

# Application Practices of Microcontroller and Artificial Intelligence Control

Liu,Li

Wuchang Shouyi University, Wuhan, Hubei, 430064, China

**Abstract:** To explore the application effects of microcontroller (MCU) and artificial intelligence (AI) control across various fields, this paper first analyzes the fundamentals of MCU and AI control. It further examines their practical applications and pathways in intelligent home systems, industrial manufacturing, and healthcare. The paper also analyzes the outcomes and advantages of these applications, with the aim of providing a reference for the effective implementation of MCU and AI control, thus promoting their future development.

**Keywords:** Microcontroller; Artificial intelligence control; Application practice

DOI: 10.62639/sspjins08.20240104

Microcontrollers (MCUs) are microcomputer systems known for their low cost, low power consumption, and high integration. These characteristics make them widely used in electronic devices and small-scale control systems. On the other hand, artificial intelligence (AI) control leverages advanced algorithms and models to enable systems to autonomously learn, make decisions, and adapt to environmental changes. The integration of microcontroller technology with AI control has not only transformed operational models and development trajectories within the industry but has also paved the way for new advancements in the era of smart technologies. This paper explores and analyzes the practical applications of microcontrollers and AI control.

## 1. Fundamentals of Microcontroller and Artificial Intelligence Control

### (1) Microcontroller characteristics and architecture

A microcontroller integrates a central processing unit (CPU), memory, input/output interfaces, timers, and other core components into a single compact unit. Its compact structure and miniaturized design enable seamless embedding into various devices, serving as the central control system for intelligent operations. For instance, in smart wristbands, a microcontroller processes data from accelerometers and heart rate sensors, controls display content, and manages data transmission through the Bluetooth communication module. This facilitates functionalities such as activity monitoring and heart rate alerts, demonstrating its role in smart device applications.

### (2) The essence and technical methods of artificial intelligence control

Artificial intelligence (AI) control primarily involves various computational approaches, including machine learning, deep learning, expert systems, and fuzzy logic. Machine learning constructs models by analyzing and learning from data, enabling system behavior prediction. Deep learning leverages deep neural networks to handle complex tasks such as image and speech processing. Expert systems use the knowledge and experience of domain experts to establish rule-based frameworks, enabling intelligent reasoning and decision-making. Additionally, fuzzy logic facilitates the processing of uncertain information and enables effective control of complex systems.

---

(Manuscript NO.: JINSS-24-4-1004)

#### About the Author

Liu,Li, female, Wuhan, Hubei province, graduate student, associate professor, research direction: Embedded, artificial intelligence,

## **2. Practical Applications of Microcontroller and Artificial Intelligence Control**

Microcontrollers are extensively utilized in fields such as industrial control and smart healthcare, where they effectively manage operational parameters of various machinery. Meanwhile, artificial intelligence excels in areas like image recognition and intelligent algorithms, offering significant application value. The integration of microcontrollers and AI is particularly prominent in smart homes, medical devices, and industrial development, showcasing high application value. Beyond these areas, this combination has also demonstrated rich experience in agricultural irrigation and intelligent automotive systems. Strengthening the analysis of practical applications of microcontroller and AI control in these domains provides essential references for their further extension and development, paving the way for more innovative and adaptive applications in the future.

### **(1) Smart home systems**

In smart appliances, the microcontroller serves as an excellent core controller, forming a close synergy with artificial intelligence algorithms. For example, in a smart air conditioning system, the microcontroller can connect to various devices such as temperature sensors, humidity sensors, and infrared human sensors. The artificial intelligence algorithm, based on the user's preset comfort preferences combined with user needs and environmental data obtained from indoor and outdoor monitoring, can automatically adjust the air conditioning modes, including cooling, heating, wind speed, and direction. If the system detects an unoccupied state indoors, it can automatically set the system to energy-saving standby mode. In a smart refrigerator system, the microcontroller can monitor information such as the internal temperature and food storage volume. Using AI image recognition technology, it can identify different types of food and provide functions such as recommending recipes based on the user's dietary habits, reminding users of insufficient ingredients to prompt restocking, and alerting them about expired food to help manage and handle it effectively.

In a smart home security system, the microcontroller is equipped with devices such as door and window sensors, smoke alarms, and cameras, which are interconnected and share data to work closely together. The information collected by these devices is processed using AI behavior recognition algorithms to monitor the user's home environment. If anomalies such as unauthorized intrusions or emergency situations like fire and smoke are detected, the system can immediately issue warnings and link relevant devices, such as shutting off gas valves or automatically turning on lights, ensuring comprehensive security for the user's home.

### **(2) Industrial manufacturing field**

Microcontrollers are widely used in industrial production lines for the effective control of various types of production equipment. For example, in CNC machines, microcontrollers can manage parameters such as tool movement trajectories and cutting speeds. Combined with machine learning algorithms in artificial intelligence, they can analyze large volumes of processing data to optimize process parameters, improve machining accuracy and efficiency, and reduce the defect rate. In the control of industrial robots, microcontrollers coordinate the joint movements of robots, while AI algorithms automatically plan paths according to different production tasks. This enables intelligent material handling, significantly enhancing the automation and intelligence levels of the entire production line.

