SMART CITIES

Simplifying Life Through Intelligent Environments

Display solutions for virtually any application requiring a graphics display

4D SYSTEMS

MAKING HUMAN INTELLIGENCE SMARTER

www.4dsystems.com.au

OVERVIEW

Smart cities have been on government agendas for decades and in science fiction for over a century. We projected them to bring shiny, space-age transformation, with connected systems, real-time data informing the human experience, and a seamless flow of information from one space to another - both physical and digital.

With the added demands of climate consciousness, pandemic-driven new ways of working, and population expansion, the smart city goal is higher on the radar than ever. With hefty investments in ICT infrastructure and leaps in technology, the smart city is poised to move from our screens to the world around us.

At the core of a smart city is its promise to simplify the lives of everyday citizens, with intelligent environments that respond to the user. But beneath this perceived simplicity is a complex network of technology, critical components of which include intelligent displays.

This paper explores the progress towards true smart cities so far and the virtually limitless opportunities yet to be realised. We look at what comprises the interconnected and complementary nature of a smart city, and the required hardware and software technology to facilitate this new reality.

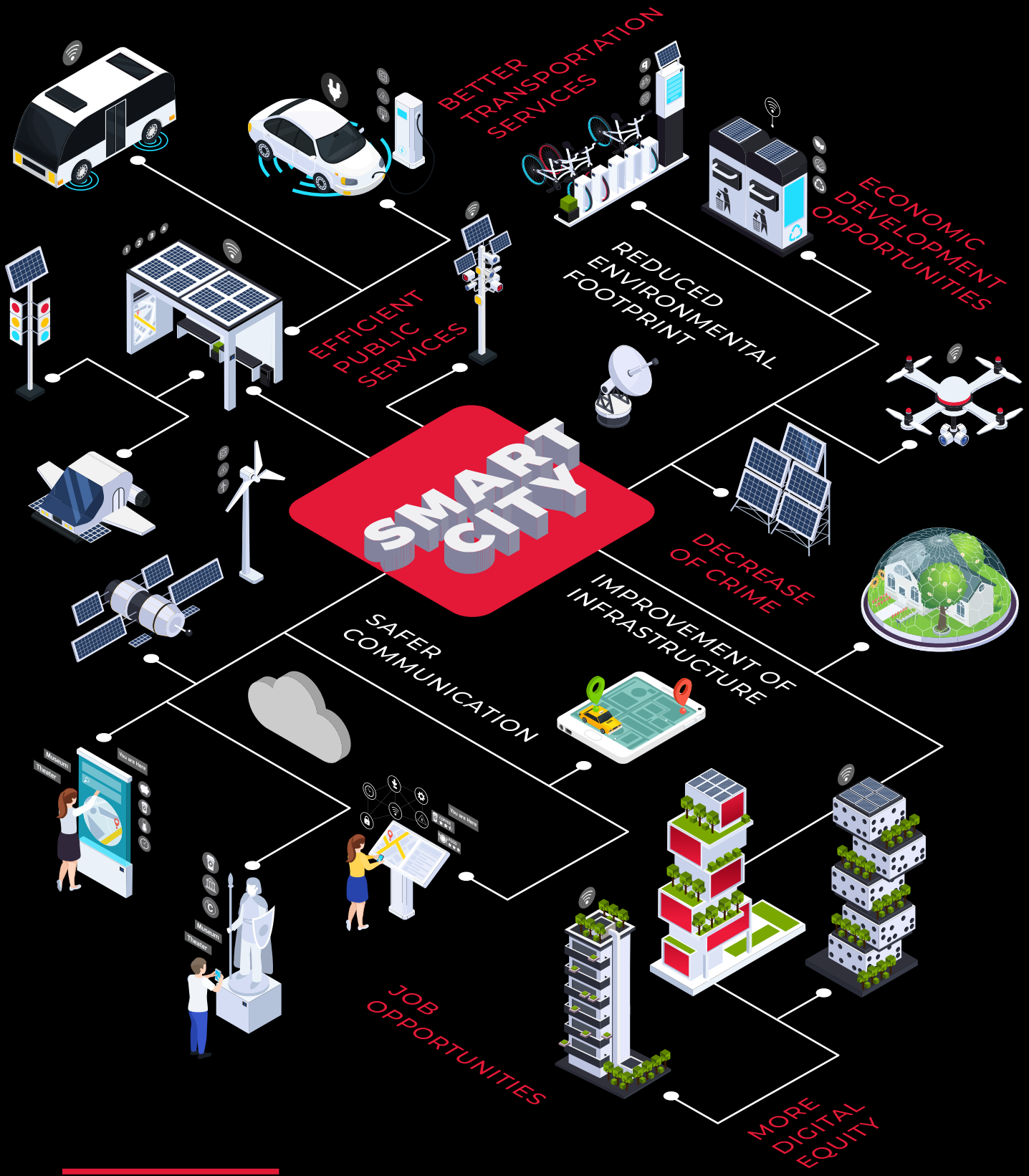
While the devices, sensors and systems that will inform this experience may seem futuristic, many are already being used in daily life or are on the cusp of being made a reality. Poised to lead these new domains is 4D Systems Technology, with display solutions for virtually any application requiring a graphics display.

Core Discussion Pillars

- **Simplicity through connection** - Understanding the purpose of smart cities: to simplify the lives of its citizens through interconnected and complementary services
- **Progress and current status** - Examining examples from the world's leading smart cities, including current progress and achievements thus far
- **Future trajectories** - Identifying areas in need of further development and opportunities for improvement
- **Smart city foundations** - Understanding the hardware and software requirements and environmental factors which impact technology selection and development
- **It's a 4D world** - The technology underpinning the success of smart cities, produced by 4D Systems

Contents

1. WHY SMART CITIES?



The proliferation of the Internet of Things (IoT) has created new opportunities for connection. One of the most notable applications could be the creation of smart cities, a paradigm that is still evolving. Smart cities involve the integration of technology into city infrastructure, with the aim of addressing growing issues including population management, urbanisation and sustainability.

