visiting the close ones in each group together makes sense. It doesn't guarantee the best answer in all cases though.

### Or just go climb a hill

Another way is to use a version of 'hill climbing' (see page 10). Here you take any old route and then try and optimise it, by just making small changes – swapping pairs of legs over, say: instead of going Faial to Pico and later Corvo to Flores try substituting Pico to Flores and Faial to Corvo, with the rest the same but in the opposite order. If the change is an improvement keep it and make later changes to that. Otherwise stick with the original. Either way keep trying changes on the best solution you've found so far, until you run out of time.

So Sasha may want to run a great tour company but there may not be enough time in the universe for her tours to be guaranteed perfect...unless of course she keeps them very small. After all, just visiting São Miguel and Terceira makes a great holiday anyway.

# Losing money and getting it back

What would an issue on mobile computing be without a mention of the mobile phone? Nothing else packs quite so much computing power into your pocket. Of course, that means it comes with its own set of promises and perils – not least in the money department. Here are a couple of examples.

## Hustlers go mobile

Living your life like Paris Hilton isn't as difficult as you might think. All you have to do is get your mobile hacked. The American socialite and top goddess in the famous-for-being-famous pantheon had her phone broken into in 2005. Her address book was posted online. Her celebrity chums, whose numbers were suddenly available to any obsessive with basic Googling skills, were mightily hacked off at the time.

Given Paris's reputation for smarts, it's maybe not that surprising that her details were stolen by guessing the password for her online account with her service provider (it was the name of her chihuahua). But in the few years since that break-in, some cleverer scams have arisen to separate you from your money by using your mobile. Mostly they depend on signing you up to premium rate services without you knowing it. For some of these scams, the hustler needs to get hold of your phone, but sometimes they can even do it through Bluetooth.


To find out how to protect yourself against these tech-savvy scams, see the full version of this article in the magazine+ section of **www.cs4fn.org**!

## How standing still can help keep us moving

It sounds like a riddle: what's long, thin, doesn't move but can help keep the traffic flowing? The answer's a smart streetlight. Car congestion causes stress and adds to pollution, and although mobile satnav systems in cars can be clever about working out the best ways to avoid the jams, they have to get the right information to make their decisions. But where does this information about local road conditions come from? Researchers in the Cambridge Computing Laboratory have come up with a dazzling idea, using the existing streetlights. Their smart streetlight design turns an existing streetlight into a traffic sensor. The Intelligent Lamp Post not only lights the street but uses infrared sensors to monitor the traffic flow. Drivers and road planners can then use the information the ILP has gathered. The ILP can be added to the existing streetlamps, saving on costs, and it makes use of the electrical power that's already there. In the future these tall and clever lampposts could also monitor pollution in the area or even provide a limited WiFi service. Quite a bright idea really.

## Can't buy happiness

When you're trying to save money, sometimes it's the little things that do you in. The impulse items, the oh-go-on-why-nots, the I'll-just-pop-in-as-I'm-passing-by-anyways. Before you know it, the money you had has drained away bit by bit. Thankfully, researchers at the MIT Media Lab in the USA are working on a solution – a smart system that reminds you to save money when you go near one of your favourite shops.

### Mark the spot

Many mobiles now come with some kind of location finding equipment on board, like GPS. That means that your phone always knows where in the world it is. The Merry Miser, made by Charlie DeTar and Chris Schmadt, is a program for your phone that knows what locations are also the biggest holes in your finances. Then, when you're out and about, and it thinks you're going to one of those places, the Merry Miser pops up on your phone to remind you money's tight.

Check out the magazine+ section at **www.cs4fn.org** to see just how the Merry Miser knows where the holes in your pocketbook are.

