iBYTES

Welcome to the second issue of *iBYTES*, your support update, providing useful and relevant information to our ICT centres and helping to support the OCR ICT community. We aim to highlight the developments that may be of interest to you in the teaching of our GCSE ICT specification.

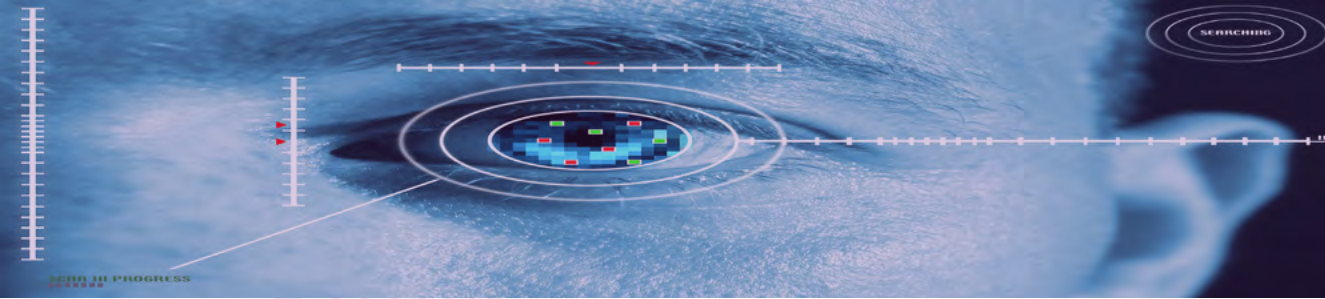# Biometrics
– once science fiction, now reality

Immersive (Virtual) Worlds

GCSE ICT2010

Biometrics – once science fiction, now reality

Fifteen years ago, when studying input devices within ICT lessons, teachers and text books often made reference to using biometric impressions in the future such as IDs rather than numbers, codes or swipe cards. At the time, it seemed that using fingerprints, or a scan of a retina, to buy chips or borrow a book was something out of science fiction movies and would never really take off. Over the last few years, however, the technology has become more available and, with more sophisticated methods of committing fraud, it has become essential to have a unique method of identification which cannot be tampered with or altered.

This edition of *iBytes* will explore the topic of biometrics, the technologies behind it and the ICT systems that make biometrics useful.

What is biometric technology and how can it be used in schools?

(Ref: Becta guidance on biometric technologies in schools: www.guardian.co.uk/technology/2009/mar/05/biometrics-data-protection)

Biometric technology is the use of technology to measure, record and analyse one or more physical or behavioural characteristics unique to each person. The physical characteristics include fingerprints, retina and iris patterns, voice, facial shape and hand measurements, while handwriting and typing patterns are behavioural characteristics that can be used in this way.

Biometric technology is used where confirmation of a person's identity is required. A student in a school is first registered on the system and has their identity authenticated; they will then be allocated entitlements (such as being able to borrow books or have a school lunch).
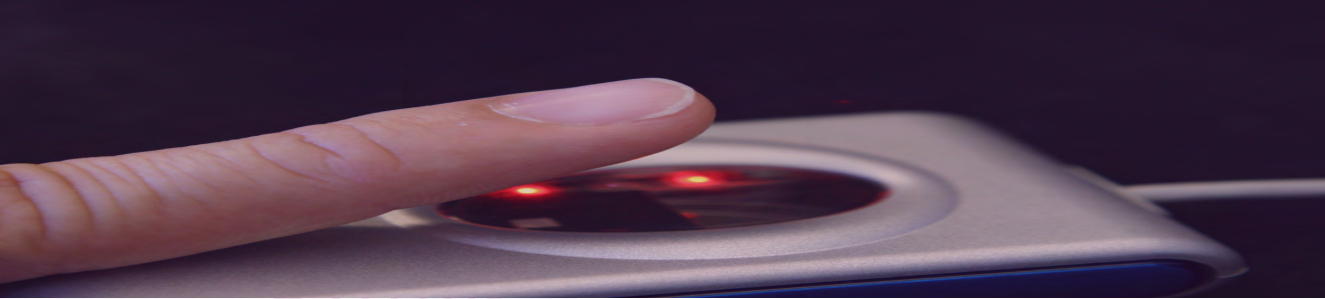
Using fingerprints to identify students is commonly used in schools and an estimated one million children have had their fingerprints taken to enable them to borrow a school library book or to pay for a school lunch. And 2-D facial recognition is now also being introduced in some schools.

