

计算机科学与技术学院

本科毕业设计（论文）中英文摘要

专业名称 物联网工程

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摘要

随着我国经济社会的飞速发展、城市规模的不断扩大，生活垃圾的产生量不断在增加，而且成分日益复杂。在这一背景下，垃圾分类问题逐渐成为人们关注的焦点，其中以城市生活垃圾的分类处理和资源化利用最为重要。生活垃圾分类对于城市良好生活环境的建立和资源最大化利用具有重要意义，而垃圾桶作为人们在生活中随处可见的环卫基础设施，随着垃圾分类的到来而得到越来越多的关注。在这个快速发展的时代，不仅分类垃圾桶正在普及，智能垃圾桶在很多城市也能看到。在我国，虽然各城市大都制定了垃圾分类的相关政策，但由于人们对于垃圾分类意思薄弱、分类知识欠缺等原因，导致实际分类效果并不理想。

目前关于垃圾分类系统的相关研究较少，其应用主要为传统垃圾桶，但它存在一些不足之处：

（1）垃圾分类效率低。传统垃圾桶只是简单的摆设两个或多个垃圾桶并标识可回收和不可回收等，主要依靠后期人工收集、分类，这样虽然能够实现较高的准确率，但是存在分类效率低、分类周期长、人工分类繁琐且劳动强度大等问题。

（2）垃圾桶因垃圾超重变形。很多垃圾桶由于受到材料、温度等因素的限制，特别是塑料环保垃圾桶，在长时间使用后不可避免的都会出现一些老化的现象，超过最大载荷会出现变形。若环卫工人没有及时清运垃圾，可能还会开裂并导致垃圾桶的报废，给环卫部门造成一定的经济损失。

本文主要提出了一个基于语音识别的智能垃圾分类系统，针对当前垃圾分类系统的不足进行了以下研究：

（1）通过语音识别垃圾种类，通过主控芯片控制各个模块的协调工作。

（2）语音输出用于和用户交互，反馈垃圾分类信息，提高用户体验。

（3）使用蓝牙技术进行无线通信，获取系统相关数据信息。通过分析这些信息，能够获取垃圾桶工作状态，以及垃圾桶存储情况，方便工作人员根据统计情况进行统一处理。

（4）通过舵机驱动设备根据指令控制垃圾桶的开闭，进而方便实施垃圾分类投递。

本设计以单片机 STM32F103C8T6 核心板为智能控制中心，结合 LD3320 非特定人语音识别模块、SG90 舵机控制模块、HC-05 蓝牙无线通信模块、JQ8400 语音播报模块及其外围辅助电路，构成了一个集多种功能为一体的智能语音垃圾分类系统。

语音识别智能垃圾分类器系统，是通过非特定语音识别技术结合 STM32 微

处理器对垃圾进行智能分类的研究项目。本系统实现了通过语音智能识别垃圾种类，监测垃圾投放次数、垃圾桶开闭状态，通过语音播报垃圾种类，通过舵机控制开闭垃圾桶，从而用户可以通过语音的形式便捷地对生活垃圾进行分类投放。按照国家规定和标准将垃圾分为不同的种类，通过语音识别不同垃圾的种类开启相应垃圾箱进行垃圾的回收，并实时监测垃圾分类箱开闭状态与回收次数等数据。当系统启动后，由非特定的人说出唤醒词来唤醒语音识别系统，随后说出垃圾名称发出语音指令，垃圾名称语音指令经过 LD3320 语音识别模块转化成特定字符串，再通过串口发送到 STM32 微控制器。STM32 微控制器接收到语音识别模块传来的预先设置好的指令，然后便通过蓝牙模块将指令信息发送到 PC 端，同时将指令信息发送到指定舵机控制器，实现舵机的转动进而控制对应垃圾分类器开闭，从而实现垃圾的自主分类。该设计能够方便高效地对生活垃圾进行分类管理，达到垃圾分类投放的效果，提高垃圾的资源价值和经济价值，降低处理成本。

本设计能实现语音识别垃圾种类、开闭垃圾桶回收垃圾，并将分类垃圾桶相关数据信息上传到电脑端。通过测试各个模块之间的接口是否正确、测试每个模块的程序设计是否有误、测试整个系统是否满足设计功能和性能的要求，保证了系统的稳定性与可靠性。

