# Automated Classification of Rubber Seed Clones using Combination Two Different Sensors with Arduino

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***Abstract*–This paper describes work on automated system device that able to identify and different type of rubber seed clones. This paper also describes on rubber seed clones classification. There are five different types of rubber seed clone being taken into this work as a sample which are the RRIM2015, RRIM2002, RRIM2020, RRIM2023, and RRIM2024. 30 samples from each type of rubber seed clones is taken of measurement and make it total into 150 samples using in this work. For data measurement, two type of different sensor is involve which is QRE1113 and LDR. The input reading was taken from detected light that reflected form the rubber seed skin surface and the data being controlled by the Arduino, act as controller to perform the desire output. All reading data been taken and will displayed on LCD display. To perform the data analysis, one – way ANOVA measurement is used to get all the the possible value needed in this project which are mean, median, standard error, minimum value and maximum value. Error plot was constructed from ANOVA analysis in order to observe and identify if there any overlapping occur between the rubber seed clone using in this project.**

***Keywords – Rubber seed clones, QRE1113, LDR, data analysis, ANOVA***

## I. INTRODUCTION

Malaysia, comprising 14 states from Peninsular Malaysia and East Malaysia is among the world's most important rubber growing area. In order to ensure continuous supply of quality latex and heavewood to manufacturers, replanting with higher yield rubber tree clones is hence very important [1]. From this point, seed plantation needed a quality rubber tree series clone and must been utilised effectively. At this moment, there are more 30 clones of rubber trees in Malaysia. Diferrent rubber seed clones have a different features such as colour, texture, pattern and weight. The conventional way of rubber seed identification is by look and match its appearance to the closest appearance photo from library text. In advance, experienced workers can classified by just look at the features but still unreliable enough to get high percentage accuracy,consumes less time as well as reduce labor cost. Two type of sensor which are QRE113 and LDR perform together in this project to get measurement radiation light reflected from the seed surface.

### *A. RRIM2000 Clone Characteristic*

Figures below describe the type of rubber seed clones that used as a sample in this project.

Figure 1 : RRIM2023

The RRIM2023 seed is medium in size,smooth and light brownish with light brown stripe. Mostly it can be slightly rounded[2].

Figure 2 : RRIM2020

The RRIM2020 seed is small in size, smooth and shining with light brownish seed coat. It can be square to slightly rounded shape. Overall growth and seed production of this clone is considered good for both latex and timber production [1, 2].

Figure 3 : RRIM2002

The seed size of RRIM2002 is big. It has smooth surface. The colour is dark brownish. It can be slightly oval to slightly rectangular[2].

Figure 4 : RRIM2024

The seed size RRIM 2024 is medium. It is smooth, shining and brownish seed coat. The shape is square to slightly rectangular. The colour is brighter compared to the other clones. Overall growth and seed production of the clone is below average. This clone is recommended only for latex production [1, 2].

Figure 5 : RRIM2015

The RRIM2015 is small in size, smooth surface with dark brownish colour and big dark brown stripe. It size can be slightly oval to slightly rectangular[2].

## II. METHODOLOGY

The process involved in order to analysis on the rubber seed clone can be simplified as Figure 6 below.

Figure 6 : process flowchart

### *A. Samples Collection*

The samples of rubber seed clone used in this study were taken from the Rubber Research Institute of Malaysia (RRIM). There are five types of rubber seed clone involves, which are RRIM 2023, RRIM 2020, RRIM 2002, RRIM 2024 and RRIM 2015. Meanwhile for each type of rubber seed clone, 30 samples were prepared in order to obtain the readings to be analyzed as a result.

*B. Hardware Design*

There are few hardware and component that been involved in this project.

Figure 7 : QRE1113

QRE1113 breakout board features a digital output, using a capacitor discharge circuit to measure the amount of reflection. The board's QRE1113 IR reflectance sensor is comprised of two parts - an IR emitting LED and an IR sensitive phototransistor. When you apply power to the VCC and GND pins the IR LED inside the sensor will illuminate. A 100Ω resistor is on-board and placed in series with the LED to limit current. The output of the phototransistor is tied to a 10nF capacitor. The faster that capacitor discharges, the more reflective the surface[5].

