



PROGRESS OUTCOME 6

Selling cellphone cases

Context

A Young Enterprise group called Caseman has designed and made iPhone cases with a 3D printer. They have approached Hemi to help them create a system for producing invoices.

In consultation with Caseman's CEO (John Smith), Hemi has identified the information each invoice should show and that a database will be required to meet end-user requirements.



Insight 1: Design decisions based on client needs

During discussion with John, I identified that the database would require a number of tables (e.g., customers, items, and invoices) to allow the group to keep track of each invoice. I had to consider how to enter the data, the information the database needed to produce, and who would be using this information.

I explained to John that using validation and drop-down lists based on already available information would minimise data-entry mistakes. John wanted to allow other members of the team to access information, but to avoid the duplication of orders (a problem that had already occurred), he requested that the database be set up so that only he could add new invoices. He agreed to the use of permissions and passwords to make this possible.

John also wanted to be able to create emails to offer new products or special offers to previous customers and to offer the specials to customers who had paid in full. I explained that this could be done using advanced queries and sending the results to his email program (Apple Mail).



Insight 2: Developing the outcome

I started by identifying the information I needed for the tables. My solution could not be in the form of a flat file because a customer might want to order several different cases for family and friends. I decided to set up a relational database.

The main table for the database became the invoices table, where a record of each invoice is stored. It includes a primary key field (pk_InvoiceID) that is unique and increases by one for each new invoice. I also included an items table, in which each item appears once with a specific price attached to it. If John needs to update pricing in his invoices, he only needs to change it in that table.

Because each invoice can have more than one item and any item can appear on many invoices, I needed to create a many-to-many relationship. I did this by creating a simple join table.

I linked the 'Invoice_Item' field to the 'Item_Name' field in items so that each line in the invoice would only be able to select an item available in the items list. 'Item_Cost' is retrieved from the items list and populated with a simple script. Although not strictly necessary for creating invoices, I added a customer table to make it easy to create invoices for previous customers and to support the email function that that John had requested.



Insight 3: Testing using data

Once I had designed the main invoice table layout, I tried adding some data to the system. I immediately realised that as well as looking up previous customers, John would need to add new ones. I included that option in the layout and tested it by adding several different records.

My display for the line items worked well, but I needed to add a delete button and a simple script to give the correct value for the price for multiple orders of the same item.

I also realised the need for a total, which I created with a summary field. I tested the invoicing system by selecting a name from the existing customer list, which updates every time a new customer is added.



Insight 4: Data security measures

I then considered data security and privacy in the design.

To allow other members of the team to look at invoices but not create new ones, I set up two password-protected accounts. The one for 'staff' allows read-only access. The other account is specifically for John. It allows him to create and delete invoices but not to change layouts or scripts. Only I can do that as the designer, which protects the intellectual property that I have asserted over the design of this database.

Because both of these accounts use passwords, all the customer information and database details are kept private and secure.



Insight 5: Setting up the auto-email

John was very pleased with the final design of the database and the ability to keep track of invoices and find customers quickly. I started work on the option to create a simple email that would send a promotional message to customers who meet certain criteria. This was much more complicated than I'd expected because the same customer can have more than one invoice.

I set up a field to count the total number of invoices a customer has in the system. I then created a new 'Paid' field for each invoice, which John selects when an invoice is paid. To complete the query, I created a calculation that compares the number of invoices a customer has against the number of 'Paid' entries. If they match, the field status is marked as 'True' and the customer is eligible to receive an email.

To generate the email that John wanted, I created a simple data-entry form for adding a message title and message content. I then created a script that would carry out the query and produce an email that merged customer information with the message.

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PROGRESS OUTCOME 6

Designing a speaker box

Context

The school's integrated course encourages specialist students to combine their expertise to develop multi-disciplinary outcomes. An end-of-year occasion attended by whānau, local business, and council members celebrates these outcomes.

Jarrold and Krish have been working across two specialist technological contexts: digital and resistant materials, and construction. During the early scoping aspect of their project, they surveyed the school's three senior year groups. The most popular request was for a small Bluetooth® speaker and amplifier for linking with students' phones.

Jarrold explored the idea further with some of the students and decided that the device could include an audio-reactive LED matrix. The matrix would run a number of visualisation modes to react to the music via a microphone inside the speaker box.



Insight 1: Design and construction decisions

As the digital expert, I began to design and model a suitable electronic system. I met regularly with Krish, my construction partner, to ensure that we both understood the specifications and requirements. For example, we clarified the speaker-box measurements to make sure that the box could house an audio Bluetooth® amplifier board, an open source microcontroller (to control the LED matrix), a power supply and speakers, and a small, single-supply electret microphone circuit. We knew that to be fit-for-purpose, the outcome needed to look good and work well.

For the amplifier board, I sketched some circuit diagrams to show how I planned to build and control the amplifier, and I researched the components I might need and which would be suitable.



