Development of System for Automatic Exchanging Toilet Paper

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Abstract

This system can exchange toilet paper automatically only installing on ready-made goods toilet paper holder.

Measurement of the color of the toilet paper and its core is using the color sensor and depending on its measuring RGB value, an automatic exchange of toilet paper to move the servo motor by using the Arduino.

Keywords: color sensor, servo motor, Arduino

1. Introduction

Everyone use toilet at home, station and public facility. There are many people who experience that who used toilet one before didn't exchange toilet paper though toilet paper runs out. Reasons for people who don't exchange toilet paper are some next matters. They are "They have habit to exchange by environment in which they grew up.", "They can't find that toilet paper run out." and "It is dirty to exchange toilet paper after relieving themselves." But most of reason is "It is bothersome." Reserve of toilet paper almost put on shelf or floor in rest room, work of exchange finish from 10 seconds to 20 seconds when it use toilet paper holder such as shown in Fig.1. Some People who feel they often exchange toilet paper appear. There is person who feels frustrated. Due to some people never replaces the toilet paper run out, other people feel like they replace the toilet paper quite often. That some people don't replace the toilet paper gets on other people's nerves, and sometimes they have trouble about that.

Taking out toilet paper becomes problematic in the restroom at the station and the public facilities. This is because toilet paper is easy to exchange in the general toilet paper holder. The rate of people who had taken out that, as shown in Fig.2 is a few, but a lot of people troubled by taking out toilet paper ⁽¹⁾. There is almost antitheft toilet

paper holder with key ⁽²⁾, but it has hard to use the plane, for example that takes labor of exchange and a need to buy special toilet paper.

In addition to that, there is a device that can be replacing the toilet paper by pressing a button, but there are people who think the exchange that is bothersome.

Fig. 1. General toilet paper holder.

Fig. 2. Rate of bringing out toilet paper ⁽¹⁾.

Fig. 3. Overview of this system.

By developing toilet paper holder for automatic exchanging, Toilet administrator or cleaning company replenishes toilet paper only, then decreasing to take out toilet paper and don't need to exchange toilet paper by users who use the restroom. In addition, it isn't the burden of the people with disabilities because the restroom user doesn't need to exchange toilet paper. However, because the toilet paper holder that is currently installed must be removed once, it takes the cost.

2. Structure

2.1 Structure of Body

Purpose of this system is to automatic exchange toilet paper. Overview of this system is shown in Fig.3. The body is composed of toilet paper holder, color sensor, continuous rotating servo motor, and Arduino. This time, Arduino is performing all of the control.

The color sensor is placed on the inside of the toilet paper holder. The color sensor is always measuring the RGB value of the toilet paper and sending Arduino the RGB value. When the color sensor detects toilet paper core, the sensor sends signal to Arduino and servo motors run and exchange the toilet paper. The aluminum case has been placed under the body. This is attached the servo motors pulleys with wire. The Stock of toilet paper is put in the aluminum case.

2.2 Structure of System

The exchanging system is roughly divided into two: the moving unit and the sensor unit.

The sensor unit is composed of a color sensor, and Arduino. When the color sensor irradiates light to an object, the sensor receives the reflected light. The reflected light is different by the color of the object that is irradiated light. The color sensor is measuring the color of the toilet paper. Usually, the color sensor detects the white color of the toilet paper. However, when the toilet paper is used up, the core of toilet paper appears. In that case, the color sensor

Fig. 4. Electrode plates move away.

Fig. 5. Electrode plates are contacting.

Fig. 6. The circuit that detect exchange toilet paper

measures toilet paper core's color. Due to that, the different RGB value is sent Arduino by the color sensor. By

detecting this difference of value by the Arduino, the system can know the timing of changing toilet paper. Also, if the RGB value sudden change, the system can predict toilet paper is stolen. When the system detects the toilet paper core, the system transmit the instruction to the Moving unit thorough the Arduino program.

Moving unit is composed of servo motors, Arduino and toilet paper holder. Arduino has a role to control the moving part. The direction of rotation of the servo motors is controlled by the signal submitted by Arduino. The servo motors rotate the pulleys based on the instruction from Arduino. The aluminum case attached pulley with wire. The stock of toilet paper is placed in the case. When the servo motor is rotated, the stock of toilet paper is moved upward with aluminum case by pulleys and wire. Due to that, the toilet paper core is pushed the stock of the toilet paper and exchanged. The timing of exchanging the toilet paper is detected by the Arduino. The electrode plates attach toilet paper holder's arm. The 5V is applied to electrodes. Usually, each electrode plates are contacting and molding the circuit, but when exchange the toilet paper, the electrode plates are move away. So, the circuit is disconnected. However, when the system has finished exchanging toilet paper, the toilet paper holder's arm returns former state. Due to that, the timing of stopping rotate servo motors is determined by measuring the voltage of the circuit by the Arduino. The electrode plates and circuit is shown in Fig.4, 5 and 6.

2.3 Exterior Design

Exterior is designed as follows: we fixed toilet paper to wood board. The servo motors are also fixed to wood board. The color sensor is attached in the toilet paper holder as shown in Fig.7. We made place of putting stock of toilet paper by aluminum plate. The pulley attached the servo motor and aluminum case with wire. Exterior is shown in Fig.8.

3. Experiment

3.1 Procedure of Experiment

At first, we began to move the servo motor by using the Arduino. We rotate servo motor and move upward the aluminum case with stock of toilet paper. Also, we tested the servo motor whether it stopes rotation when the exchange toilet paper process has finished. We discriminated the toilet paper and toilet paper core by using color sensor. The distance between the toilet paper and

Fig. 7. Color sensor

Fig. 8. Exterior Design

color sensor is 3 cm.

3.2 Result of Experiment

As a result of the experiment, the system can drive properly. In the experiment of servo motors, the servo motors can lift the aluminum case with stock of toilet paper. Also the servo motor could stop at the timing of finishing exchange toilet paper. Due to that, we know the electrode plate is working. The condition of this experiment is shown in Fig.9 and 10. In the experiment of the color sensor, the sensor could measure the color of the toilet paper and toilet paper core. The appearance of this experiment is shown in Fig.11 and 12. The obtained RGB value is sent to Arduino. From the difference of value when measuring toilet paper and toilet paper core, Arduino could discriminate the state of toilet paper whether it used up or not.

Fig. 9. The toilet paper is exchanged by servo motors

Fig. 11. The toilet paper is measured

Fig. 10. The state that finished exchange process

Fig. 12. The toilet paper core is measured

4. Conclusion

We developed a system to exchange toilet paper in automatically. The system could detect used up toilet paper. After detecting that the toilet paper is already used up, the system could the exchange toilet paper. However, this system can exchange only one toilet paper. Therefore, we will improve the system to become able to put many stock of toilet paper.

References

- (1) Portal site of toilet paper
<http://www.toiletpaper.co.jp/vote/result04.html>
- (2) “Role guard”, Hokkaido SCOTT, Inc.
<http://www.pref.hokkaido.lg.jp/kz/csk/grp/02/5-99.pdf>