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[Automatic Dehydration Level Detection Devices \(Equipped With pH Measurements and Calculation Of Body Fluid Requirements\) Diana Dwi Damayanti¹, Her Gumiwang Ariswati¹, I Dewa Gede Wisana¹, Hendra Winarno²](#) [1Electromedical Engineering Department of Politeknik Kesehatan Kementerian Kesehatan Surabaya Jl. Pucang Jajar Timur No. 10, Surabaya \(60282\), Indonesia](#) [2Universitas Muhammadiyah Gresik Jl. Sumatera No.101, Gn. Malang, Randuagung, Kec. Kebomas, Kabupaten Gresik, 61121, Indonesia](#) [E-mail: dianadamayanti275@gmail.com](#) [Article Info](#) [Abstract](#) [History](#) [Articles: Receive Mei 15, 2020 Revised August 10, 2020 Received August 30, 2020](#) [Dehydration is a condition that occurs when the loss of body fluids exceeds the amount entered in the body so that it can disrupt the balance of minerals in body fluids. Most people do not feel thirsty until finally, they experience a period of severe dehydration, which can cause physical, cognitive, fatigue; if not corrected immediately can cause death. The purpose of this study is to design a dehydration and urine pH detection devices automatically. The contribution of this study is that this device is equipped with urine pH measurement and automatic body fluid calculation. This device is](#) **Keywords:** [able to detect urine color levels, read urine pH values, and provide information on body fluids needed](#) [Dehydration to treat the patient's condition when detected. The sensors used in this device are color sensor TCS34725, pH meter sensor module SKU-016 and DS18B20 temperature sensor, the calculation of the TCS34725 amount of fluid that must be entered automatically from the patient's body weight input. The pH meter programming uses Arduino Nano as the main controller with a 128x64 graphic LCD. From the testing Graphic LCD that has been done, it is known that the percentage error in the module is 3.5%, which means that it is still in the tolerance value because the tolerance limit is 5%, for the sensitivity test results get a value of 60% and specificity of 70%. Thus, it shows that the device is feasible and can be implemented as a dehydration detection device that is carried out independently at home.](#) The corresponding author: This is [open access articles and licensed under Creative Commons Attribution-Non-Commercial 4.0 License](#) [Her Gumiwang Ariswati](#) [Electromedical Engineering Department International, Politeknik Kesehatan Kementerian Kesehatan Surabaya Jl. Pucang Jajar Timur No. 10, Surabaya \(60282\), Indonesia](#) [E-mail: ariswatihergumiwang@gmail.com](#)

I. INTRODUCTION

Health monitoring can be done independently, one of which is biochemical tests which are generally often carried out by many people. One of the biochemical tests is a urine examination, which is done independently at home. Urinalysis is recommended to be part of the initial examination of all patients because it is cheap, feasible, and provides productive results[1]. Urine examination in patients provides very extensive information based on existing parameters and can indicate problems in the body. Information that can be identified includes urine color, urine sediment, urine pH, protein, glucose, nitrite, red blood cells, and white blood cells, bilirubin [2]. In the urine color and pH check, the test is usually done manually using a color strip that uses strip paper as a comparison. The results are often obtained by semi-quantitative analysis, where only people with expertise can read the results of the manual test. In the context of health, home-monitoring is generally done by reading manually reading error-prone. Also, parents or people who are color blind are likely to face difficulties in conducting rapid visual analysis, which can lead to incorrect results. Therefore biochemical tests are automatic and can provide easy information that is very much needed in such cases. Biochemical tests through urine can detect kidney damage, from the results of these tests immediately carried out further tests on the patient, to follow up on the treatment of kidney damage[3][4]. Dehydration or loss of body fluids is often experienced unconsciously. [Most people do not feel thirsty until finally, they experience a period of severe dehydration](#)[5][6][7]. Water is needed in the body for metabolic processes, body temperature regulation,