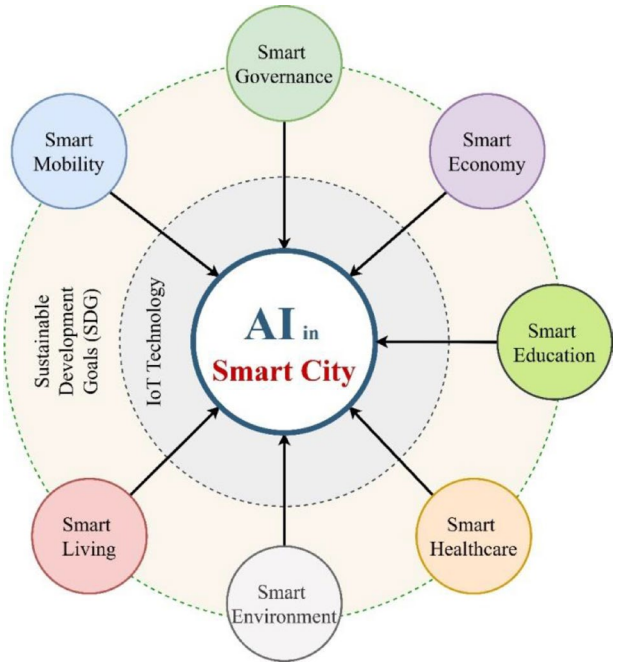
At their core, a smart city should simplify and improve the lives of its citizens. This improvement can only be achieved through interconnected and complementary services, allowing the seamless transfer of information between spaces - both digital and physical.

> *A smart city, according to IBM, makes the most use of all the linked data available today to better understand and regulate its operations while also maximising the use of limited resources.*[1]

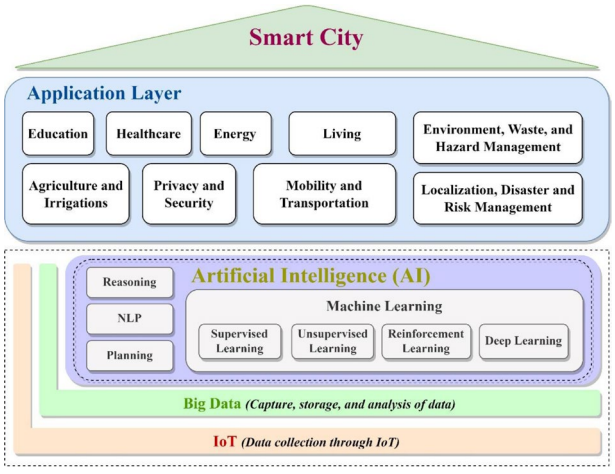
The earth's population is projected to reach 9.8 billion[2] by 2050, with twice as many people living in urban (68%) rather than rural settings. Smart cities are no longer hypothetical constructs of an idealised future. They are now a necessity for sustainability and ensuring quality of life.

There are further potential benefits for smart city residents, including greater citizen and government engagement, reduced environmental footprints, reductions in crime of 30 - 40% and less time spent commuting by 15 - 20%, as found by McKinsey & Co[3].

Cities are complex, adaptive systems in which people, physical infrastructure and technology interact. If we are to address the systemic challenges of net zero, climate resilience or circular economy, then system-based solutions are required.



Major domains of smart city — source ScienceDirect



Conceptual smart city-AI framework — source ScienceDirect

1 H.M.K.K.M.B. Herath, Mamta Mittal, 'Adoption of artificial intelligence in smart cities: A comprehensive review,' International Journal of Information Management Data Insights, Volume 2, Issue 1, 2022, https://doi.org/10.1016/j.jjimei.2022.100076

2 Hannah Ritchie and Max Roser (2018) - "Urbanization". Published online at OurWorldInData.org. Retrieved from: https://ourworldindata.org/urbanization

3 Woetzel, Jonathan; Remes, Jaana; Boland, Brodie; Lv, Katrina; Sinha, Suveer; Strube, Gernot; Means, John; Law, Jonathan; Cadena, Andreas; von der Tann, Valerie, 'Smart cities: Digital solutions for a more livable future', 2018, https://www.mckinsey.com/capabilities/operations/our-insights/smart-cities-digital-solutions-for-a-more-livable-future

2. THE STATE OF PLAY

Smart cities cannot be discussed without mention of NEOM's 'The Line'[4]. Described as the world's "first cognitive city", The Line is focused on uniting autonomous technologies, including AI, robotics and IoT. The city will leverage Project NEOS, a platform designed to simplify the movement of both data and people, and power the city's communication infrastructure. The Line was initially planned to be completed by 2030, however there is speculation its opening could be as late as 2050.


The Line, Neom city

On a global scale, cities are beginning to embrace smart city initiatives with varying success.
Singapore, in particular, has made notable headway towards smart city realisation. One of their initiatives is a parking guidance system[5], which gives drivers access to real-time data regarding parking availability. Parking spaces are monitored by sensors that relay information to electronic displays and connect to a mobile application. While simple, this is a prudent example of how effectively connected systems enhance and simplify citizen life.

This complex web of interconnection requires powerful AI technology. A tool already at our disposal, AI is projected to allow over 30% of smart city applications by 2025[6], including transport, sustainability, social welfare and vitality. The recent uptake of IoT (Internet of Things) has resulted in billions of sensors and connected devices, upon which the beginnings of a truly connected infrastructure can be built.

However, the ability to ingest, analyse, and extract value from that volume of data requires a massive transformation in the supporting digital and computing systems.

Small cities, by nature, are easier to digitise. Older, larger cities, like Rome for example, are characterised by heritage buildings and historic streets. European highways generally feature less digital signage, and public transportation displays are often non-existent. Such places are more difficult to digitise, but smaller, newer cities present immediate opportunities.

The engineering required cannot be understated, as civil engineering in the design and construction of smart infrastructure is fundamental to all other aspects of a smart city.

