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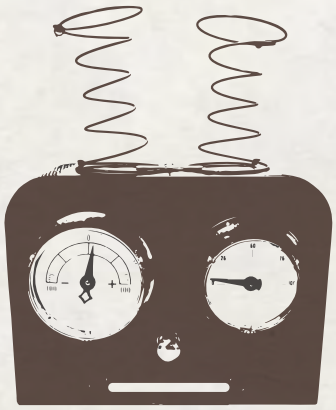

FRIENDLY DATA MONITOR

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CONTENTS

OVERVIEW 3

THE BRIEF 4

RESEARCH 5

DESIGN 7

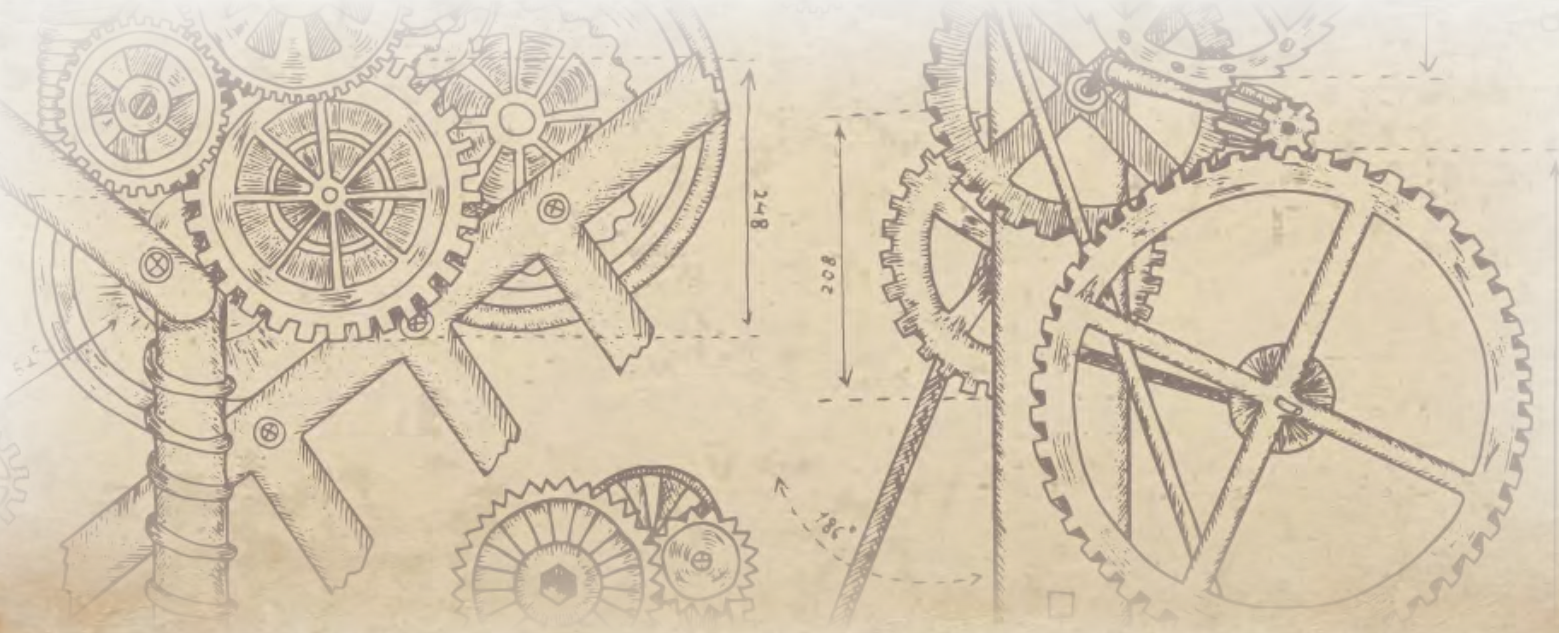
PROTOTYPING 8

BUILD 9

DATA MONITORING 10

FEASIBILITY & OPPORTUNITIES 11

REFERENCES 12



OVERVIEW

In a nutshell...

This project, produced for the *Enhanced Design Tools* course as part of Master in Design studies at Griffith University, aims to **help people understand and relate to data by displaying it in a visual and tactile way**.

The project involves building a physical product to answer a specified design intent, while researching and using appropriate design tools and latest technologies.