关键词：物联网；智能环卫；语音识别；智能硬件

Abstract

With the rapid development of China's economy and society and the continuous expansion of the city scale, the production of household garbage is constantly increasing, and its components are increasingly complex. In this context, garbage classification has gradually become the focus of people's attention, among which the classification and disposal of urban household garbage and the utilization of resources are the most important. Garbage classification is of great significance for the establishment of a good living environment and the maximization of resources in cities. As a sanitation infrastructure that can be seen everywhere in people's life, garbage cans have attracted more and more attention with the advent of garbage classification. In this era of rapid development, not only are classified bins becoming popular, but smart bins can also be seen in many cities. In China, although most cities have formulated relevant policies on garbage classification, the actual classification effect is not ideal due to people's weak intention and lack of knowledge on garbage classification.

At present, there are few researches on garbage classification system, and its application is mainly traditional garbage cans, but it has some shortcomings:

(1) Low efficiency of garbage classification.

Traditional garbage cans are simply equipped with two or more garbage cans and marked recyclable and non-recyclable, etc., which mainly rely on manual collection and classification in the later stage. Although this can achieve a high accuracy rate, there are problems such as low classification efficiency, long classification cycle, tedious manual classification and high labor intensity.

(2) The garbage can is deformed due to overweight garbage.

Due to the limitation of materials, temperature and other factors, a lot of garbage cans, especially plastic environmentally-friendly garbage cans, will inevitably appear some aging phenomenon after a long time of use, and deformation will occur when the maximum load is exceeded. If sanitation workers do not carry garbage in time, they may crack and scrap the garbage cans, causing some economic losses to the sanitation department.

This paper mainly proposes an intelligent waste classification system based on speech recognition, and the following researches are carried out to address the deficiencies of the current waste classification system:

(1) Identify the type of garbage through speech and control the coordination of

each module through the master chip.

(2) Voice output is used to interact with users and feedback garbage classification information to improve user experience.

(3) Bluetooth technology is used for wireless communication to obtain relevant data information of the system. Through the analysis of these information, the working status and storage status of the dustbin can be obtained, so that the staff can conduct unified processing according to the statistical situation.

(4) Control the opening and closing of the garbage can according to the instruction through the steering gear driving equipment, so as to facilitate the implementation of garbage classification and delivery.

This design takes the MCU STM32F103C8T6 core board as the intelligent control center, and combines the LD3320 non-special person speech recognition module, SG90 steering gear control module, hc-05 bluetooth wireless communication module, JQ8400 speech broadcast module and its peripheral auxiliary circuit to form an intelligent speech garbage classification system integrating multiple functions.

Speech recognition intelligent waste classifier system is a research project that combines non-specific speech recognition technology with STM32 microprocessor to carry out intelligent waste classification. This system realizes intelligent recognition of garbage types by voice, monitoring garbage delivery times and the status of open and close garbage cans, broadcasting garbage types by voice, and controlling the opening and closing of garbage cans by steering gear, so that users can easily classify and release household garbage by voice. According to the national regulations and standards, the garbage is divided into different categories, and the corresponding garbage bins are opened for garbage recycling through speech recognition of different categories of garbage, and the data such as the open and closed status of garbage ledger and The Times of recycling are monitored in real time. When the system is started, a non-specific person will speak the wake-up word to wake up the speech recognition system, and then speak out the garbage name to send a voice command. The garbage name speech command will be converted into a specific string through LD3320 speech recognition module, and then sent to STM32 microcontroller through the serial port. The STM32 microcontroller receives the preset instructions from the speech recognition module, and then sends the command information to the PC terminal through the bluetooth module, and sends the command information to the controller of the designated steering gear, as to realize the rotation of the steering gear

and control the opening and closing of the corresponding garbage classifier, so as to realize the automatic garbage classification. This design can be convenient and efficient for the classification and management of household garbage, achieve the effect of garbage classification and placement, improve the resource value and economic value of garbage, and reduce the treatment cost.

The design can realize voice recognition of garbage types, open and close garbage bins to recycle garbage, and garbage sorting bucket data information uploaded to the computer terminal. By testing whether the interface between each module is correct, whether the program design of each module is wrong, and whether the whole system meets the requirements of design function and performance, the stability and reliability of the system are guaranteed.

Key words: IOT; smart sanitation; speech recognition; STM32.