摘要

物联网技术在厨电行业落地是一种必然的发展趋势。目前物联网技术在油烟机设备的应用主要体现在智能控制和可视化终端，但这些技术的应用存在一定的不足：油烟吸力的智能控制只实现了在固定的档位间自动切换，没有做到无级智能调速；智能控制体验很差，用户终端操控得不到即时反馈甚至控制失败；智能可视化终端只是控制油烟机开关的工具，缺少更多的实用功能设计。

本文针对目前商用油烟机控制技术上的缺点，基于物联网技术设计智能商用油烟机系统。通过技术需求分析，搭建如下智能系统整体框架：设计双智能网关与商用油烟机室内外关键模块物理连接，实时获取设备生产数据；利用GRPS通信技术保持智能网关与设备云平台远程长连接，将数据上传至云端；设计Web、APP客户端，实现系统的多端可视化，并设计多种高可用的功能模块。在该智能系统框架下，油烟机设备、智能网关、云平台与客户端之间形成一个闭环的数据传输链路。

针对目前油烟机智能控制上存在的操作不灵敏、固定档位控制等缺陷，本文基于模糊PID控制器设计了无级调速机制，该机制通过燃气灶油烟浓度实时地调整风机功率以减少电能浪费。模糊控制技术有效降低了PID控制器的超调量约20%，缩短了调整时间近180秒。通过对风机模拟测试及参数分析，模糊PID控制器下油烟风机功率与燃气灶工作数量呈正相关，燃气灶半工作状态下，可以减少接近60%电能损耗。

本文针对系统中传感器多，并发数据流量大的问题，实现了基于动态调度算法的多层网络限流机制，分别在智能网关中实现动态死区调度机制，在云平台实现基于令牌桶算法的动态调度限流机制。多层网络限流机制的设计减少了系统通信闭环链路中70%的数据流量，近40%的网络请求响应延迟。同时提升了系统的并发负载能力，与只设计负载均衡机制的云平台对比，资源使用率降低了10%。

关键词：商用油烟机、智能系统、无级变频控制、网络流量控制

# ABSTRACT

There is an inevitable trend that the Internet of Things(IoT) technology will be applied in the industry of kitchen appliances. So far the IoT technology is mainly used in intelligent control and visualization in range hoods, which has certain deficiencies in the practical application. For example, it is only able to switch automatically between fixed gears instead of stepless intelligent speed regulation; no immediate feedback and control failure lead to poor experience of intelligent control; the intelligent visual terminal only controls the switch of range hood, which lacks more practical functions.

This paper points out the shortcomings of current control technology of commercial hood, and then it introduces an intelligent commercial hood system based on the IoT technology. It builds an integral framework of the intelligent system through analyzing the technical requirements, which as follows: obtain equipment operation real-time data via designing physical connection between dual intelligent gateway and indoor and outdoor key modules of commercial range hoods; upload data to the cloud via using GRPS communication technology to maintain a long-term connection between the intelligent gateway and the equipment cloud platform ; realize multi-terminal visualization of the system with a variety of highly available functional modules via designing Web and APP clients. Under the framework of this intelligent system, a closed-loop data transmission link is formed among the range hood, the intelligent gateway, the cloud platform and the client.

This paper points out the current shortcomings in the intelligent control of range hoods, such as insensitive operation and fixed gear control, and then it introduces a stepless speed regulation mechanism based on the fuzzy PID controller. This mechanism adjusts the power of fan in real time based on the gas fumes concentration of the gas stove, which aims at reducing energy waste. The fuzzy control technology effectively reduces the overshoot of the PID controller by approximately 20% and shortens the adjustment time by nearly 180 seconds. Through the fan simulation test and parametric analysis, the power of the fan under the fuzzy PID controller is positively related to the workload of gas stoves. Therefore, when the gas stove is half-operated, it can reduce the loss of energy by nearly 60%.

This paper points out that there is too much sensors in the system to large concurrent data traffic, and then it introduces a multi-layer network current-limiting mechanism based on a dynamic scheduling algorithm. In addition, a dynamic deadband scheduling mechanism is implemented in the smart gateway, and a dynamic scheduling current-limiting mechanism based on the Token Bucket Algorithm is implemented on the cloud platform. The design of the multi-layer network current-limiting mechanism reduces the data traffic in the closed-loop link of system communication by 70%, as well as nearly 40% of the delayed response of network requests. At the same time, the system's concurrent load capacity is improved comparing with a cloud platform only having a load balancing mechanism, which reduces the resource utilization rate by 10%.

**Keywords:** commercial range hood, intelligent system, stepless frequency conversion control, Network traffic control