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SCREW THIS.

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ME2 CORDLESS HANDTOOL PROJECT

EXECUTIVE SUMMARY

The original brief was to design a cordless hand tool for the DIY or household market. The design needed to include a rechargeable battery to power a high speed, low torque motor with the aid of a transmission. Several initial designs were considered, which are presented at the end of this report.

The chosen design took the form of an automatic corkscrew, with target markets of the bar industry, young professionals and those of the older generation with arthritis. It features a sleek, ergonomic design that stands freely on a fashionable charging base made of European Walnut Wood that will really stand out in any bar or kitchen environment.

Engineering analysis has been performed on all components, with the general calculations behind the motor and battery selection presented, followed by two dynamically loaded components; the internal spring to control the depth of penetration into the cork and the planetary gearbox that makes up the transmission. Evidence is clearly presented that the components have been sufficiently designed against failure.

The high quality materials used mean that this will result in a long lasting, excellent value for money product. Research was conducted into existing hand powered corkscrews, to find the best mechanical design to create into an automated product.

This has resulted in a product with an extremely long life for occasional use, and a life of almost a decade for frequent use. The uncertainties for the project have been estimated, and it is clear that any risks have been mitigated. Finally, the estimated profit margin for the first year is an attractive €1 million.

CONTENTS

REFERENCES

[1] Boardman, B. (1990) 'Fatigue Resistance of Steels', ASM Handbook: Properties and Selection: Irons, Steels, and High-Performance Alloys, 1(1), pp. 674 [Online].Accessed: 18/03/17).

[2] The Wine Institute. 2010. PER CAPITA WINE CONSUMPTION BY COUNTRY. [ONLINE]. [Accessed 23 March 2017].

[3] Arthritis Research UK. 2013. Osteoarthritis. [ONLINE]. [Accessed 23 March 2017].

INITIAL RESEARCH AND CONCEPTS

Initial research was conducted in the form of an IBIS Chart (see Figure 1 below.) This allowed key design requirements to be realised in the early design phases of the project. It was clear that the product would be used in either a kitchen or a bar setting, possibly in front of guests or customers so the overall aesthetic would be extremely important. An area the target market could be expanded to include would also be the elderly or those with arthritis, so ergonomics were considered to ensure the product was not too heavy and was comfortable to grip.
Desirable features were considered, such as including LEDs in the casing to shine on the wine bottle whilst the cork was turning. This could also possibly help the elderly if they were hard of hearing to see that the product was working.
Being able to remove the cork from the corkscrew was highlighted as an important feature as having to manually twist off the cork from the screw would defeat the purpose of having an electric wine opener in the first place. Therefore having a motor that could have the direction of rotation reversed was vital.