joint lubrication, distribution of nutrients, and so on[8][9]. [Acute dehydration can cause physical and cognitive disorders, heatstroke and fatigue, and if severe and uncorrected, even death](#)[10][11]. Apart from [infants and people with special medical conditions, athletes, military personnel, workers, and older adults are at particular risk of dehydration due to their physical activity, environmental exposure, and the challenges of maintaining fluid homeostasis](#)[12][13]. The earliest detection of dehydration is the color of urine, which is often unknown is the calculation of fluids that must enter the body when dehydration is detected, therefore the need for an [Indonesian Journal of Electronics, Electromedical Engineering and Medical Informatics \(IJEEEMI\) 87](#) automatic dehydration detector and is equipped with an automatic calculation of the amount of fluid entering the body. Also, the pH level (Power of Hydrogen) plays an important role in the maintenance of human metabolic activity. The kidneys have a role in regulating the concentration of hydrogen ions in body fluids to prevent acidosis or a way to excrete acid or alkaline urine[2]. In the body can describe accurately the concentration of hydrogen ions in it. Excessive acidity of urine may be a sign of diabetes, systemic acidosis, dehydration, etc. Urinary excessive alkalinity may be a sign of bacteriuria or kidney failure[14]. The reverse, the pH of the urine becomes alkaline can be due to urinary tract infections, pyloric, chronic kidney failure, certain drug therapies. Examination of urine color and urine pH does not have to wait to the clinical laboratory, and the examination can be done at home as an early detection if dehydration is detected so that it can be handled directly by entering fluids in the body as needed by the body and can be checked again until it is classified as normal urine. Likewise, with the pH value in the urine if the reading of the pH value is not normal then immediately carried out further examination and treatment, because it indicates a problem in the kidney[15][16]. A similar study was conducted by Rint Zata in 2017 with the title Dehydration Detection System Based on color and ammonia levels in the urine based on TCS3200 and MQ135 sensors with the Naïve Bayes method[17]. From this device, the level of dehydration and the level of ammonia in the urine were detected. However, the device has not been equipped with body fluid needs. Subsequent research was carried out by Ika Shofiyah Naharin in 2018, and she developed an automatic detection of dehydration levels based on the color of urine supplemented with the number of fluid needs. The device uses the TCS3200 color sensor to detect the color of urine and the amount of fluid needed for the body. However, there has been no development of measurements for other urine components, the TCS3200 sensor reading error value is still relatively high, and the device is not yet portable, so there are limitations in placement when making measurements. Further research was carried out by Alexander et al. in 2018, and they propose a urine dehydration system based on urine color [18]. The device uses the same sensor as what the author will develop, namely the TCS34725 color sensor. In his research, he gave conclusions and hopes for future research to establish the system to modify other parameters such as pH, specific gravity, glucose, etc. This system can be implemented in a home system[19]. Based on the weaknesses and limitations that have been mentioned in previous researchers, among others: 1) There is no other parameter to detect dehydration other than the color of urine 2) not portable; 3) the type of sensor used is less than the maximum in detection. Against this background, the authors intend to research the title Detection of Dehydration and Urine pH Automatically. It was using a sensor that is different from before using the TCS34725 sensor and adding another parameter in the examination of the urine component, namely the measurement of the pH value. It is hoped that this device can help to monitor health at home through early detection of dehydration as well as knowing the needs of fluids in the body and knowing the pH of urine to determine whether there are metabolic

