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| edx+cmyk_50mmProject Activity Log | | | | | | | |
| Learner Name | | Ashwin Ahuja | |  | Learner number | 5501 |  |
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| Centre Name | | St Paul’s School | |  | Centre Number | 14627 |  |
|  | |  | | |  | |  |
| Unit Name | | Artefact Extended Project | |  | Unit number | P304 |  |
|  | |  | | |  | |  |
| Teacher Assessor | | Dr Tomi Herceg | |  |  | |  |
|  | |  | | |  | |  |
| Proposed project title | | | User Friendly Secure Handheld Password Manager | | | |  |
| This form should be used to record the process of your project and be submitted as evidence with the final piece of work.  You may want to discuss:   * what you have done (eg, from one week to the next) * if you are working in a group, what discussions you have had * any changes that you have or will need to make to your plans * what resources you have found or hope to find * what problems you are encountering and how you are solving them * what you are going to do next | | | | | | | |
| Date | Comments | | | | | | |
| 14th September 2015 | **Activities Undertaken:** I have completed a number of SolidWorks tutorials in order to better my CAD abilities. I learnt about new tools such as Equations and am beginning to learn about Simulation. The tutorials completed were: Lofts, Surfaces, Advanced Design and Equations  I have also been researching a number of possible ideas, understanding how they might fit inside the purview of solving a problem and understanding whether the ideas were feasible to accomplish inside a term and a half. Additionally, in order to help visualise one of my ideas, and to test my SolidWorks abilities, I attempted to design a basic idea for a smart water bottle. My research also included whether other such products existed, and how they worked.  **Problems Encountered:** I realised that a couple of my ideas would be far too time-consuming and thus not a realistic goal for my project.  **Steps Taken to Overcome:** As well as discarding one idea, I began to consider the possibility of finding a smaller part of the other idea, thus making a more focussed project which could still be feasible.  **Plan for Following Week:** I hope to continue the research into my ideas and begin to choose one of them. I also hope to continue my learning on SolidWorks – especially learning to use the simulation features of the application. | | | | | | |
| 21st September 2015 | Activities Undertaken: Using the new tools offered by SolidProfessor, I began to explore the world of SolidWorks Simulation, by watching the first few videos. In addition, as part of homework, I continued to research what existed regarding my ideas, and how they worked, preparing a talk regarding them, learning from Dr Gardam’s presentation about what an effective idea would be. In addition, I attempted to continue to research the possible solutions to my problems, thinking about how I could in fact simplify my ideas, focusing on a specific part of the product, and researching and modelling that part in depth. I also completed a few more tutorials on SolidWorks, such as the animation tutorial, which would easily allow the user to see inside a complex product easily. Finally, I am also beginning to conduct some research on how to use EagleCAD, a ubiquitous software for Electronics Design (and Simulation), since my product would likely contain an element of electronics.  Problems Encountered: I faced a number of computer related issues, including a reinstallation of SolidWorks originally failing, before finally succeeding after a period of pain. Additionally, I struggled to find a good source of information for EagleCAD, which was both upto date and was comprehensive enough for me to gain a good understanding of a tool.  Steps taken to overcome: By following steps online, I was able to remedy the problem that I faced during installation. Additionally, after a period of research I found a Sparkfun tutorial online for EagleCAD which at least appeared to cover the basics effectively.  Plan for following week: Building off opinions of others in my class, and using research for the homework, I hope to reduce the number of possible ideas, finding which is the most feasible, whilst still being interesting for me, and challenging. Additionally, I hope to continue the tutorials for EagleCAD and SolidWorks. | | | | | | |
| **28th September 2015** | **Activities Undertaken**: In the theoretical taught lesson, we received a continuation to the introduction to Fluid Dynamics, and also an introduction to Mechanical Analysis, especially into the elasticity of materials – using Young’s Modulus, and how to find the statistics of different materials – using MathWeb.com. Additionally, I continued to research the existence of my problem, asking a few friends if they encountered similar ideas. I also received an introductory lesson on SolidWorks Simulation, using the SolidWorks Express package, and am currently completing a homework – which would begin to use the skills acquired. Finally, I completed the tutorial on EagleCAD and am currently experimenting, using the skills for CanSat as a preparation for the EP.  **Problems Encountered:** I was unable to access the SolidWorks Simulation tools on the student edition.  **Steps taken to overcome:** I was able to use the SolidWorks that exists on the computers in school to do my simulation homework, and experimenting with the tools.  Plan for the following week: I hope to continue the tutorials for Simulation in SolidWorks. | | | | | | |