The need

Data means nothing until it is put in context. However, the exponential growth of 'Big Data' is making it very difficult for human beings to relate to. A lot of this data is generated by individuals (via Internet-connected devices) and monitored by organisations who use data to track performance, monitor sustainability initiatives, improve customer satisfaction or support business decision making.

Data has personal relevance to everyone, not just business analysts or researchers. If individuals understand the impact of their everyday actions and decisions, and can see how these impact the bigger picture, they can shape the future.

Data visualisation can help make data more accessible. Usually, data is visualised on digital devices in the form of tables, graphs, data dashboards and information graphics. These visualisations are often quite complex and not easily understood by non-technical audiences. How do we help people extract information that is relevant to them, and give data a human context?

Answering the need

The proposed solution is a '***Friendly Data Monitor***'. This is designed to be a new, more accessible way of visualising data – turning data into meaningful information and giving it a human context by displaying data in a way people can see, hear and feel.

Rather than showing a mass of data, the monitor will show just a couple of key indicators. These indicators can be adjusted to reflect whatever the person or organisation wants to monitor at the time.

The data monitor could be used by an individual, or displayed on a company's reception desk as a highly visible, tactile way to communicate relevant data to staff and customers.

Design of the solution

The proposed data monitor takes the principles of a digital data dashboard (used by organisations to monitor data on screen) but instead displays data on analogue dials set into a physical product.

The product will be built to a human scale, with a 'face' design that makes it look friendly and encourages the viewer to anthropomorphise the product. Anthropomorphism, where people assign human characteristics or behaviours to non human objects, helps people build relationships with their possessions or objects they interact with (Lee, Shen, Bei, & Yang, 2014).

Although the data monitor will have old technology on the outside, it will have new tech on the inside. The dials will be driven by a servo motor connected to a microcontroller and programmed to display a set of data. For this prototype, the data will not be fed via a direct Internet feed, but will be simulated by programming the microcontroller with variable data.

THE BRIEF

Project requirements

The specific project requirements are as follows:

- ***Timing:*** Project must be completed within 6 weeks.
- ***Documentation:*** The process is to be documented via photos, notes, blog posts and videos.
- ***Technologies:*** Must use one or more technologies studied previously, including laser cutting, 3D printing, microcontrollers or apps.
- ***Budget:*** Costs to be kept to a minimum, preferably within a maximum budget of $100
- ***Sustainability:*** Materials to be locally and sustainably sourced wherever possible, to minimise environmental impact. Use a combination of found, recycled and new materials, as appropriate
- ***Design style*** choose a visual style or theme consistent with the aims of the project

Design theme

The Friendly Data Monitor will be built to reflect a specific design theme: **Steampunk.** This is a genre of design, writing and culture that merges vintage machinery/styles with science fiction. It intentionally uses anachronisms and mechanical technologies to speculate on what the future might have looked like in Victorian times. Steampunk arose from the fantasy and science fiction novels by authors such as H.G. Wells and Jules Verne (Goho, 2018).

> ***"Some scholars argue Steampunk provides a progressive analysis of past, present, and future social conditions."***

(Goho, 2018)

This theme is appropriate because it relates to how people interpret the future through the lens of the past – just as people look at past or current data to inform future decisions or actions. Because the Steampunk style uses objects and styles based on the past, there is potential to build a more sustainable solution that uses fewer new resources.

Figure 1 Wells' work was published in sci-fi magazines in the 1950s. (Two Complete Science Adventure Books, 1950).

Figure 2 Rod Taylor, starring in the 1960 film version of H.G. Wells sci fi novel "The Time Machine." (Rod Taylor, 2015)

RESEARCH

Scope of research

The project research investigated big data, digital data dashboards, analogue gauges, Steampunk styles, similar projects, and sources for materials and information.

Big Data

The term 'Big Data' is often described using the three Vs of Volume, Velocity and Variety (Mediratta, 2015). It is hard to grasp the sheer scale of data in circulation. The amount of data generated worldwide is growing at the rate of 2.5 exabytes a day. 90% of all the world's data was created in the last two years (IBM, n.d.).

> ***Big data feeds directly into decision support systems used by commercial and government organisations to analyse trends, plan strategies and adjust tactics in response to real time or historic market information.***

(King, 2018)

Digital data dashboards

A data dashboard is designed to give an overview of data, showing key metrics and highlighting trends or issues. The user can then drill down to more detailed data. On the dashboard, data is displayed using techniques such charts, tables, icons, images or interactive visualisations that can be manipulated by users.

