COLOUR DETECTION AND COUNTING SYSTEM FOR TOY BALLS

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For my lovely mum and dad, thanks for your sacrifice towards my success.
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ABSTRACT

This project attempts to detect and count colour toy balls using Light Dependent Resistor, LDR. The LDRs will detect the reflected colour of toy balls with the help of Light Emitted Diode, LED. The output voltage for LDR is determined by using voltage divider concept. After comparing the voltage with the determined voltage range, it is then converted to digital signal. The digital signal acts as an input to the PIC microcontroller. Then, counter will count the amount of colour toy balls successfully detected by the LDR sensors. Basically, digital cameras are used as sensors for colour detection process. However, the increscent quantities of digital cameras for colour detection process will increase the cost. In this project, the LDR sensors are used to sense the colour toy balls because the costs for LDR sensors are much lower than digital cameras.

ABSTRAK

Projek ini bertujuan percubaan untuk mengesan and mengira bola permainan berwarna dengan menggunakan perintang peka cahaya. Perintang peka cahaya dapat mengesan pantulan warna daripada bola permainan dengan bantuan “LED”. Keluaran voltan bagi perintang peka cahaya adalah ditentukan dengan menggunakan konsep pembahagi voltan. Selepas pembandingan voltan dengan julat voltan yang ditentukan, voltan tersebut akan ditukarkan kepada isyarat digital. Isyarat digital tersebut bertindak sebagai masukan kepada “PIC microcontroller”. Kemudian, pengira akan mengira jumlah bola permainan berwarna yang berjaya dikesan oleh perintang peka cahaya. Pada dasarnya, digital kamera digunakan sebagai pengesan dalam proses pengesanan warna. Namun, penambahan kuantiti digital kamera untuk proses pengesanan warna akan meningkat kos. Dalam projek ini, perintang peka cahaya digunakan untuk mengesan warna bola permainan kerana kosnya lebih murah berbanding digital kamera.

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LIST OF ABBREVIATIONS

LDR – Light Dependent Resistor

IC – Integrated Circuit

DC – Direct Current

AC – Alternative Current

LED – Light Emitting Diode

PIC – Programmable Interface Circuit

BCD – Binary Coded Decimal

OP-AMP – Operational Amplifier

A/D – Analog to Digital

IR– Infrared

I/O – Input/ Output

MOD– Mode

CHAPTER I

INTRODUCTION

1.1 Project Background

Most of people today consider electronic gadget as an important device that can help improving and helping their daily life. People reliance upon electronic devices has risen significantly throughout the past ten years, and they demand for cheaper, convenient and faster ways to complete their task such as detecting, sorting, and counting coloured objects. Therefore, lots of products are designed to meet the demand.

Basically, there are many types of colour sensor for detecting the colour objects such as Infrared, IR sensors, digital cameras and etc. Unfortunately, some of the prices of colour sensors in market are expensive. Therefore, this project attempts to design cheaper colour detection and counting system using LDR.

1.2 Objectives

The main objectives of the project are:

i. To identify and distinguish the colour of toy balls.
ii. To count the amount of colour ball after colour detection process.
iii. To display the number of toy balls in the collector.

iv. To segregate the toy ball according to its colour.

1.3 Problem Statements

Some of color sensing devices are using infrared (IR) concept where it requires a pair of emitter and receiver. Unfortunately, if either one of the components from IR sensor was malfunction, then it is not easy to detect because the ray is invisible. Meanwhile, it is quite challenging to fix the angle between the transmitter and receiver.

In contrast, this project uses LED to emit light to the object then LDR will receive the reflected light from the target. The reason is because the light emitted from LED is visible if compare to IR sensor. So, LED and LDR are easy to use and manageable especially in fixing the angle between them. Since, different colours reflect in different intensity light, and then LDR is capable to be a colour sensor.

1.4 Scope of Work

The scopes of this project are:

i. LDR is used as a sensor in colour detection circuit.
ii. Decimal counter is used to count the number of collected toy ball in container.
iii. Seven segment displays is used as display.
iv. DC motor is used to push the toy ball into container.
v. Only RED, GREEN and BLUE colour of toy balls are used in this project.