In schools, biometric technology takes measurements that capture the uniqueness of the source but doesn't capture a complete image. This method means that the original cannot be recreated from the data – eg a fingerprint cannot be recreated from the data stored about it. When a student's fingerprint is first taken, a unique number is generated from the fingerprint and it is this number that is stored, rather than an image of the fingerprint. When facial recognition is used, measurements relating to the nose, upper lip and cheeks are converted to a unique number, which is encrypted and stored.

Find out more about biometric technology:
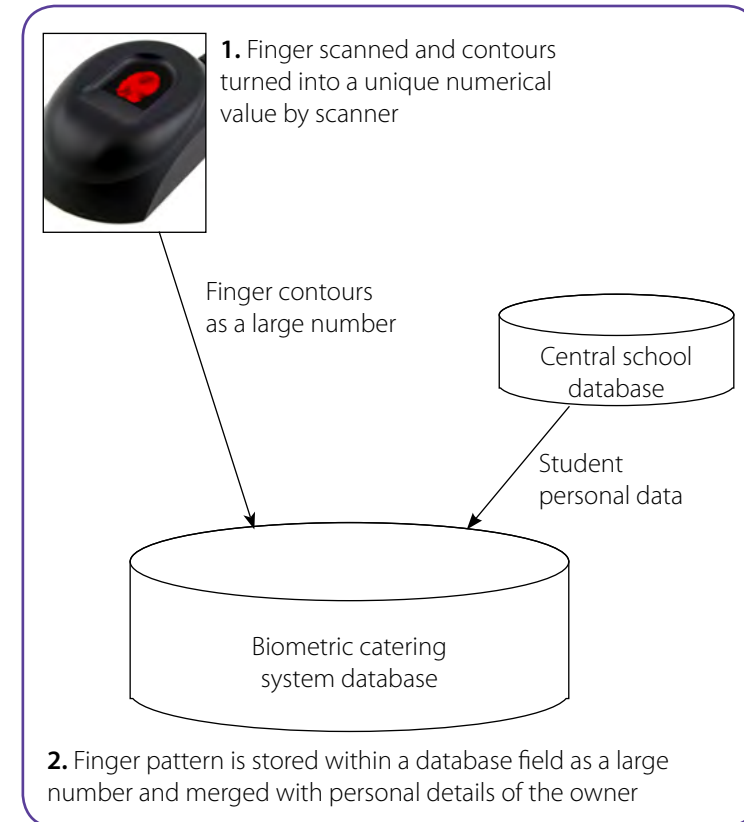
Application of biometrics in a school canteen

Cashless catering in schools is not a new idea and has been operational in schools for about the last ten years or so. In a traditional cashless catering system, a magnetic swipe card or smart card is loaded with money which can then be used to pay for food in the canteen – rather like a gift card in a shop. Although this system reduces the need for students to bring money to school and makes service quicker, a major risk is that students lose their cards or have them stolen – which can cause problems for everyone involved. The introduction of using a fingerprint to purchase lunch removes the need for a card, as it is a fingerprint that identifies the account and gives access to any funds – and this is more secure.
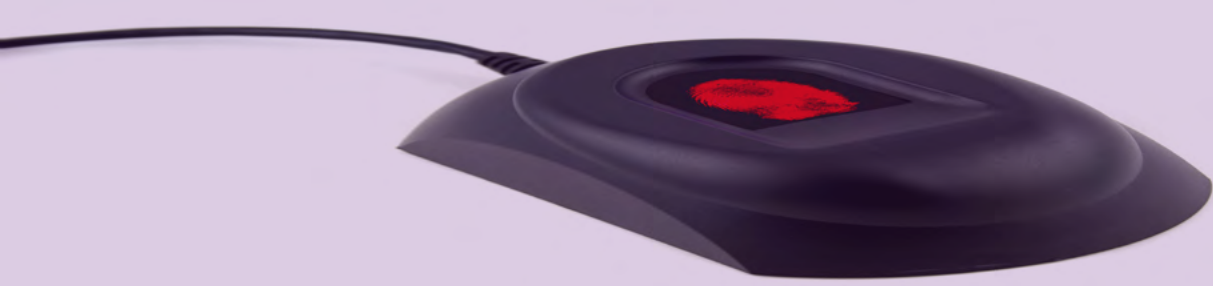
Before biometric catering is implemented, each student needs to be set up on the system. This involves scanning each finger to record data and then linking the finger's impression to the personal details of its owner. Student details will already be on the system, as they are imported from the school's central database, so registering students will be fast.

