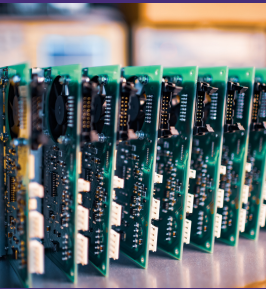
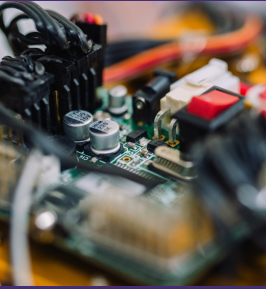


A GUIDE TO MODERN EMBEDDED COMPUTERS

# Unlocking Innovation



EMBEDDED  
TECHNOLOGIES

# Table of Contents



Introduction	03
Evolution of embedded computers	05
Types of embedded computers	08
Key components and features	10
Embedded computers across industries	14
Future trends	16
Embedded Technologies Success Stories	18
Next Steps	19
Get to know ETE	20
Copyright	21

# Introduction

In the vast expanse of the digital universe, there exists a category of technology that has silently shaped our world for decades. These unsung heroes, known as embedded computers, are everywhere.

## But what is an embedded computer?

An embedded computer, is an integral component of most embedded systems, has a combination of hardware and software and designated to perform a specific function. They are in food processing equipment, airplanes, automobiles, phones... The list goes on and on. They are in beating heart of countless devices and systems that have seamlessly integrated themselves into our lives.

## The Space Odyssey

While the term "embedded computer" might not conjure images of interstellar voyages, it's worth noting an impressive early example of embedded computer and a first computer based on silicon integrated circuits. was a guidance computer used aboard the Apollo command and lunar modules., this pioneering piece of hardware sported a 15-bit word length, on a mere 2K of Core memory, a 2MHz clock speed, and 36,864 16-bit (including parity) words of Core ROM. In its day, it weighed a staggering 32 kilograms—an embodiment of technology's infancy in the realm of embedded computing. I'm sure it was designed in 1965 whilst listening to Bob Dylan's - Like a Rolling Stone!

Fast forward to today, and you'll find that the electronics used in modern embedded computers can easily fit on the tip of your finger. Take, for instance, the [BOXER-6406-ADN](#) a small but mighty industrial embedded computer. With four processing cores and clock speeds thousands of times faster, it's a testament to the exponential growth of embedded technology. Its internal processor cache memory alone boasts a whopping 6 megabytes!

## The Quantum Leap in Technology

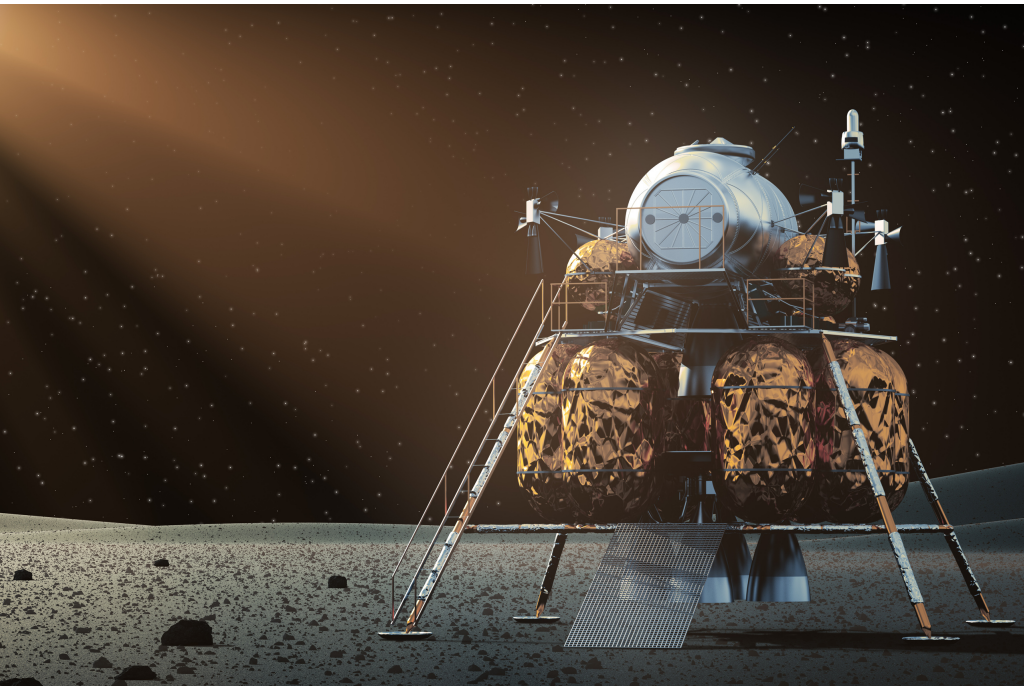
To truly appreciate the leap in technology, let's draw a parallel between solid state storage Core storage—a technology of the past—and a modern microSD card.

