

ENHANCING EXPERIENCE THROUGH SMART LIFESTYLE DISPLAY SOLUTIONS



HUMAN CENTRED INTELLIGENT DISPLAY

*The crucial ecosystem bridge that integrates digital
automation and intelligent human choices*



1. INTRODUCTION

Touchscreens form a significant aspect of the way we view and interact with the world today. Most of us interact with digital displays and touchscreens multiple times daily. Banks, fast-food outlets, public transport, stores and many more such services rely on touchscreens for efficient operation, providing us with an easy-to-use and adaptable interface. Similarly, our home appliances and wearables commonly feature touchscreens through which we make health, work, and lifestyle choices regularly.

The post-Covid *new normal* era has accelerated the use of embedded display solutions in lifestyle products because of the added health and safety advantages (which are discussed in detail in later sections). However, the more significant driver to incorporate embedded display solutions using touch in lifestyle products has been the wide array of choices they enable the users of such products to be able to make. Mechanical knobs, buttons, and dials limit choice simply due to the physical space they take on a lifestyle product, let alone the technological limitations they place and the aesthetics they compromise.

On the other hand, digital touchscreens embedded into a product offer vastly increased choices for users through interface technology, and they add to the aesthetics of the product itself. Much of this happens through the automation of data processing that enable a seamless method for integrating the data that can then be intelligibly used. The common assumption continues to be that automation takes human decision-making out of the loop because automated systems are often more efficient. And that is true, but only for **predictive** data.

But, as in any product where humans interact with machines of any kind, it is the **non-predictive** functions that humans continue to surpass data automation, helping us make smarter decisions. In essence, data automation of predictive functions help humans make more **intelligent choices**. And smart lifestyle products are one of the most interactive of products where the importance of human choice is at the forefront.

There are many ways humans can interact and input their choices into the digital ecosystem. Touch and voice are the most common methods to input non-predictive human choices. The most discrete method still, is touch: touchscreens that display an array of choices that can be quietly made without announcing it to the rest of the people nearby: privacy and choice are still amongst the most important personal liberties that individuals prioritise and seek to preserve.



1.1 Embedded Display Solutions: Integral to Smart Lifestyle Products

Display solutions are not just a secondary component in lifestyle products, but an essential part that re-embed the human element of intelligent choices through graphic user interfaces. At the back end, the efficiency of automated data and the technology that drives digital products is unquestionable. At the front end, it is the ability to enable human choices through the backend data and its associated technology: **smart display solutions and its technology is the bridge between predictive and non-predictive data.**

When designing smart lifestyle products that meet the needs of users, the integration of display solutions is an integral part of the overall design of the product. Display solutions are not a technology of the past, but are an essential part of the next generation of innovations linked to **intelligence augmentation** (IA). IA – the use of information technologies to increase human intelligence performance – is rapidly innovating the technology space in general, and smart lifestyle products in particular. Wearables, water dispensers, toasters, and coffee makers, to name a few, are evolving into digital processors of intelligent information, but none would be of optimal value if it was not for display screens using touch (and non-touch) technology for humans to make intelligent choices that meet their needs and solve their problems.

