

Design of a New Type of Intelligent Trash Can

Hong Liu

School of Electrical Information, Shanghai Dianji University, Shanghai 200240, China

**Corresponding author E-mail: liuhong@sdju.edu.cn*

ABSTRACT

The intelligent trash can designed in this paper is a combination of a variety of modern technology, such as: bluetooth interactive technology, infrared distance measurement technology based on flight time algorithm, environmental temperature and humidity monitoring technology, the ambient light sensor technology, etc. The intelligent trash can, which is designed in this paper, can compress the garbage. This innovative function is mainly based on the infrared ranging sensor, which determines whether to compress the garbage by judging the depth of the trash can, and can largely solve the problem of 'false full' of the trash can. In addition, the intelligent trash cans can be monitored in real time by used of the bluetooth technology and the upper computer, such as the remaining capacity, the switch status of the trash can lid, the temperature and humidity inside the trash can and whether the trash can is full. Through the unified management and monitoring of the trash cans in the region, the operation cost of garbage collection can be reduced, the efficiency of garbage collection can be improved, and the environmental pollution caused by the long-time accumulation of garbage can be avoided.

Keywords: intelligent rubbish bin, bluetooth interaction, flight time algorithm, sensor, compression

1. INTRODUCTION

In the early days of the development of the trash can, the trash can was only used as an ordinary container for collecting waste. After a period of time, due to people's pursuit of practicality and beauty of trash cans, a series of renovation has been carried out on the trash cans. The styles circulating in the market can be divided into the following three types : (1) Cover type. One of the most common types of trash cans effectively prevents the spreading of the smell of garbage in the trash bins. [1]. (2) Foot stomping type, which prevent the hand from touching the lid of the trash can. (3) 360-degree rotation type. At present, most of the urban trash cans are of the type, and the rotating trash can facilitates the dumping and recycling of waste, which greatly saves the physical strength and time of the sanitation workers[2].

The process of disposing rubbish is a rather complicated process, while the birth of intelligent dustbins is the product arising to solve the high cost, low efficiency and complexity of traditional dustbins. In the 21st century, various sensor modules have gradually appeared on the market, and also provided

various functional expansions for the intelligent trash can, such as infrared ranging sensor, photosensitive sensor, pressure sensor, sound sensor and so on [3].

In this paper, a new type of intelligent trash can is proposed by studying the problems of traditional trash can. This new intelligent trash can takes into account the trash container volume, designs the full overflow warning module of the trash can, and conducts centralized monitoring and management of the trash can in the area[4]. At the same time, an extension interface of the designed trash can is reserved for new functions in the future.

2. DESIGN OF INTELLIGENT TRASH CAN BASED ON ARDUINO

The Arduino Uno used in the paper is a single-chip microcomputer ATmega328. ATmega328 SCM is an integrated circuit, which has the AVR core processor, and the reasonable working temperature range between -40°C to $+85^{\circ}\text{C}$. The input and output port of the Arduino Uno has 14 optical digital sides, and analog input ports has six, distribution in the hardware on the development board has a ceramic crystals is 16 MHZ, a USB connection port for link to the computer, a power supply socket, a ICSP for

communication interface and a black RESET button, as shown in Fig. 1.

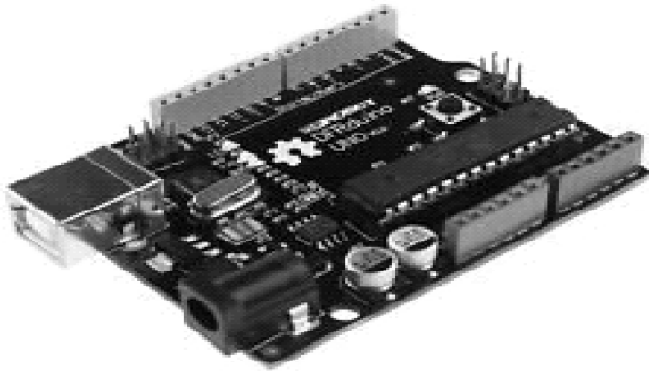


Figure 1: Physical picture of Arduino Uno

According to the functional requirements, the intelligent trash cans studied in this paper are divided into sensor module, wireless communication module, compression module, power module and receiving terminal, as shown in Fig. 2.

