Intermediate

From dumb pipes to smart sensors

1 FIBRE optics are most commonly associated with communications. But fibre optics can do more than just act as pipes for transporting data; they can also be used as sensors that can gather data. Compared with electrical sensors, they are smaller, cheaper, longer-lasting and can operate at much higher temperatures (600°C rather than 125°C). And unlike electrical sensors, fibre-optic sensors are not susceptible to electromagnetic interference and can therefore be reliably used in power plants, magnetic-resonance imaging laboratories and other situations where such interference abounds.

2 The most common type of fibre-optic sensor in use today is called a “Bragg grating”, which is the fibre-optic equivalent of a strain gauge. A Bragg grating is a region of a fibre where the refractive index has been modified so that it varies in a precise, periodic way. This causes the grating to reflect light of a specific wavelength (ie, a specific colour). As the fibre is stretched or compressed, the wavelength that is reflected then changes accordingly, and the strain can be determined. Changes in temperature also change the fibre’s properties in predictable ways. By incorporating several Bragg gratings into a single fibre, each tuned to reflect a different wavelength, it is possible to measure the variations in strain or temperature along the fibre's length. Bragg gratings are used to measure strain in things like turbine blades, and are now cheaper than conventional strain gauges.

3 Indeed, fibre-optic sensors are replacing electrical sensors in many areas of engineering, science and medicine. The spread of this technology from the laboratory into everyday use has barely begun. Several new types of fibre-optic sensor are being developed.

4 The first is a fibre with multiple cores. Such fibres can be used not just to measure strain, but also to measure the degree of bend and its direction. Bragg gratings are etched into each core of a four-core optical fibre. When the fibre bends, some of the gratings are stretched and others are compressed, and the wavelengths they reflect change accordingly. It is then possible to calculate the direction and the angle of bend. This approach is ideal for monitoring structures such as aircraft wings and yacht masts, and a single fibre can do the work of hundreds or even thousands of electrical sensors.

5 Another new type of sensor is based on a conventional optical fibre, the end of which has been modified in various ways. In one example, a small hole, just an eighth of a millimetre in diameter, is drilled into the end of a fibre using a high-powered laser. A copper membrane is applied, creating a small air cavity inside the fibre. The optical properties of the fibre then vary depending on the pressure differential across the membrane. The result may be the fastest reacting pressure sensor ever made: it is ideal for measuring such things as blast waves.

6 Optical fibres have already slashed the cost of communications. Evidently their ability to reduce costs while delivering ever-increasing amounts of data extends to sensing, too.

Taken and adapted from The Economist
http://www.economist.com/science/tq/displayStory.cfm?story_id=4031101

From dumb pipes to smart sensors – TASKS

A) Answer the questions.

1 What are the advantages of fibre-optic sensors?
2 What is the most common type of fibre-optic sensor in use today?
3 What can fibre-optic sensors with multiple cores be used for?
4 What new types of fibre-optic sensors are mentioned in the article?

B) According to the text, are the following statements TRUE or FALSE?

1 Electrical sensors are not susceptible to electromagnetic interference.
2 Fibre-optic sensors are often used instead of electrical sensors.

C) In the text, find synonyms to the following expressions.

1 to collect and put together (*paragraph 1)*
2 changed (*paragraph 2)*
3 numerous (*paragraph 4)*
4 to press something or to make it smaller (*paragraph 4)*
5 usual, traditional (*paragraph 5)*
6 qualities, features (*paragraph 5)*

From dumb pipes to smart sensors – KEY

A) Answer the questions.

1 What are the advantages of fibre-optic sensors?

They are smaller, cheaper, longer-lasting and can operate at much higher temperatures (600°C). They aren't susceptible to electromagnetic interference and can therefore be reliably used in power plants, magnetic-resonance imaging laboratories and other situations where such interference abounds.

2 What is the most common type of fibre-optic sensor in use today?

The most common type of fibre-optic sensor in use today is called a “Bragg grating”, which is the fibre-optic equivalent of a strain gauge.

3 What can fibre-optic sensors with multiple cores be used for?

They can be used to measure strain and also to measure the degree of bend and its direction (This approach is ideal for monitoring structures such as aircraft wings and yacht masts.)

4 What new types of fibre-optic sensors are mentioned in the article?

- fibre with multiple sensors
- sensor based on a conventional optical fibre, the end of which has been modified in various ways

2 points each

B) According to the text, are the following statements TRUE or FALSE?

1 Electrical sensors are not susceptible to electromagnetic interference. **F**
2 Fibre-optic sensors are often used instead of electrical sensors. **T**

1.5 point each

C) In the text, find synonyms to the following expressions.