**Picture this:** a minuscule microSD card with a storage capacity of 8 gigabytes sitting atop a mere 8 bytes of Core memory. The contrast is staggering. In fact, today's microSD cards can boast capacities of up to 2 terabyte—a monumental advancement that far exceeded the entire world's Core storage capacities of the 1960s.

***From the lunar surface to our homes, embedded computers have redefined the boundaries of innovation.***

As we embark on this exploration, we invite you to join us on a captivating journey — a journey that spans from the Apollo missions to the cutting-edge innovations of today — we'll unravel the limitless possibilities that embedded technology brings to the forefront of the digital age.

**Let's get started!**





# Evolution of embedded computers

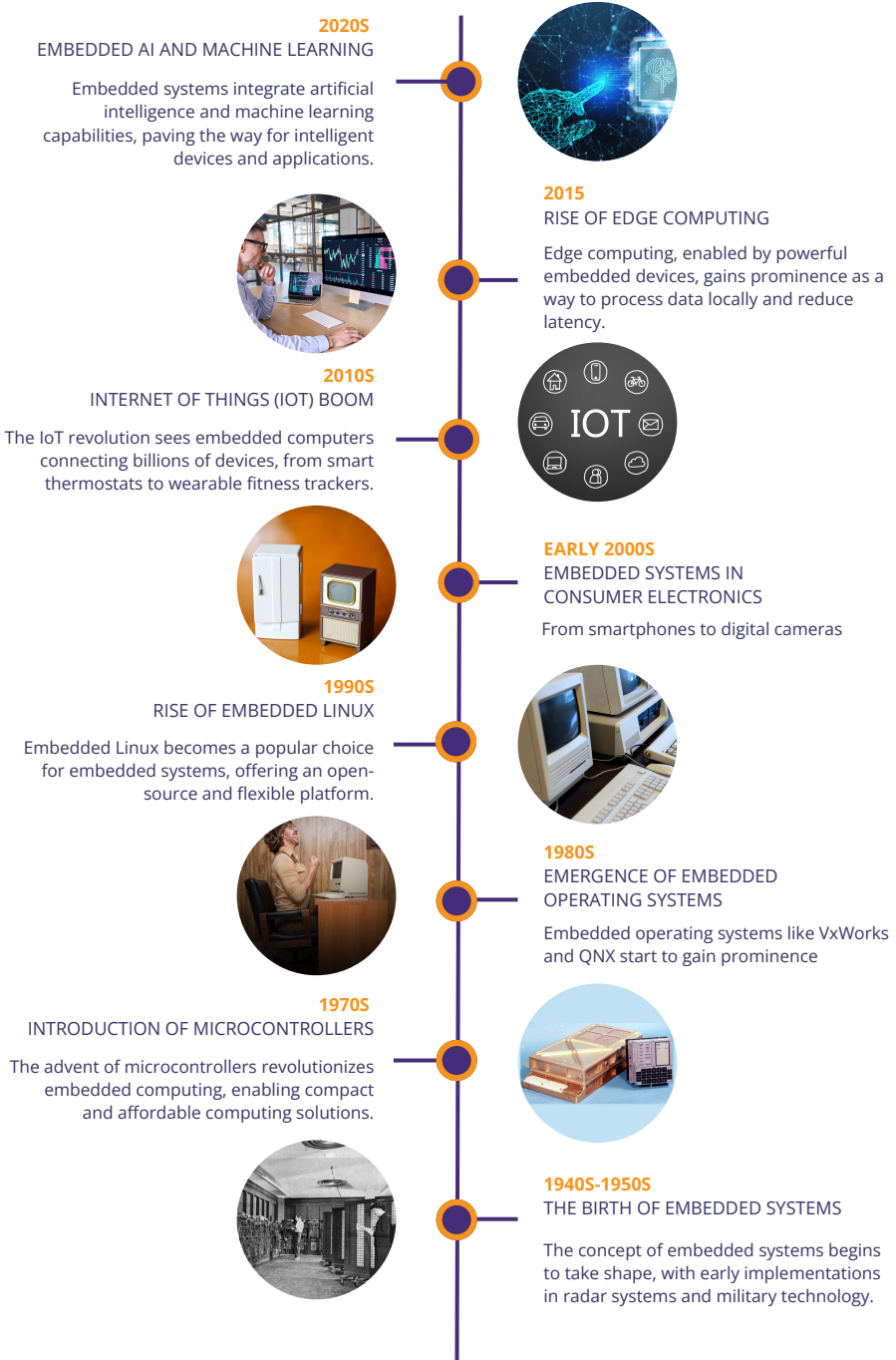
The journey of embedded computers dates back to the early days of computing when innovation was in its infancy. The roots of embedded computing can be traced to the desire for automation and the need to make machines perform specific tasks without human intervention.