problems, especially in the kidneys and the devices are made using different sensors from previous studies, and the device is made automatically and portable to make it easier to use. [This Article is composed of: Chapter 1 Introduction, Chapter 2 Material and Methods, Chapter 3 Result, Chapter 4 Discussion, Chapter 5 Conclusion, and Chapter 6 Reference.](#) II. MATERIALS AND METHODS A. [Experimental Setup](#) This study conducted using eight samples to detect and measure. Samples were obtained from liquids whose color approached the color scale urine hydration chart. B. Materials and Device In this study, we used a TCS34725 color sensor (TCS34725FN, TCS34725, Headquarter sams AG Tobelbader Strasse 308141 Premstaetten Austria, Europe) (Fig. 1), pH meter module sensor SKU-016 (PH-4502C, DIY MORE & BNC Electrode pH probe, China) (Fig. 2), temperature sensor DS17B20 (waterproof, Maxim Integrated Products, China), buffer pH 4.01 and aqua dest for calibration of the pH meter electrode, and some solutions according to the urine hydration color scale. Components used in this study is a microcontroller Arduino Nano (programming by software Arduino 1.8.2) and 128x64 LCD graphic as the display. Fig. 1. TCS34725 Color Sensor[20] Fig. 2. pH Meter Module Sensor SKU-016 C. Experiment Protocol In order to experiment, provide a liquid to be detected in accordance with the color scale urine hydration chart (Fig. 3). Elektrode Graphic LCD pH meter module sensor Buffer Amlifier Sample DS18B20 Temperature Arduino sensor Fig. 3. Liquid Accordance With The Color Scale Urine Hydration Chart TCS34725 Color Sensor Fig. 5. A Block Diagram System Begin Initialization Fig. 4. Final Information Color detection using the TCS34725 color sensor, the board is blue as in (Fig. 1), after which the liquid is measured pH using the pH meter module sensor SKU-016 as in (Fig. 2) with calibration step using buffer 4.01. then the electrodes are cleaned utilizing a tissue carefully until completely clean and dry after that dipped in aqua liquid and did the same thing. Then dip pH meter electrode in the liquid to be measured after the value appears on display. Select the weight input menu, enter digits of the when conditions are taken for sampling. Final information will come out on the screen from the detected results as in (Fig. 4) shows the level of dehydration, pH, and fluids that the body needs to overcome this. D. Diagram Block The input was obtained from the sample. First, the sample color check is performed, the color of the sample is detected by the TCS34725 color sensor, and the ADC (R, G, B) data is generated and processed by Arduino program. Second, it takes the pH of the sample. Before it carries the pH check out, the sample is dipped by a pH meter electrode and then processed by the pH meter sensor module to produce a voltage output, which is then treated with a buffer amplifier circuit. In the examination of pH temperature also affects the reading results; therefore, the sample is also measured by using a DS17B20 waterproof sensor. After that, the measurement results of the pH, temperature, and color of the sample are displayed on the graphic LCD. Display menu Color of Urine Read the ADC R,G,B sensor Converting RGB values to color levels LCD displays the level of dehydration pH of urine Read temperature sample Read pH sample Weight input Conversion to body fluid needs The LCD displays the dehydration level, the amount of liquid needed and the value (pH and temperature of the sample) Reset Yes No [End Fig. 6.](#) [The Flowchart Program Arduino](#) E. [The Flowchart](#) The flowchart of the proposed method is shown in (Fig. 6). The [program starts from the LCD initialization](#) with three menu displays, namely color detection, pH and temperature measurement, the weight input. After measuring in the first and second menus and then selecting the 3rd menu for weight input, then press enter, then the general information will appear on the LCD screen. There is also a reset button to return to the initial LCD initialization program. F. Circuit 1) pH Meter Module Sensor The pH meter input module SKU-016 is derived from the electrode dipped in the sample and the sensor output pin is connected to the buffer amplifier circuit. J1

V+ G INPUT G Po D o To MODUL PH METER Fig. 7. pH Meter Module

Sensor 2) Buffer Amplifier The input circuit is derived from the pH meter output of the sensor module, this circuit comprises 2 circuits namely a buffer circuit that functions so that the input voltage and output voltage are the same and the amplifier circuit to amplify the voltage which then outputs the incoming circuit at the Arduino A0 pin. +5 R2 R1 POT 1K -5 4 5 U2 J2 2 - R4 6 1 2 3 + 1K LM741 7 1 IN +5 POT R5 R6 1k R3 -5 1K 4 5 U1 2 - 6 3 + LM741 7 1 +5 J1 1 2 OUT J6 LED INT SDA SCL 3V3 GND VIN TCS34725 Fig. 9. TCS34725 Color Sensor 4) DS18B20 Temperature Sensor Connection It connects the DS18B20 sensor to the pull-up circuit and then connected to the Arduino D12 pin. +5 J2 R1 VCC DATA 4,7K GND DS18B20 Fig. 10. DS18B20 Temperature Sensor III. RESULT In the research carried out, it carried tests out using 8 sample colors that resembled eight levels of color scale urine hydration chart. (Fig. 11). Fig. 11. Fluid Samples Used For Measurement Fig. 8. Instrumentation Amplifier 3) TCS34725 Color Sensor It connects the tcs34725 sensor to the VCC, GND, SDA and SCL pins on the Arduino pin. A. Device Design We can see the design of the instrument (Fig. 12). There is an exact sample that has the surface of the box in which there is a tube to insert the sample at the time of color detection. There are push buttons for setting and selecting menus. There are two connectors on the right side in the picture, which are connected to the pH meter electrode and temperature sensor. Fig. 12. Automatic Dehydration and pH Urine Level Detection Device B. The Results of Program Arduino In the Arduino program is divided into 6, namely the color level reading program, the pH reading program, the temperature reading program, the weight input program, and the liquid calculation program. Pseudocode 1. The Program is to Read Color By Sensor TCS34725

```
void LOOP(void)
uint16_t r, g, b;
c;
tcs.getRawData (&r, &g, &b, &c);
Serial .print(" Color sensor ");
Serial.print(" R: ");
Serial.print( r, DEC);
Serial.print("");
Serial.print(" G: ");
Serial.print( g, DEC);
Serial.print("");
Serial.print(" B: ");
Serial.print( b, DEC);
Serial.print("");
Serial.print(" C: ");
Serial.print( c, DEC);
Serial.print("");
Serial.print("");

```

This program is used for the color reading of the sample, which will later be read the ADC value of its R, G, B.