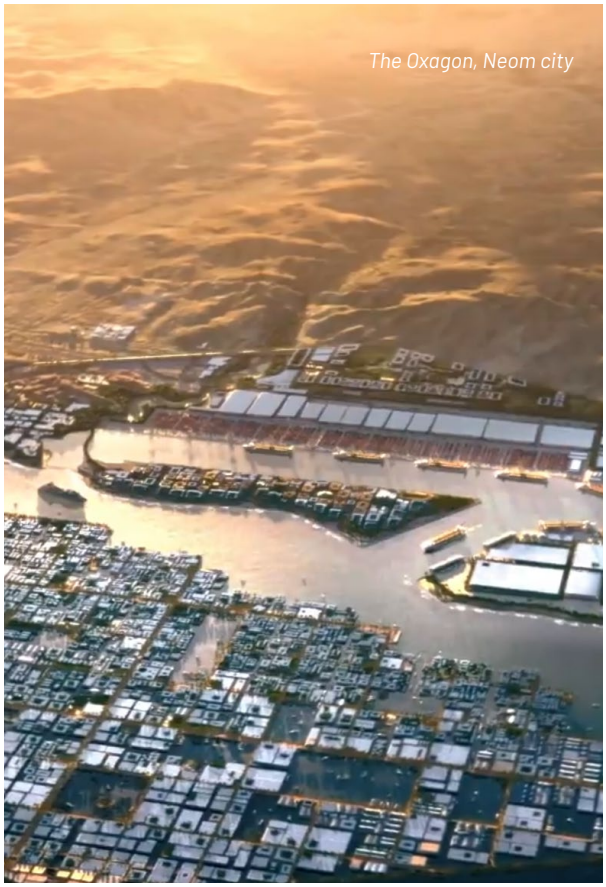

The Line, Neom city

4 'The Line', https://www.neom.com/en-us/regions/theline

5 Land Transport Authority, 'Parking Guidance System', https://www.lta.gov.sg/content/ltagov/en/getting_around/driving_in_singapore/intelligent_transport_systems/parking_guidance_system.html

6 H.M.K.K.M.B. Herath, Mamta Mittal, Adoption of artificial intelligence in smart cities: A comprehensive review, International Journal of Information Management Data Insights, Volume 2, Issue 1, 2022, https://doi.org/10.1016/j.jjimei.2022.100076

Marina Bay Sands, Singapore



The Oxagon, Neom city

Supertrees, Singapore

3. INTERCONNECTED AND COMPLEMENTARY

As smart cities are intended to simplify and enhance the lives of its citizens, the technology underpinning them needs to be user-centric and accessible by design. A solution that works for Gen Z, for example, may not work for 'baby boomers'. With a population of such diverse demographics, smart cities need to be designed with all ages, abilities, habits and preferences in mind.

Smart cities, first and foremost, must be complementary, with all systems connecting for a truly seamless flow of data. This is an area most, if not all, current smart cities are lacking. The adoption of connectivity technology has been a slow process, mainly due to the complexity of IoT projects. There is also a high cost associated with enabling this complexity. This lag in adoption is most prominently felt by the user.

> *"Smart city strategies continue to evolve. So city governments' approach to technology and data orchestration must be flexible and allow them to adjust to changing demand and vendors" - Gartner, Smart Cities Will Mitigate Social and Resilience Risks and Reward Digital Opportunities*[7]

For example, a traveller moving from one city to another uses a combination of tools and services. They use an app to find the train service information, a kiosk to purchase a ticket, board a train to the airport, use a self-service desk to check in, and may also use an app and more kiosks upon landing to access a bus, driver, etc. This flow is often interrupted by services which aren't yet assimilated; the need to find an ATM to withdraw cash, trains being delayed and apps being slow to update.

A smart city connects these elements, giving users the information they need when and where they need it.

The benefits of smart cities, however, extend beyond citizen convenience. Further areas of development potential include:

- **Sustainability and clean energy:** Green energy trends and sustainable solutions are an important aspect of smart technology to use less energy, with a lesser impact on the environment.
- **Data analysis**: More comprehensive plans and decision-making could be implemented with real-time data, also improving aspects of city life, such as maintenance schedules.
- **Smart transportation**: The data collected from smart vehicles and sensors monitoring traffic and parking services will save citizens' time with traffic and parking, and enhance the visibility of emergency crews in potentially life-saving scenarios.
- **Smart mobility**: The transition of data through networks and technology not only informs the citizen experience but also informs continuous improvement and innovation. A smart city is never truly 'finished'.
- **Rapid response**: Smart cities can also better predict and implement early warnings in the instance of natural disasters, such as earthquakes or hurricanes. Remote sensors can relay data, warnings and advice to public screens. In this way, smart cities are not only prepared to simplify life, but protect citizens in worst-case scenarios.

7 Predicts 2019: Smart Cities Will Mitigate Social and Resilience Risks and Reward Digital Opportunities, 2019, https://www.gartner.com/en/documents/3899581

3.1 PUBLIC, NOT PERSONAL

Personalisation is a growing phenomenon, with targeted marketing collateral, service customisation and the beginnings of responsive environments based on our habits. This has been enabled by the aggregation and acceleration of data-fuelled AI and ML.

While smart cities are primarily defined by technology and connectivity, personalisation involves attachments to places and people. Smart cities and personalisation are not necessarily at ends with the other, but they are likely to be maintained as separate paradigms.

Sensors and monitors are a core feature of smart cities as they allow the environment to react to a person's presence in a certain way. When accessing a train station, the identification system may be able to recognise the person by name, understand their membership or subscription and give tailored route updates based on their travel habits.

While this works on an individual level, this level of personalisation becomes unattainable in a wider city scenario. In public places, services become less personal.

3.2 PRIVACY AND SECURITY CONCERNS

The application of AI in city-settings provides benefits in automation and efficiency, however advancements also come with concerns around regulation, with issues including service discrimination, privacy, legal, and ethical matters.

By nature, smart cities rely heavily on collecting enormous amounts of citizen data. Subsequent concerns then emerge about what this data can be used for and personal privacy. With all systems being intrinsically connected, this likely extends to private matters including doctor consultations or vaccination information. It's thus understandable that questions are raised about what happens with this information.

In Toronto, Sidewalk Labs, a stablemate company of tech giant Google, was forced to abandon[8] its Quayside smart city project amid concerns over intrusive surveillance and debate about who should profit from the public data gathered.