| 5th October | **Activities Undertaken:** I had taught lessons regarding the Harvard Referencing scheme which will be used throughout the product, including practising how it could be used in Word, the tool which will inevitably be used for the project write-up, being a ubiquitous tool for word processing. Also, we received an introduction to the project proposal form, and how we should fill it. Additionally, I using my research and decision matrices decided to choose my password management problem to further develop throughout the project, thus write my project proposal form on it.  **Problems Encountered**: I spent a period of time unsure which of my few problems was the best one to continue to do for the EP.  **Steps taken to overcome:** Through some more research into the uniqueness of my solutions, and reviewing and updating my decision matrices, adding a number of more (and better) criteria, decided on the project I wanted to do.  **Plan for the following week**: Produce the Project Proposal Form for my chosen problem. | | | | | | |
| 12th October | **Activities Undertaken:** Completed my Project Proposal Form filling in all the necessary details, including why I chose the project, and my plan. After completing a first draft, I reviewed old examples, investigating the successes and failures of their PPFs (both in class, and outside), thus using them to better evaluate my own, and thus improve it. Additionally, once this was completed, I began some more research into other products in the same sector, and thus how my solution could be more effective.  **Problems Encountered**: None  **Steps taken to overcome**: N/A  **Plan for the following week:** Attempt to gain a global understanding of my problem, during a trip to Japan. | | | | | | |
| 19th October | **Activities Undertaken**: I was in Japan for an exchange, attempting to integrate into society. It also allowed me an opportunity to get first hand evidence to find out that my problem is true around the world, thus, the product could be aimed at places where English is not a first language, in fact causing a great issue where the romantic script is not necessary common (such as in Japan and China). Additionally, I was able to see some innovative technologies to attempt to solve this problem, including an attachment to a computer with a biometric sensor, which when plugged into the computer will auto-fill passwords.  **Problems Encountered**: There was the issue raised that passwords and instructions could need to be in other languages, thus maybe making use of letters that do not appear in a normal English keyboard.  **Steps taken to overcome**: Some brief thought was carried out about whether this would affect the system, and concluded, that as long as the data entry mechanism was thus made, it would not.  **Plan for the following week**: Begin research of my target market. | | | | | | |
| 26th October | Activities Undertaken: I began to look at the target market for which my product was aimed, especially the elderly, who might especially struggle to remember the large number of passwords that many have. I did this through both online research into the the numerous commentaries of the challenges of encouraging the elderly to become more accustomed to the internet, and also by asking my multiple neighbours. I found that my problem definitely existed, with many neighbours especially terming the problem as something which alienated them from using the internet. However, I quickly found that my product has a broad target market, as having mentioned my idea to wide variety of people, many mentioned their personal interest in having a solution to the problem, since they also shared it.  Problems Encountered: I struggled to identify a specific target market, an important feature of my project.  Steps taken to overcome: I concluded that though I could identify a sector of users such as the elderly as a specific concern, given their needs are more specific, the product could also be used for a far wider range of people, given my research into who suffered from the problem  Plan for the following week: I plan to continue my research into the target market, as well as beginning my research into solutions (however flawed) to the problem, that already exist. | | | | | | |
| 2nd November | Activities Undertaken: As well as continuing to ask a number of people about their experiences using a number of people (further finding more and more that the problem has a large target market), I began research into the existing solutions that people use. I found that the solutions were easy to divide into two, the low tech solutions, such as a notebook, and the high-tech, though in my opinion flawed, solutions, such as modern password manager software. Additionally, in taught lessons, I was assigned my tutor assessor, and was briefed on project planning, and instructed to produce a project plan, with Gantt and PERT charts.  Problems Encountered: Struggled to exactly identify the priorities of my research and indeed project, whether it was Mechanics, Software or Electronics, thus being unsure how to dedicate time to each in my project plan.  Steps taken to overcome: Through reviewing my own interest and complexity of each part of the project, I have producing a weighting of the project towards the software and electronics of the product, however, left myself the ability to later change the focus if I so desire.  Plan for the following week: Begin research into the history of encryption (and thus hacking – cryptography) and complete a project plan and Gantt Chart. | | | | | | |