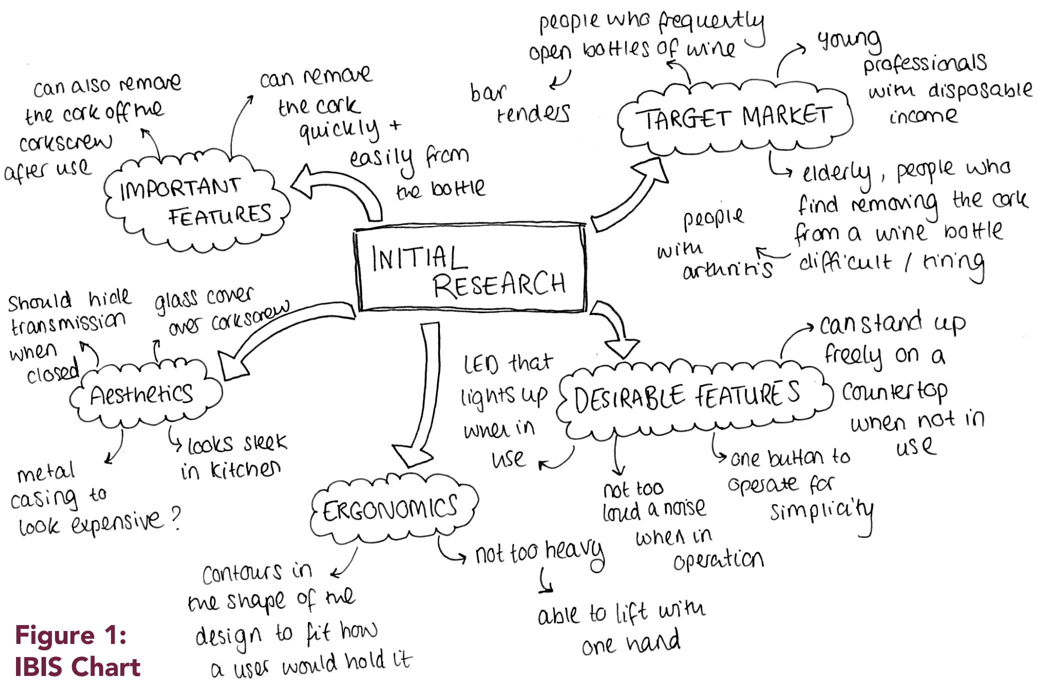


Figure 1: IBIS Chart

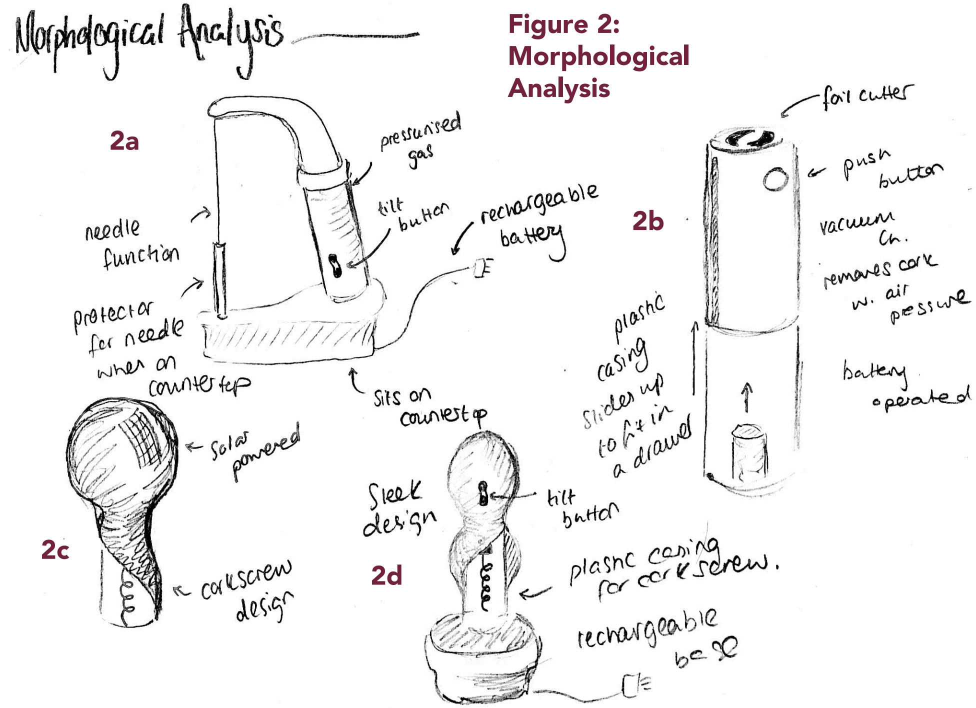


Figure 2: Morphological Analysis

Morphological analysis was performed, and so a number of different ideas for wine openers were generated, the results of which can be seen in Figure 2. Idea 2a is one of the more eccentric ideas, as it does not remove the cork from the bottle. Instead it removes the wine through the needle whilst pumping an inert gas into the bottle, preventing the wine from oxidizing. This would suit people only wishing to have one glass, whilst keeping their wine for more than a week. However it was realised that this would not suit the task brief of creating a product to retail at a maximum of €75.

Different methods of powering the product were also considered, as shown in 2c- solar panels were an attractive solution however that method was rejected on account that the product would be stored in peoples kitchens where the amount of sunlight incident on the surface of the solar panels could not be guaranteed.

EXISTING PRODUCT RESEARCH

Existing products were tested and analysed to help decide what style of mechanism to create. They were ranked out of ten in different categories including how aesthetically pleasing they were, how easy it was to remove a cork from a wine bottle (based on how much effort was felt physically from the user), how complicated it was to use the tool (based on how difficult it was to understand how to use the tool) and what other functions the tool could perform (extras). A focus group of 5 people across the target markets were chosen and the average scores recorded are presented here.

The design with the red casing came out on top in most areas except for the extra functions. So it was decided that its method of cork removal would make an excellent concept to turn into an electric product, as the transmission would only have to turn the cork clockwise and anticlockwise, rather than having to move up and down as well. Helping to reduce manufacture costs and failure modes.

Figure 3: Corkscrew 1

Aesthetic: 8
Ease of use: 4
Complication of use: 8
Extras: 5

Comments:
Upon moving the 'arms' down the cork was not fully removed. The extra component is the bottle cap opener which is nice, however if the focus of the tool is wine this is slightly unnecessary.

Figure 4: Corkscrew 2

Aesthetic: 8
Ease of use: 9
Complication of use: 0
Extras: 0

Comments:
Extremely easy to use as the user only needs to turn the corkscrew in one direction for both piercing the cork and removing it. No extras however.

Figure 5: Corkscrew 3

Aesthetic: 8
Ease of use: 6
Complication of use: 4
Extras: 5

Comments:
Required the most physical exertion to remove the cork, however the design is simple to understand and it comes with a handy foil cutter.

Figure 6: Corkscrew 2 in use

As far as the extra functions were concerned, this product was aimed at wine drinkers so adding a bottle cap opener was deemed unnecessary and would also detract from the focus of the product. However a foil cutter was considered, though making one integrated as part of the design was rejected as it would interrupt the curvature of the casing and the main target market groups were likely to already own one.

PRODUCT DESIGN SPECIFICATION

From the research detailed in pages 3 and 4 a Product Design Specification was created and is shown below as Table 1.

Category	Details	Target
Casing	Lightweight and compact	<1kg, 25cm in length and 10cm diameter.
	Attractive design	Clear packaging around corkscrew so user can see the cork being pulled out.
Transmission	Adhere to brief limitations	High speed, low torque motor.
	Maintain a suitable efficiency.	Efficiency >80%
Functional head	Corkscrew should be able to withstand the force of pulling out the cork.	Withstand more than 450N.
	Should not fail within an acceptable yield time frame.	Fatigue safety factor >2 for at least 5 years of use.
Quality	Low noise	<60dBA (normal conversation level)
	Appropriate life value of battery.	Able to open 50 bottles of wine before recharge.
User Interface	Easy to charge	Rechargeable base, easily identifiable charging system.
	Easy to use	A smart, simple method of operating the turning direction of the corkscrew.
	Ergonomics	Overall shape of device should include contours placed where a hand would hold the device.
	Storage	Corkscrew can stand up freely on a countertop, or in a cupboard.
Safety	Transmission protection	Transmission inaccessible to user.
	Water protection.	Enclose all electrical components.
	Shatterproof	All shatterproof materials so that when dropped the component doesn’t shatter on the floor causing a hazard.
Aesthetics	Materials should be of a good quality.	Metal or soft plastic casing
	See through section for corkscrew	Casing around corkscrew area to be clear plastic or glass.
	LEDs	Light to shine onto the cork when the corkscrew is turning.

Table 1: PDS

FINAL DESIGN

Figure 8 is an isometric view of the final design sitting on its charging base. Due to the low self-discharge rate of lithium-ion batteries the charging base need not be plugged into the mains or switched on very often, but it does make an attractive stand for the corkscrew to be able to stand upright. The casing halves are shown in figure 9, because aluminium is more rigid than plastic, there is no need for structural ribbing which would be seen in an injection moulded plastic casing. The only ribs featured are there to constrain components.

PDS: Good quality materials
Casing is made from die cast aluminium and the charging dock is made from European Walnut Wood and aluminium (as shown in figure 7) to ensure longevity of the product and an attractive overall aesthetic.

Figure 7: Charging Dock

PDS: Safety
All electrical components are enclosed. The corkscrew itself is too blunt to cause cuts on the skin, but is also fixed into the transmission and cannot be removed. The transmission is also inaccessible to the user.

PDS: Ergonomic
Overall shape of the device includes contours where a hand would hold the device.

PDS: See through section
A transparent plastic casing insert around the corkscrew allows the user to be able to see the cork being pulled out of the wine bottle

PDS: Easy to charge
A clearly identifiable and attractive charging base is included in the design. This also ensures another PDS requirement is fulfilled- that the hand tool stands freely upright on a countertop. It features a USB-C charger (figure 7) which is optimal because it is much smaller than a traditional USB charger, taking up a lot less space in the casing.