Figure 8 :Light dependent resistor( LDR) sensor

The light dependent resistor(LDR) consist of two Cadmium Sulphide (CdS) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity [3]. The relative sensitivity of photoconductive cell is similar with the human's eye, and its dependent on the wavelength(colour) of the incident. Basically, dark colour will absorb more light than reflect back the light and vice versa. LDR apply this theory to measure light intensity of the colour from skin surface that reflected with light. Skin surface of rubber seed clone with dark colour reflected to LDR produce the smaller reading compare to other part of rubber seed clones that consist bright colour.

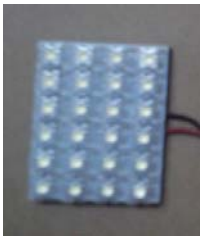

Figure 9 : Ultra-light LED

The ultra-light LED is a source light supply in this project. It operate by 12 V battery supply and consist 24 LED (6 x 4) arrangement.

Figure 10 : Arduino UNO

This system conducted by Arduino UNO shown on Figure 10 above acted as a brain of the system. Arduino consist of basic system of microcontroller with various peripheral interfaces that is programmed by an existing software platform[4]. All the sensor were connected to the Arduino to get the data measurement from skin surface of each samples and the output data will display on LCD dfrobot display shown on Figure 11 below.

Figure 11 : LCD dfrobot display

All the hardware and component was assembly and in order to measure the intensity of light, the hardware cover was designed and built with the black interior colour inside the cover. The purpose of black interior is to maximize the light reflected to each sensor by get more precisely reading data. In order to minimize outer light source, the hardware also have a top and side cover. Figures 12 below
shown how the hardware been designed and developed.

Figure 12 : (a) inside the hardware cover (b) outside hardware cover

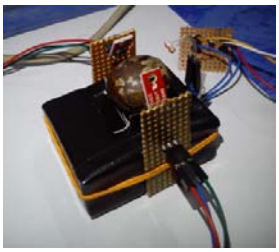

Figure 13 : position QRE1113 and LDR sensor

*C. Experiments*

The experiment were carried out to find the value of reflected light that been sense by QRE1113 and LDR sensor. To obtain a consistent and precisely reading data, the position of the sensor must been fixed in one place. Each of the samples will be at the center of the provided platform made as shown on Figure 13. There are 450 reading was taken during experiment. Every output value for each sensor of each type rubber seed clone had a specific range and this data will use during data analysis to get a result.

I. Average value for Sensor QRE1113

For each type of rubber seed clones, two sensor QRE1113 is involved to get measurement and average of two sensor value for each type of rubber seed clones was shown on Table 1 and Figure 14 below.

Table 1 : Average value range for each type of samples using QRE1113

| Type of Samples | Average Value Range |
|---|---|
| RRIM2002 | 616.0 – 824.5 |
| RRIM2024 | 467.5 – 843.5 |
| RRIM2015 | 707.5 – 844.5 |
| RRIM2020 | 566.5 – 697.5 |
| RRIM2023 | 215.0 – 677.0 |

Figure 14 : average value graph of each type of samples using QRE1113

II. Average value for Sensor LDR

For each type of rubber seed clones, one sensor Light Dependent Resistors(LDR) is involved to get measurement and average of two value which are minimum and maximum value for each type of rubber seed clones was shown on Table 2 and Figure 15 below.

Table 2 : Average value range for each type of samples using LDR

| Type of Samples | Average Value Range |
|---|---|
| RRIM2002 | 441.5 – 483.5 |
| RRIM2024 | 459.5 – 503.0 |
| RRIM2015 | 396.5 – 443.5 |
| RRIM2020 | 474.0 – 508.0 |
| RRIM2023 | 455.5 – 515.0 |

Figure 15 : average value graph of each type of samples using LDR

*D. Data Analysis*

From the data taken during the experiment, all the collective data will be analyze using one-way ANOVA in order to get the error plot for each sensor using in this paper. One way ANOVA analysis and error plot will be generated using Microsoft Excel.

## III. RESULT AND DISCUSSION

The collective data from the conducted experiment will produced parameter values for each of the sensor which are QRE1113 and LDR through the one way ANOVA analysis. . the parameter values include variance, mean, median, and standard deviation. One-way ANOVA is a general method for studying sampled-data relationships. In other word, it is statistical analysis to test the equality of three or more means at one time using variances[5]. In this paper, populations used are five types of rubber seed clone. Meanwhile, confidence level with 95% was set up for this analysis.

*A. One way ANOVA for sensor QRE1113*

Data of average value for sensor QRE113 using on 30 samples for each type of rubber seed clones must been obtain in order to proceed with one way ANOVA analysis.