During the product quality inspection stage, microcontrollers controlling image acquisition devices and sensor systems analyze various aspects of products, such as appearance, dimensions, and performance levels. Using deep learning models in artificial intelligence, these systems can quickly detect surface defects or inconsistencies, identify whether product dimensions deviate from standard ranges, and classify or grade products accordingly. In equipment maintenance, microcontrollers collect data such as temperature and current during the operation of industrial equipment. Leveraging AI-based predictive maintenance algorithms, they can identify potential faults in the equipment operation ahead of time and issue alerts within the system. This allows personnel to conduct

timely maintenance, ensuring the stable operation of the equipment and reducing downtime.

### **(3) Medical and healthcare field**

Microcontrollers are the fundamental control units in smart medical devices. For example, in smart glucometers, they efficiently control processes such as blood glucose sampling, data processing, and display. Combined with artificial intelligence algorithms, they analyze patients' historical blood glucose data, construct personalized blood glucose fluctuation models, predict trends in blood glucose levels, and ultimately provide patients with more precise suggestions and references. In smart blood pressure monitors, microcontrollers effectively collect blood pressure data. With the help of AI data analysis, they evaluate whether the patient's blood pressure remains within normal ranges, track changes in blood pressure trends, and provide doctors with diagnostic references.

At the same time, microcontrollers can be combined with wireless communication modules to create remote medical and health monitoring systems. For instance, patients wearing wearable medical devices such as smart wristbands or chest patches rely on microcontrollers to collect physiological data like heart rate and ECG. These devices transmit data via Bluetooth to cloud servers, where AI algorithms analyze the health data to provide information results. Doctors can use this data as a reference to detect abnormalities in patients promptly and implement appropriate interventions.

## **3. Application Effectiveness and Advantages**

### **(1) Enhancing system intelligence**

The seamless integration of microcontrollers and artificial intelligence control enables systems to automatically adjust their operating modes and parameters based on environmental conditions and user requirements achieving intelligent decision-making and control. For example, smart home systems automatically adapt to users' living habits and preferences, providing a customized living experience. Industrial manufacturing systems, on the other hand, automatically optimize process parameters according to production tasks and requirements, making production work more efficient and precise.

### **(2) Optimizing resource allocation**

Artificial intelligence algorithms can analyze data in fields such as industrial production and smart healthcare to control energy consumption and material usage. For instance, in industrial production, AI algorithms combined with microcontrollers enable predictive maintenance, effectively preventing downtime caused by equipment overuse. This helps avoid resource waste, extends the lifespan and usage time of resources, and ensures efficient operation. Additionally, precise algorithms assist enterprises in calculating material quantities, enabling more reasonable material preparation and further reducing resource waste.

### **(3) Improving production efficiency and enhancing quality of life**

The integration of microcontrollers and artificial intelligence in intelligent production processes significantly enhances industrial production efficiency and product quality, effectively reducing production costs. Meanwhile, in the fields of healthcare and smart homes, the application of microcontrollers combined with artificial intelligence provides people with more comfortable, safe, and convenient services and experiences.

## **4. Conclusion**

The effective integration of microcontroller and artificial intelligence control has driven transformation and

upgrades in various fields, including smart homes, industrial manufacturing, and healthcare environments. As technological advancements continue, microcontroller performance is further optimized, and AI systems become increasingly refined and mature. The fusion of these technologies fosters expansion and deepening in more domains, contributing to more stable progress for human society.

## References

- [1] Xu Weiyue, Zhang Xiaohua, Zheng Jianfeng, Chen Jing. Research on Innovative Paths for Teaching Reform of Microcontroller Empowered by Artificial Intelligence [J]. The Theory and Practice of Innovation and Entrepreneurship, 2024, 7(18): 44-47.
- [2] Ma Wenting. Design of Intelligent Handling Robot Based on MEGA64 Microcontroller [J]. Science & Technology Information, 2011, (30): 340.
- [3] Ni Danyan. Design of Intelligent Obstacle Avoidance System for Robot Movement Based on STM32 Microcontroller [J]. Automation & Instrumentation, 2023, 38(05): 52-56.
- [4] Zhao Haoran, Dong Xiaoyan, Gong Bin. Design of Household Intelligent Door and Window Control System Based on Proteus [J]. Modern Information Technology, 2019, 3(11): 183-185.
- [5] Wang Zhiyou, Chen Ying, Zhang Liang, Xie Duan. Reform Analysis of Integrating Embedded Artificial Intelligence Technology with the Principles and Applications of Microcontroller Course Content [J]. Educational Informatization Forum, 2024, (03): 51-53.