If governments are to instil citizen confidence in the collection and use of their data, standards will need to be set. A recent example of this is the EU's General Data Protection Regulation (GDPR), which has restricted[9] the use of facial recognition in city environments. Governments and businesses will need to collaborate and ensure sufficient security safeguards for citizens.

From a cybersecurity perspective, smart cities generally combine several aspects that also make them vulnerable. They tend to involve centralisation, integration and are connected to the internet. Online access often gives windows of opportunity to attackers, which can make it possible for them to access these vital systems. Centralisation and integration create the potential for these actors to do massive amounts of damage.

> *UK's National Cyber Security Centre has published a set of principles outlining how to securely design, manage and build smart cities. "New digital technology is going to improve our lives and help protect the environment, but it is essential we take steps now to make connected places more resilient to cyber attacks," said NCSC Technical Director, Dr Ian Levy.*

Systems that aren't connected to the internet are secure by nature, but internet-connected devices are more vulnerable to attack and require greater security precautions.

8 Barth, Brian J, 'Death of a Smart City', https://onezero.medium.com/how-a-band-of-activists-and-one-tech-billionaire-beat-alphabets-smart-city-de19afb5d69e

9 Madiega, Tambiama, and Mildebrath, Hendrik, European Parliamentary Research Service, 'Regulation facial recognition in the EU', https://www.europarl.europa.eu/RegData/etudes/IDAN/2021/698021/EPRS_IDA(2021)698021_EN.pdf

4. ENVIRONMENTAL HARDWARE AND SOFTWARE CONSIDERATIONS

Human-centred design is a fundamental consideration when optimising the hardware and software for smart city applications. This becomes challenging considering the different environments technology is exposed to in outdoor environments; rain, snow, heat, dust, etc. Displays and batteries under extreme heat can boil and warp, while moisture poses obvious challenges to electrical components.

Beyond device survivability, the hardware must also be fit for purpose. For highway applications, displays need to be bright enough to be visible under the full sun. The size is also an important consideration, not only for visibility but when determining how many characters the screen can support. Without proper planning, the resulting messages may not be useful or even comprehensible. Thus, the results of scaling digital signage to the masses can be unpredictable.

LED screens are generally favoured because of their versatile application in multiple environments. OLED, in comparison, is much easier to 'burn in', especially under higher temperatures. This could be remedied by adjusting the display so it constantly changes or refreshes pixels by showing different messages, for example.

In humid areas, resistant industrial displays are preferable compared to large screens. Screens designed for industrial use are generally smaller, have bigger transistors, and are less sensitive to temperature changes and humidity.

Smart cities are constructed in different ways. They can be retrofitted, wherein the technology is integrated with pre-existing infrastructure. However, as smart cities start to be built from the ground up, it's logical for the technology infrastructure to be laid down ahead of the city being built on top of it. The IT infrastructure, then, needs to be heat resistant and protected from radiation.

With sustainability being a common goal of smart cities, attention also needs to be given to how much energy is consumed. Colour, for example, captures more energy. While the energy consumption of an individual device may seem inconsequential, it quickly becomes more significant at a whole-of-city scale. Devices with low power usage, and potentially those which turn off when not in use, are preferable over less-environmentally friendly options.

This sustainability focus often involves hydroponic gardens (meaning without soil) which need careful management. These systems can quickly become elaborate and complex, particularly at the scale required by smart ciWties. Instruments and controls are required to monitor all aspects of the environment, including water levels (regulating the volume, temperature and filtering of water being circulated), the amount of sunlight received, shading, and movement of anti-glare covers. The technicians managing these environments are best equipped with a central platform and interface.

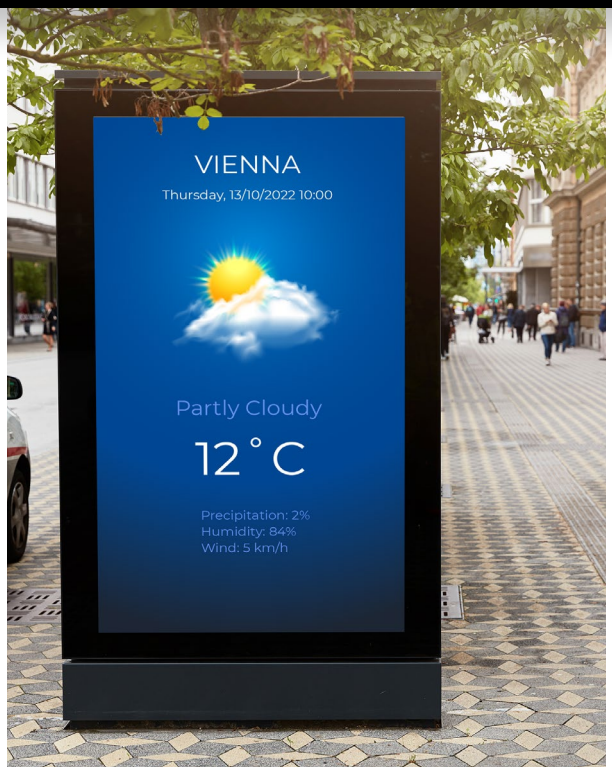
Intelligent displays are ready-to-be-installed & EMC (electromagnetic compatibility) pre-qualified display modules that enable you to quickly and easily add graphics combined with touchscreen human-machine interfaces.

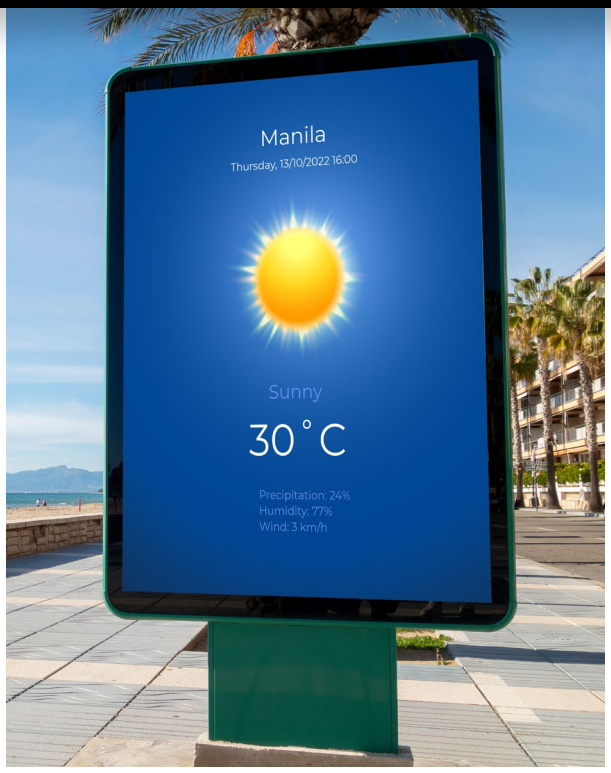
Regardless of the environment, the device or intelligent display needs to be texted within the recommended operating conditions once installed.