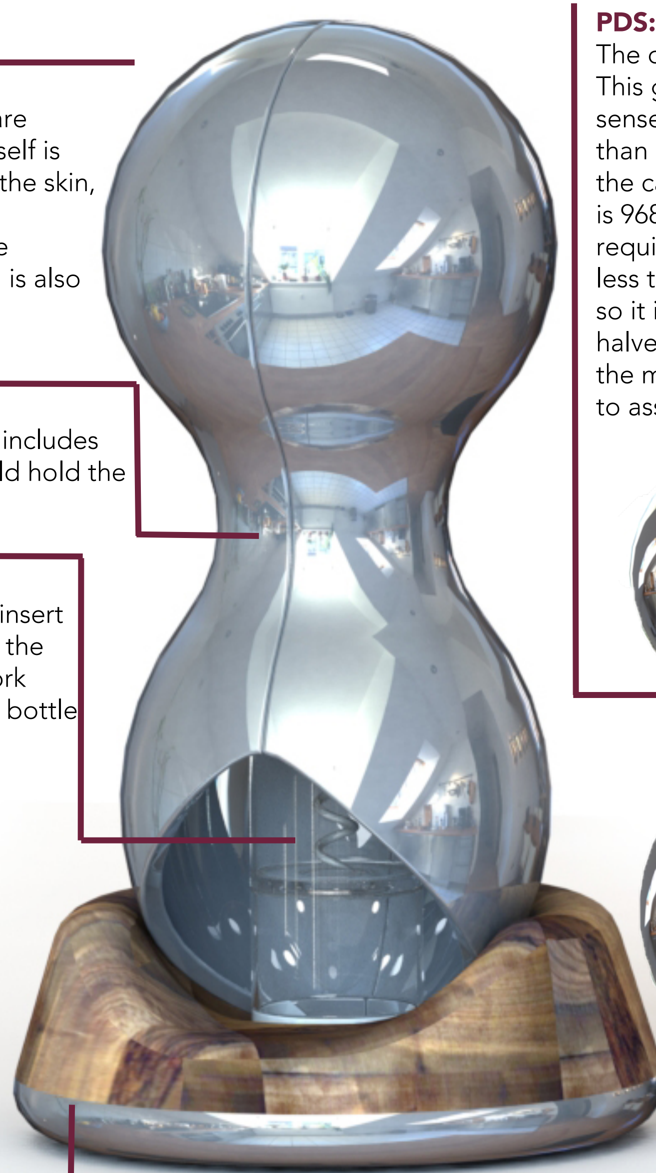


Figure 8: Corkscrew on charging dock

PDS: Casing
The casing is made from die cast aluminium. This gives the overall feel of the product a sense of higher quality. The casing is no more than a few mm thick, reducing the weight of the casing so that the overall product weight is 968g, which meets another PDS requirement that the product should weigh less than 1kg. Aluminium has a high elasticity so it is acceptable to hold the two casing halves together using a snap fit. This reduces the manufacture time as snap fits are quicker to assemble than screws or welded joints.

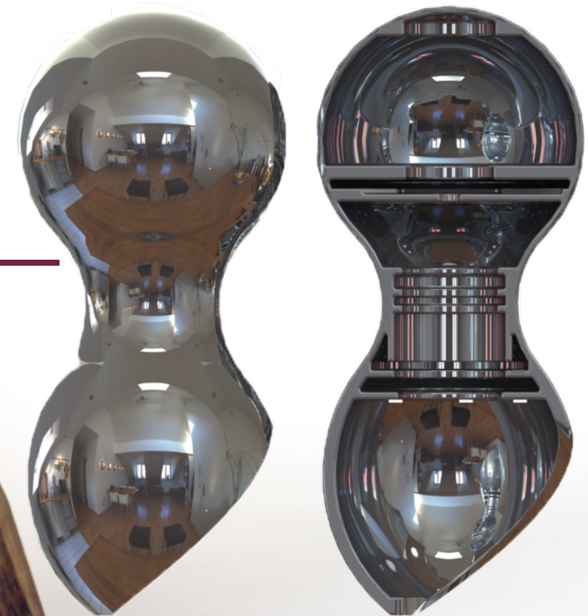


Figure 9: Casing halves

FINAL DESIGN

Figure 11 is a view of the final design with one half of the casing removed so that the internal components can be viewed. All components are stacked vertically so that the centre of mass of the product remains in the middle and the product stands upright on a countertop when in the charging base.

PDS: Motor
High speed low torque motor to adhere to original brief.
Nidec Brushed DC Motor, 7.2 W, 12 V dc, 4700 rpm.

Journal Bearing
Constrains the motor shaft and ensures the batteries are held in place.

PDS: Aesthetics
The design features 6 LEDs that shine when the corkscrew is turning which helps to alert the user when the tool is turned on. As shown in figure 10.

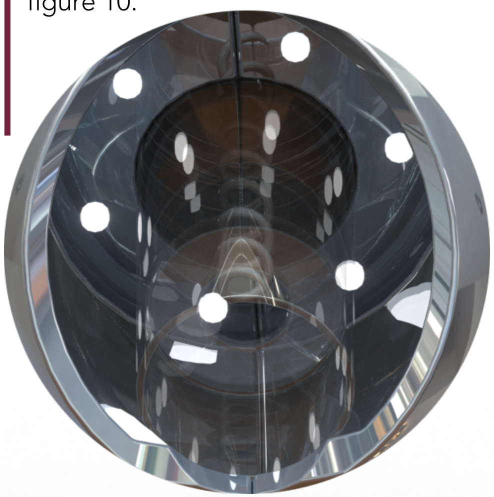


Figure 10: Underside view showing LEDs

Spring
Controls the depth of penetration into the cork. When the spring is fully compressed, the corkscrew will not go any further down, but will continue to rotate- pulling out the cork from the bottle.

Plastic Casing Insert
The ledge a third of the way up the insert sits on top of the wine bottle, when the user presses the corkscrew down on the wine bottle the insert compresses the spring.

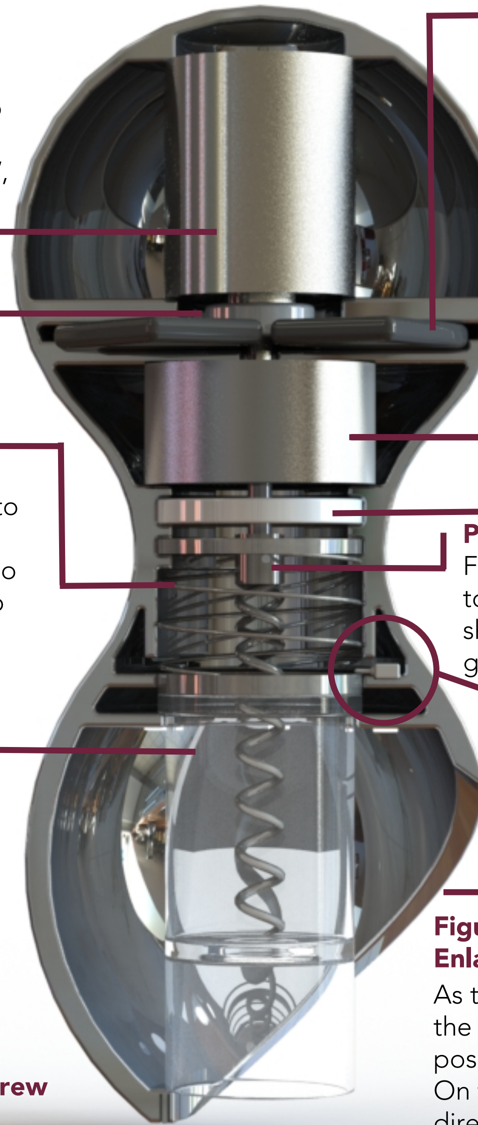


Figure 11: Section view of corkscrew

PDS: Quality
3 batteries stacked in series to minimize the space taken up.
Batteries ensure corkscrew can open more than 50 bottles of wine before needing a recharge.