| 9th November | Activities Undertaken: Produced a Project Plan, deciding to use Gantt Project, a free piece of software available for Mac and PC[[1]](#footnote-1). Additionally, I have begun to research the history of encryption, as I understood the necessity of building up in complexity of encryption methods, starting with simple encryption, like Caesar Ciphers, all the way to DES, a standard for encryption brought in in the advent of the 21st century. This ensured that the reader would not be thrown into the newest technologies. Additionally, it would create an interesting introduction. In order to research this, I have been looking at a number of sources, from the library, and online books, to university courses. I have found that alongside the history of encryption, it would be worthwhile to investigate the development of cryptography, effectively a form of hacking, which has led to the furthermost and betterment of encryption techniques.  Problems Encountered: I initially struggled to find effective academic sources which would rigorously show how certain encryption methods were flawed.  Steps taken to overcome: Using tools learned in previous taught lessons, I used tools Google provided to specifically isolate useful sources.  Plan for the following week: Produce a presentation for Dr Herceg of my research since the beginning of the half-term, specifically on the history of encryption. Additionally, I hope to proceed, as according to my plan to look at various other elements such as modern encryption techniques, such as the popular RSA algorithm and DES standards, especially looking at the variations that different people use. | | | | | | |
| 16th November | Activities Undertaken: I have produced a presentation for Dr Herceg about the history of encryption methods to be presented during the week, which allowed me to get much of my research out onto paper, thus ensuring that I would not later forget it. Additionally, I started my initial research on modern encryption techniques.  Problems Encountered: I encountered a query regarding the licensing that I should use with my project, as I aimed to put my project on GitHub, making use of the insight created by others attempting parts of my project, and sharing my own research with those who might be interested in the technical aspects of the project. Additionally, I got the issue that I was not sure how much detail I should go into on old encryption techniques, which though providing a basis into how the modern encryption techniques work, may not be specifically relevant to my project.  Steps taken to overcome: I have identified, that though a problem that I would need to resolve in the future, that it is not very pressing, not challenging the deadline of the project, thus hope to resolve it in the future. I have attempted to draw a balance between the detail and breadth, while spending more time on ciphers which have developed over time to create the most significant modern encryption techniques.  Plan for the following week: Continue research on modern encryption techniques, including emphasis on how they could be applied to my product, including file encryption using the Advanced Encryption Standard specifically, given that according to most sources, the encryption standard allows the system to be completely unhackable. | | | | | | |
| 23rd November | Activities Undertaken: Began to research modern ciphers, beginning with the Diffie-Helman Key Exchange and then RSA, before progressing to AES. Additionally, began to produce my preliminary research report, firstly deciding the structure of my research, separating it into discrete sections of research, so it would be understandable for a reader. Additionally, in preparation for the report, I am starting research into Biometrics and other parts of the research that I am yet to tackle.  Problems Encountered:   1. I found that my writing style promoted waffle, thus producing lots of unnecessary text, which will have no impact or purpose in the scale of my product. 2. I am also running late compared to my Gantt Chart as I was overly optimistic, especially with the time taken to understand modern encryption.   Steps taken to overcome / effect on plan:   1. I will attempt to read over my work at the end, and then remove or reword unnecessary parts to ensure all the information provided is directly relevant to the product. 2. I have adjusted my Gantt Chart to keep it up to date. Additionally, I will attempt to speed up the research, reducing the amount of time researching things which are ultimately irrelevant to how I envision my final product.   Plan for the following week: I hope to complete my research on Modern Encryption Techniques, and hope to finish my Preliminary Research Report before the deadline on the 4th December. | | | | | | |
| 30th November | Activities Undertaken: I completed research on Modern Encryption Techniques, before commencing and completing writing of the Preliminary Research Report, which summarises the majority of research completed to date.  Problems Encountered: I found that the Preliminary Research Report took much longer to write than I had envisaged, hence preventing me from completing any research into Biometrics or Hacking Techniques.  Steps taken to overcome / effect on plan: For the week, I decided to concentrate on the research report, and then complete the rest of the research after the deadline, before producing a supplementary document which would summarise the rest of my research not covered in the preliminary report. Thus, I have adjusted my plan and Gantt Chart to show this.  Plan for the following week: Complete research into Biometrics, and Hacking Techniques, before beginning research into specific possibilities for the control system, which would govern the feasibilities of various elements of the software and encryption. Additionally, I hope to begin the process of producing a design specification, which would lay out exactly what the product must accomplish. | | | | | | |