DEVELOPMENT ENVIRONMENTS THAT SUITS ANY APPLICATION & USER LEVEL

DESIGNER · VISI-GENIE · VISI · SERIAL

Develop, test & deploy Graphical User Interface (GUI) using **Workshop4 IDE** for Microsoft Windows





4.1 NETWORK INFRASTRUCTURE

The network that connects these devices and capabilities is perhaps the most important component. Smart cities require strong network technology and availability in order to function to full potential. There are a number of different network technologies currently on the market and each has different purposes, making them suitable for a variety of scenarios.

LoRaWAN and NB-IoT are both parts of a larger family of technologies known as LPWAN[10] (Low Power Wide Area Networking).

LoRaWAN is a power-efficient IoT protocol that comprises the LoRa radio technology, allowing for an open, reliable, and economical network deployment. The LoRaWAN specification is "designed to wirelessly connect battery operated 'things' to the internet in regional, national or global networks by targeting key Internet of Things (IoT) requirements such as bi-directional communication, end-to-end security, mobility and localisation services."

The self-deployment capabilities and maturity of LoRaWAN's chipset, gateway and cloud services makes it ideal for organisational applications where they require full ownership of their infrastructure, such as in a corporate office or enterprise campus.

NB-IoT, in contrast, is a licensed LTE radio technology offering low latency and strong security at a higher price point. NB-IoT is "a new radio added to the LTE platform, optimised for the low [bandwidth] end of the market"[11].

NB-IoT is designed for consumer IoT applications where connectivity is required at a wider scale.

> ***LoRaWAN*** *has been built to allow organisational or otherwise contained connectivity.*
> ***NB-IoT*** *is designed to cover use cases that require sending only small portions of data, but over long distances.*
> ***ZigBee*** *can facilitate more device touchpoints with high security.*

Another wireless technology which will prove integral to crafting smart cities is Zigbee.

Zigbee is a short-range networking technology, not dissimilar to Bluetooth LE with similar applications. IT's also lower-cost in implementation and offers extremely low power consumption. It supports connectivity over a mesh network topology and virtually unlimited scalability to any number of connected devices. ZigBee is most commonly used in building automation and in industrial, medical and residential control and monitoring applications.

Each network has different purposes and abilities, but no single one is the dominant option in the broad spectrum of IoT. LoRa is the most appropriate for discrete applications to communicate and transfer data between device and controller on a greater range with low power resources. NB-IoT is a more suitable choice for higher security on a lower cost, and stable wireless connection. Zigbee is ideal where large numbers of nodes need to be supported with its mesh topology.

10 LoRa Alliance, 'What is LoRaWAN Specification', https://lora-alliance.org/about-lorawan/

11 'NB-IoT explained: a complete guide to Narrowband-IoT', https://www.i-scoop.eu/internet-of-things-iot/lpwan/nb-iot-narrowband-iot/

