

Harry Cuthbert

1801146

Automotive Design

Materials and Manufacturing

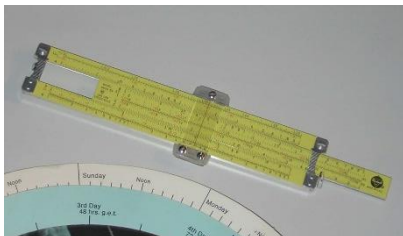
ADDA4001

Introduction

The calculator is a product that has been used for a long period of time dating back to 2000BC, however the product has only had a massive adaptation in recent years using the modern technology that has become available to us over the last few years. The calculator is a smart technological product that is able to calculate figures in seconds and I am taking this product apart to find the components that can make this product work so efficiently.

History of the Calculator

The calculator has a long history as it is a tool that has been useful to many people needing to use maths, and the first known use of a calculator was by Sumerians and Egyptians back in 2000BC, and this consisted of an abacus that used bead rods to move across creating multiple digit numbers. The abacus was a simple design of a frame which held a series of rods with 10 sliding beads, this was a suitable calculator for many thousands of years and was continued to be used for 3600 years. That was until the 17th century, around this time was the first mechanical calculator which appeared in Europe. The development of logarithms by John Napier allowed Edward Gunter, William Oughtred and others to develop the slide rule, this allowed faster multiplication and division by having sliding disks, they later evolved to allow the ability to do advanced trigonometry, logarithms, exponentials and square roots. The slide rule was used in education as well up to the 1980s. A Pickett model N600-ES was also taken with the Apollo 13 moon mission (shown in image 1, below). The first mechanical calculator was designed by a French kid named Blaise Pascal in 1642, he described his calculator as “a device that will eventually perform all four arithmetic operations without relying on human intelligence” (Blaise Pascal, 1642). The machine used gear wheels and it had the ability to add and subtract 2 values directly as well as being able to multiple and divide repeatedly. In 1820, Thomas de Colmar invented the Arithmometer (shown in image 2, below) which went on to be the first commercially viable counting machine and it was manufactured between 1851 and 1915. In 1887 though was when the push button calculators appeared through the comptometer (shown image 3, below), designed by Dorr. E. Felts. The Curta calculator (shown image 4, below) which arrived in 1948 was a calculator that was portable and made a big change to office life at that time. In 1961 came the first all-electronic desktop calculator, called ANITA (shown image 5, below). It used a mix of vacuum and cold cathode counting tubes. In 1967, the first small electronic calculator prototype was produced called ‘cal tech’ (shown image 6, below). Then modern technology took over moving to microchips and processors used today.



(Image 1, the slide rule,
<https://airandspace.si.edu/collection-objects/slide-rule-5-inch-pickett-n600-es-apollo-13>)



(Image 2, the Arithmometer,
<https://www.thecalculatorsite.com/articles/units/history-of-the-calculator.php>)



(Image 3, the Comptometer,
<https://www.thecalculatorsite.com/articles/units/history-of-the-calculator.php>)



(Image 4, the Curta calculator,
<https://www.thecalculatorsite.com/articles/units/history-of-the-calculator.php>)



(Image 5, ANITA,
<https://www.thecalculatorsite.com/articles/units/history-of-the-calculator.php?page=2>)



(Image 6, Cal Tech Prototype,
<https://www.thecalculatorsite.com/articles/units/history-of-the-calculator.php?page=2>)

Midi Calculator 8 Digit

The product I chose to analyse is a simple calculator that can be bought in most stationary selling shops. It is a low-priced calculator and does simple calculation that the consumer needs, it uses modern technology to make it efficient to use as has a solar cell to power as well as a lithium battery this means the calculator has a longer life to be used, making it more eco friendly by using solar power.