PDS: Transmission Efficiency > 80%
3 stage planetary gearbox reduces motor speed and increases torque to the required values. Each stage has a 3% efficiency loss, resulting in a transmission efficiency of 91%.

Journal Bearing
Constrains the corkscrew shaft radially.

Pin
Fixes the corkscrew shaft to the gearbox output shaft (on the 3rd stage gear connector)

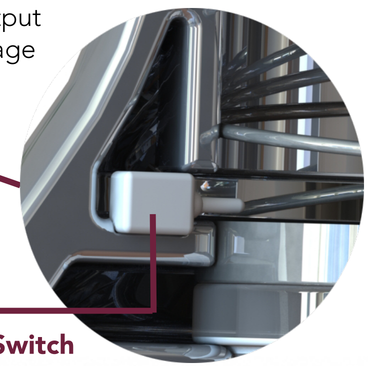


Figure 12: Internal Switch Enlarged View

As the casing insert moves upwards causing the spring to compress, the switch flicks into position causing the motor to turn clockwise. On the down stroke the switch reverses the direction of the motor removing the cork from the screw.

ENGINEERING ANALYSIS

In order to calculate the torque (T) required to remove the cork from the bottle the corkscrew was modelled as a helical V-threaded screw. This was done using Equation 1 shown below, where W is the vertical extraction force required to remove the cork. This is a standardized value that does not exceed 450N (as detailed in ISO 9727-5).

μ_s is the static coefficient of friction between cork and glass which is about 0.4.

$$T = \left(\frac{tan\phi + \mu_s sec\beta}{1 - \mu_s sec\beta tan\phi}\right) \times \frac{W d_m}{2}$$

Equation 1: Torque required to remove the cork.

Since one rotation of the corkscrew corresponds to an axial displacement equal to the pitch of the corkscrew, t, we have equation 2, where d_m is the mean diameter of the corkscrew and ϕ is the slope of the thread, otherwise known as the helix angle. This is required to complete equation 1.

$$tan\phi = \frac{t}{\pi d_m}$$

Equation 2: Helix Angle

β is defined as the semi angle of the thread as shown in Figure 13. 15° is appropriate in this case.

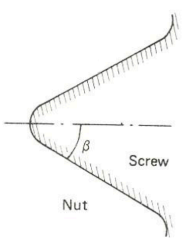


Figure 13: Semi-angle diagram

$$tan\phi = \frac{0.01}{\pi \times 0.008} = 0.398$$

Equation 3: Helix Angle calculation

$$T = \left(\frac{0.398 + 0.4 \times \sec(15)}{1 - 0.4 \times \sec(15) \times 0.398}\right) \times \frac{450 \times 0.008}{2} = 1.75Nm$$

Equation 4: Torque calculation

As you can see in equations 3 and 4, the torque required to remove the cork from the bottle is 1.75Nm, as the brief requires a low cost, high speed, low torque motor a large reduction is required.

To calculate the power required, experiments were performed to record the time taken to remove a cork from a bottle. Corkscrew 2 (Figure 4) was used as that was the model for the electronic hand tool with an average time of 5 seconds recorded. Along with equation 5, the required power (P) was calculated, with L as the length of the cork (49mm, the maximum standard cork length- ISO 9727-5).

$$P = \frac{W \times L}{time} = \frac{450 \times 0.049}{5} = 4.41W$$

Equation 5: Power required

The power and torque values were then used in the calculations for the transmission found on page 9.

A motor was selected to have minimal output speed whilst still within the brief specifications. A simple, low cost brushed 12V DC motor with a speed of 4700rpm and an output torque of 14.7nNm was chosen. In order to bring the torque up to 1.75Nm as required from equation 4, a step down ratio of 1:216 was required. As shown in figure 13, the motor shaft is a D-shaft which is optimal for press fitting to the first gear in the transmission.

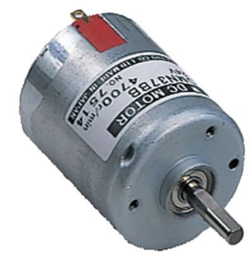


Figure 13: Motor that meets the specifications

Figure 14: Selected battery

To power the motor, lithium-ion batteries were selected because they are rechargeable, their rate of self-discharge is lower than other types of batteries and they are relatively environmentally friendly. However 12V lithium-ion batteries were too large to fit in with the rest of the design, so 3, 3.7V Li-ion batteries were chosen (as shown in figure 14). They were placed in series around the motor to generate 11.1V- within the acceptable operating limits of the motor.

This enabled the batteries to be placed in a circle, equidistant around the motor shaft which would not affect the corkscrew's centre of mass, and the batteries were extremely light weight anyway, at less than 13g each, so did not add much to the total weight of the design.

ENGINEERING ANALYSIS

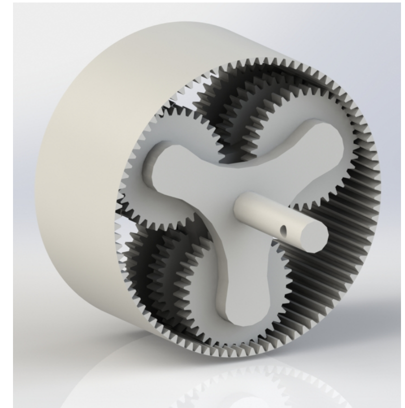


Figure 15: Planetary gearbox

To achieve the 1:216 step down ratio, 3 step downs of 1:6 were used in an epicyclic gear train. Each gear has a module of 0.5 and a face width of 3mm, these ensure the gearbox takes up minimal space in the design. Each stage contains one sun gear (18 teeth, 9mm diameter) and three planetary gears (36 teeth, 18mm diameter). As the ring gear is the stationary component in the planetary gearbox, one ring gear was selected to house all three stages, with 90 teeth, a diameter of 45mm and face width of 24mm which fitted over the stages and all the the gear connectors.
The most probable cause of failure would be tooth breakage at the root of the teeth due to bending stresses from the transmitted load. To calculate the stresses on each gear the speed first had to be calculated. Each sun gear speed was simply the output speed of the motor (or previous stage) divided by the step down ratio (6). The planetary speeds were calculated using equation 6, where N = number of teeth, n = speed and x refers to which stage the gear is in.