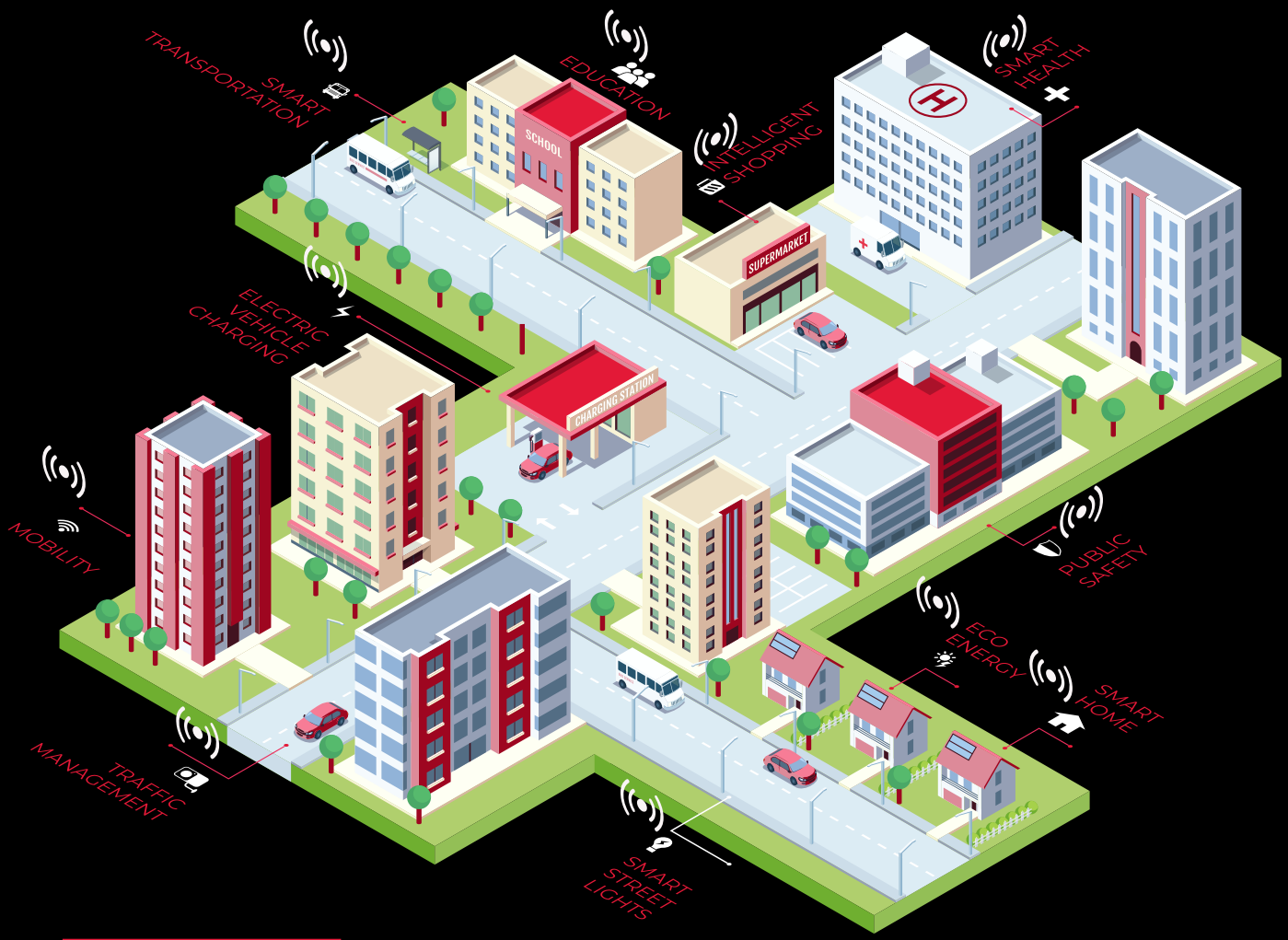
5. A WORLD BUILT IN 4D

It's increasingly apparent that the success of smart cities is largely dependent on the network connectivity and devices which allow citizens to access real-time information.

Human intelligence is crucial when it comes to making choices that are personalised and non-predictive. Display solutions are key contributors to automated data and control, and the resulting environment an individual seeks to engage with - from parking and transport, to security and public events. A combination of sensors and smart display solutions provide citizens with the right information at the right time.

4D Systems is renowned for the customisability of its technology, from solar-powered vehicles to complete building automation systems, but it also produces a range of off-the-shelf solutions, designed to integrate harmoniously with different environments.

What separates 4D Systems from other technology providers is that it has multiple options for communicating with host devices and can also act as a serial slave when used with a host MCU (Multpoint Control Unit). For example, the Texas Instruments CC2530, which mainly uses Serial for communications, can be paired with a 4D intelligent display to act as an Edge-of-Network Cloud HMI over Zigbee.



The technology designed by 4D Systems, including embedded displays and touchscreens, are able to ingest user input and determine what the user intends for the full device to do. For example, in the case of public transport automation, an integrated system already exists, wherein self-service ticket systems allow travellers to load prepaid cards. Displays of 7" are ideal for these scenarios.

An intelligent display is generally an addition to the main application and is connected to the main board via a serial connection (such as RS232, CAN2.0B, USB). The intelligent displays by 4D Systems are no exception and have the ability to integrate with existing infrastructure and software environments.

The Gen4 intelligent displays, explored further below, can also serve as standalone mini SCADA (supervisory control and data acquisition) systems, as they can generally be designed to include sensors and other input devices without using a "mainboard" or a "host" device. Diablo for example, when programmed as a host, has access to I2C and SPI protocols that most IC manufacturers use for communication.

4D Systems specialises in display solutions that are smart in two ways:

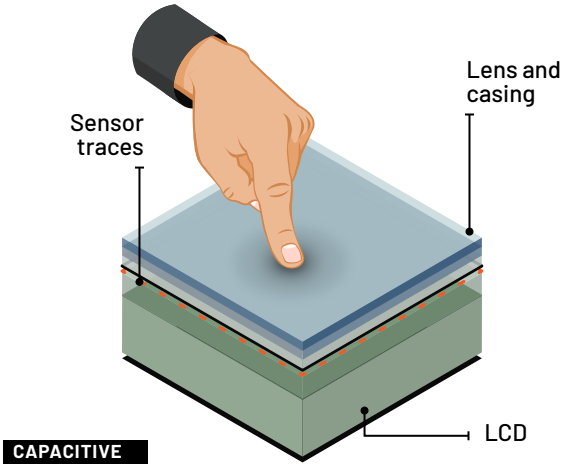
1. The technology that drives the display modules through software and processors, and its interconnectivity with the wider complex system.
2. The aesthetics of the display with which the user interacts with data at their fingertips.

5.1 TYPES OF TOUCH

These graphics displays also feature resistive or capacitive touch, for a comprehensive user interface solution that is clean and intuitive. Resistive and capacitive touch are preferential for different circumstances.

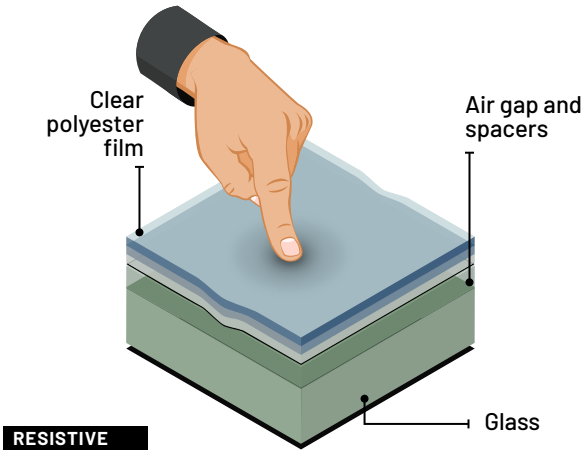
Capacitive touch panels:

- *operate under 5mm tempered glass, meaning the screen is durable and will continue to work even if it is cracked.*
- *require a bare finger to sense the electrical properties of the skin, making it the preferred choice for environments in which accidental touch may occur (such as near plants or shrubbery) without reacting to the stimulus*
- *won't suffer functionality loss due to fingerprint smudges or dirt*
- *offer exceptional image clarity due to glass layers*
- *facilitates multi-touch that enhances user experience and flexibility*
- *usually offer all-in-one solutions and can be customised based on user needs.*



Resistive touchscreens:

- *have more sensors per inch than a capacitive touchscreen; meaning the desired action can be performed using a bare finger, gloved finger or stylus*
- *are the preferred choice in an industrial setting, where operators have to use gloves on the resistive touch panel*
- *are less complex and lower cost compared to other touch technologies*
- *Are extremely durable and can be used in harsh environments*
- *is resistant to liquids like water, oil and grease and other contaminants like dust and moisture*
- *Are not power intensive*



5.2 4DISCOVERY

The suite of 4DISCOVERY intelligent display modules by 4D Systems is designed to facilitate interaction and seamless information transfer in almost any environment. Available in multiple sizes and touch options, the 4Discovery Series HMI modules are compatible with almost any host MCU or processor.