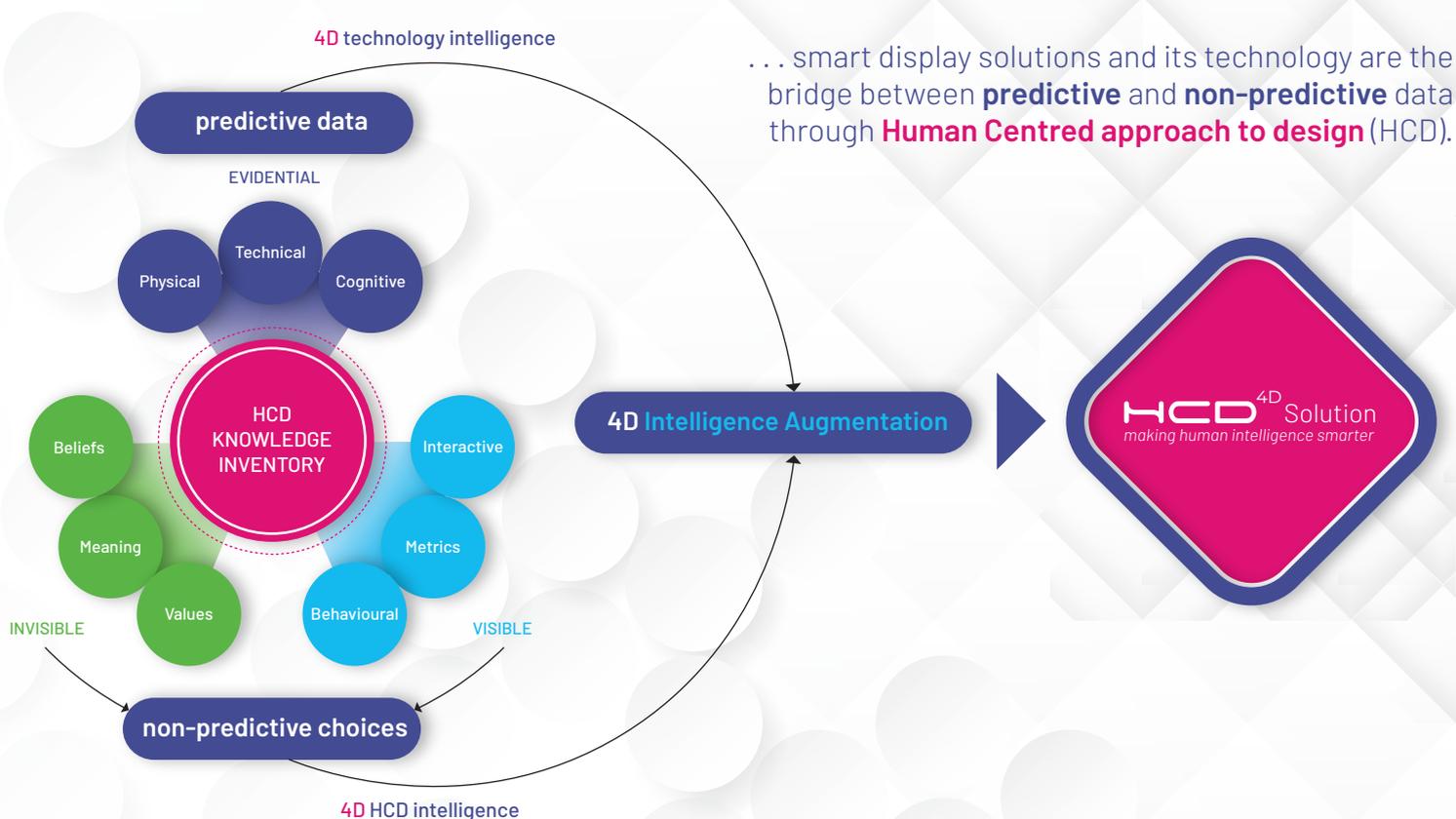
Display screens, present information to users – human beings – in such a way that amplifies personalised choice that suits their individual needs. Whilst artificial intelligence (AI) takes away the laborious task of data analytics from humans and facilitates faster and more sophisticated process-driven decisions, intelligence augmentation (IA) on

the other hand returns the human back to the centre of the equation, by embedding choice into a digitally automated ecosystem of smart lifestyle products.

4D SYSTEMS has recognized this important interconnectedness – of AI and IA – and have consistently focused on designing display solutions for lifestyle products that are smart in three ways:

- (i) The technology that drives 4D SYSTEMS' display modules use open protocols through our software and processors which offers seamless interconnectivity with the rest of a complex lifestyle product;
- (ii) The display screen with which the human interacts with data, should add to the overall aesthetics of the lifestyle product, and;
- (iii) The display module should reduce, if not eliminate the use of mechanical buttons and knobs in order to maximise the efficiency of the end product, as well as which uses fewer overall materials and thereby contributes to being a more sustainable lifestyle product.

Digital products must make **Human Centred Design** (HCD) a primary focus, and that is why 4D SYSTEMS designs its display solutions to help humans make better choices in an easy-to-use interface that is interconnected to complex data infrastructure of lifestyle products.



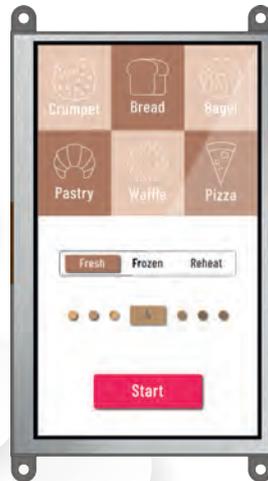
the HCD^{4D} Solution



4D INTELLIGENCE AUGMENTATION

PREDICTIVE DATA AUTOMATION

- Accurate temperature selection
- Bread thickness calibrating sensor
- Enable bluetooth
- User-selected settings memory
- Most appropriate touch-enabled display module



NON-PREDICTIVE CHOICES INTEGRATION

- Toaster manufacturer partners with master chef to calibrate temperature range for different types of breads
- Include user-selected settings
- Include IoT options for machine & human learnt iterative improvements & upgrades
- Provide graphic user interface that adds style & aesthetics

Making toasts feels like a boring chore!