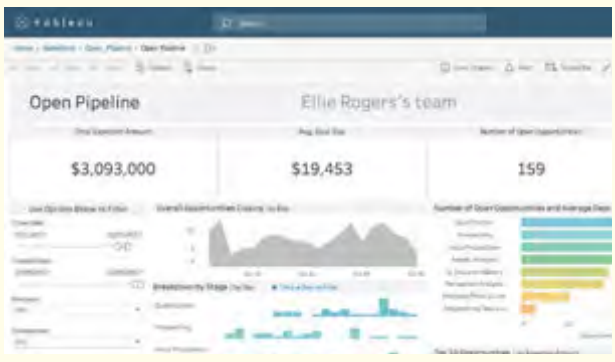


Figure 3 Example of a data dashboard (Tableau, n.d.)

Analogue gauges

Analogue gauges are used for all sorts of measurements, such as tyre pressure, water usage, voltage, speed, revs and so on. The data being measured affects the design of the dial and placement of the needle.

Figure 4 Analogue gauges from classic cars (DeMauro, 2017)

Similar projects

There are very few examples of physical data monitors linked to digital data. The closest analogy to this is a car dashboard, where dials display data from the vehicle's electronic inputs and engine management systems.

Researching similar projects on Maker websites and online resources yielded an example on the Arduino Project Hub called 'FizViz' (MIT, 2016). This is a slick analogue dial that visualises data with a moving pointer, linked to live data on a computer. Its elegant minimalism is the opposite of steampunk style, but the project shows what can be possible.

Figure 5 FizFViz data dial (MIT, 2016)

Steampunk style

Looking for visual inspiration relating to Steampunk style objects and graphic styles yields lots of beautiful images. A common theme is the use of cogs, gears, chains, brass and intentionally over-complex designs to fulfil simple functions.

Figure 6 Robot made from reclaimed materials (Brown, 2018)

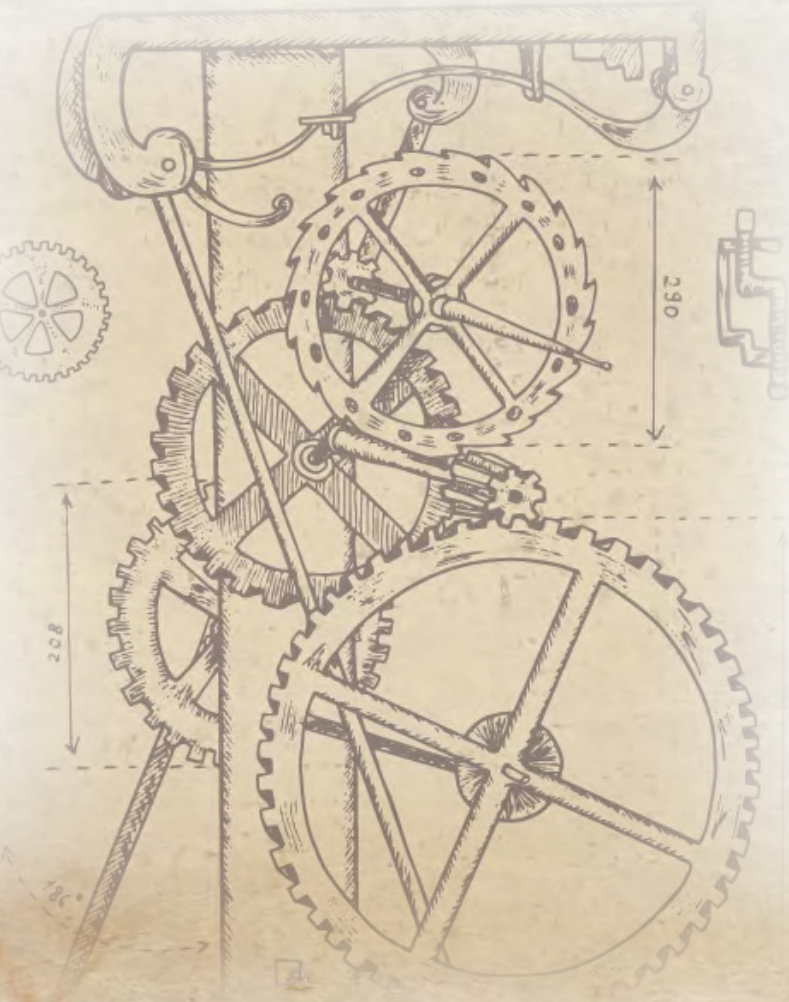


Figure 7 This over-engineered coffee machine has lots of industrial looking tubes and dials (Steampunk Coffee machine, 2016)

Figure 8 Weathered dial fridge magnets (Steampunk Gauges, n.d.)