1.5 The advantages of the project

The advantage of the project is capable to distinguish various colours of toy balls. From this project, user can easily readjust the range of output voltage response by using potentiometers, if users wanted to sense others colour of toy balls.

The following advantage from this project is capable to count automatically the amount of target in the container. The decade counter is able to count and display the amount of colour toy balls in the container.

1.6 Overview of the Report

This report is divided into five chapters. Below is brief explanation of each chapter.

Chapter 1 briefly discusses about the introduction of the project. This chapter covers objectives, problems statements, scopes of work, and the advantages of this project.

Chapter 2 covers literature review and theoretical aspect of this project. This chapter is an import part of the project in which it discusses the concept used and also about the colour sensing units and counter as the main element of the project. All the aspects needed to be consider such as specification, requirements and standards of the colour sensing units and counter are covered in this chapter.

Chapter 3 covers the methodology used in this research and development. The LDR used as the colour sensor units is discussed as well as the construction of the circuit. For simulation, the circuit is tested using engineering software.

Chapter 4 will discuss and analyze the simulation results including the output of LDR sensors, DC motors and counters response for this project.

Chapter 5 summarizes and discusses the achievement of the project. Future recommendation and suggestion for this project are also included in this chapter.

CHAPTER II

LITERATURE REVIEW

2. 1 Counter

A counter is a device that performs counting operation. Counters may be used to count operation, quantities, or periods of time. They may also use for dividing frequencies, addressing information in storage, or temporary storage. The modulus for a counter is represented as the number of states. For example, the term of „MOD-10" number is the number of states that counting from 0 to 9 and once completed it return to 0 again.

In practice, there are two types of counters for performing count operation which is count up or count down. When users have set the counter as count up mode, then counter will count in increment of value. If, users have set the counter as count down mode, then counter will count in decrement of value.

The BCD decade counter, CD 4510 is able to count from binary number 0000 to 1001 and then return again to binary number 0000 for continuing next counting operation. The results at output of decade counter are shown in Table 2.1. It can be set either counting up or down by setting „1" or „0" at UP/DOWN pin accordingly. For instance, if the counter output Q4, Q3, Q2, Q1 is 0010 and the $U/\overline{D}$ pin is set to

„1‟when clock triggered, the output will be 0011. On the contrary, if the counter is $\overline{D}$ mode then the following clock pulse will make it 0001. [1]

It also has RESET pin, so that user can reset the counter whenever necessary. When the pin is active mode such as logic „1‟ on the RESET input can clear the counter to 0000 for the counter output can reset to 0000 (in case of 4-bits counter) when desired. For example, the logic „1‟on the RESET input can clear the counter to 0000.[1]

The output for BCD decade counter is equal to 4-bits of binary output. Normally, this output will feed with another IC such as decoder IC for observing the numerical digits in 7-segments display.