Animation10

## Animate your way to prizes!

in 2010 you'll get another chance to show off your computer animation skills in Animation10, run by The University of Manchester. Create an animated film up to a minute long on your computer, and send it in – simple as that. Winners get prizes ranging from laptops to gift vouchers. You can enter beginning in January, and the deadline is 1 April 2010. To find out more visit **www.cs.manchester.ac.uk/Animation10/**

# Reality? We can do better than that

Have a look around you. As your vision wanders over objects, people and places, how do you know what or who they are? You depend on the information in your memory. Well that'll just never do. What happens if you're lost in a strange city? Or looking at something you want to find out more about? In boring old reality, you'd need a map, or maybe a travel guide app for your phone. But in augmented reality, the answer could be right in front of you.

You've probably seen augmented reality before, just not in real life. Have you ever watched a movie where a cyborg can simply glance at someone, and up will pop their name, who they work for, and the word DESTROY? That's augmented reality. It blends a normal view of the world with computerised tags containing extra information. Like many of today's gadgets it only used to exist in films and computer games, but in the next couple of years you'll see it more and more in the real world.

## The signs are all around you

The uses for augmented reality in everyday life won't be quite so much about blowing things up as they are in films. It's more about adding information to what you already see. For example, a UK company called Acrossair will soon release an application called Nearest Tube for the iPhone that would help people in London find their nearest tube station. All the user has to do is point the camera at their surroundings. The iPhone's GPS figures out the phone's location and the direction it's pointing, which it compares to the locations of the closest stations. Here's where augmented reality comes in. Instead of displaying a map or directions to the station, the user just holds up the phone and looks at the screen. Nearest Tube uses the iPhone's camera to see what the user is pointing at, and then it adds labels to the scene that show what direction the station is in. It's as if someone's hung a sign in mid-air. Then if the user points the phone at the ground, they see arrows pointing in the direction they should walk.

Image credit: Leonard Low, Flickr

## Helpful holograms

The future of augmented reality promises a lot more. One day you may not have to look on a screen to see additions to the world around you – holograms could do the job instead. Holographic arrows on the ground might point you towards the tube. If you wanted to write an email, a keyboard could hover in front of you. Then once you've sent your message, why not relax for a few minutes by turning the keyboard into a virtual air hockey table? It gets even better. Researchers at the University of Tokyo have made a prototype of a system that uses ultrasound to generate force. They want to add it to holographic systems so you can feel as though you're actually touching the object you see in front of you.

It's likely to be a long time before you'll spend your days surrounded by holograms, but the release of augmented reality programs for phones is happening right now. You won't have to wait long before you can access all sorts of extra information about what's around you. Thank goodness, because plain old reality can sometimes use some spicing up.

# Will they take the bait?

**Ben Stephenson** of the University of Calgary tells us about a surprise that's waiting for car thieves

Do you ever find yourself lost and wondering where you are? Technology can help you find yourself. Global Positioning Systems are becoming an increasingly important part of our lives, with widespread commercial, military and civilian applications. After all, it's useful knowing where you are and which way to go in order to reach your destination, whether you are driving through a busy city or hiking through the countryside.

Law enforcement agencies all over the world are also putting GPS to work to combat auto theft. Every year, over a million cars are stolen in North America. While some cars are simply taken for a joy ride, many of these stolen cars are used to commit more crimes. As a result, taking steps to prevent car theft helps reduce the overall crime rate, making communities nicer, safer, places to live.

Thanks to GPS, police forces in Canada and the US now have another tool at their disposal to catch these crooks. Bait cars are police vehicles that are designed to be stolen. To the casual observer, bait cars look just like every other car in a parking lot. But these cars are anything but ordinary, containing more high-tech gadgets than a teenager's bedroom.

Sooner or later a thief steals the bait car, and that's when the fun begins.

While the thief is busy driving away, congratulating himself on his nefarious skills, the bait car's computer is busy too. It's feeding signals that it receives from satellites orbiting 12,500 miles overhead into its GPS system so that it can determine its current location and speed. The bait car's computer is also making a call to the police command centre so that officers know that it has been stolen. At the same time, the bait car's computer is using hidden cameras and microphones to record the criminals as they drive, and sending this information to the police so that they can see how many suspects are in the vehicle, and what kinds of weapons they are carrying.