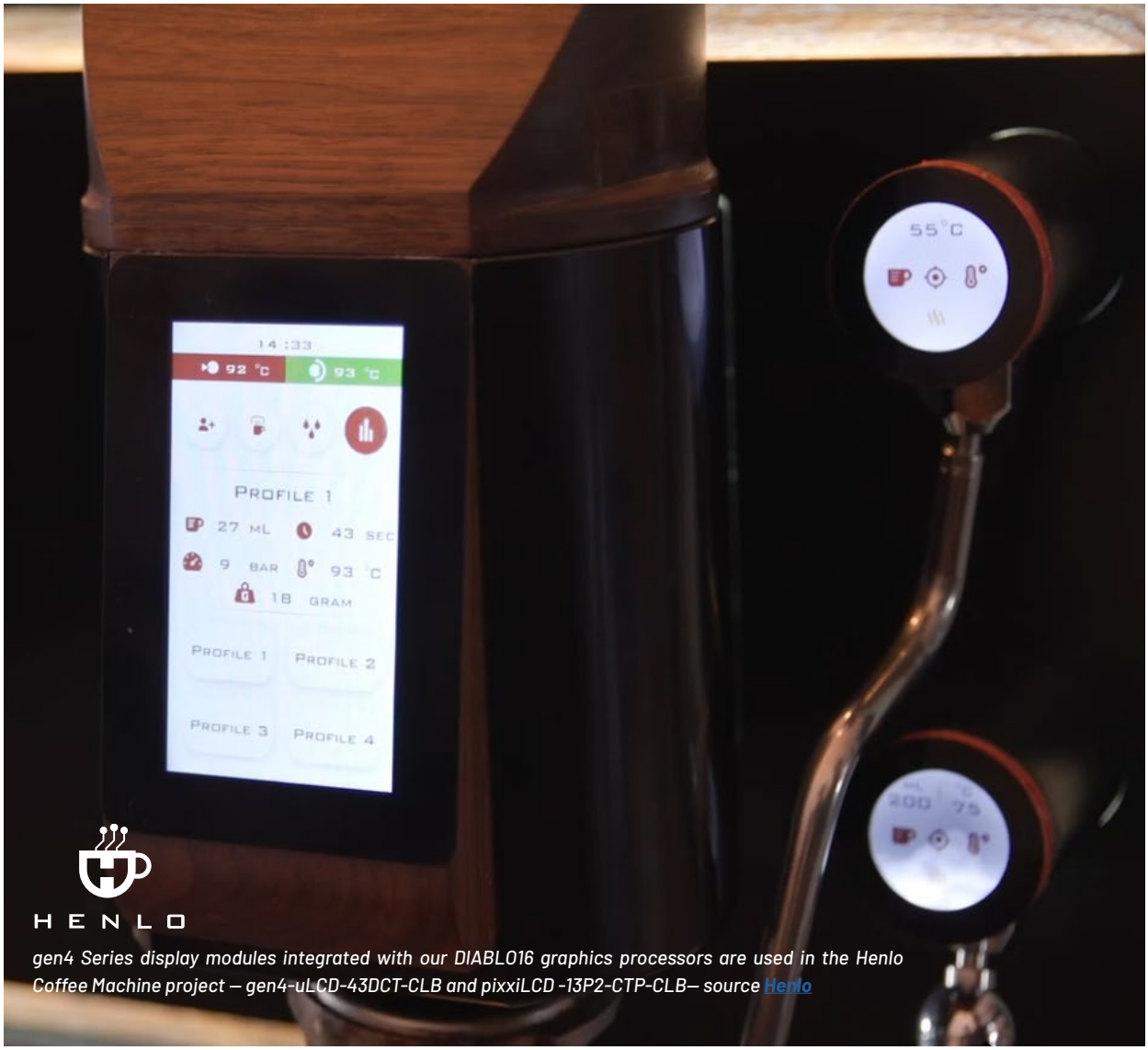
The 4DISCOVERY, a 3.5 - 5.0" integrated display, can be mounted on any flat drillable surface - and in any orientation. The 5.0" variant features a built-in infrared proximity sensor to wake the unit as someone approaches, and a switch-mode power supply enabling a wide input voltage range. This is particularly prevalent in situations where there is a need to reduce power usage, with the ability to fix the display to street lights or bus stops, for example, and it only switches on when a citizen is in the immediate vicinity. Planned for future release are 1.3" round displays powered by Pixxi - these variations multiply the flexible opportunities available.

4Discovery also features an embedded Diablo 16 processor. The Diablo16 offers a simple plug-n-play interface to many 16-bit 80-Series colour LCD and OLED displays, and is designed to work with minimal design effort as all of the data and control signals are provided by the chip to interface directly to the display.

The 4Discovery was the chosen device to enhance the guest experience at The Sinclair in Fort Worth, Texas - the world's first all-digital hotel. Through the 4Discovery, the guest can adjust the temperature of the room, the light settings in the suite's bedroom and bathroom, the window shades, and even the shower temperature to the exact degree that they choose.

Data and IoT technology weaves behind the walls of the entire hotel, quietly and seamlessly, helping share and utilise data that drives the digital technology and holistic experience. Whilst data-driven innovation supports the hotel's digital infrastructure, it is the way guests interact with that data that brings the hotel to life.

At the centre of the guest's experience is the custom-designed 4Discovery smart display system from 4D Systems. The sophisticated IoT, PoE (power over ethernet) and automated digital infrastructure operate quietly and efficiently behind the scenes, contributing to immense energy savings for The Sinclair and, thus, creating a more sustainable and energy-efficient building.