Table 3 : Average value for the samples of RRIM2002, RRIM2024, RRIM2015, RRIM2020 AND RRIM2023 using sensor QRE1113

| AVE(RRIM2002) | AVE(RRIM2024) | AVE(RRIM2015) | AVE(RRIM2020) | AVE(RR1M2023) |
|---|---|---|---|---|
| 720.5 | 717.0 | 722.0 | 667.0 | 504.5 |
| 713.5 | 702.5 | 707.5 | 655.0 | 509.5 |
| 694.5 | 650.0 | 823.5 | 560.0 | 549.0 |
| 635.0 | 676.5 | 725.5 | 646.0 | 456.5 |
| 755.5 | 669.5 | 844.5 | 656.0 | 494.5 |
| 644.0 | 749.5 | 726.5 | 650.0 | 603.5 |
| 756.5 | 808.0 | 715.5 | 627.0 | 533.0 |
| 684.0 | 681.5 | 732.5 | 616.0 | 393.0 |
| 712.0 | 704.0 | 759.0 | 658.0 | 677.0 |
| 768.0 | 843.5 | 834.0 | 639.0 | 515.0 |
| 780.0 | 783.0 | 811.0 | 586.5 | 457.5 |
| 746.5 | 731.5 | 810.0 | 609.0 | 399.5 |
| 659.5 | 763.0 | 801.0 | 697.5 | 299.5 |
| 640.0 | 729.5 | 772.0 | 642.0 | 490.0 |
| 702.5 | 692.0 | 803.0 | 695.5 | 578.5 |
| 616.0 | 762.0 | 729.0 | 566.5 | 656.0 |
| 678.5 | 632.0 | 791.0 | 612.5 | 523.0 |
| 689.5 | 676.0 | 769.0 | 677.5 | 509.0 |
| 662.0 | 608.5 | 755.0 | 631.5 | 591.0 |
| 688.5 | 681.5 | 799.5 | 658.0 | 613.5 |
| 745.5 | 467.5 | 770.5 | 642.0 | 464.0 |
| 681.5 | 701.0 | 832.0 | 565.0 | 338.5 |
| 731.0 | 687.0 | 778.5 | 656.5 | 527.0 |
| 812.0 | 726.5 | 767.5 | 642.0 | 333.0 |
| 806.0 | 731.0 | 767.5 | 610.0 | 215.0 |
| 824.5 | 647.0 | 769.0 | 633.5 | 643.5 |
| 672.5 | 790.5 | 824.0 | 594.0 | 387.5 |
| 655.0 | 735.5 | 812.5 | 637.0 | 419.0 |
| 687.5 | 749.5 | 731.5 | 650.0 | 540.5 |
| 765.0 | 515.5 | 797.0 | 644.5 | 673.0 |

Table 4 : Summary of ANOVA analysis for the samples

Table 5 : ANOVA analysis between group of samples

Table 6 : parameter values

*B. Error Plot for sensor QRE1113*

Error plot is been construct by using the value of confidence level(95%) obtain from each type of

rubber seed clones. Error plot is shown on Figure 16 below.

Figure 16 : Error plot of sensor QRE1113 using confidence level(95%)

Error plot above indicates that 2 out of 5 samples which are RRIM2002 and RRIM2024 overlap reading with each other.

### *C. One way ANOVA for sensor LDR*

Table 7 : Average value for the samples of RRIM2002, RRIM2024, RRIM2015, RRIM2020 AND RRIM2023 using sensor LDR