| 7th November | Activities Undertaken: Research was completed into different forms of biometric security including the specific advantages of biometric security over other forms of security such as a password. Forms which were investigated included fingerprint identification, palm recognition, voice authentication and facial recognition. In each the success rate and security of the form was assessed to ensure it would be hard to forge and then the feasibility of building it into the system was investigated. For example, what specific hardware would be required to allow the process to be used in the actual product. Finally, I concluded that Fingerprint Identification would be both one of the safest methods as well as relatively feasible to implement.  Additionally, a design was completed outlining what specific ciphers will be used and how they will be used, to ensure the product is secure where it needs to be as well as well as easy to use and produce. This was also due to the fact that there was a primary decision made on certain parts of the Control System, notably the Microcontroller to be used (one of the Raspberry Pi line – preferably the Pi Zero due to its tiny footprint). This was due to the flexibility offered by this and Linux, and given the wide range of flexibility that exists on the internet and elsewhere regarding how to effectively use the device. Additionally, Python, the language primarily used to program a Pi is a language familiar to myself and is notable for a number of useful libraries including Pycrypto, which includes the ability to encrypt using a number of ciphers, including AES.  Problems encountered: Given the time taken for completing Biometrics research and preliminary control system research I am yet to reach the period of completing a product specification. Additionally, I realised that I was yet to include that as a task on my Gantt Chart, thus had not allocated any time to it.  Steps taken to overcome / effect on plan: I added the creation of design specification on my Gantt Chart and project plan systems, ensuring that a sufficient period of time is allocated to it. In fact, I removed time from the designing stages, as I believed that this was the first and most important stage of the design.  Plan for the following week: I hope to write up my biometrics research, and start the complex process of choosing specific parts for the control system. Additionally, I want to start to define the processes the user will have to carry out to use the product, notably how the user will enter new passwords. Though I have a plan in my mind, this is largely not researched and so I am unsure whether it is the most efficient manner of solving the problem or whether there are better ways which I am yet to consider. | | | | | | |
| 14th December 2015 | Activities Undertaken:  During this week, a number of possible ways of getting passwords into the product were investigated. Firstly, one might be able to use wireless technologies such as WiFi or Bluetooth, which appeared at first to be very feasible (for both Arduino and Raspberry Pi) as well as allowing the system to possibly expand into other territories such as possibly storing the passwords on the cloud – which would ensure that were anyone to lose the product, the passwords would anyway be stored. However, this was ruled out due to the compromise on security that this would make. Adding the product to the internet would unfortunately mean that anyone around the globe would have the ability to attempt to hack the product, hence putting the product under excessive risk, for a little additional value. Another option that was investigated was the use of input devices such as a keyboard and mouse, which would be easier to use, however, would make the system very bulky were people to want to enter passwords on the go. Additionally, it would mean that the only possible MCU that could be used was the Raspberry Pi, since the Arduino does not have support for keyboards and suchlike. The final possibility would be making use of a touchscreen, which would also require a Raspberry Pi, as well as requiring a lot of additional work for the programming side of the system, with the requirement of producing a proper Graphical User Interface (GUI) to allow the user to communicate with the product seamlessly.  Additionally, a number of novel biometric systems, though the decision has already been made were researched to allow for a wider range of systems to be investigated during the report, hence producing a better evaluated judgement. This included sensory biometric systems, such as one produced by a London startup called AimBrain, which create security using the mannerisms of people. However, for my project, this provide that it would be far too complex. Additionally, the additionally value from basic research appeared to be largely too incremental, with most of the other systems also making use of fingerprint identification as the first step of authentication.  