Figure 9 Clockwork Universe by Tim Wetherell (Wetherell, 2010)

DESIGN

A sustainable design process

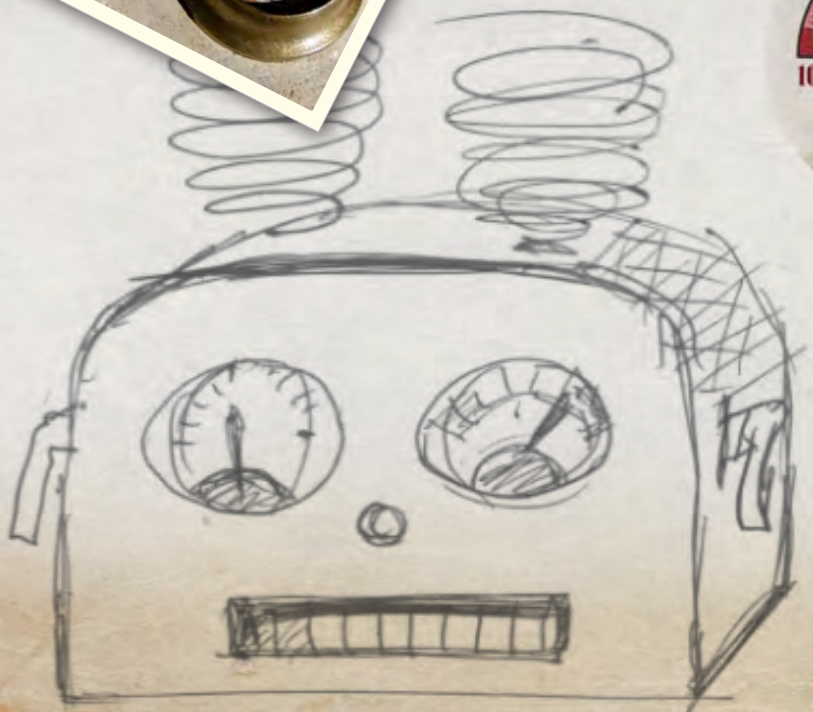
To support the aim of using sustainably sourced materials, the design process started by looking at what sort of recyclable materials were available, and designing around those (rather than sketching out a detailed design and looking for parts to make that).

The focal part of the dashboard would be the gauges, so that was the starting point.

A visit to Reverse Garbage Brisbane yielded some brass objects that looked like old gauge surrounds, but were in fact old lamp bases. They had room inside to put a dial and electronics, and cost just 95 cents to buy. In addition, Reverse Garbage also had some offcuts of clear acrylic sheets (for dial covers), black acrylic (for the dial pointer needles), and old mattress springs (which looked a bit like an old TV aerial).

The craft section of Spotlight was the source for other small items (Steampunk cogs, brass metallic paints).

Figure 10 Brass lamp bases (left), monitor sketches (below) and dial face designs (right)



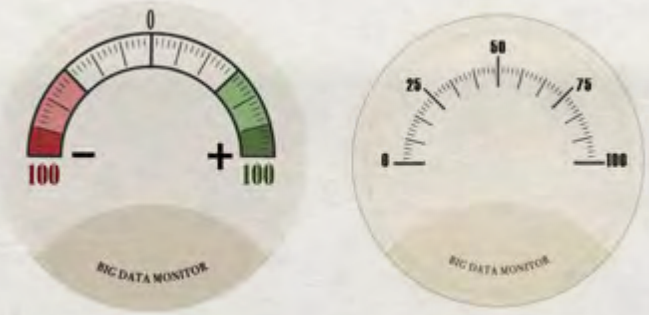
Designing the monitor

Once armed with parts for gauges, it was possible to create a design for the monitor and determine what size it would need to be to fit the gauges. The rough sketches visualised the data monitor with a friendly face (dials for eyes, CD slot for mouth) to humanise it.

Designing the dials

The dials were designed to display two different types of data:

1. ***Positive or negative*** readings (-100 to +100, centred on zero). This type of display is suitable for measuring variations from a neutral point, to track if data is going up or down – such as employee/customer satisfaction or product ratings, or constantly changing environmental data.
2. ***A continuous scale or percentage*** from zero to 100. This gauge would be suitable for monitoring data with a top limit (100%) such as sales targets, fundraising, project completion, attendance, etc.