| AVE(RRIM2002) | AVE(RRIM2015) | AVE(RRIM2020) | AVE(RRIM2023) | AVE(RRIM2024) |
|---|---|---|---|---|
| 469.5 | 406.0 | 508.0 | 507.0 | 488.0 |
| 483.5 | 424.0 | 491.5 | 498.5 | 483.0 |
| 459.0 | 437.5 | 510.5 | 515.0 | 480.5 |
| 453.5 | 443.5 | 484.0 | 504.5 | 473.0 |
| 452.5 | 426.5 | 494.0 | 487.0 | 475.5 |
| 462.0 | 440.0 | 509.0 | 501.5 | 471.5 |
| 455.5 | 438.5 | 483.5 | 496.0 | 470.0 |
| 449.5 | 422.0 | 477.0 | 490.0 | 482.5 |
| 467.5 | 426.5 | 497.0 | 486.5 | 487.5 |
| 449.0 | 411.0 | 508.0 | 473.0 | 464.0 |
| 452.0 | 433.5 | 482.0 | 489.0 | 472.0 |
| 473.0 | 435.0 | 481.0 | 509.5 | 484.5 |
| 469.0 | 438.0 | 494.0 | 482.0 | 485.0 |
| 477.5 | 427.0 | 484.5 | 483.0 | 472.0 |
| 441.5 | 425.0 | 489.5 | 469.5 | 503.0 |
| 460.0 | 439.0 | 484.5 | 473.5 | 483.5 |
| 469.0 | 432.0 | 491.5 | 482.5 | 471.0 |
| 465.5 | 416.0 | 502.5 | 474.0 | 459.5 |
| 457.5 | 434.0 | 490.5 | 460.5 | 478.0 |
| 455.0 | 427.5 | 477.0 | 465.0 | 502.0 |
| 468.5 | 438.5 | 475.0 | 461.5 | 502.5 |
| 470.5 | 435.0 | 474.0 | 456.5 | 488.5 |
| 463.5 | 429.0 | 501.0 | 464.0 | 478.5 |
| 448.0 | 420.5 | 499.5 | 499.5 | 478.5 |
| 453.0 | 396.5 | 491.0 | 455.5 | 482.0 |
| 472.0 | 429.0 | 493.5 | 479.0 | 479.5 |
| 452.0 | 415.0 | 477.5 | 499.0 | 479.5 |
| 459.5 | 428.5 | 507.0 | 499.5 | 463.0 |
| 468.0 | 410.0 | 485.0 | 480.5 | 478.0 |
| 453.0 | 414.5 | 478.5 | 451.0 | 461.0 |

Table 8 : Summary of ANOVA analysis for the samples

Table 6 : parameter values

### *D. Error Plot for sensor LDR*

Error plot is been construct by using the value of confidence level(95%) obtain from each type of rubber seed clones. Error plot is shown on Figure 17 below.

Figure 17 : Error plot of sensor LDR using confidence level(95%)

Error plot above indicates that 3 out of 5 samples which are RRIM2020, RRIM2023 and RRIM2024 overlap reading with each other.

## IV. CONCLUSION

This project conduct the test using a samples from five types of rubber seed clones which are RRIM2002, RRIM2015, RRIM2020, RRRIM2023 and RRIM2024. The test is specific on data extraction by using two different type of sensor that detect intensity reflected light from the skin surface of rubber seed clones. Combination of sensors and operate with Arduino UNO that act as microcontroller produce the desire output value in ADC unit value. One way ANOVA analysis generate the parameter value that require to produce error plot. Error plot determine the efficiency of the sensor detect the type of samples. QRE1113 is tend to be efficient on

three samples that not overlap each other which are RRIM2015, RRIM2020, and RRIM2023. Meanwhile, sensor LDR will be more efficient detection identify on samples RRIM2002 and also RRIM2015.

## V. RECOMMANDATION

As future recommendation, samples must been select in good condition without dirt on the skin surface so that the skin surface can reflect more light to the sensor. Increase the type of rubber seed clones use as a sample because RRIM2000 clones have 33 different clones.

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```
#include <LiquidCrystal.h>

LiquidCrystal lcd(8, 9, 4, 5, 6, 7);
int QRE1113_Pin = A3; //connected to analog 0
int LDR_Pin2 = A4; //analog pin 1
int QRE1113_Pin3 = A5; //analog pin 2


void setup(){
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.print("Put Rubber Seed" );
  delay(1000);
  lcd.setCursor(0, 1);
  lcd.print(" In The Box ");
  delay(1000);
  lcd.clear();
}

void loop(){

  int sensorA = analogRead(QRE1113_Pin);
  Serial.println(sensorA);
  lcd.begin(16, 2);
  lcd.print("sensor A :" );
  lcd.setCursor(0, 1);
  lcd.print(sensorA);
```

```
  delay(1500); //just here to slow down the output for easier reading


  int sensorB = analogRead(LDR_Pin2);
  Serial.println(sensorB);
  lcd.begin(16, 2);
  lcd.print("sensor B :" );
  lcd.setCursor(0, 1);
  lcd.print(sensorB);
  delay(1500); //just here to slow down the output for easier reading


  int sensorC = analogRead(QRE1113_Pin3);
  Serial.println(sensorC);
  lcd.begin(16, 2);
  lcd.print("sensor C :" );
  lcd.setCursor(0, 1);
  lcd.print(sensorC);
  delay(1500); //just here to slow down the output for easier reading
}
```