Problems encountered:   1. Possible complexity of most forms of Biometric Security systems – as well as the fact that the cutting edge part of Biometrics is very private, when contacted, AimBrain rejected the idea of providing any possible statistics of the product. This means that though the ‘normal’ forms are relatively easy to find statistics about, new innovative forms of Biometrics are very hard to find statistics about, with most companies, including AimBrain being very private about information, rejecting the possibility of giving information to me. 2. Additionally, there has been a time delay in selecting the MCU, which creates a further impact on other decisions that are required to be made. However, I am beginning to lean towards the Raspberry Pi (Zero). 3. All possible methods of inputting passwords to the device are flawed in some way.   Steps taken to overcome / effect on plan:   1. I have attempted to find some (though very inaccurate) statistics – as they are often still worth discussing as they are sometimes better for the user (less intrusive) or more secure. Additionally, there are a few forms of Biometric Security, such as simply capacitance, which since they are so poor, could be easily evaluated if necessary. 2. This is currently pushing the entire plan backwards, since I largely cannot decide anything until this is decided. Hence, I plan to complete full and complete research in the next week, deciding completely on one MCU, then allowing me to begin the design over the week. 3. The plan has been refined to allow me more time to find a better solution to the problem.   Plan for the following week:  Attempt to generate more ideas for the entering of passwords to the product, and finalise the MCU that I want to use, to allow the rest of the parts for the Control System to be chosen. | | | | | | |
| 21st December 2015 | Activities Undertaken:  During the week, I have made the final decision to make use of the Raspberry Pi as my main Microcontroller, as it ensures that I have enough power to complete all the tasks required by the product. However, I found out that I was unable to find a Raspberry Pi Zero, which would fit the footprint of the envisioned product, instead having to use the older brother, the Raspberry Pi 2. Additionally, all code would be able to be transferred from the Raspberry Pi 2 to the Raspberry Pi Zero without any alterations.  I also found and decided on another possibility for the transfer system for the passwords to be transferred to the device, which relies upon the use of QR codes. There will a number of mobile apps and a desktop app, which will produce a QR code containing the information of the name of account, username and the password to be stored. This will be read into the system using a camera, which will decode the password into the raw data. I have also chosen the camera that I will use, which is the Raspberry Pi Camera, the official module produced by the Raspberry Pi Foundation, since it will be the easiest to hook up to the Raspberry Pi, as well as being very reliable. Additionally, it will ensure that we will not need to use up the valuable single Serial port on the GPIO pins of the Pi, instead using up the Ribbon Cable on the board specifically intended for the camera. Finally, it has a more than good enough quality (5MP) to reliably find a QR code.  Following on from the decision of using a fingerprint sensor a couple of weeks ago, I managed to find the fingerprint sensor to use, the GT511C3, a module sold by Sparkfun Electronics (an American retailer). This module was chosen for a few reasons. Firstly, the production of an Arduino library by the manufacturer allows me to port it to Python. Secondly, the module is of a very high accuracy, with the manufacturers claiming the number of false positives to be around 0.001%, meaning the probability of a person other than the user being able to use the device would be very minimal. Also, there was simply a lack of available modules, with this being the smallest of the units that I could locate. However, it is important to note that the sensor is still larger than would be desired. Phone manufacturers for example produce much smaller units simply by doing it themselves and incorporating the manipulation of data that the module provides onboard on a separate processor (probably the main CPU), which would save a large amount of space.  Problems Encountered:   1. I found that the creation of a QR code posed a greater challenge than I had previously anticipated when I found the idea, and hence more investigation needed to be carried out. Additionally, I thought that if someone else were to encounter the QR code by mistake then they might easily be able to use that password, which could compromise the security of the person’s accounts in general. Hence, I decided to look at producing a basic cipher to secure this QR code. 2. I was unable to find a fingerprint sensor with an already made Python library, which meant that I would be forced to write this myself, which though not necessarily too challenging, would be very time consuming.   Steps taken to overcome / effect on plan:   1. I have added a short period of time to find a solution to this problem, however, there are a few possible third party APIs that could be used to simplify the problem, such as the Google Chart API. Meanwhile for the new cipher, some time has been allocated for this, however, this is not off pressing concern, as a cipher could be designed in a short period of time. 2. Despite there not being a specific Python library for the GT511C3, there are a few untested libraries available on GitHub, which could be built upon if necessary.   Plan for the following week:  Hopefully, given that the fingerprint sensor should arrive during next week, I would be able to complete preliminary testing on the unit. I am also hoping to have a first look at the programming aspect of the QR code reading on the Raspberry Pi. | | | | | | |