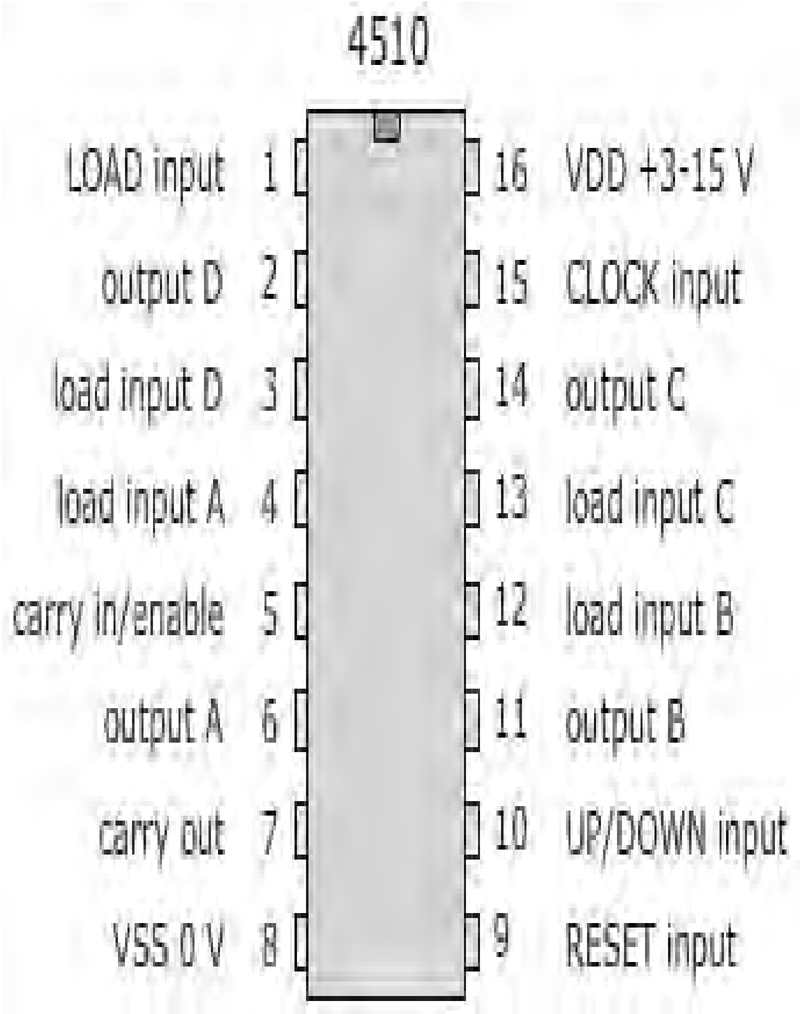

Figure 2.1 Decade Counter CD 4510

Table 2.1 Results at output of Decade Counter CD 4510 when pulses is triggered

pulse	Output D	Output C	Output B	Output A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	0	0	0	0
11	0	0	0	1
:	Sequence repeats			

2.2 BCD to 7 Segment Decoder

Normally, numerical digits can be shown in arrangement group of LEDs or 7 Segment Display. However, to display the numerical digits in the arrangement group of LEDs is considered difficult if compared with 7 Segment Display.

The 7 Segment Display can display hexadecimal characters from 0 to F. The architecture designs for 7 Segment Display uses Light Emitting Diodes (LED) for each segment. The operation for each segment is controlled by current passing through it. For example, the character „*1'* will be displayed on 7 Segment Displays when only *segment b* and *segment c* are lighted. The Figure 2.2 shows the segment patterns that are used to display the various digits. [2].

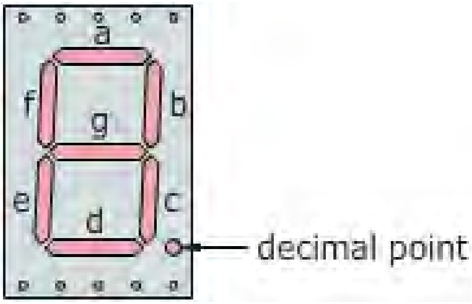

Figure 2.2 Arrangement of 7 Segment Display

In order to display the corresponding character on the 7 Segment Display, a BCD to 7 Segment Decoder is necessary to be connected and fulfil the operation. Generally, there are various types of BCD to 7 Segment Decoder such as 7447N and 4511. Although both decoder are workable with 7 Segment Display but the method for switching the outputs from the decoder to 7 Segment Display between them are different. Table 2.2 is shown comparison between these two decoders.

Table 2.2 Comparison method for processing the outputs from the decoder

BCD to 7 Segment Decoder (7447N)	**BCD to 7 Segment Decoder (4511)**
The outputs are active LOW.	The outputs are active HIGH.
Required to connect with NOT gate/ inverter IC at the outputs.	Not required to connect with NOT gate/ inverter IC at the outputs.