$$n_{planetx} = -\left(\frac{N_{sunx}}{N_{planetx}}\right)\times\left(n_{sunx} - n_{outputx}\right) + n_{outputx}$$

Equation 6: Planetary gear speeds

When the teeth mesh together a load is delivered to the teeth with a certain degree of impact, the velocity factor (K_v) is used to account for this and is given by the Barth Equation (equation 6) where V is the pitch line velocity (calculated using equation 7), (where d is the diameter of the gear). The transmitted load (W_t) is then given by equation 9. The bending stress for each gear can then be calculated using the Lewis equation (equation 10).

$$K_v = \frac{6.1}{6.1 + V}$$

Equation 7: Velocity Factor

$$V = \frac{dn}{2}\times\frac{2\pi}{60}$$

Equation 8: Pitch line velocity

$$W_t = \frac{P}{V}$$

Equation 9: Transmitted load

$$\sigma = \frac{W_t}{K_v F m Y}$$

Equation 10: Lewis Equation

Gear	Speed (rpm)	Diameter (mm)	Pitch line velocity	Transmitted Load	Kv	Stress (Pa)
Sun1	4700.00	9.00	2.21	1.99	0.73	6169.70
Sun2	783.30	9.00	0.37	11.95	0.94	28802.22
Sun3	130.00	9.00	0.06	71.99	0.99	165285.59
Planets1	1175.00	18.00	1.11	3.98	0.85	8425.71
Planets2	195.83	18.00	0.18	23.89	0.97	44081.97
Planets3	32.63	18.00	0.03	143.40	0.99	258084.40

Table 2: Gear Calculations

Where σ is the bending stress, F is the face width, m is the module and Y is the Lewis Form Factor (sun gears-0.29327, planetary gears-0.37229). As you can see in Table 2, the highest stresses are found on the third stage planetary gears which is to be expected as that is where the torque is highest. The safety factor was inputted this stress for material selection as shown in equation 11. A high safety factor was chosen because the gears are critical components to the product and the user will not be able to replace them easily.

$$\sigma_{max} = 258084\times 5 = 1.29MPa$$

Equation 11: Maximum allowable stress

This is a small maximum allowable stress. Making the gearbox smaller was considered, however it already fitted well inside the casing in proportion to the rest of the internal components and the weight increase was very small. The most inexpensive, lightest gears found were used, which are made of Derlin (polyoxymethylene) with a maximum bending stress of 97MPa, therefore failure due to tooth bending stresses is unlikely to occur.
Derlin will also make a quieter transmission than steel, helping meet the PDS requirement of low noise.

The second dynamically loaded component to analyse is the spring that controls the depth of penetration into the cork. The most probable failure mode for the spring would be due to buckling or fatigue. The maximum shear stress would occur at the inner fibre of the wire's cross section and is given by equation 12. Where D is the diameter of the coil, d is the diameter of the wire of the spring, A is the cross sectional area of the wire, F is the vertical force, T is the torque and J is the polar second moment of area of the wire ($= \frac{\pi d^4}{32}$ for a solid circular cylinder). The selected safety factor is 2, which is acceptable- as the spring is an easily replaceable component for the user, and as shown at the end of the section, the life of the spring is very long already.

$$\tau_{max} = \left(\frac{Td}{2J} + \frac{F}{A}\right) \times S.F = \left(\frac{8FD}{\pi d^3} + \frac{4F}{\pi d^2}\right) \times S.F$$
$$= \left(\frac{8 \times 450 \times 0.04}{\pi \times 0.005^3} + \frac{4 \times 450}{\pi \times 0.005^2}\right) \times 2 = 780MPa$$

Equation 12: Maximum shear stress

An important calculation to help determine whether the spring will buckle is the spring index, C shown in equation 13.

$$C = \frac{D}{d} = \frac{40mm}{5mm} = 8$$

Equation 13: Spring Index

Spring index values should be between 4-12, below 4 they are difficult to manufacture and above 12 they are extremely likely to buckle. As the spring index here is 8, it is well within acceptable limits. However to account for the possibility of buckling, the spring has been placed inside a cylindrical slot within the casing. The sides of which have been lubricated to remove any effects of friction on the force that can be delivered by the spring end.

To determine the fatigue life of the spring, the material needs to be selected. To do this we shall calculate the required modulus of rigidity, G using equation 14. N_a is the number of active coils. We are using a spring with 4 coils, however it is a squared-ground ended spring so the number of active coils is 2 (as the top and bottom coils are inactive). δ is the deflection of the spring, the amount we want it to penetrate into the cork which is about 30 mm.

$$G_{req} = \frac{8FC^3N_a}{\delta d} \times S.F = \frac{8 \times 450 \times 8^3 \times 2}{0.03 \times 0.005} \times 2 = 50GPa$$

Equation 14: Required Modulus of rigidity

Mild steel has a modulus of rigidity of 79.6 GPa. Figure 16 shows the maximum stress against the fatigue life for steel at a number of different stress ratios. The stress ratio, R is the algebraic ratio of two specified stress values in a stress cycle. Because the spring stresses are fully reversed the stress ratio is -1, the lowest curve on the graph. As calculated in equation 12, the maximum shear stress is 780 MPa. On the curve for R=-1, a maximum stress of 780MPa would give a fatigue life of over 10^5 cycles.

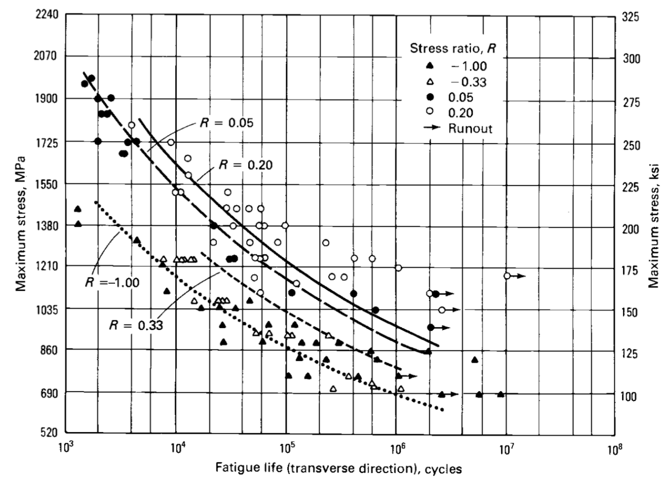


Figure 16: Fatigue life graph for steel. [1]

To determine whether or not this would be acceptable we shall look into two potential target markets illustrated in the IBIS chart (figure 1): the young professionals with disposable income (opening an estimated 5 bottles of wine per week) and the bar tenders (opening an estimated 30 bottles of wine a day).