| 28th December 2015 | Activities Undertaken:  Over the week, a little preliminary testing of the fingerprint sensor occurred, so that the transmission between the fingerprint sensor and the Raspberry Pi could occur, though I failed to get anything bar the blinking of the backlight of the sensor working. Hence, now the structure of the library has been established with the functions required simply being the enrolling of a new fingerprint and the identify (1-N) of a fingerprint.  Additionally, the entire Raspberry Pi Camera and Raspberry Pi 2 system has been initialised and been made to work with the python application PiCamera and Qrtools. The system works by rapidly taking pictures, overwriting the previous image, before attempting to find and decode a QR code from the image. If this is successful, the system is stopped and the resultant decoding is printed out, while if not the loop is repeated. However, this system is highly time inefficient, given that it leaves a pause during which time the QR code cannot be found and decoded. Hence, I am beginning to attempt to complete the system making use of OpenCV, to allow the QR code to be read from a live stream. However, this system appears to take a lot of time,  Finally, I also found a primary idea for the cipher for the transfer system, which is centered around the security of a cipher being based on the idea being novel. I have devised a system which will mean that the cipher will be based around the Polyalphabetic Cipher, however, with the shifts being executed with a key, which varies, during the encryption stage. In fact, even the length of the key will change, entirely preventing the text from being cracked using frequency analysis.  Problems Encountered:   1. I found that capturing the QR code successfully was quite challenging without a screen, hence might be irritating for users of the product, since it would likely not be able to have a colour LCD screen. 2. I did not have the time to be able to solve the problem of QR code creation, given the loss of a couple of days to family events.   Steps taken to overcome / effect on plan:   1. I feel that even without the screen, it would be plausible to allow the user to manoeuvre the product (and hence the camera) around until the QR code is recognised. 2. This will be completed next week with a higher priority, more as a proof that it is not implausible.   Plan for the following week:  Find the exact mechanism (or API) to be used to create the QR code and continue the coding of the fingerprint sensor library. | | | | | | |
| 4th January 2016 | Activities Undertaken:  The Raspberry Pi Zero managed to come back into stock, and hence I was able to order and receive a Raspberry Pi Zero. Hence from here on in, I will do all the work using this as the MCU to reduce the probability of any problems during the porting from the Raspberry Pi 2 to the Pi Zero.  I found that the Google Charts API, as previously discussed was a very good manner of generating the QR code, and this could be used for the Web-App and for the Android App. However, for the iOS app, another manner would have to found of creating the QR code, though I suspect that there might be a Core Image API which might be suitable for this.  I also began to look at various input systems for the product to allow the user to move around the product, while not needing a touchscreen. The ideal system would be the volume rocker of a Stereo System which could easily be rotated as well as being pushed, hence entering various further screens. The initial thought of simply using a potentiometer and a micro switch system was quickly eradicated as a potentiometer has a very limited amount of rotation, and hence the idea of the list of items on the main screen could not be easily expanded.  Finally, I began to look at the power systems I could use for the battery. I found that I needed to have a 5V power system to power the Raspberry Pi. I researched different times of battery chemistries, including Lithium Ion, Lithium Polymer and Nickel Cadmium batteries. I chose Lithium Ion batteries largely because they provided a decent power density to volatility ratio, as well as there being a number of charging chips, which allowed for the use of ICs to recharge the battery, removing the need for the replacement of batteries often.  Finally, I began to investigate how to ensure the password file created by the main program, and encrypted using the Advanced Encryption Standard could not easily be hacked into. This relies upon the security of the key for the file, and hence it is important to work out how the key will be generated. There are a few different ideas, such as a specific key which is generic to all of the products (were it to be mass-produced). However, this is ultimately flawed, as if one file were to be broken, all the other files produced by other identical products could be broken. Hence, it would be useful if the key for the produce would be specific to each product.  Problems Encountered:  Steps taken to overcome / effect on plan:  Plan for the following week: | | | | | | |
