A New On-line Monitoring Method for Urban Refuse Based on Ultrasonic Principle

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Abstract. Combined with the status quo and present problems of urban refuse, this paper proposes a new on-line monitoring method for urban refuse based on ultrasonic principle. Aiming at the low efficiency of urban refuse collection at present, we make a method to realize monitoring on-line by a low cost. This method use ultrasonic ranging system to monitor the amount of refuse in trash can and send the message to a monitoring center which can make a more effective plan for urban refuse collection. So this method can monitor urban refuse real-timely and improve the efficiency of collection.

1. Introduction

In recent years, the problem of urban refuse was getting worse day by day. Especially in big cities, the amount of refuse was increasing exponentially. The problems at present on urban refuse collection include collecting not in time, the low efficiency of collecting and so on. These problems, which are related to people’s life and urban construction, seriously debase people's quality of life and the image of city. So we must pay attention to urban refuse and sovle the problems as quickly as possible.

This paper is based on the problems on urban refuse at present. It construct an on-line system based on ultrasonic principle to monitor urban refuse. The using of this system can get the condition of the trash cans real-timely and optimize the program of collection. So it can improve the efficiency of collecting and be useful to slove the present problems.

2. The principle of the method

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This method use ultrasonic principle to realize the monitoring of trash can. Ultrasonic generator can shoot ultrasonic and it will reflect back when it encounter an obstacle. The reciver can get the ultrasonic reflected.
If the time of shooting is $t_1$, the time of receiving is $t_2$, the speed of ultrasonic is $v$. When the ultrasonic generator and the receiver are in the same position, we can calculate the distance between the generator and the obstacle with the three quantities:

$$l = 0.5 \cdot v \cdot (t_1 + t_2).$$

If the ultrasonic generator and the receiver are at the top of the wall of the trash can and we make the ultrasonic shoot in the horizontal direction. If the trash can is not full, we can get the distance of the opposite wall, which is named $l_0$; shown here;

When the trash can is full, the distance we get is between the refuse and the wall, which is named $l'$. The relationship between $l_0$ and $l'$ is:

$$l' < l_0.$$

If we set 0.5l0 as a threshold, we can judge the trash can is full or not by the distance we measure. So we realize the monitoring to trash can by the use of ultrasonic principle.

### 3. The realization of the method

The realization of this method not only need the theory, but also hardware design. For this problem, we design a device which can monitor the refuse on-line based on ultrasonic principle.

The design consists of two parts: 1. Refuse monitor, 2. On-line monitoring center.

Part 1: Refuse monitor is made of an ultrasonic distance measurement module, a MCS—51 single chip computer, and two dry batteries and an EnOcean wireless module. The ultrasonic distance measurement module can measure the distance and sent it to the MCU, which is powered by the dry batteries. And the MCU sent the information to Part 2 by the wireless module. The schematic is as follows:
Part 2: On-line monitoring center is the software part. It uses a wireless module to receive the information from part 1, then integrate it and send it to the computer. The monitoring center can show the condition of trash cans on-line.

This design uses part 1 to collect data and send it, and part 2 to receive the data which is integrated by software. By this design, we can monitor the condition of trash cans within the area on-line.

Actually, this method also has some weaknesses. Its transmission distance is limited, so the area cannot cover a whole city. And the refuse monitor part is susceptible to rain, so its waterproof ability should be improved. The power consumption of part 1 is still a little high, so we must replace the battery regularly.

4. Summary

In this paper, ultrasonic principle is fully used to measure distance. And we put forward a good design to realize the theory. This design is made of two parts, one is to collect information and the other is to integrate data and realize the visible monitoring. With the help of this design, the efficiency of collection will be improved. And the problems of refuse collection at present will be better resolved.

Because of the weakness at present, there is room for improvement. First, we can expand the scope of communication by a cascade way. Second, we must improve its waterproof ability so it can be used longer. Third, the MCU should stop running in a specific time to reduce its power consumption. At last, this design should be used in a specific environment and find its problems in using. Only by practice, this design can be popularized.

Urban refuse is a long-term problem which cannot be solved in a short time. The method put forward in this paper cannot solve it right now, but it can advance the reform on the collection of urban refuse.
References