1 to collect and put together (*paragraph 1)* – **to gather**
2 changed (*paragraph 2)* - **modified**
3 numerous (*paragraph 4)* **- multiple**
4 to press something or to make it smaller (*paragraph 4)* – **to compress (compressed)**
5 usual, traditional (*paragraph 5)* **- conventional**
6 qualities, features (*paragraph 5)* **- properties**

1.5 point each

Total 20 points

Intermediate

Data with a human touch

1 DATA networks can take many forms. They can be constructed using towers with coloured flags, carrier pigeons, electric pulses travelling along wires, or bursts of laser light whizzing along optical fibres. But perhaps strangest of all is the idea of using the human body itself as a network. While it sounds bizarre, systems that use the body to link up different devices are already available—and they might even be quite useful.

2 First in line is Matsushita, a Japanese industrial giant. Last September it launched a “Touch Communication System” under the slogan “Data transfer via fingertips”. It allows users to pick up information from a device simply by touching it. The information is then stored in a compact gadget worn on a wristband, and is transferred when the user touches another device. Very weak currents are used to transmit data across the skin's surface, and the data-transfer rate, a mere 3.7 kilobits per second, is much slower than a dial-up modem.

3 Even so, Teraoka Seiko, a Japanese firm that makes measuring instruments, has begun to incorporate the technology into its line of electronic scales, registers and printers. The resulting keyless data-entry systems are being targeted at salesmen who handle bulk merchandise that is unsuitable for labelling with bar-codes, such as big chunks of meat and fish.

4 Skinplex, devised by Ident Technology, a German start-up, is a similar system designed with security applications in mind. You carry a device with a unique identifying code on your body, perhaps embedded in your watch or glasses. The code is transmitted via your skin as soon as you touch a receiver, embedded in a car door, for example.

5 As well as having potential security advantages, transmitting data from one device to another via the user's skin also sidesteps the problem of radio interference as other “personal-area network” devices, based on the established Wi-Fi and Bluetooth wireless technologies, proliferate. So why is the technology not more popular? For one thing, it is still quite new: Microsoft was awarded its patent for skin-based data transmission only in June last year, for example. Another problem is the need to maintain direct contact with multiple devices. Sending music to a set of headphones via the skin makes sense—but means that the music-player must be touching the skin too. And health worries over mobile phones and other sources of radiation mean that people are not quite ready to accept the idea of signals being transmitted via skin. Besides, the data rates achievable may simply be too low.

6 Many of these drawbacks are being addressed by NTT, Japan's telecoms giant. Instead of passing an electric current through the skin, its “RedTacton” technology works by inducing tiny fluctuations in the body's existing, but very weak, electric field—in much the same way that a radio modulates a carrier wave to transmit sound. This means that the transmitter need not be in direct contact with the skin, but can be in a pocket or purse: the technology works through multiple layers of clothing, up to 20 centimetres from the body. The receiver is based around an electro-optic crystal, the optical properties of which change in sympathy with the body's electric field. These variations are detected by a laser and an optical sensor, and the transmitted data can then be extracted. NTT says a data rate of 10 megabits per second is possible, making the user's body equivalent in capacity to an office Ethernet network.

7 The technology could have all sorts of uses, since it also works with inanimate objects such as walls, floors, furniture and even water. Music could be transmitted from your PC to a music-player in your pocket when you sit down at your desk, for example; or you could unlock a door by touching it.

Taken and adapted from The Economist
http://www.economist.com/science/tq/displayStory.cfm?story_id=4031119

Data with a human touch - TASKS

A) Answer the questions.

1 What technologies that use the body to link up different devices are mentioned in the article?
2 Why isn't the Skinplex technology more popular at the moment?
3 What are the advantages of the RedTacton technology?
4 What are some of the possible uses of the RedTacton technology?

B) According to the text, are the following statements TRUE or FALSE?

1 The transfer of data with “Touch Communication System” is as fast as with a dial-up modem.
2 Keyless data-entry systems may be used for handling goods that are unsuitable for labelling with bar-codes.

C) In the text, find synonyms to the following expressions.

1 to connect (*paragraph 1*)
2 to introduce (a new product on the market; *paragraph 2*)
3 aimed at (*paragraph 3*)
4 to avoid (*paragraph 5*)
5 disadvantage (*paragraph 6*)
6 difference (between similar things; *paragraph 6*)

Data with a human touch - KEY

A) Answer the questions.