The first embedded systems emerged in the mid-20th century when engineers began integrating simple computer circuits into industrial machines, creating the foundation for what we now know as embedded computers.

These early systems were often rudimentary, with limited processing power and functionality, but they paved the way for the technological revolution that would follow.

Over the decades, embedded computing has seen remarkable milestones and transformations. From the introduction of microcontrollers to the development of sophisticated system-on-chip (SoC) designs, the evolution has been relentless.

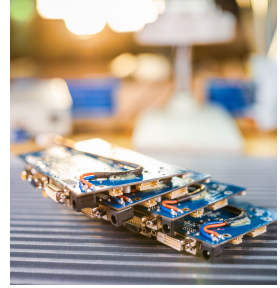
**Some key milestones in this journey include:**



**Embedded computers have evolved so much, working tirelessly behind the scenes to enable the devices and systems we rely on daily. Their role is multifaceted and indispensable:**

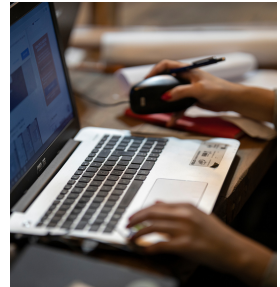
### **AUTOMATION**

Embedded computers are the brains behind automation in industries like manufacturing, where they control production lines, robots, and machinery, optimizing efficiency and precision.



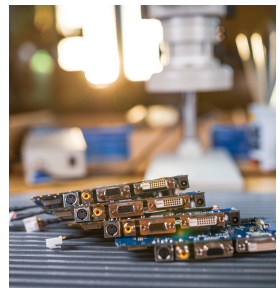
### **CONNECTIVITY**

They enable seamless communication between devices, allowing your smartphone to interact with your smart home appliances or your car to navigate using GPS.



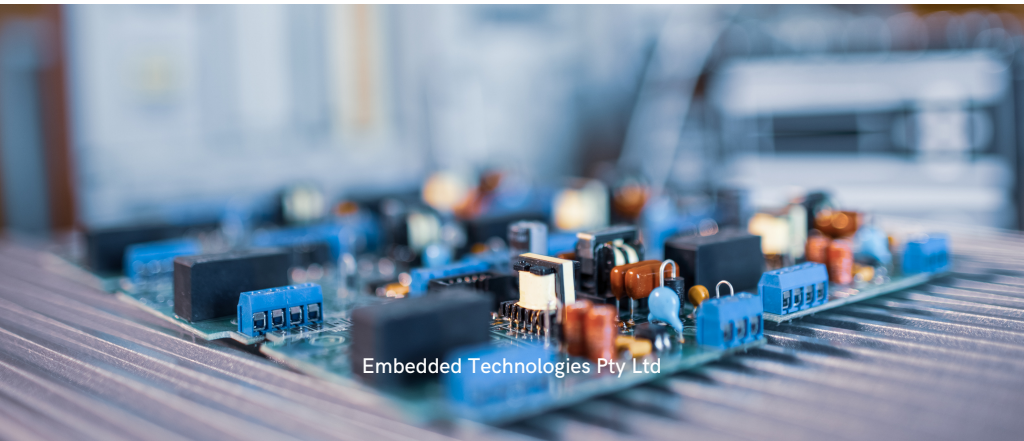
### **DATA PROCESSING**

Embedded computers process vast amounts of data in real time, making split-second decisions in applications like autonomous vehicles and medical equipment.



### **EFFICIENCY**

They improve energy efficiency in buildings, industrial processes, and transportation systems, contributing to sustainability efforts.



# Types of embedded computers

Embedded computers come in a diverse range of form factors, each tailored to specific applications and use cases. Understanding these form factors is crucial for selecting the right embedded computer to meet your unique needs.

**Let's explore some of the most common form factors and their applications.**

## SINGLE-BOARD COMPUTERS (SBC)

Single-board computers are self-contained systems with all components, including CPU, memory, and I/O interfaces, integrated onto a single circuit board. They are compact and ideal for applications with space constraints.

**Applications:** IoT devices, Robotics, Educational platforms

## COMPUTER-ON-MODULES (COM)

Computer-on-modules are highly modular, with a CPU module that can be plugged into a carrier board. This modularity allows for flexibility and scalability in design.