PROTOTYPING

Choosing sustainable materials

As one of the objectives was to minimise waste, it was important to check sustainability of materials used.

The monitor's cabinet was to be made from plywood, because it is cheap, easy to work with, and suitable for use with a laser cutter. The material can be stained or painted to give it a weathered, Steampunk look.

Plywood is made by sandwiching thin layers of wood, with each layer rotated to increase strength (Woodguide, n.d.). Its environmental credentials depend on the type of wood used and the glue that binds the layers together. The plywood supplied by the university is Hoop Pine Ply, which is made from Hoop Pine grown in NSW and Queensland and certified following the Responsible Wood system (Austral Plywoods, n.d.).

Another way to reduce waste was to use off-cuts of plywood or acrylics from other students' projects, and to leave any remaining material in the workshop for other students to use.

Test cutting curved plywood

Plywood can be made to bend by cutting small patterns that allow it to flex, often called lattice hinges. (Porterfield, 2017) There are a number of different ways to do this, so the chosen patterns were tested on a small piece before laser cutting the main components.

Figure 11 Testing the plywood bend

Cardboard prototyping

The artwork for the parts to be laser cut was created using Adobe Illustrator. The panel components, dial covers and pointers were prototyped in cardboard, measured and checked for fit. This resulted in some minor adjustments to sizes.

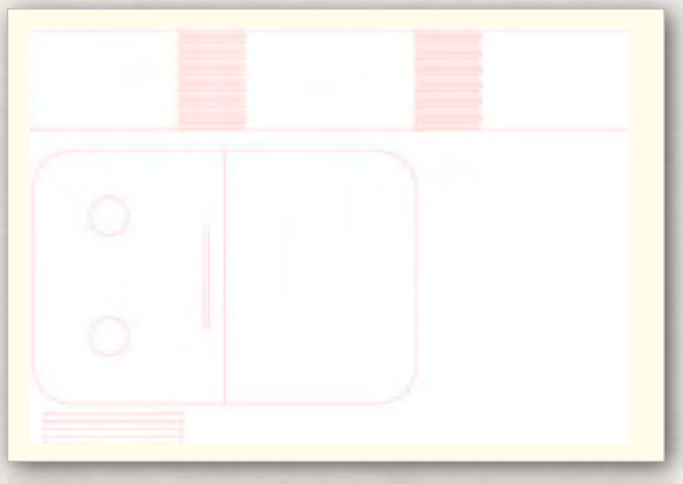


Figure 12 Panel artwork (top), Cardboard prototype of front face (middle), cardboard prototype of dial/pointer (bottom)

BUILD

Building the cabinet

Once the designs had been prototyped and adjusted, the wooden panels could be laser cut from plywood and built into a cabinet. Some extra pieces of wood were added inside, to enable the panels to be glued or screwed together, and to add overall strength. A joining piece with rubber stoppers was also added inside, to give the CD a place to rest when inserted via the 'mouth' on the front of the cabinet.

Once that was done, it was possible to mount the other parts onto or inside the cabinet to get the dials working. The cabinet could then be wood stained, for an antique look, and decorated with brass handles (to look like ears), a brass knob (for a nose) and even some brass earrings.

Building the dials

The dial faces were printed onto paper and mounted onto card, centre punched with room for the pointer needle.

The brass dial cases were adapted to take the servo motors that would be needed to drive the pointers, by screwing a small piece of ply inside the case with a cut-out that was exactly the size of the motor.

The dial pointers were cut from a small piece of black acrylic, and mounted onto the dial faces and motor with a small grub screw.

Finally, the dial covers were cut from clear acrylic, to the size of the top of the dial cases, so they could be mounted with the small steampunk cogs using the three retaining screws.

Ease of maintenance

The monitor has been designed for easy maintenance. The electronic parts inside can be accessed by unscrewing the back panel, and the power pack can be turned on via a hole in the back panel aligning with the power button. Inside the unit, the battery pack or power pack can be removed via a couple of screws.

The dial covers can be removed by undoing one screw, giving access to the pointers, and the brass dial cases can then be unscrewed from the front if needed.