| 11th January 2016 | Activities Undertaken:  I have now finally defined and justified my cipher system for the production (and decoding from the products side) of a QR code. I also produced a system to test the cipher, by attempting to hack the key, using a generic piece of simple code, and hence comparing it with other basic (and complex) ciphers.  I also decided to use a 9V rechargeable battery with the chip being the SMD (SOT23) MAX1555, since it appears simple to use and has a comprehensive datasheet with an example of how to use it. Additionally, the chip is highly recommended online, with a number of companies using this chip to produce their charging breakout boards, such as Sparkfun and Adafruit. Finally, I will use a Linear Voltage Regulator (probably another SMD – SOT23 packaged) to get the 5V to power the Raspberry Pi. Though using a switching voltage regulator would be more efficient, I feel that for the currents that we are dealing with, the differences would be largely minor, and hence the added difficulty would be unnecessary.  I also chose the screen that I want to use, which created a number of problems. The vast majority of screens that I could find used a Serial connection, creating an issue, since the Raspberry Pi has only one Serial port, and this must be used with the Fingerprint Sensor. Though it could be possible to hard-wire a Serial connection through one of the USB ports on the Pi Zero, this may or may not work, as well as being very fiddly. Hence, I was forced to look for I2C screens. I also chose to use Character screens, since I had no need for any graphical elements, and they were generally cheaper, and more clear for the user, an important part of the specification for the elderly. Hence, I chose a backlit 16x4 LCD display from Rapid Electronics.  I also began to start to look at the possible mechanical designs for the product, as well as defining the materials and manufacturing processes. In my preliminary research report, I had suggested that the hardness was the main issue, however, Dr Herceg informed me that I had in fact misunderstood the principles and in fact toughness was the issue, and hence I hope to complete some research into toughness, and specifically what defines the toughness of a material and do some research.  Finally, I also found a good method of getting the key for encrypting the passwords, by using the specific code for the fingerprint of the user from the device, and using this, and only allowing the product to read from the fingerprint sensor should the first checks of the user’s fingerprint pass successfully.  Problems Encountered:   1. The Raspberry Pi Zero, since it is much contracted from the Raspberry Pi 2, no longer has the Camera ribbon connector on the board, and so another camera system must be found to allow for the capturing of images in order that the QR code could be found and decoded. 2. I am concerned that a user could cut the power to the system and then manually remove the data from the Fingerprint Sensor, since the data is stored on board the fingerprint sensor in an unencrypted state, and simply requires a rudimentary understanding of electronics for a user to extract raw fingerprint data from the device. 3. I failed to find any ready-made Ashby Plots for toughness, and hence was not easily able to compare the toughness of the product vs other important factors -such as the cost and the density.   Steps taken to overcome / effect on plan:   1. Due to the lack of the ability to use the official Pi Camera board, I must resort to other possible mechanisms for getting pictures. Though a GPIO camera could be used, this would appear to have to be of a very low quality (all that is available), as well as having to use a Serial port, bringing up the same problem as I had when selecting the LCD. On the other hand, the other possibility is using a Mini Webcam, connecting the webcam straight to a USB port (through an OTG connector) to the Raspberry Pi, then use one of numerous Python libraries to control it. Though this means I have to return to the development of this, I don’t think it should take that much time, given the extensive documentation in using a webcam with a Raspberry Pi Zero. 2. There is the idea of using a Supercapacitor to power the system if the battery were to be disconnected without telling the software beforehand. Hence, the command to delete all the fingerprints could be sent despite the power having been cut. 3. I managed to find some empirical data on various websites for the strength of various polymers, from which I could create an Ashby Plot of my own.   Plan for the following week:  Redefine the camera system for capturing the QR code.  Produce Ashby plots regarding the toughness of various materials.  Test the supercapacitor to power the system. | | | | | | |
| 18th January 2016 | Activities Undertaken:  I found the exact mini webcam that I wanted to use, which was a very small HD webcam from China, which though not very well supported in terms of datasheets, but given its purpose this should not have a big impact. Additionally, I chose to use the ffmpeg Python library to control the communications between the Pi Zero and Webcam, allowing it to take a picture and find the QR code.  Additionally, after further testing, I found that despite a 0.5F 5.5V capacitor (a relatively large capacitor) I would not be able to power the Raspberry Pi for any decent period of time. Hence, I have chosen to use an ATTiny85, an Atmel chip which can have the Arduino Bootloader on it, and hence use the GT511C3 Arduino library, to be powered by the supercapacitor, as it takes a much lower current (around 10mA, at until 2.7V). This can read from the battery (using an ADC) to find out when the battery has been cut, powering itself from the capacitor and then sending the delete signal to the fingerprint sensor. The capacitor would also charge when the battery becomes powered again.  