Pseudocode 2. The Program is to Convert RGB Digital Data to Color Levels Make 8 program for 8 color scale of urin hydration, for example as follows :

```
IF ((reda >= 1.12 & reda <= 1.13) && (greena >= 1.07 & greena <= 1.08) && (bluea >= 0.79 & bluea <=0.81)) THEN u8g.drawStr(37, 40, "Normal");
condition=1;
ENDIF ELSE IF ((reda >= 1.15 & reda <= 1.19) && (greena >= 1.04 & greena <= 1.05) && (bluea >= 0.75 & bluea <=0.80)) THEN u8g.drawStr(20, 40, "Dehydrated ");
condition=4;
ENDIF ELSE IF ((reda >= 1.14 & reda <= 1.19) && (greena >= 0.98 & greena <= 0.99) && (bluea >= 0.82 & bluea <=0.88)) THEN u8g.drawStr(20, 40, "Severe Dehydration");
condition=8;
ENDIF ELSE u8g.drawStr(20, 40, ".....");
ENDELSE

```

This program is used to convert the reading data in the form of R, G, B values to a color level. This program is used for setting tools to achieve correct and accurate readings.

Pseudocode 3. The program is to Read pH Value

```
DEFINE int pHvalue = analogRead(phSensorPin);
VoltagePh = 5 / 1024.0 * pHvalue;
phadc= pHvalue;
Tphhitsegp=ro(gVroamItaigseuPshe)d;

```

for reading the pH meter module

Pseudocode 4. The Program is to Calibration 1 Point

```
DEF FhIiNsEprogram is used for the adjustment of the pH meter
pH=(-0.0184* pHvalue)+18.481;

```

When the sensor was performing calibration, the media was set using a pH powder of 4.01. The formula added to the program is made using Excel to adjust the value when the setting is done.

Pseudocode 5. The Program is to Readings From The Temperature Sensor

```
LOOP (void)
ListsienngsoPrsr.oregqruaemstT6e.mTpheerapturroegs(r)a;m is to calculation of the
amoSuenrtiaol.fpfriunitd("=n=ee=d=eTdeminptehreatbuored:y");
Serial.println(sensors.getTempCByIndex(0));
delay(1000);
ENDLOOP