Temperature control is very limited & often overtoasts

Cannot choose different bread types, causing over or under toasting.

Needs to be hidden away after use, does not add to kitchen aesthetics



USER-IDENTIFIED PROBLEMS



... augmentation of technological intelligence - **placing human choice at the centre** - and doing so with aesthetic appeal is what 4D SYSTEMS excels in and offers innovative solutions for.

2. THE ART OF EMBRACING TECHNOLOGY

Functional technology is paramount in any digital product; functional aesthetics makes such products excellent. More and more users show greater preference to products with display screens to not only provide them with choices right at their fingertips, but also that adds to the aesthetics of the product. Users want their home appliances and wearables to have ease of use through technology that offer choices, but as importantly they want the products to be aesthetically pleasant that enhance the sensory elements of their lifestyle.¹

This balance between technological functionality, practicality of use, and bringing both of them together with aesthetically pleasant display modules has been a hallmark of 4D SYSTEMS' display solutions. The technology behind its display modules is driven by powerful processors developed by its own **4D LABS**, and fully compatible to be programmed for the most functional and pleasing graphics user interface through its integrated software development platform, **Workshop4**.

The inhouse developed processors, software, and its PCB-integrated display modules place 4D SYSTEMS to offer exceptionally well designed and human-centred embedded display ecosystem that are readily able to be integrated into a diverse range of end-products.

2.1 4D SYSTEMS PROJECT BRIEF: State of the Art Espresso Maker from Henlo & Co.

The South African premium espresso machine manufacturer, Henlo & Co, designs and manufactures its machines that offer a "revolutionary brewing experience" through:

- **Data driven analytics** that reveal the quality of coffee being brewed that yields the best coffee for coffee drinkers being the beneficiaries of its premium machines used in commercial cafes around the world;
- **Consistency of perfect execution** in every shot pulled which is meticulously benchmarked to the original recipe of the barista, and;
- **The right tools to create the impeccable flavour**, where ingredients can be precisely chosen and measured.