Figure 1. Biometric catering registration process

1. Finger scanned and contours turned into a unique numerical value by scanner

Finger contours as a large number

Central school database

Student personal data

Biometric catering system database

2. Finger pattern is stored within a database field as a large number and merged with personal details of the owner

When a finger is scanned, contours in the finger are read by the scanner and the unique pattern is saved as a large number within a database along with other personal details including name, address and account balance.

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How police and school fingerprint scanners record identities

1 Individual's index finger (or thumb) is pressed onto scanner

2 Scanner reads unique pattern plotting specific distinctions (minutiae)

3 Points are linked forming a pattern recorded as a number or algorithm used for comparision
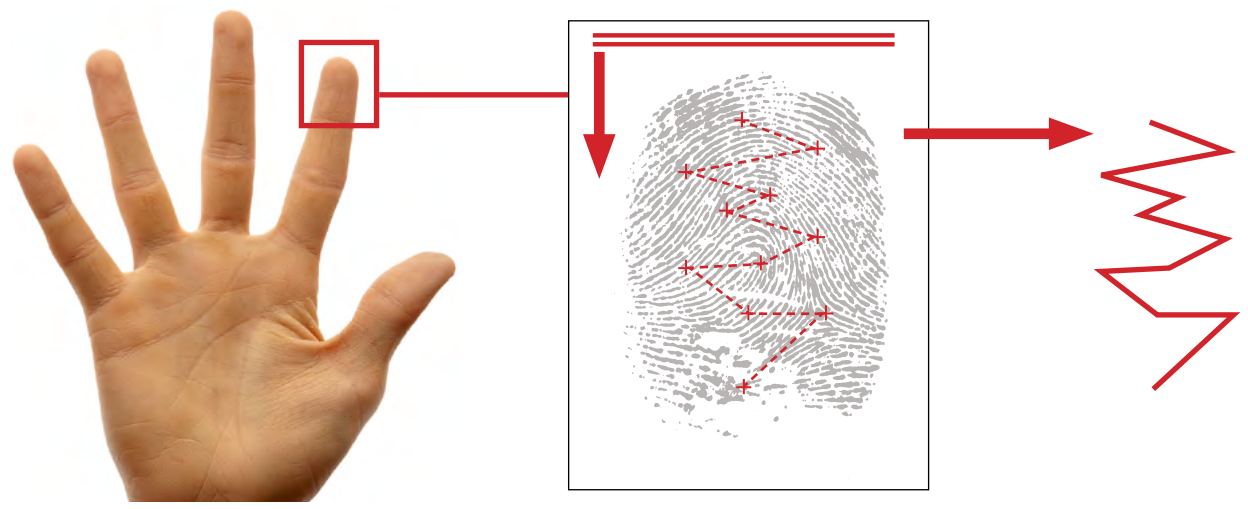
Figure 2. Diagram showing how finger scanners work

To credit the account with money, students can either insert cash into a top-up machine situated around the school or parents can use a web interface to add funds using a credit card. The balance needs to be updated in real time so that funds can be used straight away. As the machines are in school, these will be faster at updating the balance than the online payment gateway.

Figure 3. Payment machine that can be used by students to top up their account balance. The finger is scanned to retrieve the account details, then money is entered into the machine and the balance is updated. It happens in real time so the money can be used straight away