Equation 15 illustrates the lifetime of the spring for the young professional and equation 16 shows the lifetime of the spring for the bar tender. As you can see, the spring has what could be considered a practically infinite life for the young professional, and an acceptable life for the bar tender. Making mild steel a good choice of material, and ensuring the gears won't fail due to fatigue.

$$Life = \frac{10^5}{52 \times 5} = 385\ years$$

Equation 15: Spring life (young professional)

$$Life = \frac{10^5}{365 \times 30} = 9\ years$$

Equation 16: Spring life (bar tender)

COSTING

A table containing the cost of each component and the total product cost can be found below in table 3. Initial set up costs (such as the costs of moulds) have been included per part, and so the cost per unit should drop in year two of sales.

Part	Material	Method of Manufacture	Cost (€)
Casing	Aluminium Alloy	Die Cast	2 @ 8.76
Motor	Nidec Brushed DC Motor (multiple materials)	Purchase	2.06
Batteries	Polymer Lithium Ion Battery	Purchase	3 @ 0.57
Journal Bearing 1	Derlin	Extruded	0.23
Journal Bearing 2	Derlin	Extruded	0.34
3 sun gears	Derlin	Extruded	3 @ 0.17
9 planetary gears	Derlin	Extruded	9 @ 0.15
Ring gear	Derlin	Purchase	0.16
2 gearbox connectors	Derlin	Injection Moulded	2 @ 3.12
3rd stage connector	Derlin	Injection Moulded	3.15
Pin	Derlin	Extruded	0.04
Corkscrew	Steel	Purchase	0.68
Spring	Steel	CNC Coiled	0.05
Casing insert	ABS	Injection Moulded	3.18
Switch + USB-C	Multiple materials	Purchase	0.2
Charging Base	European Walnut Wood	CNC Milled	3.46
		Sub total	**40.88**
		Total including labour/assembly costs	**44.968**

Table 3: Cost Analysis

With a recommended retail price of €70, and a price to sellers of €55. Once the original batch of 100000 units is sold the expected profit margin is approximately €1 million.

UNCERTAINTIES BEHIND PRODUCT IDEA

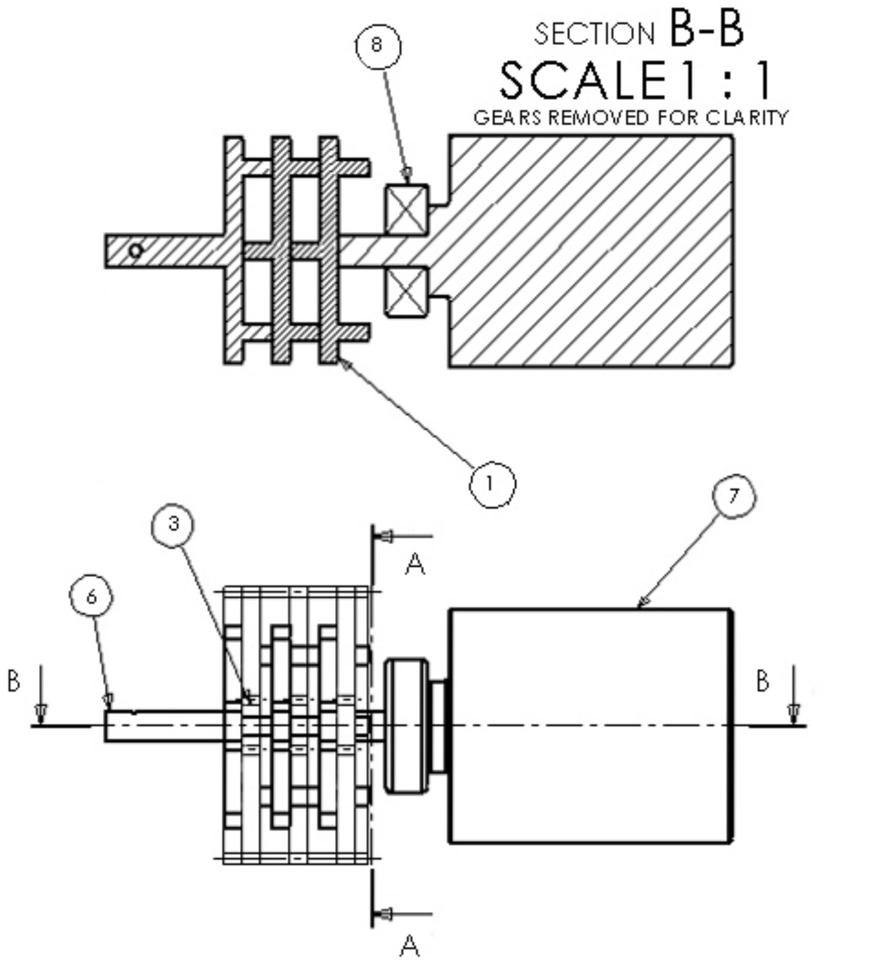
There will always be a number of risks associated with any new product. In the case of production uncertainties, if more than 100000 are required this will not be a huge issue due to the purchasing of many components and the fact that the majority of the manufactured components are injection moulded which has a short manufacture time. However due to the relatively niche market this is not a huge likelihood.

As far as overproduction is concerned, whilst it's true that wine drinking is facing a slight decline, countries such as Britain and Germany have had increases of 2.4% and 1.1% respectively [2], and over half of the worlds wine consumption is done in Europe [2]. Also over 1.3 million people in the UK alone have arthritis in the wrist[3]. It is therefore reasonable to assume the production batch will be sold. In the unlikely event of this happening, the profit margins are such that there is some room for the product's price to be reduced, enticing more consumers.