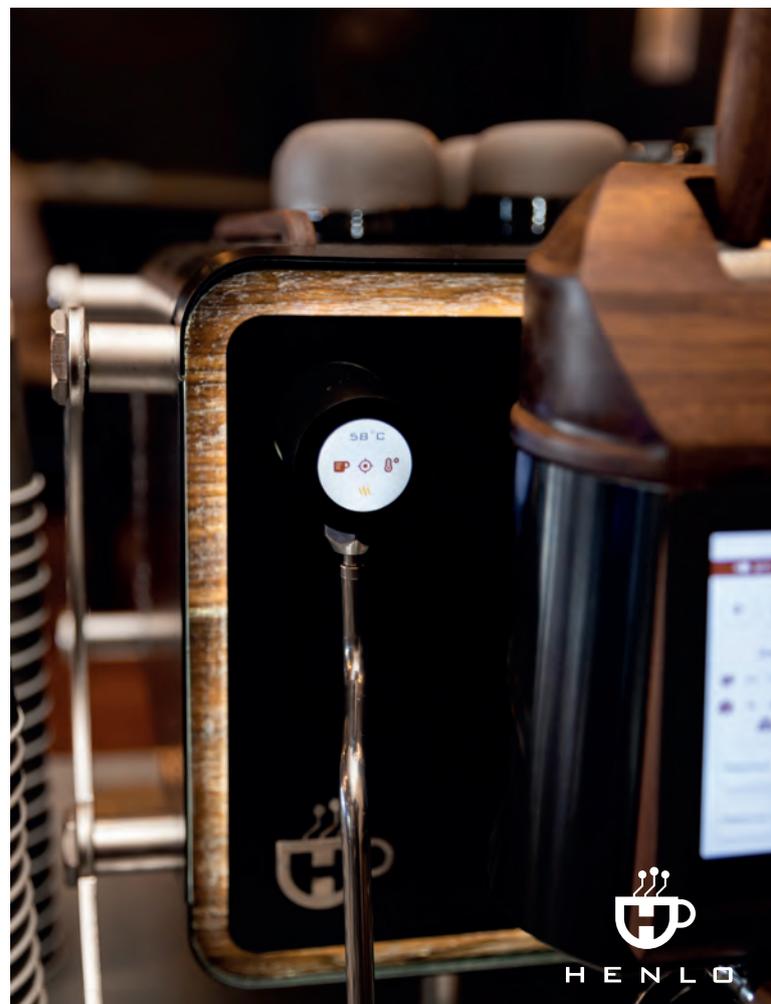
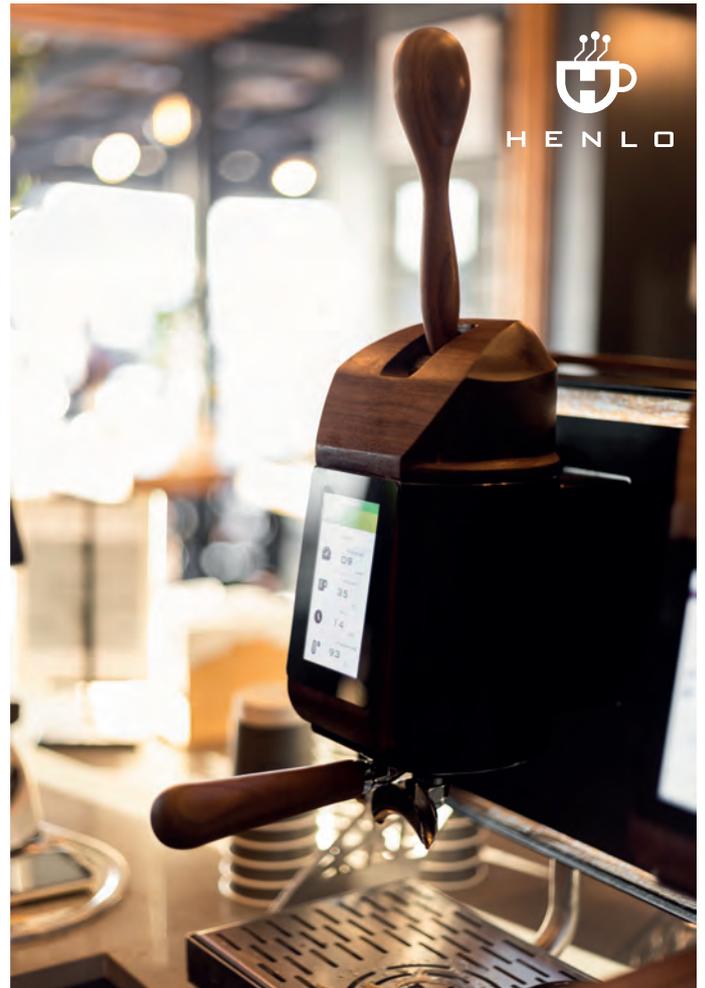
The automation of data allows Henlo's latest espresso machines to control variable pressure, temperature, and brewing time, as well as precisely measuring the ingredients to craft impeccable experience of coffee. The backend accuracy of data is brought to life through its precision-driven display modules rather than knobs and dials of yesteryear coffee machines. The display module gives the barista choices of brew types and control to maintain consistency that pulls just the right and impeccable flavour of coffee.

Henlo espresso machines have become a visual attraction for coffee customers who are often dazzled by the display screens with sleek graphics user interface. Luckily, the machines make superbly tasting coffee so the visuals do not outplay the taste!

According to Henlo's managing director, Henlo van der Westhuizen, customers for coffee come to coffee houses for "consistency of flavour". "We want the franchise owners", he explained, "to be able to see objective data about how their coffee is doing. We want to give them the tools to make more consistent coffee and be objective about the performance of their barista".

In order to achieve this critical objective - consistency - for people to return and enjoy coffee at a particular outlet, touchscreens provide the tool to control the machine's capability to achieve high levels of accuracy that pulls impeccable flavour. "4D SYSTEMS' solution played well into our idea of building machines that last by creating an ecosystem that is software driven. We also needed a way to keep our user experience fresh and that is where the 4D touchscreens really shine", Henlo explained.

In line with 4D SYSTEMS' goals to amplify human centred choices in digital products and which are lasting and sustainable that align with ESG aspirations, Henlo confirms that, "The screen allows us to quickly build updates that offer brand new experiences", which yesteryear machines with knobs and dials cannot. Every time a totally new machine with knobs and dials is built that offers "upgraded choices", new raw materials are used to manufacture the physical machine. But, with software driven touchscreens, the same machine is entirely upgraded digitally as baristas learn more through the data the machine provides.