Insight 2: Trialling components and construction

Firstly, I had to gather electronic components – the Bluetooth® module, LCD Bluetooth® module, and lithium polymer battery speaker. The amplifier components included left- and right-channel amp modules, a transformer, a switch and hardware materials.

Getting the correct speakers for the amp was a challenge. We learned that the load handled by an amp (expressed in Ohms) has to match the load of the speaker, so, for example, you need to use an 8 Ohm speaker with an amp rated at 8 Ohms.

I worked closely with Krish as he measured and cut out the various parts of the speaker box, such as the top panel for the push-button controls. As we added components, we tested all parts to make sure they were still functional (so that we didn't fry anything and everything was put together correctly before being powered up). We also investigated the potential draw on the battery.



Insight 3: Configuring the network components

Potential challenges centred on aesthetic and functional factors. For example, the LED display was an important part of the complete unit and needed to look good. But I had to make sure it was earthed properly, as otherwise it might malfunction.

I sketched out a step-by-step plan as I worked through the best way to lay out the components inside the speaker. I also found I had to shuffle the components around to insert the LED baffle in the enclosure.

Once I had determined the layout, I had to connect the components from the JST PCB connectors.



Insight 4: Testing the final outcome

Once we had installed everything, we tested the speaker with a range of phones. For our first test, we turned on the speaker and connected my phone to Bluetooth®. I wanted to test the sensitivity of the microphone because the LED panel responds to this sound source. I found I had to adjust the MIC_HIGH and MIC_LOW parameters in the code to improve how the panel would read and react to the sound.

We then tested the sound source with Krish's phone to make sure the settings worked on a different make of phone. Finally, some senior students tested the speaker box in a variety of settings. They reported that it worked well and looked great!

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PROGRESS OUTCOME 6

Farm connections: Further extending the network

Context

The school farm has been operating with an established computer network in the shearing shed (see Snapshot 8). The farm manager now wishes to expand data collection and analysis across the farm to monitor soil moisture, humidity levels and water trough levels using recently purchased Wi-Fi-enabled technologies. The redesigned network must also further improve student safety and connectivity while ensuring that students are not able to 'hack' the system.

In consultation with the farm manager and the school network manager, Callum has been given access to computer equipment no longer needed by the school.



Insight 1: Planning the outcome

This was a large job, so, in discussion with my teacher, we agreed that I would enhance the existing network to take on the Wi-Fi technologies and another student would develop the monitoring solution.

I sketched out a plan of components, hardware and software for a working network and how the devices would connect with each other. I discussed the plan with the network manager and farm manager. We identified that the network needed to recognise and communicate with a range of devices and that these would require a reliable way to connect to the network.



Insight 2: Developing the wider network

I set up wireless devices to communicate with the network and configured the IP addresses assigned by the DHCP (Dynamic Host Configuration Protocol). I then found that the network topology was inadequate for this setup because the devices could not connect with a reliable signal.

I researched my options and decided that a different network topology was required because of the farm's unique environment. I carried out a site survey and began mapping, using Google Earth™ to place mesh nodes above water and away from animal interference.



Insight 3: Refining my understanding

I realised that in order to have this large and complex network function reliably, I needed to consider the layout as a whole. I researched the OSI (Open Systems Interconnection) model and found that its goal is the interoperability of diverse communication systems with standard protocols. This model allowed me to structure my network within a seven-layer system so that others could easily track my process and setup.

I developed a schematic that showed the different parts of my project against these seven layers – that is, the physical, data link, network, transport, session, presentation, and application layers. I decided to set up a VLAN (virtual local area network) to manage this connectivity using Ethernet bridging.



Insight 4: Implementing a mesh network

Now it was time to set up the mesh network that would communicate via different sensors situated around the farm. I set the sensors up and configured their settings to ensure connectivity. One sensor would not establish a connection, so I manually assigned an IP address to it. This worked, so I reset it to 'dynamic' and restarted the server, which resolved the issue.



Insight 5: Testing the functionality

I decided to configure ICMP (Internet Control Message Protocol) on this network because it allows computers on a network to share error and status information. I wanted ICMP for network discovery and mapping and decided there was little risk of cascading ping floods, so I changed the configuration setting to allow for this.

I used a variety of tools and techniques to make sure that the network was functioning as it should. I ensured that all the IoT (Internet of things) clients were sending data to the server, and I checked aerials, power and water tightness on devices that were not sending data.

All mesh nodes were operational and communicating. I completed some simple diagnostics, including powering components off and on to make sure that the network would still function if one of the nodes went down.

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PROGRESS OUTCOME 6

Designing a flexible booking system

Context

The school catering department holds an annual fundraiser in support of local charities. The department has asked Abby's digital technology class to create a program to manage the sale of tickets and collection of revenue and to produce PDF tickets electronically. The program needs to produce a spreadsheet giving the numbers of meals required for one lunchtime and two evening sittings, customers' specific dietary requirements, and their table and seat numbers.



Insight 1: Design decisions

In planning the program, I used a flowchart and pseudocode to include all of the required functionality. As there were many variables, I decided the best solution was a program that included a GUI (graphical user interface) easy for the person taking bookings to use and that would generate the information needed by the caterers.