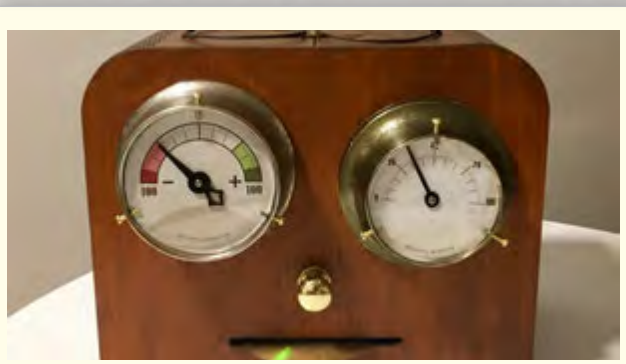


Figure 13 Various aspects of the build stage

DATA MONITORING

What's inside the monitor

The Friendly Data Monitor contains some simple electronics to support the function of the monitor as a means of processing data and moving the dial pointer to show physical changes in data.

Mounted inside the back panel of the cabinet is a small breadboard with Micro:bit microprocessor. This is wired to a battery and power pack, and connected to two servo motors. These motors are positioned in the centre of the dial cases and the dial needles are fixed to the top of the motor, above a small spacer arm. This enables the pointer to move up to 180º to point to numbers/marks on the face of the dial.

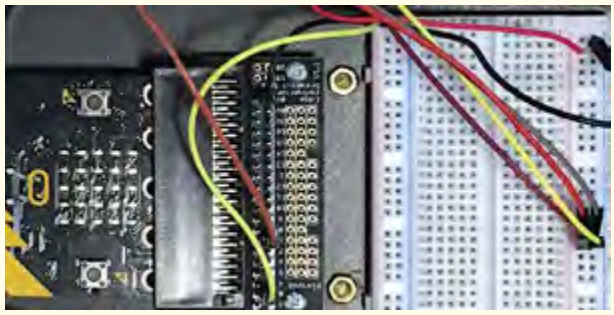


Figure 13 Close-up of the Micro:bit and breadboard

Programming the gauges

The programming language for the microprocessor is in Javascript, created using the visual Microbit Makecode online coding tool (Microsoft, n.d.). This method allows for easy adjustments to code while testing, as the Microbit can be plugged into a laptop and any changes can be saved directly onto the Microbit.

The two gauges have been programmed to simulate a data feed, as follows:

- **Left gauge** (zero-centre meter): this has been coded to show data fluctuating by random amounts above and below the central zero point, to a fraction within the extremes of -100 and +100.
- **Right gauge** (0 to 100): this has been coded to increase gradually from 1 to 100, with some minor fluctuations. Once it reaches 100, it will stop for a few seconds, then reset to zero.

Scenarios for monitoring data

There could be a number of scenarios for the above data simulation. For example, a business owner may want to measure customer reactions to a new product (using the left gauge to measure positive and negative responses) while also using the right gauge to monitor percentage of sales against a daily target (with the 100 mark being the target, which can be reset daily).

Figure 14 Code for the two gauges. The code at the left is for the right (0-100) gauge and the shorter code at right is for the +/- gauge

FEASIBILITY & OPPORTUNITIES

Post-project review

The project was successfully completed within the scope of the brief, and achieved its stated design intent of displaying digital data in an analogue way, with the aim of giving it a human context.

The product has been well received so far, based on informal user feedback. People like the friendly face and love seeing the dial pointers move. Whether or not they would be keen to see the monitor every day, and whether it is effective at helping them understand and relate to data, would be a subject for further research.

Production feasibility

Because the product was built as a **one-off prototype** product using some found objects and recycled materials, it would need to be approached differently were it to go into mass production. In particular the brass dial case 'eyes'' may need to be built from scratch or sourced from one supplier. The dial faces could be printed in different designs, to allow for different types and units of data being measured.

I would suggest this is the sort of product that should never be completely mass produced.

Part of its charm is in its old style Steampunk look. Its friendly face should be individual – different on every monitor produced (just as human faces are unique).

Feeding live data

For the purposes of this project, the data was hard-coded to simulate a data feed and demonstrate proof of concept.

However, there is an opportunity to integrate a direct data feed, transmitted live via Bluetooth direct from the Internet. This is certainly feasible, but due to the variety of data that could be connected and the research needed to set up a data feed, it falls outside the scope of this project.

Full story: cazazz.com.au/friendly-data-monitor/

Figure 15 Photographs of the final product. For video showing the dials move, see: https://youtu.be/7eqkw7rBVkA

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