PARTNER PRODUCT PROFILE



PARTNER INFORMATION	NAME	Henlo & Co Pty Ltd
	COUNTRY	South Africa
	WEBSITE	https://henlo.coffee
	ENQUIRIES	henlo@henlo.coffee
	PROJECT DESCRIPTION	<p>We are a South African based commercial espresso machine manufacturer who aims to revolutionise coffee through IoT integration with premium industry standards – both in functionality and data flow. Our ecosystem offers consistently exceptional coffee, that continuously train baristas as they use the machine.</p> <p>Data from how well your baristas use the feedback from the machine to adjust the grind/tamp style is automatically recorded and reported back to you. Fraud and other losses of both beans and milk can easily be identified in addition to an objective overview of the performance of your baristas.</p>
4D SYSTEMS PRODUCT PROFILE	4D PRODUCTS USED	<ul style="list-style-type: none"> • gen4-uLCD-43DCT-CLB • pixxiLCD-13P2-CTP-CLB • Workshop PRO IDE licence
	CUSTOMER FEEDBACK ON TECHNICAL ADVANTAGES	We chose to use the -CLB (cover lens bezel) products, as the glass bezel completely seals the screen from moisture exposed during coffee brewing, while touch screens give full control over the user experience.
	CUSTOMER FEEDBACK ON KEY 4D SOLUTION ADVANTAGES	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Ease of interface programming - ease of using Workshop4, reducing time on programming <input checked="" type="checkbox"/> Ability to design custom GUI - flexibility to design & deploy useful and aesthetic GUI <input checked="" type="checkbox"/> Successfully incorporate improved user functions - embedded display solution eliminates manual knobs & buttons whilst increasing choice of functions for users <input checked="" type="checkbox"/> Advantageous integrated display solution - Integrated 4D processor, seamless Workshop 4 development environment & minimised space for PCB were advantageous <input checked="" type="checkbox"/> Fast time to market - accelerated integration into the end product, whilst keeping costs low <input checked="" type="checkbox"/> Helpful customer support - 4D SYSTEMS staff assistance made product development easier <input checked="" type="checkbox"/> Competitive price - viable overall cost of incorporating the embedded display solution into the end-product

2.2 SAFETY, HEALTH & VALUE ADVANTAGES

Display screens, particularly touchscreens, are a better solution than knobs and buttons in the new normal due to a stark increase in infectious diseases such as COVID-19. Although the risks of infection from surfaces is low,² display screens offer clear advantages that promote better health and safety standards.

Here are five key advantages of incorporating display screens into OEM products, from home appliances like water dispensers, coffee makers and toasters, to wearables for healthy living and for medical monitoring purposes:



Display screens are easy to clean and disinfect, as opposed to knobs and buttons. All 4D SYSTEMS' screens are disinfectant-safe and readily accept wipeable films to be installed if needed. Early types of machines and appliances with buttons are difficult to clean or disinfect because they provide an uneven surface with small gaps which are not easy to reach, and possibly avoided, during cleaning. Touchscreens, on the other hand, provide a flat and even surface which allows for easy and thorough cleaning in both commercial as well as home settings.³



Public touchscreens help reduce close contact in times where physical distancing in public spaces is necessary. Touchscreens can greatly reduce (or even eliminate) the need for face-to-face interaction with customers and help everybody maintain reasonable physical distancing recommended by the authorities when needed. When used in conjunction with effective hygiene control, this can prove a much safer alternative to normal customer interaction for many commercial sectors. Check with our support staff for more information on our screens and safety recommendations.



Display screens reduce repair and maintenance costs because knobs and buttons either break or malfunction more frequently. Associated with cleaning, common problems that contribute to malfunction of buttons and knobs are dirt and grime as well as regular use. Display screens overcome such problems and offer a better value that allows equipment and appliances to also last longer. Reduced maintenance – both cost and time – as well as longer functional life directly and positively impact ecological sustainability. 4D SYSTEMS is committed to high standards for its products, especially connected to environmentally responsible solutions, and that is why it is an ISO-9001 and ISO-14001 certified company and currently undergoing attainment of ISO-26000 certification.