1 What technologies that use the body to link up different devices are mentioned in the article?

- Touch Communication System
- Skinplex
- RedTacton technology

2 Why isn't the Skinplex technology more popular at the moment?

- it's still quite new
- it's necessary to maintain direct contact with multiple devices
- it's still related to certain health worries
- at the moment the achievable data rates are too low

3 What are the advantages of the RedTacton technology?

The transmitter need not be in direct contact with the skin, because the technology works by inducing tiny fluctuations in the body's existing electric field. The technology works through multiple layers of clothing, up to 20 centimetres from the body.
According to NTT, a data rate of 10 megabits per second is possible, making the user's body equivalent in capacity to an office Ethernet network.

4 What are some of the possible uses of the RedTacton technology?

The technology could have all sorts of uses, for example for transmission of music (information/ data) or unlocking door.

2 points each

B) According to the text, are the following statements TRUE or FALSE?

1 The transfer of data with "Touch Communication System" is as fast as with a dial-up modem. **F**
2 Keyless data-entry systems may be used for handling goods that are unsuitable for labelling with bar-codes. **T**

1.5 point each

C) In the text, find synonyms to the following expressions.

1 to connect (*paragraph 1*) – **to link up**
2 to introduce (a new product on the market; *paragraph 2*) - **to launch**
3 aimed at (*paragraph 3*) – **targeted at**
4 to avoid (*paragraph 5*) **– to sidestep**
5 disadvantage (*paragraph 6*) – **drawback**
6 difference (between similar things; *paragraph 6*) - **variation**

1.5 point each
Total 20 points

Intermediate

Electronic paper

[1] A TECHNIQUE originally used to cut headlight glare in cars' rear-view mirrors has been adapted to create a new "electronic paper" display for MP3 players and mobile phones. It is called NanoChromic display, or NCD, and it was shown operating on a converted iPod by Dublin-based company Ntera at the DEMO@15 technology show in Arizona.

[2] Unlike LCDs, electronic paper displays can be viewed from almost any angle and in a wide range of lighting conditions, much like paper itself. Another key characteristic is that they require very little, if any, power to maintain an unchanging image.

[3] At the heart of an NCD is a layer of a so-called "electrochromic" material, which is normally transparent but turns blue when a negative charge is applied. It requires no moving parts. This makes NCDs quite unique among electronic paper technologies.

[4] Electrochromic material has been used in the past to darken rear-view mirrors in cars. In Ntera's new display, an array of transparent electrodes made of metal oxide semiconductor, mounted on a transparent film, allows it to produce images with a resolution of around 0.25 millimetres, or 100 dots per inch. Adding an opaque white layer of titanium dioxide behind the electrochromic layer creates a white backdrop to the monochromatic images that makes them more readable. The company is also planning to eventually develop a colour display.

[5] There should be a room for a variety of different types of display. Historically there has never been a universal display. They all have trade-offs. It is expected that different technologies will lend themselves to different applications.

[6] Displays that require no power to maintain the image might be best suited for poster-like advertising banners. Others might be more suited to mobile devices or for shelf-edge displays that show prices in supermarkets, where power consumption is less important than the ability to change prices quickly throughout the store. So far, none of the companies making electronic paper has been able to achieve good high-resolution colour images.

[7] Although Ntera's NCDs have no moving parts, the displays are unable to switch pixels on and off fast enough to be used in TVs or in streaming video on a computer monitor. This is because electrochromic displays can take some time to build up charge.

[8] Ntera hopes that its display will give it the edge in applications that require high definition. It has designed the electrodes to have an uneven surface, to maximise the number of electrochromic molecules that make contact with it. This creates a denser, better-defined image and also allows the pixels to be switched on and off faster.

Taken and adapted from the New Scientist

Electronic paper – TASKS

A) Answer the questions.

1 What was the original use of the technique that electronic paper is based on?
2 What are the key characteristics of electronic paper displays?
3 What can displays such as NCD be used for?
4 Why has Ntera designed the electrodes to have an uneven surface?

B) According to the text, are the following statements TRUE or FALSE?

1 Ntera's NCDs can produce images with a resolution of around 0.25 millimetres.
2 As Ntera's NCDs have no moving parts, they can be used in TVs or in streaming video on a computer monitor.
3 At the moment electronic displays are not capable of switching pixels on and off very fast.

C) In the text, find synonyms to the following expressions.

1 changed into a different form or for a different purpose (*paragraph 1*)
2 to keep, sustain (*paragraph 2*)
3 clear, see-through (*paragraph 3*)
4 attached to something, fixed (*paragraph 4*)
5 amount used (*paragraph 6*)
6 rough, unequal (*paragraph 8*)