# *Arduino based Balancing Robot*

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***Abstract*—In this paper, we propose a balancing robot system that can operate wirelessly through mobile app based on Arduino. We design the shape of the robot using 3D modeling, and make a designed robot using 3D printing technology. In addition, a two-wheel drive robot is equipped with Arduino to control the balancing of the robot and to operate the robot via WIFI**

***Keywords—3D Printing; arduino; balancing robot; PID control; mobile app***

## I. INTRODUCTION

A variety of robots are being developed using Arduino[1,2]. PID control technology, which is the core technology of balancing robot, is a technology that can be used in various fields as well as motor control[3,4,5]. The purpose of PID control is to measure the output of the object to be controlled and to calculate the error to extract the necessary value for control. In this paper, a balancing robot is implemented by PID control. The outline of the robot is produced through 3D printing. Controlling the balancing robot through Arduino programming and moving the robot by controlling the stepping motor and the sub motor based on the communication of the WIFI module.

## II. ROBOT BODY

### *A. 3D Modeling*

We use 3D modeling tools to model each part of the balancing robot. Balancing Robot is important in overall structure and balance. In order to model the robot in 3D, various discussions and actual data are needed depending on the connection parts of the parts, the positions of the modules to be mounted, the weight, and the mounting method. To support the overall weight, the base and wheel are designed with the center of gravity and mobility in mind. Designed files are managed by exporting each part as STL file.

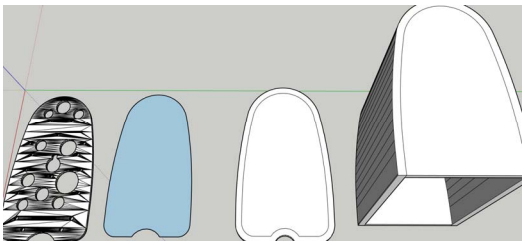

*Fig. 1.* Example of 3D Modeling by SketchUP

### *B. 3D Printing*

We use a 3D printing program to collect the parts in a printable size and output them.

*Fig. 2.* Example of 3D Printing

## III. BALANCING CONTROL OF ROBOT

By using the data received from the 3-axis acceleration gyro sensor (MPU_6050), the stepping motors balance themselves and move through the PID control. The PID allows flexible automatic control using the spelling P (Proportional), I (Integral), D (differential). The PI control is used to solve the problem that the deviation is reduced through the P control but the error does not become zero. When P control is used, there is always error. If error is integrated over time and collected over a certain value, PI control reduces error as much as possible.

Finally, the PID control is a PI control with D control (differential control) added. In the D control, the manipulated variable is determined by the amount of error in differential control.

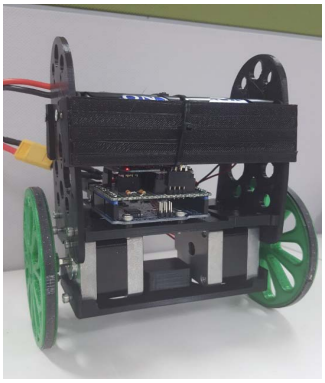

*Fig. 3.* Balancing Robot.

## IV. MOBILE APP.

The Mobile APP for balancing robot manipulation is developed using Android Studio. The mobile app must set the esp8266 internally to the WIFI AP mode for communication and then turn on the power to enable the esp8266 to host the WIFI communication. Then the Mobile APP connects to the esp8266 and makes data communication. When using the arrow buttons in the APP, the mobile app is designed to change the color of the button, informing which button was pressed, and passing the data stored in the button to the balancing robot. Then, Arduino reads the received value and performs the stored action on the read value.

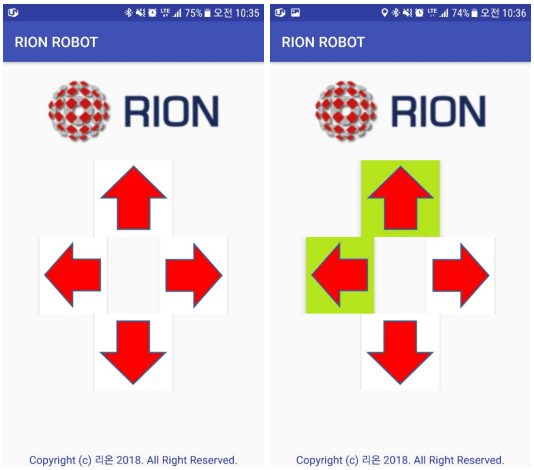


*Fig. 4.* Example of Mobile App.

## V. DISCUSSION

In this paper, we propose a balancing robot capable of radio control through mobile app based on Arduino. The principle and manufacturing technology of the proposed balancing robot can be a two-wheel drive vehicle for the purpose of future enlargement. In addition, the proposed robot system can be applied to various fields by adding various modules such as a camera and an ultrasonic sensor.

## ACKNOWLEDGMENT

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