Display screens reduce the overall cost of equipment and appliances by allowing human interaction through touch and thereby resolving the problem of having an overwhelming number of mechanical knobs and controls, which frequently can be very impractical as a solution to offer choices to users that are needed. This is one of the reasons that the car industry is fast adopting touchscreen solutions over mechanical controls. According to the market research firm IHS Markit,⁴ for example, approximately 98% of all cars to be sold in USA already had touchscreens as of 2017. And that is just the car industry, in USA alone! Similar trends are seen in home appliances and other lifestyle products.⁵



Display screens combine all of the above in a stylishly aesthetic manner, and 4D display solutions help designers and engineers of equipment and appliances turn technology into art. Human Centred Design is a cornerstone of 4D SYSTEMS' philosophy for Excellence, and design aesthetics is something we place a strong emphasis on alongside our commitment to high quality display solutions that can help make human intelligence smarter.

4D SYSTEMS is a crucial **ecosystem bridge** between digital automation and intelligent human choices through its smart display solutions incorporated into smart lifestyle products in commercial applications and as easily in home appliances and personal wearable applications. Intelligence augmentation of artificial intelligence data is at the centre of 4D SYSTEMS' Human Centred Design (HCD) for all of its display technology that help make human intelligence smarter.

3. IN FOCUS: 4D smartLIFESTYLE SOLUTIONS

3.1 The GEN4 Series: Making Data Visually Alive

The GEN4 series of display modules has been designed by 4D SYSTEMS to minimise the impact of display related circuitry, making them a highly suitable solution for integration into lifestyle products. The Gen4 display solution is seamlessly integrated into products that will substantially benefit from an embedded display solution.

The Gen4 modules are powered by the fully configurable DIABLO16 and PICASO graphics processors from its own 4D LABS. They are all 100% compatible with the Workshop4 IDE and its 4 different development environments, providing product designers and engineers with a wealth of options for programming and controlling their system that offers sophisticated utilisation of data and at the same time adding to the aesthetics of the end-product.



OPTIMISED SPACE USE

When space is limited, our GEN4 Series provides sleek adaptability without compromising on the aesthetics. Applications like elevator call buttons should be more than a mechanical button; they can be an architectural expression of aesthetic design, just as display screens that might be needed in industrial applications with limited space but still maintaining aesthetic graphical user interface.



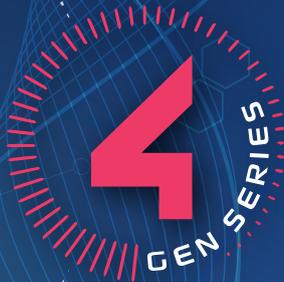
DIGITAL TRANSFORMATION

Transition your product from traditional knobs and buttons to a digital display interface, or when designing new range of products, the GEN4 Series is versatile and offers transformational benefits ranging from:

- Incorporating significantly increased number of choices, right at your fingertips;
- The ability to incorporate IoT options that help make smarter choices;
- Offering a hygienically safer surface by utilising touchscreen displays and remote interfaces;
- Reducing maintenance costs as well as digitally upgrading better options and choices.

