

# Design of Intelligent Environmental Protection Garbage Can Based on LPC1752

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**Abstract:** According to the traditional dustbins require manual operation of heavy workload and low efficiency, the multi-sensor fusion technology makes the trash method run automatically, and the Cortex M3 - LPC1752 as the controller, nRF905 wireless data transmission module for wireless remote control carrier, liquid crystal screen 12864 for man-machine interface to set up hardware platform. The pyroelectric sensor detects the trash in the surrounding environment, the metal detection sensor to achieve autonomous recognition for garbage category, with large torque motor driven actuator to compress the garbage, convenient for garbage collection, with solar panels for power system. The system program software is written in C language. The experiment shows that the predetermined functions of the intelligent garbage can can be realized, and the operation is stable and reliable.

**Keywords:** Intelligence, environmental protection, LPC1752, garbage classification, obstacle avoidance

## INTRODUCTION

With the improvement of living standards, living garbage at a faster rate of growth, a lot of places Chinese already in garbage dilemma, in our country, the trash can next to the harsh environment, not only affects the appearance of a city, but also caused serious pollution to the atmosphere, water and soil, a serious threat to people's life. Therefore, garbage disposal is urgent. Waste not only pollutes the environment, but also wastes resources. If garbage is not treated well, it will affect the development of the city and the progress of mankind.

Now, some developed countries such as Japan, Germany and the United States, has achieved a garbage recycling, while the domestic garbage is basically the traditional design way in some public places, although everywhere displays the trash, but the lack of humanization design, inconvenient and unsanitary use, most of them do not consider the rubbish trash classification recycling, the surrounding environment is bad, easy to cause air pollution, so there is a domestic garbage barrel design most of the defects.

This design is a new multifunctional environmental garbage can, which can effectively alleviate the waste pollution and waste of resources.

## GENERAL SYSTEM FORMULA OF SYSTEM

The design takes LPC1752 as the main controller. The system is composed of five parts. They are control part, sensor part, drive part, display part and voice part.

Control part: using LPC1752 as the central controller, the main control is voice broadcast, liquid crystal display, pyro electric sensors, metal detection sensors. When someone came to the trash near the voice module a beep, the garbage can be automatically opened when the detected garbage into, metal detector sensors, automatic classification of garbage, garbage category and system status display on the LCD screen colleagues.

The sensor part uses the pyro electric sensor to detect human body, into using infrared sensors to detect garbage, type using metal sensors to detect the garbage, trash when moving, obstacle avoidance using ultrasonic sensor.

Driver module: using L298N drive chassis and trash bin, with the ultrasonic sensor for the steering control; using ULN2003 drive internal turning plate, realize turning around the plate rotation.

Display module: use LCD12864 to display the current status of garbage bin and the type of garbage detected.

The overall block diagram of the intelligent environmental garbage can is shown in Figure 1.

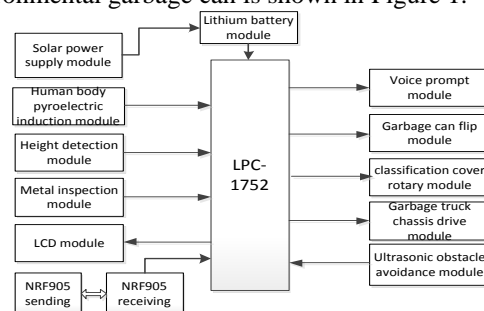


Figure1 Ball picking robot structure

**HARDWARE DESIGN OF INTELLIGENT ENVIRONMENTAL PROTECTION GARBAGE CAN**

**Core Controller and System Power Supply**

The controller uses LPC1752 development board. LPC1752 is a microcontroller based on the Cortex-M3 kernel, suitable for embedded applications requiring high integration and low power consumption. LPC1752 CPU operating frequency can reach 100MHz, LPC1752 peripheral component including up to 64KB Flash memory, 16KB data memory, USB interface, Device 8 channel general DMA controller, 4 UART, 1 CAN, 2 channel SSP controller, 1 SPI ports, 2 I2C ports, 6 channel 12 bit

ADC PWM, motor control, quadrature encoder interface and 4 general timer, 6 outputs of the general PWM, with a separate battery powered ultra low power RTC and up to 52 general I/O pins. [4]. In order to ensure the endurance, power supply system by using ACE 30C 3500mAh 7.4V lithium battery, solar panel output voltage 12V, after stabilizing for lithium battery, LM7805 and AS1117 respectively using the voltage regulator module for power supply to the motor, sensor and main control chip.

**Motor Drive Module**

The L298N driver chip is used here to drive the DC motor. It is a high performance H bridge driver IC, and its schematic diagram is shown in Figure 2.