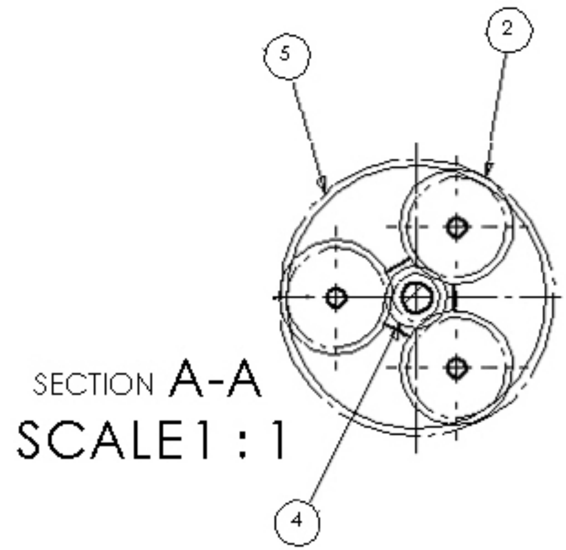
Uncertainties due to Brexit are relatively low, as even with the UK's increased wine consumption, countries such as Italy and France still drink far more in comparison. The top 5 world countries that consume the most per capita list is dominated by European countries, with the number one being the Vatican City State [2], which although is not part of the EU has trade deals that mean it's exempt from duties and taxes. The Vatican would also be an ideal market as over 60% of the population is over the age of 60, meaning they are more likely to suffer from arthritis in the wrist, falling into another target market group illustrated in figure 1. To protect against uncertain tax increases it is worth forming hedging and future contracts, if Brexit were to cause issues however, the US could be a potential target market as they consume 13% of the worlds wine. [2]

With certain additions to the design of the product, the target market could be expanded to include blind people. The distinct shape and feel of the object would make it unmistakeable in a blind person's home, and adding sounds to the product to tell the user when the cork was fully removed would make the product available to those with sight loss. It is clear that Screw This is a quality innovative product, with a long life and expanding target markets to ensure large future profits.

SUB ASSEMBLY DRAWING



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	ST0001	PLANETARY GEAR CONNECTOR (1ST AND 2ND STAGES)	2
2	ST0002	PLANETARY GEAR, 0.5M, 36T, 20PA, 3FW, BORE DIAMETER 3	9
3	ST0003	SUN GEAR, 0.5M, 18T, 20PA, 3FW, BORE DIAMETER 3	2
4	ST0004	SUN GEAR, 0.5M, 18T, 20PA, 3FW, BORE DIAMETER 5	1
5	ST0005	RING GEAR, 0.5M, 90T, 24FW	1
6	ST0006	PLANETARY GEAR CONNECTOR (3RD STAGE)	1
7	ST0007	BRUSHED DC MOTOR, 12V, 4700RPM	1
8	ST0008	JOURNAL BEARING, OUTER DIAMETER 22MM, BORE DIAMETER 5MM	1



TOLERANCES
X ± 0.5
X.X ± 0.1
X.XX ± 0.02
ANGULAR ±1°
SURFACE FINISH MACHINED FACES Ra 6.3

THIRD ANGLE PROJECTION

	NAME	DATE
DRAWN	FIONA BOYCE	13/03/17
CHECKED	MAX MARLOW	24/03/17
APPROVED		

MATERIAL: N/A

ALL DIMENSIONS ARE IN MILLIMETRES

DO NOT SCALE DRAWING

A4 SCALE 1:2

TITLE: TRANSMISSION SUB ASSEMBLY DRAWING

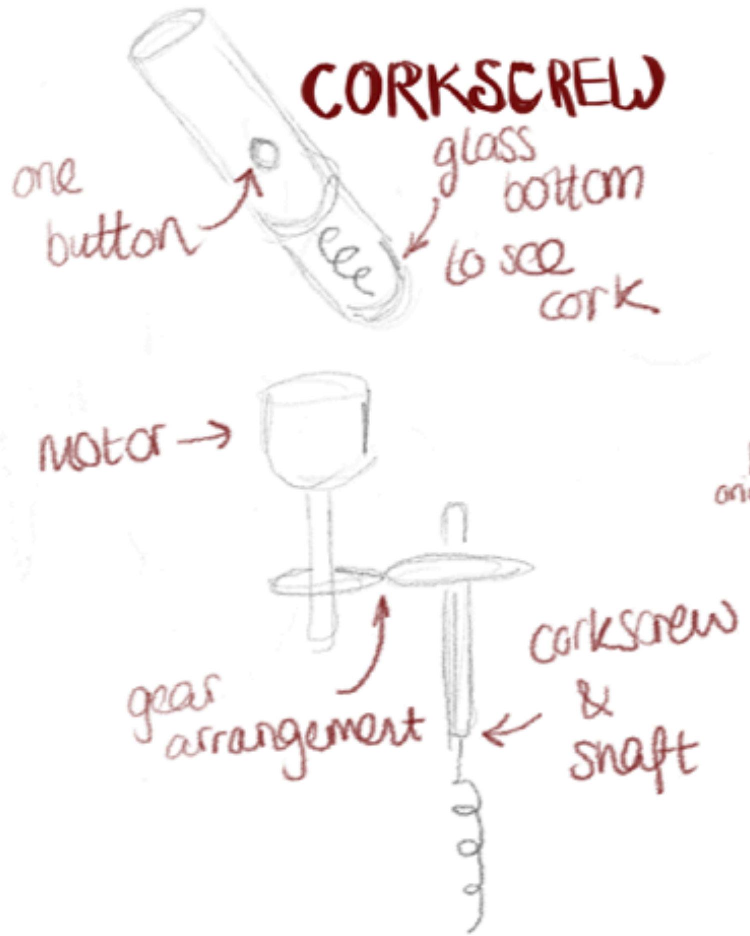
DWG No. DWG0001

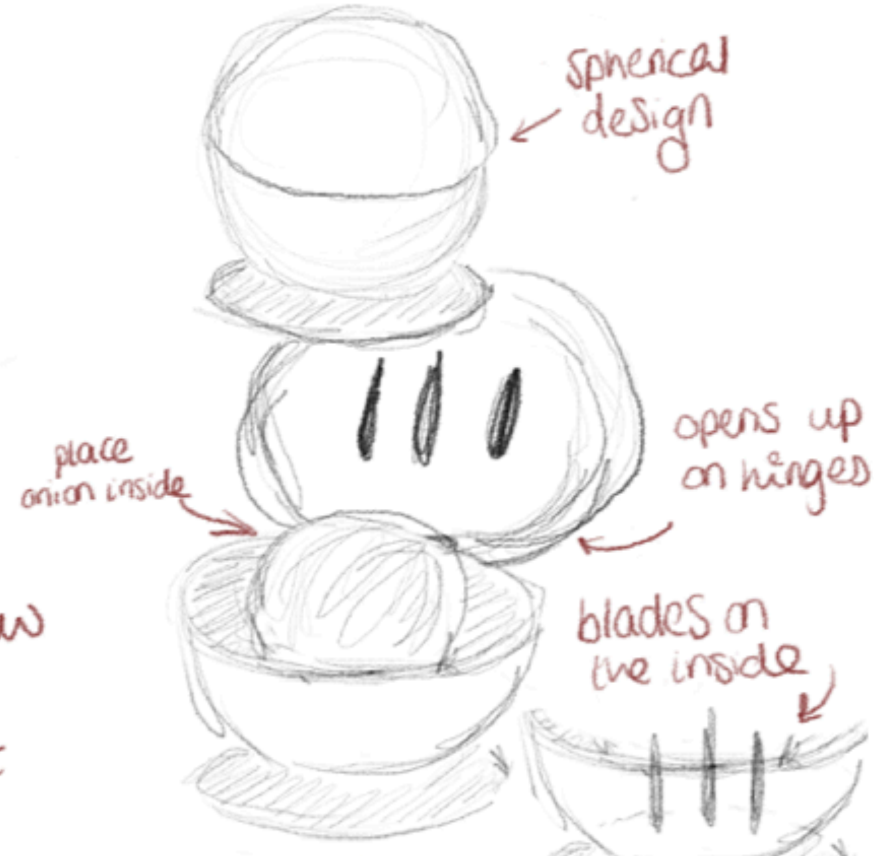
Imperial College London
Department of Mechanical Engineering