INTERACTIVE ENVIRONMENT

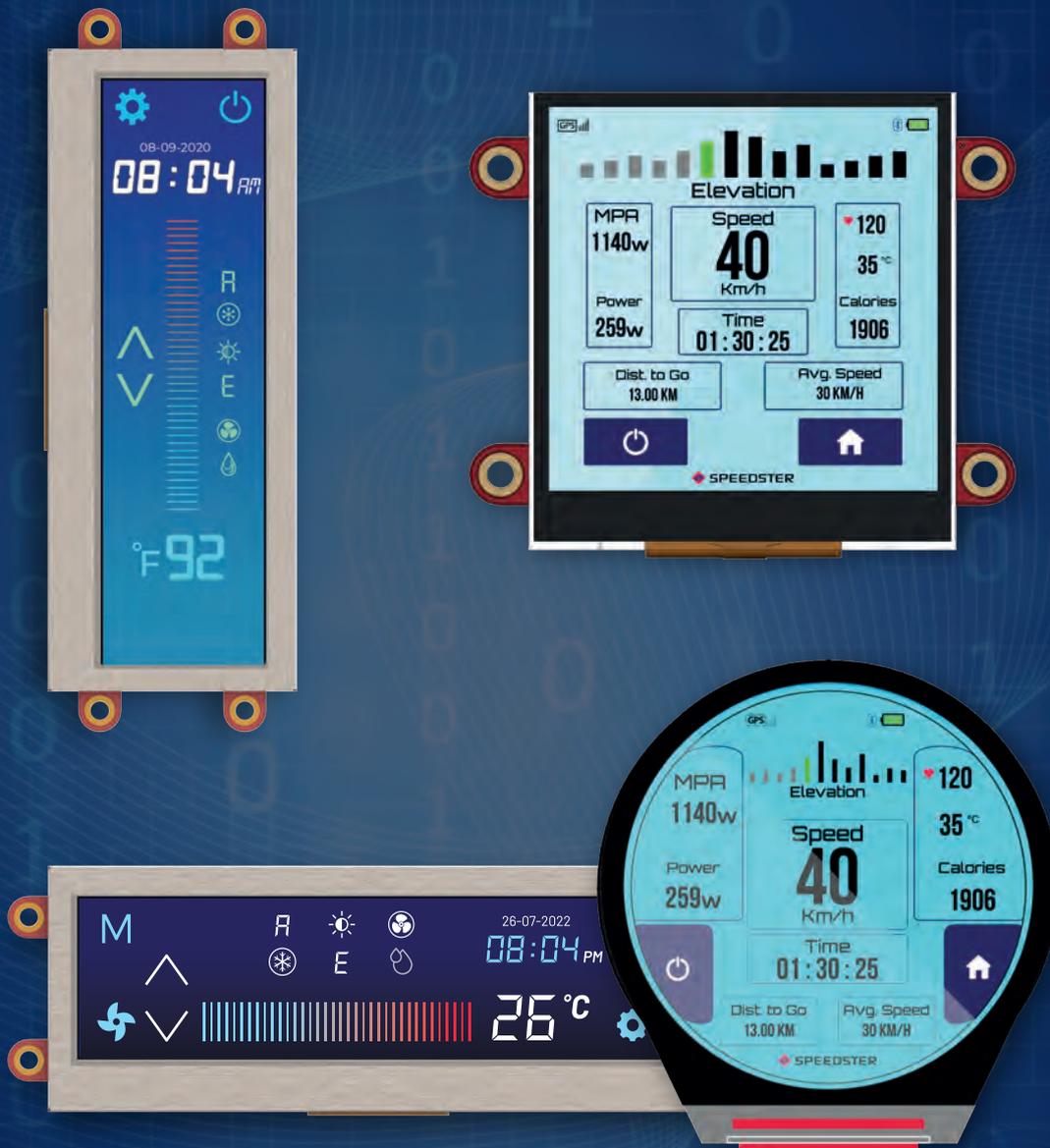
From interactive features in cars, to industrial workspace the PICASO & DIABLO-16 processors that drive the GEN4 series of embedded display solutions, can be programmed using our Workshop4 IDE even by a novice. And engineers and product designers can incorporate functions limited only by their imagination.



3.2 PixxiLCD: Compact, Sleek, Powerful

The pixxiLCD display modules are a part of the new and revolutionary series designed and manufactured by 4D SYSTEMS. Developed with low total cost of ownership in mind, the compact intelligent display modules offer an array of functionalities and options for any designer, integrator or user wishing to add a full colour HMI into their lifestyle product.

The pixxiLCD modules are powered by the fully configurable PIXXI graphics processor from our own 4D LABS and are 100% compatible with the Workshop4 IDE, offering a wealth of options for the user to program and control their systems, which allow various functionalities such as touch detection, microSD or serial flash memory storage, GPIO, and ADC, along with multiple millisecond resolution timers, as well as UART and I2C communication.



pixxiLCD

A unique offering of **intelligent display modules** in full colour incorporating round, square & rectangular formats

3.3 Workshop4: Feature-rich Software Solution

Workshop4 is a comprehensive integrated software development platform by 4D SYSTEMS for all of the 4D family of processors and modules. The IDE combines the Editor, Compiler, Linker and Downloader to develop complete 4DGL application code. All user application code is developed within the Workshop4 IDE.

Combined with **4D SYSTEMS** intelligent display modules or **4D LABS** graphics processors, **WORKSHOP4** allows you to design, develop, test, and deploy your graphical user interface easily and quickly without having to worry about low level design or development.



WORKSHOP4's rich feature set and drag and-drop-style development approach enables engineers and designers to develop impressive interfaces or any embedded display solution and facilitates fast time to market.

GLOSSARY

Artificial Intelligence (AI) : Computerised simulation of human intelligence processes, by machines that relieves humans having to undertake those processes and tasks. AI is often the foundation of automations and predictive systems.

Human Centred Design (HCD) : Design and implementation of technology that is driven by an ethos to help humans make better choices in an easy-to-use interface that is interconnected to complex and automated digital infrastructure.