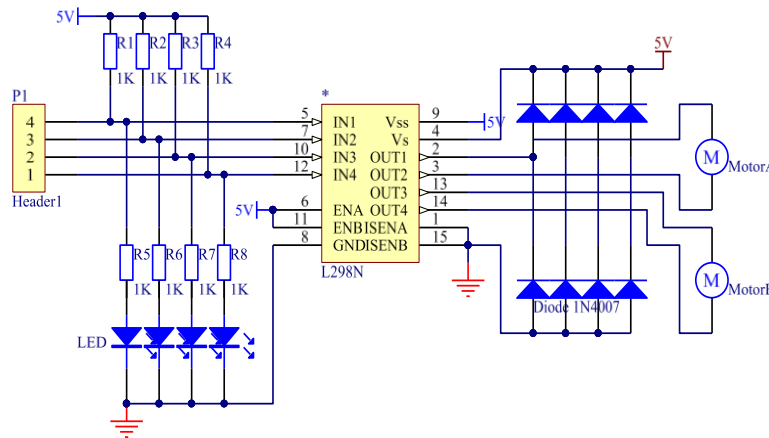


Figure 2 Schematic diagram of DC motor drive module

Three DC motors are used in this design, the trash cover open drive DC motor drive chip with a L289N, and with the implementation of the limit switch on the cover of the action, the other two DC motor installed in the bottom of the trash barrel, driven by a L298N, realize the trash can move forward and backward, turn left, turn right and stop.

Two 28BYJ48 stepping motors are used in the middle of the garbage can to realize the turning of the bucket, and the two ULN2003 chips are used to drive the angle to control the angle accurately.

**Design of Metal Detectors**

The metal detector can detect the principle of metal objects is the principle of electromagnetic induction, a conductor moving in a magnetic field, cut magnetic lines, according to the law of electromagnetic induction induced electromotive force generated in the conductor, thus generating electricity, because the conductor surface shape and the flux distribution is not uniform, resulting in uneven current distribution in the conductor, often in its path a vortex, called eddy current. The probe of metal detector is the key component, it is an inductance coil with magnetic core, the smaller the inductance coil is, the better. The

schematic diagram of the metal detector is shown in Figure 3.

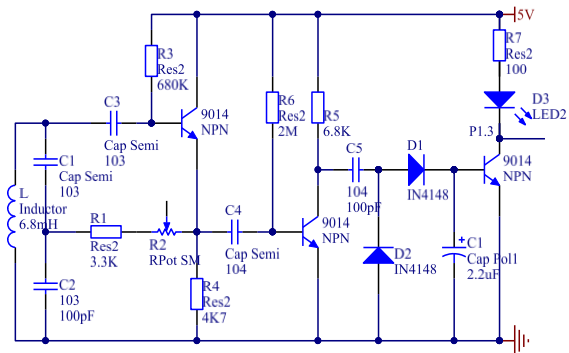


Figure 3 Schematic diagram of metal detectors

**RF Wireless Control Module**

The wireless control of the system is achieved through the wireless transceiver module NRF905.

NRF905 is a monolithic RF transmitter chip from Norway's Nordic Corporation, operating at 1.9-3.6V, 32 pin QFN packages and operates on 433/868/915MHz ISM channels (industrial, scientific, and medical). NRF905 single chip wireless transceiver work consists of a fully integrated

frequency modulator, a demodulator receiver, a power amplifier, a crystal oscillator and a modulator. The

nRF905 wireless communication module is shown in figure 4.

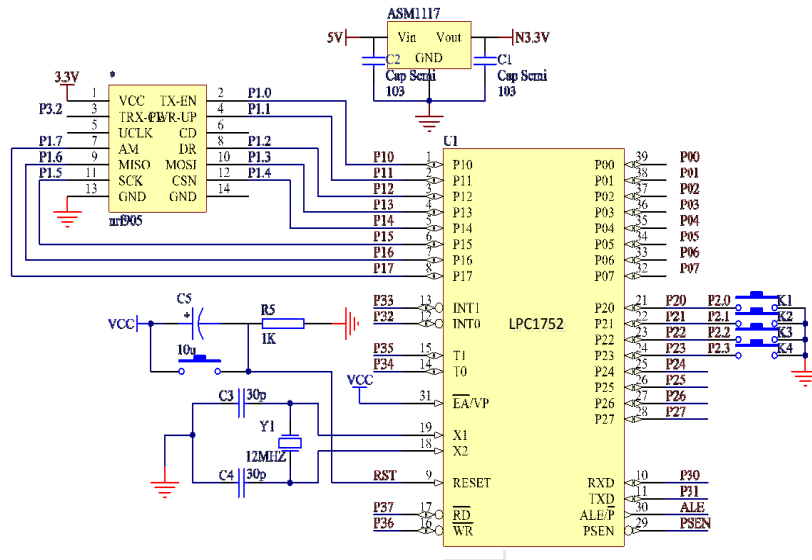


Figure 4 Wiring diagram of nRF905 and main controller

The communication interface between this module and LPC1752 is as follows:

- 1) mode control interface: mode control interface by the PWR and TRX CE, TX en composition control composed of nRF905 tuner of four working modes: power down and SPI programming model; standby and SPI programming mode; transmission mode; receiving mode.
- 2) SPI interface: SPI interface by CSN, SCK, MOSI and MISO to form.
- 3) State output interface: to provide carrier detection output CD, address matching the output AM and data ready output DR.

NRF905 wireless receiver module of the host computer to the fixed in the rubbish box through the nRF905 wireless transmission module to send commands to the remote control instruction, which corresponding to the received and converted into CMOS level data to the main control module LPC1752, finally produced by LPC1752 PWM (pulse width modulation) signal to drive the motor through the control of the garbage, the timing is different, the garbage can complete the corresponding action.

### SOFTWARE DESIGN OF INTELLIGENT GARBAGE CAN SYSTEM

All the detection and control procedures of the garbage bin are designed, including the main program, the DC motor drive subroutine, the metal nonmetal classification and display subroutine, and the wireless communication module program. System procedures are mainly written in C language, each functional

module of the program by the main program and a number of subroutines, the main program includes the definition of GPIO port initialization and NRF905 configuration procedures. The main program flow chart is shown in figure 5.

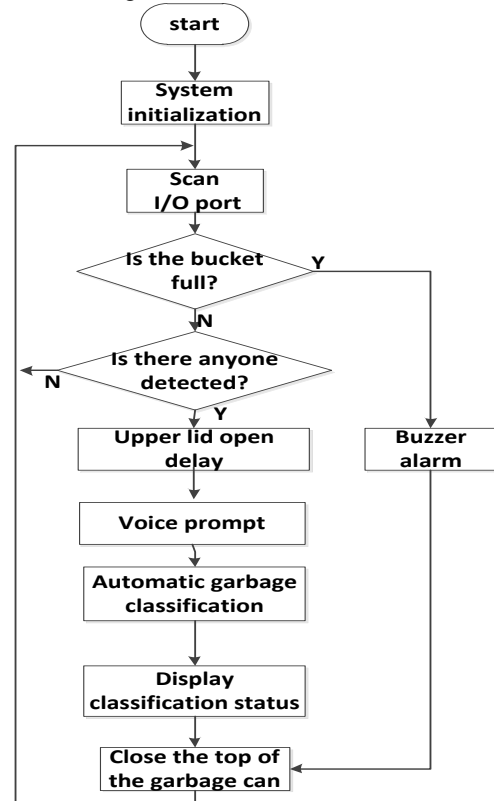


Figure 5 main program flow chart of system

The software compiled correctly downloaded to the supporting hardware, achieve the expected function. The actual objects photo is shown in figure 6.

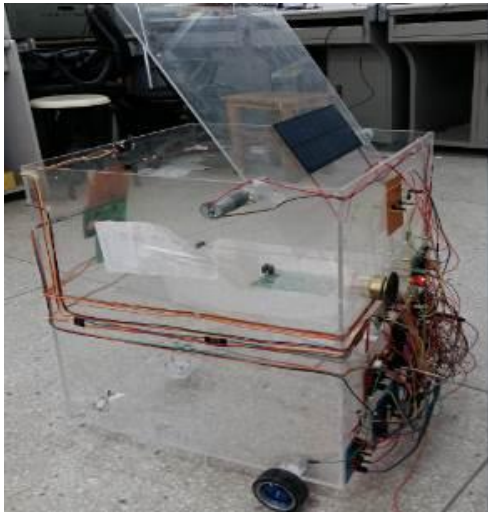


Figure 6 the actual objects of intelligent garbage can

### CONCLUSION

This paper mainly completed the design and manufacture of intelligent environmental protection garbage cans and wireless remote control system. The hardware part mainly completes the infrared detection module, DC motor module, stepper motor module, voice broadcast module, metal detection module, solar power module, LCD module, wireless communication module design. The system software aims at realizing the system function, and adopts the modular structure design. The system achieves the desired planning function, and can be wirelessly controlled by the host computer, the wireless control distance can reach 50 meters, and stable and reliable.

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