Figure 4. Example of an online payment gateway where parents can top up their child's balance using a credit or debit card
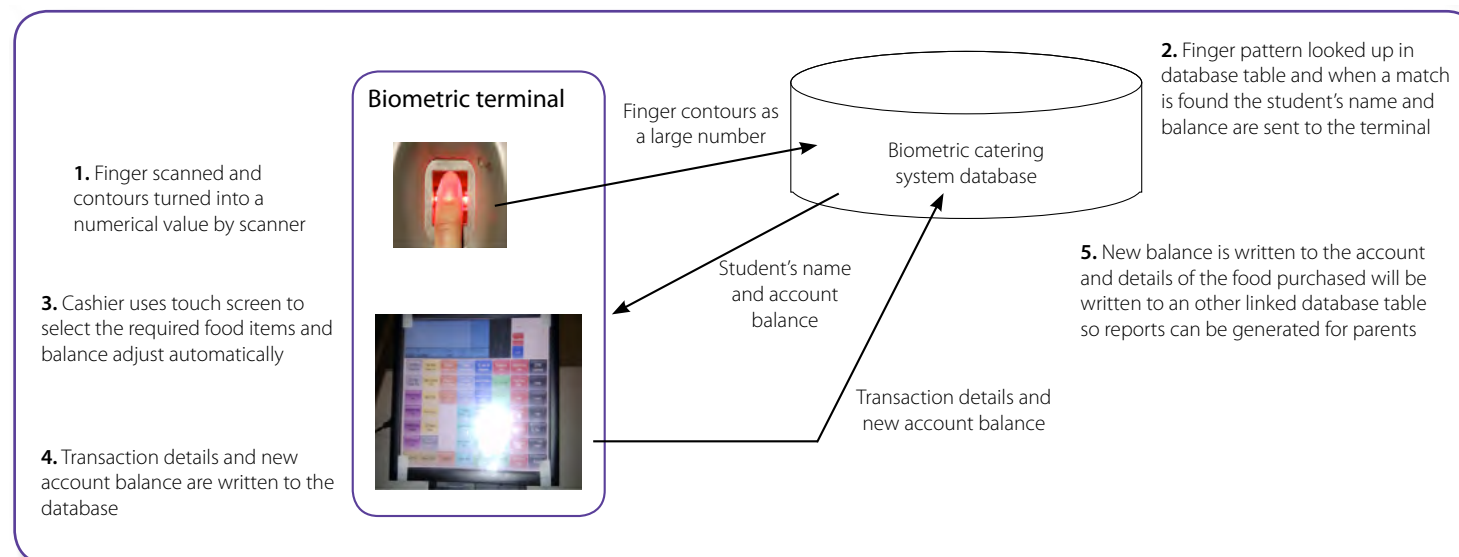
Each time a purchase is made, a finger is scanned and the numbers generated from reading the contours of the finger are compared with the ones stored on the biometric catering system – when a match is found, the account details – including balance are retrieved.

The cashier will select the food items the student has chosen using a touch screen. The balance is updated as each item is selected and if funds become too low the till will alert the cashier and excess food items can be confiscated.

Figure 5. Cashless catering till with finger scanner

Figure 6. Biometric catering registration process

Biometric terminal

1. Finger scanned and contours turned into a numerical value by scanner

Finger contours as a large number

Biometric catering system database

2. Finger pattern looked up in database table and when a match is found the student's name and balance are sent to the terminal

Student's name and account balance

3. Cashier uses touch screen to select the required food items and balance adjust automatically

5. New balance is written to the account and details of the food purchased will be written to an other linked database table so reports can be generated for parents

Transaction details and new account balance

4. Transaction details and new account balance are written to the database

For the system to work properly, the user interface of the touch screen must be organised so that it is easy to find items (this is known as being user friendly). Often goods will be put into natural subcategories of the same type so they can be found at speed. A touch screen layout for a newsagent's terminal may look something like the diagram below.

Daily Newspapers	Sunday Newspapers	
Arts & Culture Magazines	Business & Finance Magazines	Computer & Technology Magazines
International Magazines	Children's Magazines	Lifestyle Magazines
Motoring & Transport Magazines	News & Current Affairs Magazines	Science & Nature Magazines
Sport Magazines	Women's Interest Magazines	

TOUCHSCREEN

There are four things you need to design when creating a new system:

1 Navigation screens including a main menu
2 Input screens – used to enter data into the system
3 Output screens – used to view data on screen
4 Reports – printed material from the system.

Designing usable systems

In order to design a system that is usable, you need to take the following into consideration:

- **Who will use the system:**
  - Will the system be for competent computer users, or the general public who may be wary?
  - What is the age of the average user of the system?
  - Will the system have to cater for both beginners and experienced users?

- **What tasks the computer is performing:**
  - Is the task very repetitive, and does the task require skill and knowledge?
  - Do tasks vary greatly from one occasion to the next?

- **The environment in which the system will be used:**
  - Will the environment be hazardous or noisy, or calm and quiet?