**Applications:** Medical devices, Industrial automation, Aerospace systems

## SYSTEM-ON-CHIP (SOC)

System-on-chip devices integrate all essential components onto a single chip, including CPU, GPU, memory, and peripherals. They are power-efficient and compact.

**Applications:** Smartphones, Wearable devices, IoT edge devices

## BOX COMPUTERS

Box computers are standalone devices enclosed in a ruggedized chassis. They offer high performance and are suitable for demanding industrial environments.

**Applications:** Industrial automation, Transportation systems, Military applications



## PANEL PCS

Panel PCs combine an embedded computer with a touchscreen display in a single unit. They are commonly used in human-machine interfaces (HMIs) and kiosks.

**Applications:** Retail kiosks, Medical devices, Manufacturing control panels

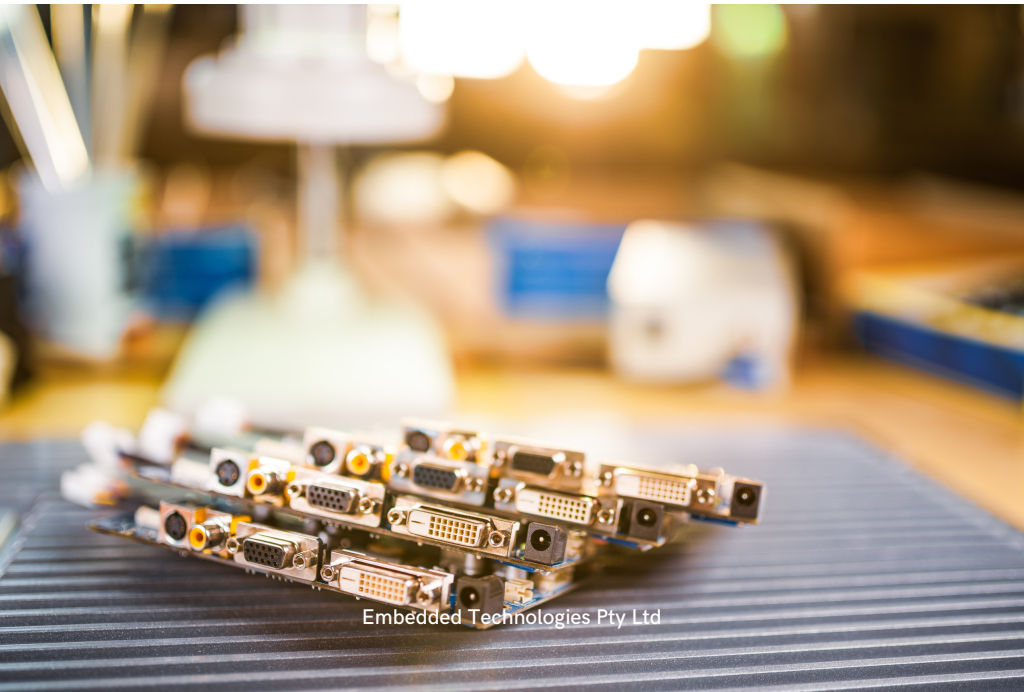
## EDGE SERVERS

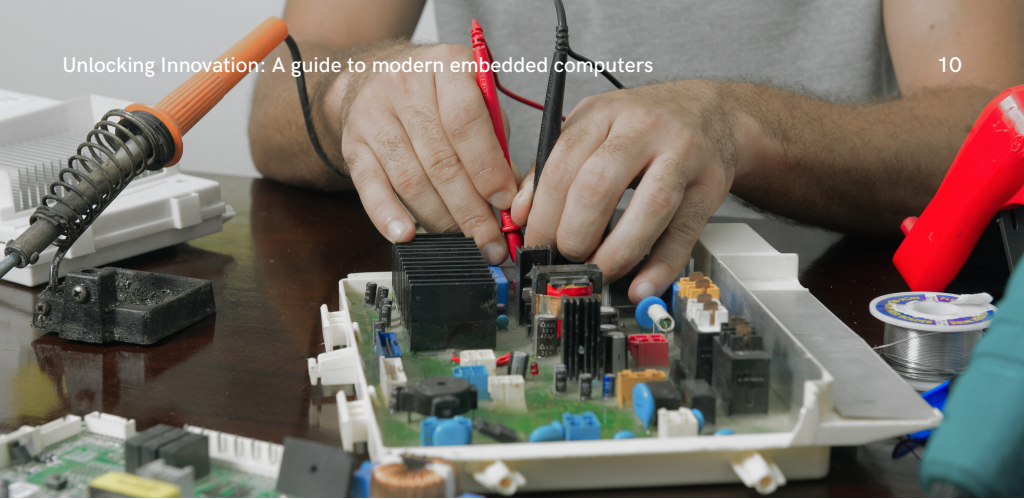
Edge servers are compact yet powerful computers designed for data processing at the network edge. They facilitate real-time data analysis and decision-making.