Using the GPS tracking data, police officers move in and stop the stolen bait car. What if the suspects try to flee? No problem. The bait car's computer also knows how to receive and respond to instructions from the police command centre. If the thieves try to run then the police can send a message to the car which forces it to slow down and lock its doors, trapping the thieves inside. This avoids a dangerous high-speed chase, which is good for everyone's safety, including the thieves'.

So anyone inclined to steal a car should remember that not only are they ruining someone else's day, but they could also quickly find themselves in front of a judge and jury, watching a video recording of their illegal deeds.

Given that evidence, a verdict of 'not guilty' seems unlikely.

### The gravity of the situation

What connects the speed of sound and the Nintendo Wii? It's all got to do with Bloodhound SSC, the supersonic car we told you about in issue 9. Have a look at the magazine+ section on our website, **www.cs4fn.org**, to find the answer.

# Back (page) of the net!

**Nothing is more mobile than the human body and more so when it plays sport. As we all want to get fitter and live longer, scientists are using computers and mobile internet communications technologies to help patients heal, athletes prepare for competitions, stream live video of sporting fixtures to mobile phones, and even let sports fans get involved in the game in ways not previously possible.**

## Who, when, where?

Where would TV sports pundits be without the ability to draw rapid, colourful and often conflicting computer overlays on football pitches to prove their points? Cricket's third umpire uses the accuracy of video playback, and tennis has the computerised line judge. As the level of competition gets higher, the need to accurately apply the rules becomes more important, and computers don't support any particular side.

**GOAL! Computer technology will continue to shift the goal posts**

## Get the right moves

For an elite athlete, all that keeps them from a world record-beating throw or sprint or jump can be some small error in the way they approach their critical moves. Computers can give coaches the sorts of exact details needed to help improve the athletes' style. Motion capture systems, as used in the movies, allow computers to record the positions of the joints in the human body as it jumps around. After attaching small reflective patches all over the body, a multitude of cameras can track the patches' positions in 3D space. This moment-by-moment information is combined with clever devices called force plates, which measure the weight distribution of the body as it stands and moves. Together the technology allows a real scientific approach to setting out training plans and getting the best from the best.

**GOAL! Move like you mean it**

## Shape up and ship out

An athlete's body shape can be critical in achieving peak performance. Body scanners are computer controlled devices that can scan the body all around and produce detailed vital statistics. This information can be used to create equipment custom-built to help individual athletes, like body-hugging suits to reduce water resistance in swimming, or the right enclosure for the rider in a canoeing event. A good fit makes for a better performance. Designs can then be simulated on computers to see how well they work in theory, but on the day it's the athletes that win. The computer science is only there to help.

**GOAL! Every little helps**

## Have a go?

Major sporting events get people interested in sports. Computer scientists have developed virtual reality systems that let ordinary folk try out new sports in a safe environment. Rather than skiing a dangerous run in the Alps, wannabe skiers can try it out by slipping into a ski simulator. After strapping on the real skis, computer-controlled measurement systems allow the skier's body movements to be translated into a realistic, realtime video of their ski run projected onto the screen on front of them. The skis can push back too,under computer control – if you slide over bumps on the virtual ground, you feel them. This use of computers to produce realistic physical sensations through devices attached to the body is called haptics, and the next generation of computer games might just have devices that shake you around a bit.

**GOAL! Get involved, have a go**

## Work that body, inside and out

Mobile devices can monitor the ways our body is reacting to what we're doing. Devices can record and transmit your heart rate and body temperature, indicate your level of physical activity and read your body position, your respiration rate, and even in some cases, body fluid levels. There are even devices that can check if you've been taking your medicine. These devices are built into pills, and activate when swallowed. Via a bandage-like skin patch, they can send information from your other body monitors to your doctor, saying what you have taken, and when and how your body is reacting. Collecting information from an individual patient can help in their care, but also being able to collect this information from a vast number of different patients can help ensure the medicines are doing what they should.

**GOAL! Personal medicine in the future will contain a big dose of computer science**

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