The sensor module is equivalent to the ‘eyes’ and ‘ears’ of the intelligent trash can, which contains the infrared sensor, the humidity sensor and the light sensor. The sensor module is mainly responsible for collecting the state and the situation of the trash cans, and then get back the data to the upper machine, which decides how to handle the garbage.

The wireless communication module runs through the communication system of the intelligent trash cans, and realizes the data communication.

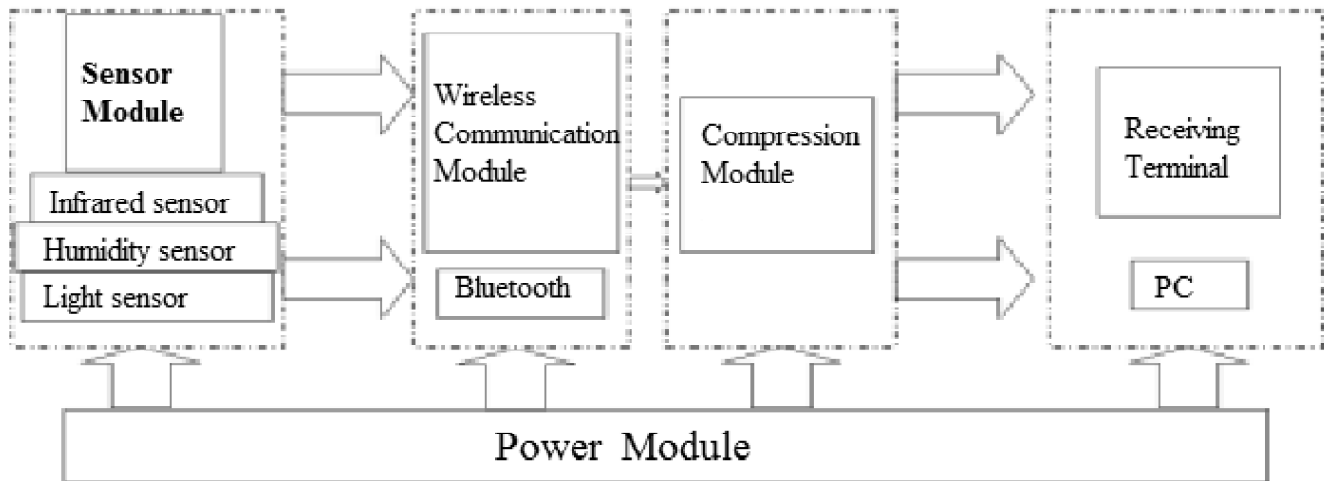


Figure 2: Module composition of intelligent trash can

The compression module is the highlight and innovation point in this design. The hardware structure, which is similar to the mechanical arm, is used in the compression module. The mechanical arm can squeeze the garbage according to the depth of garbage in the trash can.

The receiving terminal is a PC . All detection and operation of the sanitation workers are basically completed at the receiving terminal. They can detect the state of the trash can at the receiving terminal, and make different solutions and adjustments according to the different states of the trash can.

The power module supplies power to the entire system.

3. HARDWARE DESIGN BASED ON ARDUINO INTELLIGENT TRASH CAN

3.1. Infrared ranging sensor based on flight algorithm

The infrared ranging sensor DFR0107 adopted in this study has different color interfaces, which are yellow port, red port and black port. The red port and black port are the positive and negative poles of the power and the yellow cable is the data cable[5]. When the module is connected to the power, the yellow port line as a role is to process and collect the datas, and then transforms the datas into “distance” through the linear formula of the flight time algorithm. The accurate range of the infrared rangefinder is 30mm-

9000mm. When the distance is less than 30mm, the calculation results will have errors due to the limitations of the algorithm. The error value is less than 10mm in the same position.

3.2. Ambient light sensor based on photodiode

The ambient light sensor adopted in this study is DFR0026, which is a sensor based on photodiode. Its purpose is to detect the light intensity of the surrounding environment and interact with the microcontroller. The ambient light sensor (DFR0026) is superior to the traditional photosensitive sensor based on the photoresistance, which has higher reliability, better sensitivity, smaller volume and faster reaction speed. As the traditional photosensitive resistance is easily affected by the environment temperature, the reaction speed under light is not fast, which is easily consumed and leads to higher costs.