- **What does the user require:**
  - Do all outputs need to be printed out?
  - What data needs to be entered into the system?
  - How is the data entered into the system?

Design tips

- **Input screens:**
  - Used to enter data or instructions
  - Should not be able to access previously entered data
  - Fields need to be in a natural order
  - Fields need to be large enough for data to be entered
  - Fields need a suitable label
  - If using columns, we work left to right and top to bottom, each column at a time
  - Group data items with a common theme together, eg personal details, medical details, bank details
  - Use pastel colours so you don't give the person who is entering data a headache or eyestrain – avoid bright green at all costs
  - Should have an add or submit button and a close button (if online a reset button).

- **Output screens:**
  - Used to display data – may be locked to avoid accidental editing/deleting
  - Each data item should be clearly labelled and set out in a natural order
  - Common data should be grouped together – perhaps even on different screens accessed through buttons
  - Space is important to make reading the data off the screen easier – avoid clutter
  - Use pastel colours so you don't give the person who is viewing the data a headache or eyestrain – avoid bright green at all costs
  - Should have buttons to navigate and search through the data, close the form, and perhaps edit/delete facilities.

● **Reports:**
- Need to remember that they will be printed out so layout is very important, they must fit on the page properly, and all data needs to be visible. Change the page orientation if appropriate to landscape – use print preview to check prior to finishing your implementation
- Each field needs to be labelled correctly and perhaps emboldened so they stand out
- Need to ensure that the fields are long enough so all data is displayed
- Each report should have a title that is clear
- Use appropriate headers and footers, within which the name of the report, page number, and date should be displayed.

**Discussion** ? Click here

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The biometric catering system has several advantages including the following:
- Money does not need to be brought into school so students are less likely to be bullied.
- There are no cashless catering cards to get lost or stolen.
- Students on free school meals get the money automatically into their accounts so people don't know their personal circumstances.
- Serving is quicker, as it is only necessary to scan a finger and select the items on the touch screen terminal.
- There is increased hygiene, as no money – carrying germs – passes between the servers and purchasers.
- If the balance is exceeded then cashiers are informed automatically and excess items can be confiscated.
- As all purchases are linked to an account, parents can find out what their children have been purchasing.
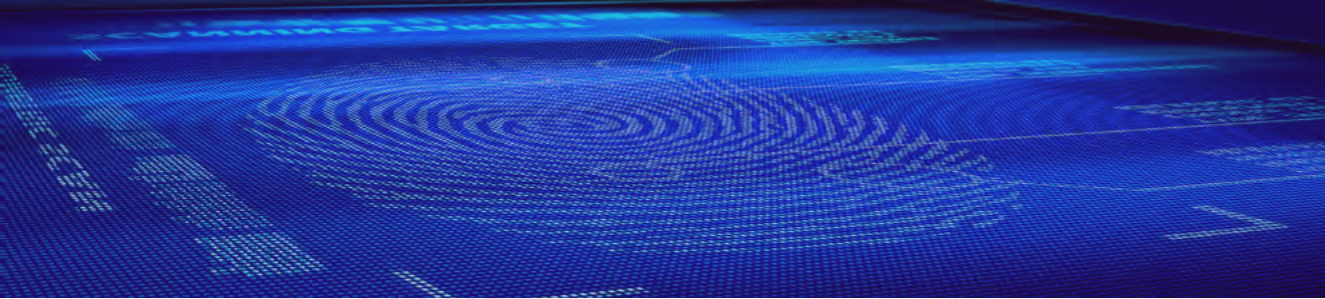
Introducing Bytes Academy

Bytes Academy is a school located in the Midlands and has an above-average proportion of students on free school meals. The head teacher Mr Johnson, along with the governors, thinks that it is a good idea to introduce a cashless catering system within the school which uses biometrics. They are also interested in how a similar system can be used in the school library to speed up the issuing of books and avoid problems with students constantly losing their library cards.

Keeping data safe and secure

Because schools hold personal data about students, they must follow the requirements of the Data Protection Act. There are eight main principles of this act, which you can find in the first issue of *iBytes*.

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From a parent's point of view, security of data may be an issue. Mr Johnson will need to reassure parents about this and other issues before he implements the new system. Although there is nothing specific in the Data Protection Act that states that a parent's permission needs to be obtained before biometric technology can be used in a school, Mr Johnson would like to have the parents' support and will present to them the pros and cons of using biometric technology.