SHEET 1 OF 1 REVISION 1

INITIAL IDEAS

CORKSCREW





ONION CHOPPER

TOAST CHAINSAW

Heating element?

* chainsaw provides novelty element

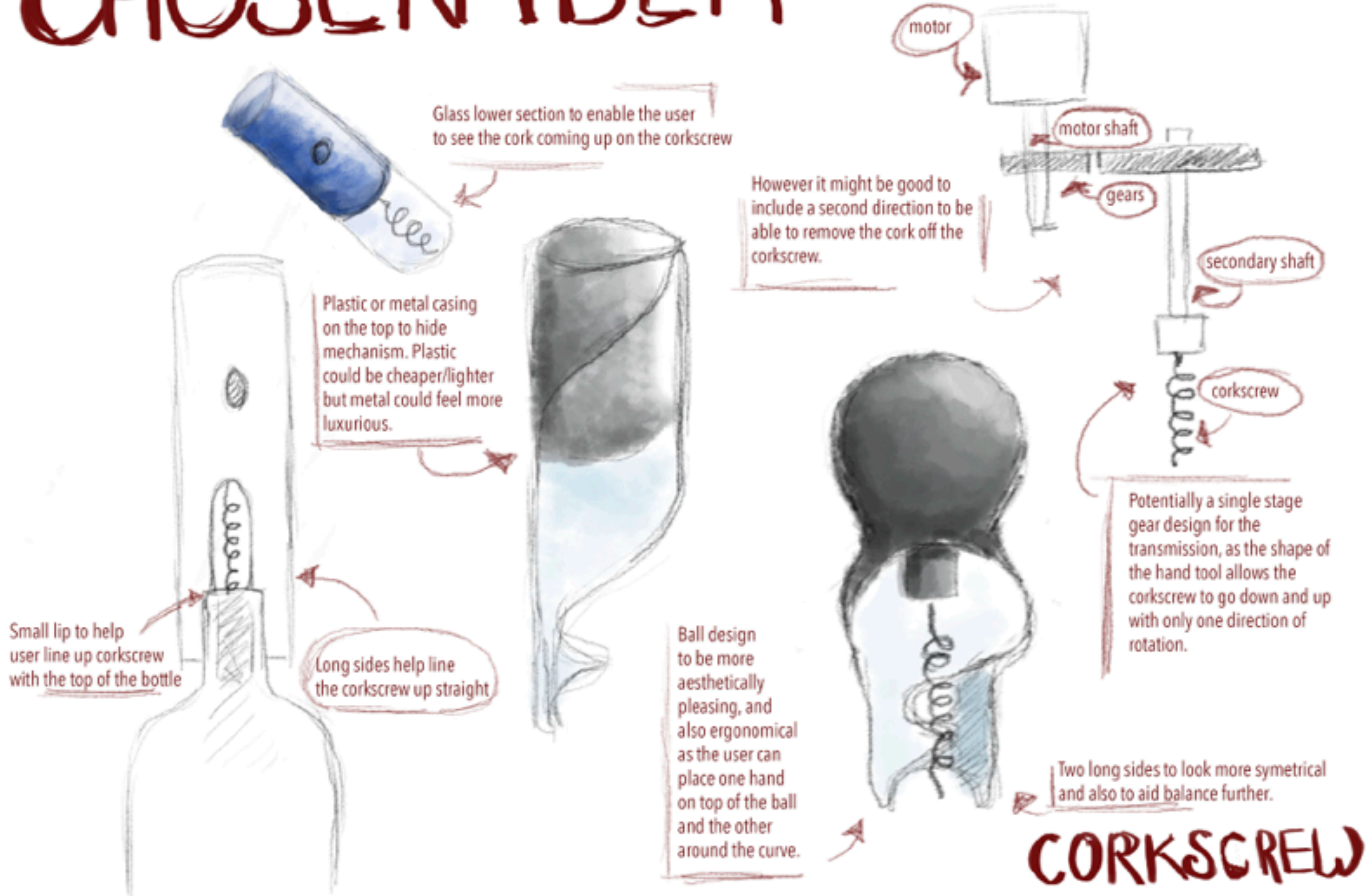
motor

chain

would be able to cut bread → and make toast at the same time!

* but could costs be kept low enough to appeal to the novelty market?

CHOSEN IDEA-


Glass lower section to enable the user to see the cork coming up on the corkscrew
Plastic or metal casing on the top to hide mechanism. Plastic could be cheaper/lighter but metal could feel more luxurious.
Small lip to help user line up corkscrew with the top of the bottle
Long sides help line the corkscrew up straight
However it might be good to include a second direction to be able to remove the cork off the corkscrew.
motor
motor shaft
gears
secondary shaft
corkscrew
Potentially a single stage gear design for the transmission, as the shape of the hand tool allows the corkscrew to go down and up with only one direction of rotation.
Ball design to be more aesthetically pleasing, and also ergonomical as the user can place one hand on top of the ball and the other around the curve.
Two long sides to look more symetrical and also to aid balance further.
CORKSCREW

WEEK 2 SUBMISSION

<u>Cordless Hand tool Project Planning- Fiona Boyce</u>

My proposed Gantt chart for the project is shown below, sections have been left intentionally broad so as to allow for flexibility should it not go to plan. However I will try to adhere to the chart as much as possible. The date for the Design Gateway will be set on the 19th January with my tutor.

The writing of the report I believe should be an ongoing process, and so sections of it will be written during the project. For research, I will look at existing models and try to examine any recurring flaws that I can address with my model, and also perform any experiments that are necessary to obtain enough data for the calculations stage of the project.

I have chosen the corkscrew as my product to develop during the project. I find the transmission likely to be the most realistic to work, and the design considerations to be the most interesting, as the scope for creating an aesthetically and ergonomically pleasing product will be greatest with this choice.