# Lesson 7 – GPS treasure hunt and encryption

|  |  |
| --- | --- |
| 40BThe big picture – why is this relevant? | 41BLearning objectives: |
| This lesson introduces the use of an LCD screen for the first time. Throughout the course learners will have been using the IoT to send data wirelessly. This lesson also looks at the importance of encryption. | * Understand why encryption should be used when sending and receiving data * Understand how different ciphers can be used to encrypt data * Understand how to connect and LCD screen * Understand how to take GPS readings and navigate using GPS |
| 42BEngagement – how can I engage learners? | 43BAssessment for learning |
| * Learners will enjoy wiring up an LCD screen on a breadboard. For the first time they will be able to develop an application which displays data on the Arduino * Learners will understand how encryption works and will enjoy challenging their fellow learners to crack their encryption codes * The kinaesthetic treasure hunt will appeal to many learners | **Expected progress:**   * Learners will understand the need for encryption * Learners will understand how the Caesar cipher works * Learners will be able to connect an LCD screen to their Arduino with support * Learners will understand how GPS coordinates can be used to find a location   **Good progress:**   * Learners will understand how encryption works * Learners will understand the Caesar cipher and will recognise the short comings of the cipher * Learners will be able to follow introductions to connect an LCD screen to the Arduino * Learners will understand how GPS coordinates are generated to find a location   **Exceptional progress:**   * Learners will be able to code the Caesar cipher using Python * Learners will be able to suggest more advanced ciphers * Learners will be able to independently connect the LCD screen to the Arduino * Learners will be able to code their own cipher using Python * Learners will be able to suggest alternatives to GPS for location services |
| 44BKey concepts: | 45BKey words: |
| * GPS coordinates can be used to find a location or record a location * An LCD screen can be used to display data on the Arduino * Data can be intercepted during transmission so it is important that it is encrypted | * LCD screen * Cipher * Encryption * Plain text * Cipher text * Security * Breadboard * GPS * Private key * Public key * Symmetric * Asymmetric |
| 46BDifferentiation: | 47BResources: |
| More able learners could explore how the different ciphers can be coded using Python. | * .ppt * Arduino MKR 1010 (or other MKR board) * Breadboard (optional) * MKR low power GPS module * LCD screen with I2C connector * GPS worksheets * Encryption worksheets |
| Lesson flow | |
| * Introduce learners to the project. They will be creating a GPS treasure hunt. Give learners 10 minutes to explore how GPS works. Discuss findings with the group. Ask learners whether there are any other options to record location data other than GPS. Are there are issues with using GPS on a mobile device? * Discuss with learners how the Arduino transmits data wirelessly. Can they identify any issues with this? Discuss how data can be intercepted during transmission. Traditionally wire-tapping methods may have been used but nowadays data can simply be intercepted during wireless transmission. Ask learners whether they can think of any ideas about how this data can be protected. Introduce the concept of encryption. Highlight the meaning of the key terms: plain text, cipher text, cipher. * Introduce learners to the simplest cipher: the Caesar cipher. Ask them to crack the cipher which is on the worksheet. More able learners may wish to code this up in Python and then use their program to crack the cipher. Learners should then create their own message which a fellow learner can crack. * Discuss how secure this cipher is. There are issues as there are only a few alternatives when implementing the cipher so it will be relatively easy to crack using a brute force method. Introduce learners to the concept of symmetric and asymmetric methods. Introduce the meaning of public key and private key encryption. * Learners should then develop their own secure cipher which a fellow learner should try to crack. At the end of the activity, stress that computers cannot generate truly random numbers. Discuss how the Vernam cipher is one of the most secure ciphers and why. * Learners should then be introduced to the hardware that they will be using for the treasure hunt. Demonstrate how the LCD and GPS module can be connected to the Arduino board. The LCD will need to be connected using I2C. Learners should use the circuit diagram to build their device. * Demonstrate the code that is required to display the current GPS coordinates on the LCD screen. Learners should then code up their devices. | |
| Making | |
| * At this stage in the lesson, learners should have developed a working GPS device. They are now going to create a treasure hunt. Learners should come up with an IoT related sentence. They should then encrypt the sentence. Each encrypted work should then be written on a separate piece of paper. Learners should then hide the words within an area on the school site. When each word is hidden, they should make a note of the GPS coordinate for where the word is hidden. Once all the words have been hidden, the learner should make a note of the coordinates where each word can be found. They should pass this ‘treasure map’ to a fellow learner. They should then follow the clues to collect the different words. Once they have collected all the words, they should the decrypt the sentence. | |