In the design the ambient light sensor is mainly used to judge the situation of the can lid. If the lid of the trash can is opened, the ambient light sensor can detect light, and then takes back the tray, which is compressing down the rubbish, to prevent accidentally others to squeeze the garbage into the tray. As the switch of the trash can lid is instantaneous, so the environmental light sensor based on photodiode is more suitable for the the intelligent trash can than the environmental light sensor based on photosensitive resistance. The physical picture of the environmental light sensor was shown in Fig. 3.

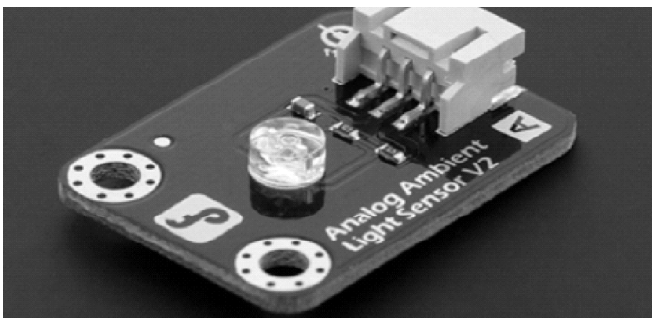


Figure 3: Ambient light sensor DFR0026

3.3. Temperature and humidity sensor DHT11

The temperature and humidity sensor used in the design is DHT11, as shown in Fig. 4. It is a hybrid sensor of temperature and humidity, and it contains

calibrated digital signals for output, which ensures its outstanding stability, excellent reliability and high accuracy. For the addition of temperature element, humidity element and a tiny 8-bit single-chip microcomputer of the NTC, the cost of the temperature and humidity sensor has been successfully controlled, and its anti-interference ability and response speed have been guaranteed. It has three parallel pins which are easily connected to the Arduino board.

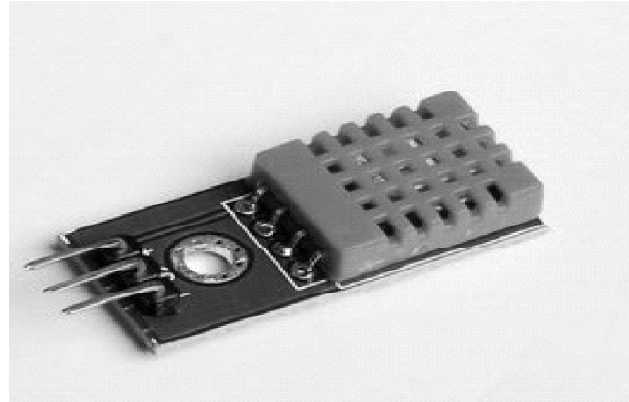


Figure 4: Temperature and humidity sensor DHT11

In this design, the DHT11 has the same function as the infrared range sensor, which is also used as the 'eye' and 'ear' of the intelligent trash can. Because the rotting garbage in the trash can often the transmission source of urban virus, especially in hot summer days, wet garbage rots at an alarming rate. In order to solve the problem, the DHT11 was installed to monitor the situation of the trash can. Once the temperature and humidity of the trash can reaches the threshold, then the spray system, which is built in can, will spray disinfectant for garbage. Timely sterilization of high - rot garbage, the virus was put an end to spread from the root. When spraying disinfectant, the sensor will send an alarm message to the sanitation workers to recall the garbage in the trash can.

3.4. Bluetooth module HC05

In the design, the bluetooth module is used to the data communication between the upper computer and Arduino. Compared with wifi communication, bluetooth communication is widely used in smart devices. The mass production of bluetooth makes it

very cheap. Besides, bluetooth is often used in point-to-point mode, so it is very convenient to establish communication, while wifi communication is not suitable for cost or AP devices or routers and the power consumption of wifi is also a major problem. The same six 5-battery power supplied to the wifi communication module can only last for a few days, while the bluetooth communication module can last for several weeks. Due to the limitations of the supply module of the trash can, the wifi communication is not used. The bluetooth communication module used in the design is HC05.