Over the week, I also created an app to encode the required data and produce a QR code for the specific serial numbered product, with a specified Name of Account, Username and Password, encrypted using my designed cipher. I designed it using Xamarin.Forms, and so with one piece of work, and minimal coding in Swift, Java and C#, I can quickly generate 3 separate apps with almost identical user interfaces. I hope to be able to test the system with the product camera system as soon as possible.  Following the previous research into the forces that would be applied onto the product, even if it were to be dropped, I increasingly found that I would have few issues with the toughness of the product, and that the likelihood of the material choice having much of an impact on how often the product were to be broken when dropped was low. However, I did find that the manufacturing method did have an impact. For example, though ABS and PLA are generally relatively tough as materials, simply due to the process of 3D printing, the toughness of the product would be vastly reduced. Finally, I also began to look at the ergonomics of the product, to ensure that the ‘handheld’ product would be comfortable to hold in one’s hand. I accomplished this in two ways, firstly by doing research into products (as suggested by Ms Douglass) which are manufactured specifically to be comfortable to hold in one hand, especially items like phones. I also began to look at and attempt to interpret empirical anthropometric data, which would allow me to specifically find the ideal dimensions of the product.  Problems Encountered:   1. A lack of knowledge in how to use Xamarin.Forms made making the apps particularly challenging.   Steps taken to overcome / effect on plan:   1. I was able to go through all the paperwork on the Xamarin website about how to get started using the application. Additionally, I was able to download the book published by the founder of Xamarin for free online, which included a sizeable portion on getting started with this system, and this offered a nice introduction to using it.   Plan for the following week  Produce a number of SolidWorks models for the product – which can be evaluated and tested.  Define the materials to be used in the product.  Test the ATTiny85 to delete all fingerprints from the GT511C3. | | | | | | |
| 25th January 2016 | Activities Undertaken:  The entire operating system has now been designed on paper, and hence simply waiting to be coded.  The manner of controlling the product was finally determined with the use of a rotary encoder with a built in push switch. This ensures there is some feedback when the user rotates the knob, while also allowing continuous rotation. Additionally, as the only possible product easily available, it also has a built in RGB LED which might allow the product to indicate the state it is in, such as whether it is locked or unlocked, removing the need for another LED on the product, hence cleaning it up a bit. Though originally, I wanted to make use of another push switch as a back button, on Dr Herceg’s recommendation, these have now been scrapped, with back being the bottom of the scrolling screen.  Problems Encountered:   1. I had a severe lack of time this week due to work for the Weizmann Physics (Safe-Cracking) Challenge, so a number of things that I could have completed this week have not occurred.   Steps taken to overcome / effect on plan:   1. I hope to catch up on this work over the next two weeks, and especially during half-term, where I hope to write up justifications for much of the definitions that I have completed during this term. | | | | | | |
| 1st February 2016 | Activities Undertaken:  The Fingerprint Sensor Library has now been completed and is completing all the required actions successfully, though there are a few stylistic changes to be made to ensure the program is as efficient as possible.  Additionally, I was finally able to test the use of the Supercapacitor to power the ATTiny85, and this appeared to be largely successful, however, I found having to program the ATTiny using another Arduino to be quite irritating, and this made me consider the possibility of implementing an FTDI chip to program the chip, however, I have felt that this complexity (they require quite a lot of accompanying circuitry) is not worth it, especially the simplicity of the program of the ATTiny, hence not requiring too many iterations.  Problems Encountered:   1. Due to the Weizmann Safe Cracking Challenge, I had very little time to work on my EP, meaning I am behind my plan, though I still hope to meet my deadline of defining all the components, mechanics and how the software will work by half-term. 2. Additionally, I am very far behind on the Mechanics front, though I have produced 3 separate SolidWorks Designs, I am yet to do any stress testing on SolidWorks Simulation, or indeed using physical models. Finally, I am yet to even define the material to be used.   Steps taken to overcome / effect on plan:   1. I have allocated more time during half-term to catch-up on this work, and ensure that even if I miss the deadline I am very close to it. 2. I have adjusted the Gantt Chart to reflect this, and to leave some time for me to do it during half-term.   Plan for following week:  Get rotary encoder and LCD working, and start to bring all systems together to produce one breadboard prototype of the final product. Define the material and manufacturing process to be used. | | | | | | |
| 9th February 2016 |  | | | | | | |

1. Ganttproject.biz,. 'Ganttproject: Free Desktop Project Management App'. N.p., 2015. Web. 19 Nov. 2015. [↑](#footnote-ref-1)