Advantages of using biometric technology in schools

- Students do not need to remember to carry money or a smart card to buy lunch.
- There is a reduced chance of bullying and theft if students aren't carrying money.
- Students can't use another student's smart card to purchase lunch.
- Students who receive free school lunches are not easily identified.
- Students don't need to remember to carry a library card to borrow books.
- There is no library card for a student to lose or have stolen.
- If biometric technology were also used for recording attendance at the school entrance, it could:
  o Provide accurate data on students who are entitled to the EMA grant
  o Reduce time taken registering students at the beginning of a day/class
  o Record incidences of truancy accurately
  o Reduce the incidences of unauthorised strangers entering a school.

Disadvantages of using biometric technology in schools

- A single biometric could provide access to huge amounts of personal data about a student, which could be a security worry if the data were stored on removable storage media.
- Some people think that if children get used to having their fingerprints or faces scanned then they will accept it in future life and not question whether they want their personal data available to organisations.
- As with all IT systems, if the system goes down due to power failure, etc then staff and students may not know what to do.
- There will be a large initial expense in setting up the system, due to hardware and software costs.

Discussion

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How do we present a proposed solution to an audience?

When producing a presentation, it is important to consider the audience it is aimed at: we need to consider their age, interests and background.

Discussion

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Mr Johnson wants to present his solution to two different audiences so he will need to consider the following:

- The staff at the school may understand the problems encountered with the current non-ICT systems better than the parents so they will need convincing that the new system would make life easier in the school environment than the current system; they may have questions about how to use the new system and the reliability of an ICT system in school.
- The parents of the pupils in the school may have concerns about the security of data stored about their child and they may be worried that the data might be misused and passed on to a third party.
- Both audiences consist of adults and are of the same age range so the language and appearance of the final presentation will only need to take adults into consideration.

Mr Johnson will need to consider what software to use to present his solution to his audience. He could use:

- A word processed letter or report
- A newsletter produced using DTP
- Slideshow software to produce a multimedia presentation
- Web-publishing software to add pages to the school website
- Video-editing software to produce a video.

It is important that Mr Johnson gets his message across to his audience effectively, so he must carefully consider the advantages and disadvantages of each method before making his final decision.

- **Letter/report produced using word processing software:**
  o Text can be entered easily.
  o Images can be combined with the text, although this feature can be limited in word processing software.
  o Bullet points and tables are easy to use.
 o Final document can be emailed or printed for distribution.

- **Newsletter produced using DTP software:**
  o Images and text are more easily combined than in word processing packages.
  o Text and images can be layered for greater effect.
  o Different page setups can be used, such as newsletters with multiple columns.
  o Final document can be emailed or printed for distribution.

- **Multimedia presentation produced using slideshow software:**
  o Text and images are easily inserted and combined in one document.
  o Objects on each slide can be animated to keep the audience's attention and to only display objects as they are needed.
  o Sound can be added.
  o Video can be added.
  o Text and images are easily layered.
  o Final document could be presented by Mr Johnson at a meeting or distributed via email or DVD.
  o The audience/presenter can choose the route to follow through the presentation and return to previous slides to clarify a point.
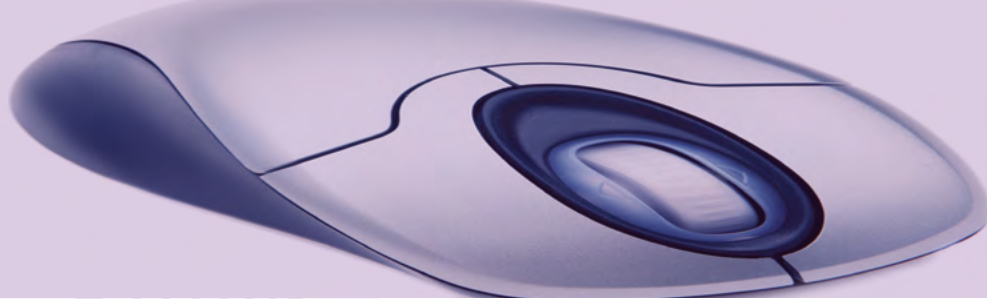
- **Web pages produced using web-publishing software:**
  o Text and images are easily inserted and combined in one document.
  o Sound and video can be added to include multimedia elements.
  o An individual can browse the pages at their own pace.
  o A website can be designed to be easily accessible for people with disabilities.
  o Interactive feedback forms can be included for the audience to ask questions or make comments.