**Applications:** Edge computing, Surveillance systems, Smart cities

Choosing the right embedded computer depends on factors such as performance requirements, form factor, environmental conditions, and power efficiency.

In the following sections of this eBook, we will go deeper into these considerations to help you make informed decisions when selecting an embedded computer for your specific application but don't forget, **we are always here to help you make better decisions and you can contact us [HERE](#).**





# Key components and features

To comprehend the inner workings of embedded computers, it's essential to grasp the core components that define their functionality. These components work in harmony to execute tasks, process data, and interface with the world.

Just as each instrument plays a vital role in producing harmonious melodies, the components within an embedded computer work in concert to orchestrate its functions.

**In this section, we'll peel back the layers and immerse ourselves in the symphony of fundamental elements that give life to embedded computers.**

- **CENTRAL PROCESSING UNIT (CPU)**

Imagine the CPU as the maestro of this symphony, conducting with precision and grace. This mastermind is responsible for executing instructions and performing calculations. Its prowess defines the processing power and speed of the entire system, much like a conductor shaping the tempo and intensity of a musical performance.

- **MEMORY (RAM AND STORAGE)**

Just as a musician relies on sheet music, embedded computers need memory to bring data and programs to life. RAM, or Random Access Memory, acts as the sheet music stand, providing temporary storage for data and programs in active use. Meanwhile, storage solutions like SSDs or eMMC serve as the library, housing data persistently even when the power is off, ready to be accessed at a moment's notice.

- **INPUT/OUTPUT (I/O) INTERFACES**

The I/O interfaces are the connectors that bridge the embedded computer to the external world, much like the instrumentalists on a stage. These interfaces come in various forms, from USB ports and Ethernet connections to GPIO pins and serial ports, adapting to the unique demands of each performance or application.

- **OPERATING SYSTEM (OS)**

Behind the scenes, the operating system (OS) takes on the role of a backstage manager. It oversees the allocation of resources, ensures the smooth execution of applications, and provides the user interface. Embedded computers may rely on specialized embedded OSs or Linux-based distributions, each tailored to its specific needs.

- **POWER MANAGEMENT**

In the world of embedded computers, energy efficiency is paramount, much like a tightrope walker maintaining balance. These systems often operate in low-power environments or run on batteries, necessitating clever power management strategies. Power-saving modes and voltage regulation ensure that the show goes on smoothly.

### ***The symphony doesn't end with the core components.***

In addition to this core components, embedded computers may offer specialised features and interfaces tailored to specific applications:

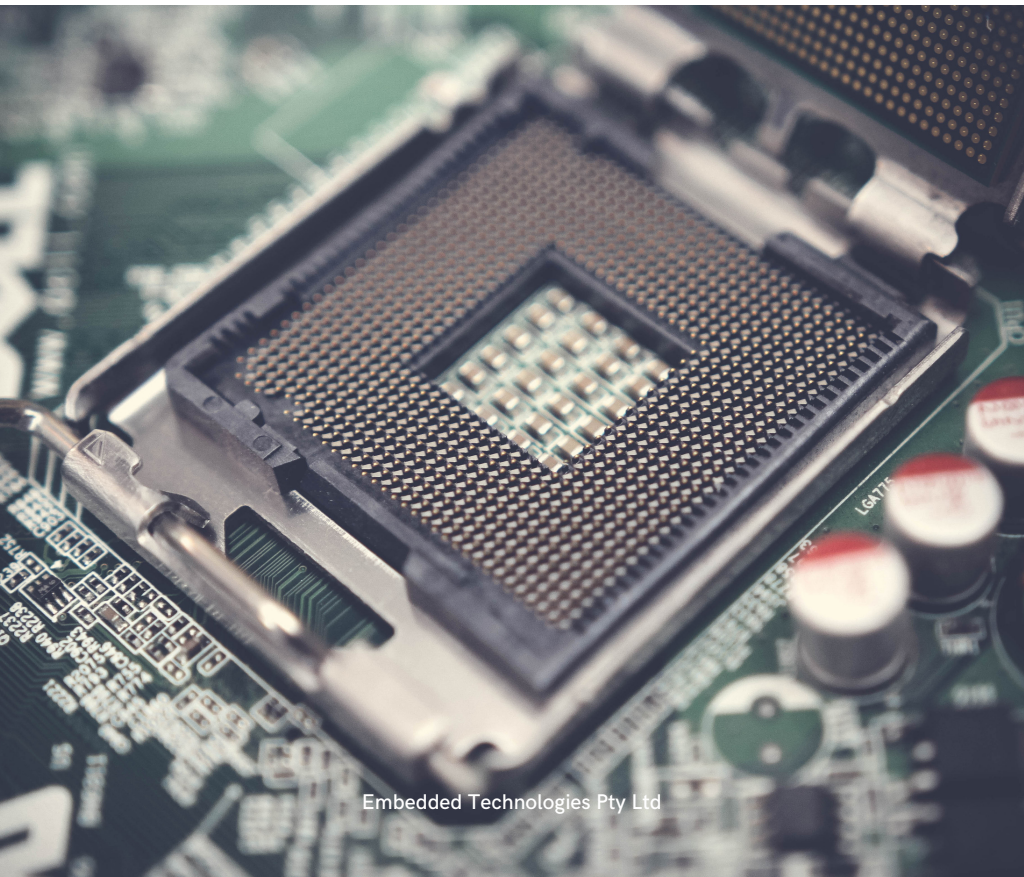
- **Graphics Processing Unit (GPU):** For applications requiring visual processing or graphics rendering, embedded computers may include a GPU.
- **Connectivity Options:** Wireless connectivity options such as Wi-Fi, Bluetooth, and cellular modems enable communication with other devices and networks.
- **Hardware Acceleration:** Some embedded computers incorporate hardware acceleration for tasks like encryption, video decoding, or artificial intelligence (AI) processing.
- **Ruggedisation:** In harsh environments, ruggedized embedded computers are built to withstand extreme temperatures, vibrations, dust, and moisture.

*As technology advances, embedded computing continues to evolve.*

Several advanced technologies are shaping the future of embedded systems:

- **Artificial Intelligence (AI):** Embedded computers are integrating AI capabilities for tasks like image recognition, natural language processing, and predictive analytics.
- **Internet of Things (IoT):** IoT connectivity and sensors enable embedded computers to collect and transmit data for smart applications and remote monitoring.
- **Edge Computing:** Edge computing empowers embedded computers to process data locally, reducing latency and enhancing real-time decision-making.
- **Miniaturization:** Advancements in semiconductor manufacturing enable the creation of smaller, more energy-efficient embedded systems.

Understanding these components and their orchestrated harmony is the key to **unlocking the full potential of embedded computing** — a journey that promises a future filled with endless possibilities for your business.



***Move forward.  
Good things  
are up ahead.***

# Embedded computers across industries

As we approach each industry, you'll witness the remarkable versatility of embedded computers. They adapt, innovate, and elevate performance, turning challenges into opportunities and propelling each sector into a future defined by efficiency, precision, and connectivity.

## TELECOMMUNICATIONS

In the realm of telecommunications, embedded computers play a crucial role in maintaining seamless communication networks. From routers managing data traffic to base stations ensuring seamless mobile connectivity, these computers play a pivotal role in keeping the world connected. Embedded systems in this industry must deliver reliability, low latency, and high data throughput to meet the demands of modern communications.

## HEALTHCARE AND MEDICAL DEVICES

Embedded computers are the lifeline of modern healthcare and medical devices. They power diagnostic equipment, patient monitoring systems, and even surgical robots. From MRI machines to patient monitors, these systems are indispensable in the medical field. Patient safety, accuracy, and compliance with medical regulations are paramount in this industry.

## INDUSTRIAL AUTOMATION

Factories and manufacturing plants rely on these systems for precise control, monitoring, and optimization of production lines. Programmable logic controllers (PLCs) and industrial PCs ensure that factories operate efficiently and with minimal downtime. These systems are designed for rugged environments and are essential for achieving automation and operational excellence.

## DEFENCE AND AEROSPACE

High-stakes missions demand unwavering reliability, and that's precisely what embedded computers deliver in the defense and aerospace sectors. Embedded systems control unmanned aerial vehicles (UAVs), guide missiles, and manage radar and sonar systems. These computers must meet stringent reliability and security standards to ensure the safety and success of military and aerospace operations.

## TRANSPORTATION AND MINING

Embedded computers are the brains behind modern transportation systems and vehicles. In automotive applications and in mining, they control engine performance, manage infotainment systems, and enhance safety through advanced driver assistance systems (ADAS). In transportation, embedded systems power traffic management, ticketing, and navigation systems. Reliability, real-time performance, and safety are paramount in this industry.