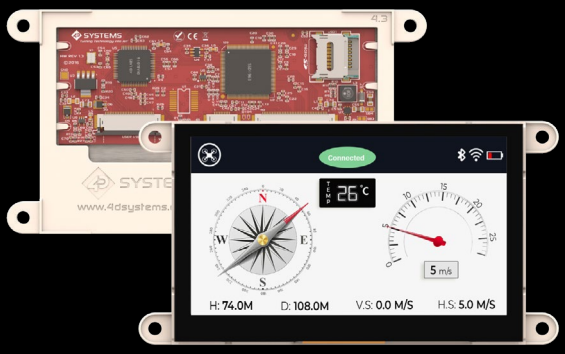


gen4 Series display modules integrated with our DIABLO16 graphics processors are used in the Henlo Coffee Machine project – gen4-uLCD-43DCT-CLB and pixxiLCD -13P2-CTP-CLB– source Henlo

5.3 gen4-HMI Intelligent Displays

The GEN4 Series of display modules has been designed by 4D Systems to minimise the impact of display related circuitry and provide a platform suitable for integration into a product that will substantially benefit from an embedded display solution.

Designed specifically for ease of integration and use, with careful consideration for space requirements and functionality, several devices in the GEN4-uLCD Series is 100% compatible for the Workshop 4 IDE and its 4 different development environments, providing product designers and engineers with a wealth of options for programming and controlling their system. The gen4-IoD Series has its own environment and gen4-4DPi, gen4-4DCAPE and gen4-FT series are not programmable, making them ideal for simple deployments.



The Gen4-IoD Series includes internet enabled modules. This series is powered by a programmable WiFi chip, ESP8266, allowing ease of connectivity with the world wide web. Paired with IoT modules, such as ESP8266/ESP32, gen4-uLCD modules can also integrate with most systems connected to the internet.

The GEN4 Series is versatile and offers transformational benefits ranging from:

- *Incorporate significantly increased number of options 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*
- *Several different connections make it easily connectible with different devices*

With rapid urbanisation, air quality management is also a primary focus to ensure citizen wellbeing. 4D Systems worked with Airinspace who, as the name suggests, is focused on developing ways to provide clean air in space. It was a key priority that the user experience remained as simple and ergonomic as possible. The embedded displays used vary across the PIXXI, GEN4 and uLCD range. Airinspace was able to design their screens and graphic components without writing a line of code, and it was easy to develop the interfaces based on customer feedback.

4D Systems have already demonstrated the abilities of their products to integrate with aquatic environments. One of their projects was with MicroPlasma Ozone, a company that manufactures Smart Ozone Systems to automatically maintain the health of in-ground swimming pools. GEN4 (specifically the gen4-uLCD-43DT) technology was employed to facilitate user interaction, real-time monitoring, and error warnings. The display was designed to show the values for Ozone Gas Flow (L/min), Temperature (°F), Humidity (%RH), and Ambient Ozone Gas (ppm), and system health. This is not dissimilar from the application which would be required for hydroquatics, in which water composition, flow and temperature would need to be monitored and controlled.

5.4 INTERFACING WITH POPULAR PLATFORMS

Intelligent displays are extensions of the platforms supporting them. Engineers choose to add displays to platforms in order to interact with the information stored within. Microcontrollers, for example, read data from sensors and a display allows the user to see this information in real time. 4D's technology is able to interact with all popular platforms.

gen4-uLCD-43DCT-AR — source 4D SYSTEMS

gen4-uLCD-43DT-PI — source 4D SYSTEMS

Arduino, for example, is an open-source platform consisting of both a physical programmable circuit board (a microcontroller) and an IDE (Integrated Development Environment) which is run on a computer, and used to write and upload computer code to the physical board. Arduino has a large user community, free and broad ranges of libraries of codes, and relatively low cost components. Its flexibility makes it a suitable choice for a wide range of projects.

Raspberry Pi is another platform, commonly used by engineering students to learn programming skills. However, it's also used in hardware projects and home automation. Raspberry Pi operates in the open source ecosystem and its main supported operating system, Pi OS, is open source and runs a suite of open source software. Raspberry PI is a robust and affordable option for smaller projectsand its low power draw makes it very energy efficient. While it's an ideal platform for learning. It's not necessarily an ideal base for a commercial embedded or IoT product.

4D technology is also compatible with other embedded Linux systems, including Ubuntu Core, Omega 2 and Jetson Nano. These are some of the most popular choices for IoT projects, however the platform choice will largely depend on the use case.

CONCLUSION

With the rate of global population expansion and pressing issues including the environment and sustainability, the transition towards smart cities is no longer a hypothetical construct of science fiction, but a growing necessity.

Technological advancements in IoT, AI and ML now provide us with the foundations to begin building true smart cities. Whether these cities are built from the ground-up or integrated with pre-existing infrastructure, the right technology must be in place if the full potential is to be realised.

Intelligent displays are just one piece of this transition puzzle, providing citizens with new ways to engage with their environments and equipping them with the information they need, when they need it.

Placed at the forefront of the intelligent display movement is 4D Systems. The projects undertaken to date demonstrate the ability of 4D technology to support this new age of city-wide connectivity. They have the innovative graphics display solution for virtually any application requiring a graphics display, with or without touch. Their modules can be integrated with a variety of systems and environments, from in-home connectivity to outdoor city modernisation.

Smart cities offer unlimited potential to simplify and enhance the lives of citizens, drive significant environmental benefits and solve pressing issues around urbanisation. The realisation of this potential requires commitment and investment from governments to build the cities of tomorrow. The technology required, however, is already available and advancing rapidly. The public technology decisions made now will largely shape our future.

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About 4D Systems

4D Systems is a global leader in the design, development, and manufacture of intelligent display solutions for high-tech industries ranging from medical, industrial, automotive, and commercial use. Our products and solutions utilise the latest state-of-the-art OLED and LCD technologies with embedded custom graphics processors that deliver stand-alone functionality, eliminate low level development requirements and provide unrivalled ease-of-use and time-to-market for developing virtually any application requiring a graphical user interface.

4D Systems started as an idea, which grew to become a global company that engineers real world solutions. We want to empower forward thinking engineers, designers, and organisations who, by using our products, also help solve real world problems and make a positive impact, one display solution at a time.

Contact 4D SYSTEMS

Get in touch to discuss your latest projects, display experience, our products or to request any information. We'd love to chat.

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