Products Materials and Manufacturing

Part	Material	Manufacturing
Plastic Keys	ABS plastic	Injection moulding
Processor Chip	Mainly sand, to create silicon	Wired up to solar cell and battery for power and LCD screen to display
Keyboard Membrane	silicone	Polymer casting
Circuit Board	Fibreglass, epoxy resin, copper foil	Materials are stacked, and heat pressed, then etched onto surface and cut
Lithium Battery	Lithium metal oxides, vanadium oxides and olvines	Wired up to processor chip to power when not solar powered
Battery Cover	ABS plastic	Injection moulding
Screws	Stainless Steel	Thread rolling
Outer Shell	ABS plastic	Injection moulding
Solar Cell	Doped silicon	Solar cell wired together with processor chip
LCD Screen	Glass, polarised fil, both electrodes, liquid crystal and a mirror	LCD screen stuck with self-adhesive foam to acetate and placed over outer shell

Advantages of Method

The advantages of using injection moulding is it is a fast method of producing thousands of the parts in a short period of time and so making it cost effective in the long run despite high initial costs. The other parts will be bought as components in mass quantity and then will be fitted to the injection moulded parts to produce the final product. The method is very fast and cost effective as it is a constant cycle that is always working and so is a successful method

Future Developments

The future of calculators will move towards more modern technology and will look at adapting the calculator to be more like a modern-day phone, products are always looking to be improved and to

make it simpler for the user. “The masters of Science and Technology are looking at calculators that can be activated and operated by voice” (<https://www.quora.com/What-will-the-future-of-the-calculator-be>) This shows that calculators could move to voice control and so will eliminate the need for the buttons, this will be able to compact the calculator smaller and allow it to be better suited to the modern day consumer. Another change to the calculator could be to allow network sharing so that calculations can be shared to others, this is designed to benefit education. However, the future developments of the calculator seem like they are moving to much towards a phone, but as technology develops the more products update as well.

Summary

The calculator is a tool that has been used for thousands of years, it has developed over time to allow it to be more widely available to users at affordable prices because of the advances in technology. The future of calculators seems ominous because of the use of phones and modern technology and so for the calculator to continue its use in modern society it will need to use new technology such as voice commands to produce something that will appeal to consumers.

Bibliography

<https://www.thecalculatorsite.com/articles/units/history-of-the-calculator.php> – The history of the calculator

<https://airandspace.si.edu/collection-objects/slide-rule-5-inch-pickett-n600-es-apollo-13> – The history of the calculator

<https://sciencing.com/material-used-calculators-solar-cells-2339.html> - Products materials and manufacturing

<https://electronics.howstuffworks.com/lcd2.htm> - Products materials and manufacturing

<https://formlabs.com/blog/guide-to-manufacturing-processes-for-plastics/> - Products materials and manufacturing

<https://www.tms.org/pubs/journals/jom/0809/daniel-0809.html> - Products materials and manufacturing

The calculator



The plastic shell of the calculator as well as the buttons are made from ABS plastic because of it being a stronger plastic than others and being able to injection mould it cost effectively. It is injection moulded by already having a mould of the shape of the calculator. ABS plastic pellets are heated and pushed through to fill the mould, it is then cooled to allow the polymer to set and once removed from the mould the part is finished and ready to be used at the next stages of putting the calculator together.



The processor chip is wired up to a solar cell and wired through the back of the outer shell to the lithium battery in the back, the processor chip is then placed inside connected to the circuit board and the 2 power sources. The LCD screen is then held with self adhesive foam to the inside of the calculator shell and then an acetate sheet over the screen which is glued to the borders to protect it. The LCD screen is connected with a display to the processor chip so that an image can now be produced.

The solar cell is fitted similar to the LCD screen by using self adhesive foam to hold it in place against the inner shell. The method of putting together the calculator is very basic and is what you would expect from a low end calculator and would likely break easily if dropped because of the basic assembly.

Finally the battery cover which has tongue and groove joins allows it to easily slide on and off of the back casing easily allowing the user to access battery in back. The outside case is attached to the front with 6 screws, 2 of them in the middle are deep sunk screws so that it holds the calculator firmly pinched and together to stop movement inside of the calculator.

This image shows the layout of the inside components all laid out in the structure they fit together inside, the design shows the 2 frames the sandwich the inner components as well as showing the lack of components inside as is a technological product but only minimal parts inside, the main being the processor chip that is able to power the whole product, and that is shown by the wiring that connects to the different parts (battery wiring was cut from processor chip in photo). The overall product was a simple yet complex product in technology but shows the advancements made.