## MARINE

On the high seas, embedded computers are the captains of maritime technology. They steer naval vessels, submarines, and commercial ships, ensuring safe navigation, communication, and mission-critical operations. These systems control sonar and radar equipment, underwater drones, and communication arrays, contributing to maritime security and defence.

*Technology is constantly evolving and the role of embedded computers in helping these industries will only grow, opening doors to new possibilities and driving us towards a smarter and more **connected world**.*



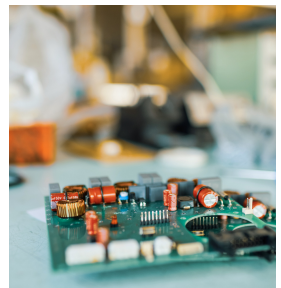
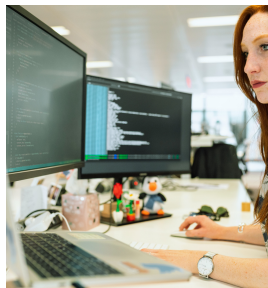
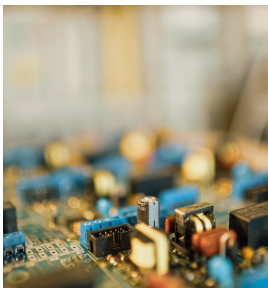
# Future trends

Embedded computing, a cornerstone of modern technology, brings a set of exciting future trends that define its dynamic landscape.

In this section, we'll explore emerging trends, innovations, and the strategies to prepare for the future of embedded computers.

The landscape of embedded computing is continuously shaped by emerging trends and groundbreaking innovations that expand its horizons and capabilities and some of them are:


- ✔ **Artificial Intelligence (AI) and Machine Learning:** Embedded systems are integrating AI and machine learning algorithms to enable tasks such as image recognition, predictive maintenance, and natural language processing, unlocking new realms of automation and decision-making.
- ✔ **Edge Computing:** Edge computing is redefining how embedded systems process and manage data. By bringing computation closer to data sources, edge computing reduces latency, supports real-time analytics, and enhances decision-making at the source.
- ✔ **Internet of Things (IoT):** Embedded computers serve as the heart and soul of the Internet of Things (IoT), connecting billions of devices and enabling data-driven insights, automation, and remote monitoring across various industries.
- ✔ **5G Connectivity:** The advent of 5G networks is revolutionizing embedded computing by providing high-speed data transfer and ultra-low-latency communication, opening doors to innovative applications and use cases.
- ✔ **Ruggedized Solutions:** Industries such as defense, manufacturing, and maritime demand ruggedized embedded systems capable of withstanding harsh environmental conditions, reinforcing the need for robust and durable solutions.








As we navigate the dynamic landscape of embedded computing, it is essential to prepare for the future and embrace the transformative potential it holds.

To thrive in this evolving ecosystem, **several strategic considerations** come to the forefront which we talk about next.

 **Skill Development:** The emergence of new technologies such as AI, IoT, and edge computing demands a workforce that is well-versed in these areas. To remain competitive, investing in skill development and ensuring your team includes experts in these fields is crucial. By nurturing a pool of skilled engineers and developers, you'll be better equipped to leverage the capabilities of emerging technologies.

 **Security Focus:** In an increasingly interconnected world, security takes centre stage. Strengthening security measures and proactively mitigating evolving threats is a continuous commitment. A robust security strategy not only safeguards your embedded systems but also protects sensitive data and ensures the reliability of your applications. Prioritizing security will be paramount in the years to come.

 **Sustainability:** Sustainability is a growing concern across industries. Designing energy-efficient embedded solutions and considering their environmental impact is no longer a choice but a necessity. As regulations become more stringent and consumers demand eco-friendly products, embedding sustainability into your embedded computing solutions will be crucial for long-term success.

 **Continuous Learning:** The pace of technological change shows no signs of slowing down. To stay at the forefront of embedded computing, both organizations and individuals must commit to continuous learning and adaptation. Staying informed about the latest trends, innovations, and best practices will empower you to make informed decisions and remain competitive in a rapidly evolving landscape.

*By embracing these strategies and future trends, you position **yourself and your organization** to thrive in a world where embedded computing continues to **drive progress, innovation, and transformation** across industries.*

# Embedded Technologies Success Stories

At Embedded Technologies, we take immense pride in our collaborations with visionary clients who have harnessed the power of embedded computing to achieve remarkable results.

Here are two inspiring success stories that highlight the innovation of our valued clients:

## PATHFINDER AUSTRALIA

**Challenge:** Pathfinder Australia, a leading system integrator, sought to elevate the precision and efficiency of their pattern cutting equipment. Their challenge was to create a seamless interface between the machinery and the operators, ensuring precise control and real-time monitoring.