My aim was to make the user interface as simple and inviting as possible to ensure a smooth booking process. Inputting the data was going to be tricky to organise because it contained multiple variables and input events. I discussed my initial plans with the catering manager to check if I'd overlooked anything.



Insight 2: Writing the program

As I began writing the code, I took account of the caterer's wish to be able to reuse the program for subsequent events. This meant I needed to use a modular design to add flexibility. I had to battle early on with the reset facility because an incomplete booking could give an incorrect remaining number of seats. I corrected this after finding an error missing from the reset code that would have stopped the program from running.



Insight 3: Refining and trialling the program

As the fundraiser is for charity, I wanted the program to give the person buying the seats a couple of opportunities to confirm they were happy with their purchase. I also decided to add a countdown of remaining seats on the GUI to encourage buyers to tell their friends they were selling out. I tested the program with classmates to ensure that seats couldn't be double-booked and that it was easy to use.

In the final testing session, the catering manager noticed that the PDF tickets didn't include the seat number. I had missed this error when running my planned test cases, which showed that it's important to test a system with its end-users. I was happy that I could fix this error after the catering manager discovered it.



Insight 4: Evaluating the final outcome

Our debugging had fixed all the errors, so the final program worked efficiently.

Being able to reuse the program means other groups in the school can also use it. The school production team has asked for my help to set it up for their performances. In the next version I'll include a function to check if there are enough tickets left each time a purchase is made, and to provide feedback if there are not. To encourage ticket sales, I'll also add the ability to automatically email a link to event information on the school website to a buyer's friends when the buyer is making a booking.



PROGRESS OUTCOME **6**

Monitoring wildlife

Context

For his digital technology project, Finn has elected to design and build a system to help a local ecosanctuary monitor wildlife. The system needs a web-based interface so that staff and volunteers can remotely monitor the enclosures and a graphical function to make the best use of the data.



Insight 1: Research and end-user consultation

In order to understand the requirements and purpose of the project, I met with a range of end-users and stakeholders, including the primary manager of the site, the volunteers who help manage the wildlife, and an electronics expert who understands electronic systems in outdoor environments. I also needed to visit the site to understand the physical requirements and constraints.

From my research, I realised that my system had to be accessible for people such as the volunteers at the ecosanctuary, so it needed to have a user-friendly interface and be easy to maintain.

I could see I would need to integrate specialised knowledge from a range of digital technologies, including electronics, programming, databases, and web coding, in the development of my outcome. For example, I needed to develop a way to graph the data collected by the system. Graphing shows visible trends in data over time and would help the ecosanctuary staff to analyse the data collected.

I researched some existing graphing-interface solutions, using GitHub and YouTube, to see how they were designed. I decided to use HTML5 to create the graphs because it's up-to-date, fast, and secure. I wanted to build something based on current technology to future-proof the system as much as possible.



Insight 2: Key design decisions

I decided to use online project-management and code repositories to manage the project and version control.

When developing the hardware and software for the website's front and back ends, I considered:

- which devices and alert representations would best suit the volunteers
- how to develop a system that would suit a volunteer organisation with limited funding
- how to set up the system so that it could be maintained and developed in the future without incurring major costs.

I decided that my platform would be released as open source and that I would only use open-source software to develop the outcome. This was both an ethical and a cost-saving decision. I also decided that all of the components should have a modular structure to make it easy to add new alerts or monitoring in the future.



Insight 3: Building and testing the system

This system is for use in monitoring outdoor areas, so my solutions had to be weatherproof. I tested different casing options to find one that would be both inexpensive and watertight.

I had to work out how to transfer data from the sensors to the central system in an outdoor environment in which network wires are impractical because of the distances involved. I ran a series of tests for radio range and frequency propagation over terrain to determine the impact that weather or radio interference would have on reception.

I configured the software to trigger the alert system if a gate was triggered and had been open too long. Data was sent via Picaxe using a RADIUS (Remote Authentication Dial-In User Service) server that I also configured.

To determine if gates were open or closed, I first tried a Hall Effect Sensor. However, a pin broke off the HES I was using, which raised concerns over the delicacy of the device and how to secure it to a gate.

I decided that a more robust solution was a magnetic reed switch. I drilled the magnet and embedded it in the gate, and used the same poking-through-wood approach for the sensor. The Picaxe was protected in a plastic container attached to the side of the fence post, making it both decent looking and weather resistant.

I knew that the application needed to be user-friendly, so it was important to get the interface to work well on mobile devices to provide quick and easy access to data. After some research, I chose a system that uses two cascading style sheets (style.CSS and mobile.CSS) for the different screen sizes of computers and cellphones.

This was far easier than having two different websites and meant I could manage them both from one codebase. Also, the ability to download data makes it easier to analyse (for example, in custom programs). To allow this, I created a PHP script that automatically gets the relevant data from MySQL and puts it in a CSV file.

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