2.3 Variable Resistor

Variable resistor is an electronic device that consists of track with connections at both ends and the wiper which can be switchable along the track as the user turn the spindle. The material for the track of potentiometer may make from carbon, cermets (ceramic and metal mixture) or coil of wire (for low resistance). The architecture design of the track may design in rotary or straight track version. The name of the potentiometer is called slider when the track is designed in straight version. [3]

Normally, the variable resistor can perform several modes for resistance adjustment in electrical circuit. If user wants the variable resistor used as rheostat, two electrical connections are required to be connected at the wiper and another one end of the track. However, if user wants the variable resistor used as potentiometer, three connections will be used for electrical connections respectively. [3]

Meanwhile, some reference book or article may name that variable resistor as potentiometer. Normally, the manufacturer will specify the maximum resistance, linear or logarithmic track, and physical size for the potentiometer. The information related to the resistance and type of track is normally marked on the body of potentiometer. For example, when the words are marked *10K LIN* these represented 10kΩ in linear track. However, if the words are marked *1M LOG* these represented 1MΩ in logarithmic track.

Besides, potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. However, potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load. The Figure 2.3 below is shown the real image of a variable resistor.

Figure 2.3 Real image of variable resistor

2.4 DC Motor

Motor is a device which converts electrical energy into mechanical energy. For a DC motor, its input electrical energy is supplied with a DC supply. In practical, the field winding of a DC motor will produce a required magnetic field while armature conductors acted as current carrying conductor and then the armature conductor will experience a force. So, when a conductor is carrying a current and place perpendicular in a magnetic field, the overall armature will experience a torque and start rotating which is show in Figure 2.4 below. [4]

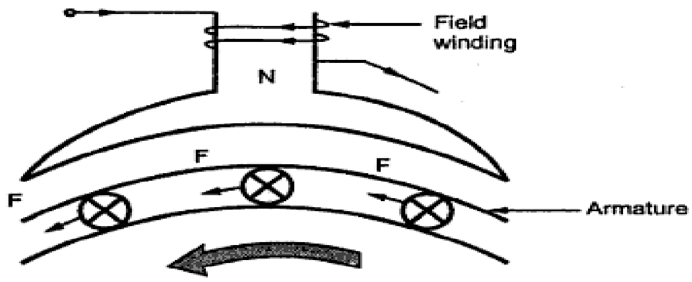

Figure 2.4 Torque exerted on armature and armature start rotating

Any current carrying conductor produces its own magnetic field around it, hence this conductor also produce its own flux, around. The direction for determine the flux can be determined with *Right hand thumb rule*. However, the flux produce by the permanent magnet is considered main flux. In order to determine the direction of rotation of a DC motor, the Figure 2.5 is shown the method for determine the rotation of armature by using *Fleming Left Hand rule*. [4]

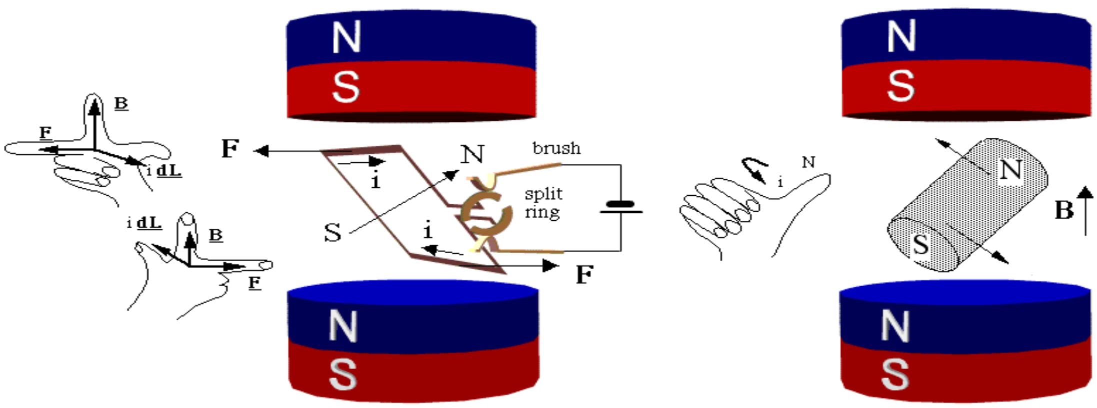

Figure 2.5 Determination the rotation of armature by using *Fleming Left Hand rule*