**Solution:** Pathfinder Australia turned to Embedded Technologies for a cutting-edge solution. They implemented our Fanless Embedded Box PC and Modular HMI Panel PC (Omni-2155-BT) as the Human Machine Interface (HMI) for their pattern cutting equipment. These rugged and reliable embedded systems seamlessly interface with the equipment's motors, providing operators with precise control and real-time monitoring capabilities.

**Outcome:** Thanks to Embedded Technologies' solutions, Pathfinder Australia achieved enhanced precision, efficiency, and user-friendliness in their pattern cutting equipment. This not only improved the quality of their products but also increased production efficiency, resulting in cost savings and heightened customer satisfaction.

## SMARTGUIDE

**Challenge:** Smartguide, a trusted system integrator, embarked on a mission to revolutionize public transportation by providing accurate and accessible tram and bus stop timetables. Their challenge was to create high-brightness, sunlight-readable displays that could withstand the rigors of outdoor environments and high temperature environments

**Solution:** Smartguide partnered with Embedded Technologies to bring their vision to life. They leveraged our Pico-ITX Boards (PICO-APL1) Durapixel Industrial Display to develop robust timetable displays. These displays offer high brightness and sunlight readability, making them ideal for outdoor use.

**Outcome:** With Embedded Technologies' solutions, Smartguide successfully deployed tram and bus stop timetables that provide commuters with accurate and easily readable information, even in bright sunlight. This has led to improved passenger experiences, increased ridership, and enhanced public transportation services.



# Next steps

The previous success stories exemplify the transformative impact of embedded computing solutions provided by Embedded Technologies. We are committed to driving innovation and enabling our clients to achieve their goals through cutting-edge technology. Our journey is fueled by the success of our customers, and we look forward to many more collaborative achievements in the future.

Now that you've gained insights into the world of embedded computing, Embedded Technologies can help you select the right embedded computer for your project, **it's time to take the next steps toward achieving your goals.**

As you explore our catalog, you'll discover the limitless possibilities that embedded technologies can bring to your projects. To leverage our cutting-edge embedded solutions effectively and enhance your digital environment, reach out to our team for a consultation.

We'll discuss your project requirements, objectives, and challenges to recommend the most suitable Embedded Technologies products for your needs!

***The future of embedded computing is dynamic,  
and we're here to support your business every step of the way.***



# Get to Know ETE

***Embedded Technologies Pty Ltd (ETE) is your premier destination for cutting-edge embedded solutions.***

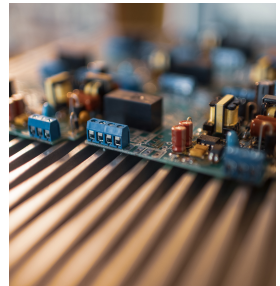
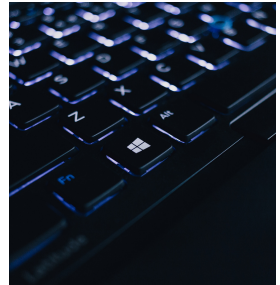
ETE is more than just a technology provider, we are your trusted partner on the journey to digital excellence.

Explore a world of possibilities with ETE's diverse product range. From compact embedded computers to high-performance industrial displays, our solutions cater to a broad spectrum of industries. Our expertise spans across telecommunications, healthcare, industrial automation, defense, aerospace, transportation, and automotive.

At ETE, quality and innovation are not just words; they are the cornerstones of our identity. Our commitment to quality ensures that every product we offer undergoes rigorous testing to exceed industry standards. We are driven by innovation, always at the forefront of technological advancements, ready to inspire creativity and drive progress.

Discover ETE's difference as we go deeper into the world of modern embedded computers, their evolution, and their incredible impact across industries.

**[Join us on this journey towards excellence and innovation.](#)**



## Why Choose Us

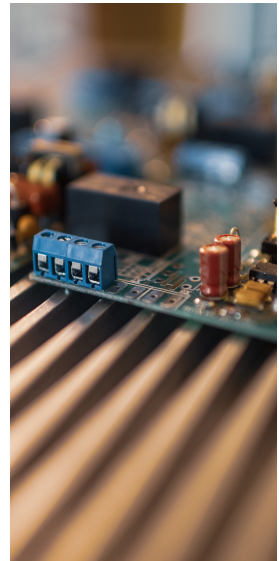
- Operating since 2000, leverage of years of practical experience and knowledge
- Australian owned and operated
- Established and proven track record of success
- Local support and product development assistance
- No idea too small, no project too big

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