Intelligence Augmentation (IA) : The use of automation and artificial intelligence that uses information technologies to increase human intelligence performance. In other words, IA is the ability of AI systems that helps make human intelligence smarter by using a Human Centred Design ethos.

Internet of Things (IoT) : A digitalised network of physical objects – things – that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

Smart Display Solutions : Touchscreen display modules, like those from 4D SYSTEMS, that is a consciously designed bridge between human initiated inputs through the touchscreen that provide non-predictive and variable data to the predictive automated and digital systems.

REFERENCE NOTES

1. Source: <https://b2b.hdl-automation.cz/cz/ke-stazeni/marketing/firemni-prezentace/reference-letiste-dubajn>.
2. Undergoing EMC compliance.

QUICK LINKS

1. For information on gen4 products by 4D SYSTEMS, go to:
<https://4dsystems.com.au/products/4d-intelligent-hmi-display-modules/gen4-hmi-display-modules> .
2. For information on pixxiLCD products by 4D SYSTEMS, go to:
<https://4dsystems.com.au/products/4d-intelligent-hmi-display-modules/pixxilcd-display-modules> .
3. For more information about the Henlo premium coffee machine, go to:
<https://4dsystems.com.au/blog/case-study-henlo-premium-espresso-machine/> .
3. For more information and enquiries about how 4D SYSTEMS can assist with your smartLIFESTYLE product by integrating smart display solutions, send your enquiry to enterprise@4dsystems.com.au .

ABOUT 4D SYSTEMS

The Company

4D SYSTEMS Pty Ltd is a global leader in engineering solutions through robust research, development and manufacture of intelligent graphics solutions driven by creativity. Our compact and cost-effective intelligent display modules utilise the latest state-of-the-art OLED and LCD technologies with embedded custom graphics processors that deliver stand-alone functionality and eliminate low-level development requirements. Combined with our comprehensive software tools, our modules provide unrivalled ease-of-use and time-to-market for developing virtually any application requiring a graphical user interface with or without touch functionality.

Established in 1990, our extensive experience allows us to transform concepts and ideas into cutting-edge hardware and software solutions. Our engineering team consists of highly skilled and creative electronics and software engineers who work in close partnership with world-class production facilities. With ISO:9001 and ISO:14001 certified manufacturing facilities, we focus on delivering the highest level of quality and customer experience. We are headquartered in Sydney, Australia with one European office in Vienna, Austria, as well as representative offices in New Zealand, Malaysia, Philippines and the UK. Our solutions are available globally through our extensive worldwide distribution network.

CORPORATE STANDARDS

To operate as a globally competent and respectable solutions provider, we are continuously adopting internationally recognised standards that help us deliver safer and better products that help our customers solve problems using our display solutions technology.



ISO 9001

We received our certification in 2019, and as an ISO 9001-certified company, our focus is to deliver highest level of quality through our production quality assurance process, delivering the consistency in all our products that our customers can rely on for design, production, delivery as well as support.



ISO 14001

From the earliest time of startup of 4D SYSTEMS, we have been an advocate for minimising waste in parallel with being environmentally responsible. In 2021 we attained ISO 14001 certification as a result of our commitment to holistic stewardship toward the environment.



ISO 13485

We take our quality management systems extremely seriously, and since 2021 we have been investing in attaining ISO 13485 standards to meet Medical Device Directives, regulations and responsibilities as well as demonstrating our commitment to the safety and quality of our display solution for medical devices.



ISO 26000

Our 6-Article Ethos is already built on the foundations of ISO 26000; they together guide 4D SYSTEMS to engage in and contribute to social responsibility aligned with our mission, vision, as well as the beneficial interests of the environment, and all of our stakeholders. Humane Capital is a key principle underlying our efforts to comply with and be recognised as an ISO 26000-certified enterprise from 2022 and beyond.

4D Philosophy for Excellence

The 4D Philosophy for Excellence is our continued commitment to design and manufacture the best solutions for our customers that meet the highest standards of quality, service and function.

We have developed a system to do exactly that: our internally developed framework for excellence is called THE AKNAR METHOD.

The AKNAR METHOD borrows inspiration from existent best practices that are contemporarily practised in the wider industry, to create a hybrid Philosophy that is unique to 4D SYSTEMS.

THE AKNAR METHOD



The AKNAR METHOD enables our organisation to go beyond systems that often narrowly focus on problem-solving & standardisation only. By being agile, knowledge-driven, network built on relationships, adaptable to change and resolute on decision-making, the 4D Philosophy for Excellence is brought to life in all departments of 4D SYSTEMS.

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