- **Video produced using video-editing software:**
  o Sound can be added for an audio explanation.
  o Special effects can be added to the video or sound.
  o Still images can also be included.
  o The final presentation can be recorded to DVD for distribution or put on the school website.

Whichever method Mr Johnson decides to use to present his proposed solution, he will need to contact the parents – either by sending them the letter or newsletter by email or post, or by writing to them to tell them of the slideshow/new web pages/video. To contact the parents of all of the pupils in school, Mr Johnson will transfer existing data in a school database to an email or a letter, using mail merge.

Advantages of mail merge include:

- Each letter is personalised for the individual recipient, with their name and contact details.
- Only one copy of the letter needs proofreading for errors, so saving time.
- Data in the database will have been checked (using verification and validation where appropriate) so there is a reduced chance of errors in the letter.
- The data in the database can be re-used for future correspondence.

Discover and **do**

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Word search

Word search clues

- A term used when talking about a person's identity being confirmed or checked
- An integrated circuit that carries all the functions of a central processing unit
- Data generated from a fingerprint
- Software that allows videos to be altered by cutting, joining, etc
- The way one slide changes to another in presentation software
- The data generated from biometric technology about a person would need this done to it to keep it safe and secure
- An alternative technology to biometrics for electronically paying for school lunches without the need for cash to be handed over
- The movement of an object in slideshow software, such as entrance effect
- The transfer of data from a database to a letter or email
- Signals that are continually variable
- A set of rules that have to be followed for communication to be able to occur between computers
- This is how personal data needs to be kept
- Special type of ROM that can be erased and re-written to
- The addresses of computers on a network or the internet

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Specification criteria map

	Content specification	Page number in specification
Presenting a proposed solution to an audience	2.1.3; 2.2.4; 2.3.6	8, 13, 16
Software used to present information to an audience	2.1.1; 2.2.2	7, 12
Use of mail merge and email to communicate with parents	2.1.2; 2.3.5	8, 15
Biometric technology	2.1.9	11
Keeping data safe and secure	2.1.5; 2.3.9	10, 17
Design of input screens	2.4.2; 2.5.3	18, 20

Immersive (Virtual) Worlds

An immersive world (virtual world) is a 3-D virtual reality world in which people can communicate and interact with other 'virtual people', usually known as 'Avatars'... The most common immersive world is known as 'Second Life' and in recent times, universities and businesses have created virtual worlds in which their students and employees respectively can engage and interact with each other virtually...

Considering how emergent immersive worlds are, it is interesting to see how educational and business/commercial organisations have utilised the benefits that immersive worlds offer; the key benefits include communication, collaboration and access to information and learning opportunities. Immersive worlds have been seen to be used by business/commercial organisations, education establishments (universities being the most common) and by individuals and groups for online gaming and communication.

This is an exciting and new area of technology and very relevant to Key Stage 4 students, some of whom may already be engaging in immersive worlds. In addition, this technology has much scope and potential to grow and become widely used for the young generation, who will become used to this way of communicating, learning and accessing information.

Immersive worlds is an excellent topic area for the B063 module, as it incorporates many aspects including ICT Systems (2.3.1), Project Planning (2.3.4), Exchanging Information (2.3.5), Legal, Social and Ethical Issues (2.3.8) and Current and Emerging Technologies (2.3.10). Due to this topic area hitting so many different aspects of the B063 module, it will be unrealistic to cover this in a single one-hour lesson and sufficiently cover the key aspects of the syllabus thoroughly or in any great depth...

Download Immersive (Virtual) Worlds teaching materials to use in the classroom:

- Presentation slideshow
- Starter Activity task sheet
- Lesson plan
- Student task sheet

Do you have a **passion** for technology?

Do you have a passion for a technological area? Do you have a lot of knowledge of this area? Do you think that you could write an **iBytes** document using that knowledge? We are on the lookout for imaginative and dynamic teachers to write **iBytes** documents. They should be informative, exciting to read and centred around a recent technological development. They should also strongly and visibly link to the specification of our **GCSE in ICT**.

If you feel that you could contribute an **iBytes** document, please email Julian Parkin on **julian.parkin@ocr.org.uk**

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