3.5. Mechanical structure

The TowerPro SG90 steering gear designed is used to make two driving shafts of the compression mechanical arm. Through the connection between the steering gear and the cardboard, a diamond mechanical structure which can be compressed downward is simulated. The diamond mechanical structure is shown in Fig. 5.

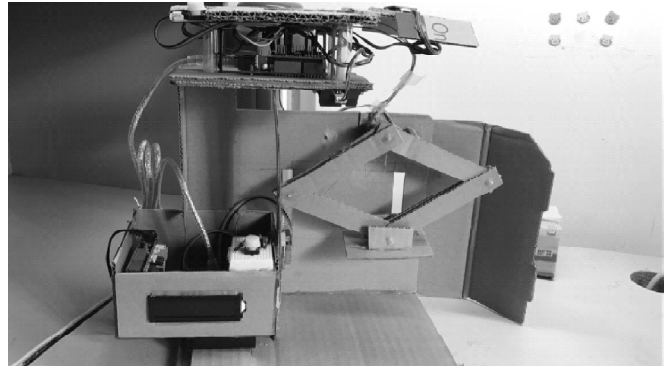


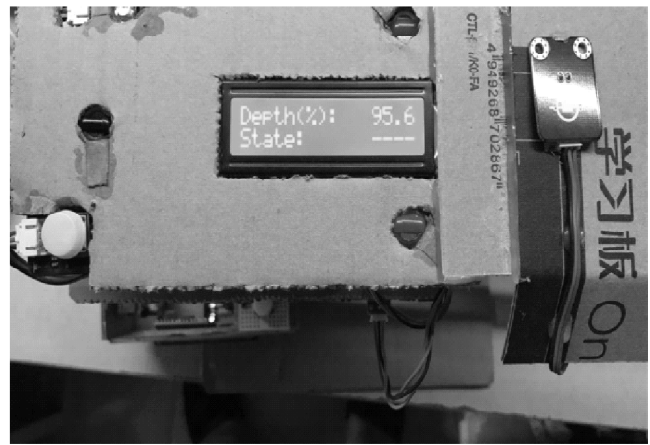
Figure 5: Configuration diagram of compression arm

3.6. Intelligent trash can

The power supply of the intelligent trash can is provided by six batteries, and two liquid crystal modules I2C LCD1602 are used to show the remaining capacity, status, temperature and humidity inside the trash can, respectively. The digital button is used to replace the Reset button on the Arduino board. The red LED light module is used to warn sanitation workers or those who is falling the rubbish



(a) The LCD panel display of the temperature sensor



(b) The LCD panel shows status and capacity of the trash can

Figure 6: LCD module I2C LCD1602

to notice that the pallet is squeezing rubbish and not be hurt by the pallet. The liquid crystal module I2C LCD1602 is shown in Fig. 6.

4. CONCLUSIONS

This paper generally introduces the design concept of the intelligent trash can based on Arduino. Starting from its system module structure, it introduces sensor module, wireless communication module,

compression module, receiving terminal and power module, respectively. Then, the processing procedure of the intelligent trash can is described. The logical relationship between modules is clarified, and the design concept and thinking are clarified. In order to prevent locking of the system, a soft reset code is written in the system, and the button, which is put on the top of the trash can, has been built for the convenience of the users. The software used for

demonstration is mainly used for receiving, storing and exporting datas.

The future work will focus on perfecting the technical blind spot of the serial port monitor built by Arduino and increasing the practicability and feasibility of the intelligent trash can.

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REFERENCES

1. K.A. Monika, R. Nikitha, S.B. Prapulla, G. Shobha, International Journal of Engineering Science and Computing, Volume 6 Issue No. 6 (June 2016).
2. <https://www.telegram.org>. Google Scholar
3. S.S. Navghane, M.S. Killedar, V.M. Rohokale, IoT Based Garbage and Waste Collection Bin, May 2016.
4. Mary Saji Ruhin, Gopakumar Drishya, S Harish Kumar, K N Mohammed Sayed, S Lakshmi, A Survey on Smart Garbage Management in Cities using IoT, Nov. 2016.
5. Technical specification about GSM Modem-SIM900A, [online] Available: <http://www.propox.com/download/docs/SIM900.pdf>.