```

This program is used for reading the temperature value at the time of pH

measurement because the temperature value affects the pH value, therefore, a temperature sensor must be added when measuring the pH of the sample. TABLE I. MEASUREMENT RESULTS Pseudocode 6. The Program is to Calculation of Fluid Requirements IF (condition==3) BN=BB; ENDF IF (condition==4) BN=BB*100/96; ENDF IF (condition==1) u8g.drawStr(0, 15, "NORMAL"); ENDF ELSE IF (condition==1) u8g.drawStr(0, 15, "DEHYDRATED"); ENDF ELSE IF (condition==1) u8g.drawStr(0, 15, "SEVERE DEHYDRATION"); ENDF ELSE u8g.drawStr(0, 15, "....."); ENDF This program is used to automatically calculate the body's fluid requirements using a formula and input derived from the patient's body weight C. The Results of The Output TCS34725 The output of the sensor detection is displayed on the graph (Fig. 13) for easy reading. 1.3 1.2 Normalize output 1.1 1 0.9 R G B 0.8 0.7 1 2 3 Color Scale 4 5 6 7 8 Fig. 13. Graphic RGB Value of Output TCS34725 Sam Module ple TCS3472 5 1 R=1.12 G=1.08 B=0.81 2 R=1.16 G=1.07 B=0.77 3 R=1.18 G=1.06 B=0.76 4 R=1.18 G=1.05 B=0.76 5 R=1.13 G=1.04 B=0.83 6 R=1.16 G=0.99 B=0.85 7 R=1.15 G=0.99 B=0.87 Weight pH gain meter when dehydr ated 2.80 60 2.69 54 2.97 46 2.73 47 2.65 48 2.67 56 2.65 45 Weight gain when Status normal conditio n 62.5 Norm al 54 Norm al 46 Norm al 50 Fair 50 Dehydr ated 56 Dehydr ated 45 Very dehydr ated Fluid need (mL/ d ays) 2300 m l 2180 2020 2060 2100 2264 2054 8 R=1.15 Severe G=0.99 3.20 48 50 dehydr 2120 B=0.87 ated Table I. explains about overall measurements when the device works in sequence according to the system made. D. Measurement Error TABLE II. CALCULATION OF PH SENSOR ERROR VALUES Deviation (comparison Sample pH pH (comparison device- (Module) device) Module/ comparison device)| 1 2.8 2.46 0.13821 % error 13.8211 2 2.69 2.16 0.24537 24.537 3 2.97 3.26 0.088957 8.895706 4 2.73 2.86 0.045455 4.545455 5 2.65 2.46 0.07724 7.72358 6 2.67 2,87 0.069686 6.968641 7 2.69 2.52 0.06746 6.74603 8 3.2 3.01 0.06312 6.31229 Average 1 : 4.84128 Table II. explains the calculation of the error pH value in the module compared to the comparison device. TABLE III. CALCULATION OF TEMPERATURE SENSOR ERROR VALUES Sample Temperature Temperature of the of the sample sample (module) (codmevpiacreis)on Deviation |(comparison device- Module/ comparison device)| % error 1 29 28.6 0.01399 1.3986 2 29.38 28.5 0.03088 3.08772 3 29 28.7 0.01045 1.0453 4 29.5 28.6 0.03147 3.14685 5 29.63 28.7 0.0324 3.24042 6 29.75 28.8 0.03299 3.29861 7 29.31 29.3 0.00034 0.03413 8 29.94 28.9 0.03599 3.59862 Average 2 : 2.35628 Table III. explains the calculation of the temperature value in the module compared to the comparison device. Overall error value Error = A1+A2 16 = 4.84128+2.35628 = 3.59878% 2 IV. DISCUSSION Previous research in 2017 which is conducted by Rint Zata [17], there was a development of parameters that detect through the color of urine gas and ammonia gas, and other studies mostly using TCS3200 color type sensors, for the current development using TCS34725 color sensors whose quality is better because there are IR block filters. Further research was carried out by Alexander et al. in 2018 [18].The device uses the same sensor, namely the TCS34725 color sensor. Still, the dehydration detection parameter is only through the color of urine and suggests that there be additional development of other parameters. Now, this study is done by adding a different parameter, namely urine pH, because pH affects the dehydration condition, and I also add that the calculation of body fluids is needed automatically. In Table II. and Table III. that this device is suitable for use as detection of dehydration at home as early detection of dehydration status in the body. [V. CONCLUSION This study shows the development of a community movement to check urine itself by making a dehydration level detection device that is equipped with urine pH measurement and automatic body fluid calculation. This study uses Arduino programming to create the desired system. Program processing uses Arduino Uno and is displayed on a 128x64 graphic LCD. This study has an error value of](#)

3.5%%, which means that it is still in the tolerance value because the tolerance limit is 5%, a sensitivity of 60% and a specificity of 70%. That it shows that the device to be feasible and can be implemented as a dehydration detection device that is carried out independently at home.

In the future, I expect it, that development can be carried out for the addition of other urine component detection parameters. REFERENCE [1] S. Dey, T. Saha, and U. Narendrakumar, "Analysis of Urine as Indicators of Specific Body Conditions," 2017. [2] J. M. Sands and H. E. Layton, "The Physiology of Urinary Concentration : An Update," *YSNEP*, vol. 29, no. 3, pp. 178–195, 2009. [3] M. Velikova, R. L. Smeets, J. Terwisscha, P. J. F. Lucas, and M. Spaanderman, "Smartphone-based analysis of biochemical tests for health monitoring support at home," vol. 1, pp. 92–97, 2014. [4] R. Loesnihari, "Peran analisa urin pada penanganan penyakit ginjal dan traktus urinarius," vol. 45, no. 3, pp. 167–176, 2012. [5] I. M. Krecar, M. Kolega, and S. F. Kunac, "The Effects of Drinking Water on Attention," *Procedia - Soc. Behav. Sci.*, vol. 159, pp. 577–583, 2014. [6] Y. Women et al., "Mild Dehydration Affects Mood in Healthy," *J. Nutr.*, vol. 142, no. 2, pp. 1–7, 2012. [7] L. E. Armstrong, E. C. Johnson, and M. F. Bergeron, "COUNTERVIEW: Is Drinking to Thirst Adequate to Appropriately Maintain Hydration Status during Prolonged Endurance Exercise? No," *Wilderness Environ. Med.*, vol. 27, no. 2, pp. 195–198, 2016. [8] D. L. Costill and W. Fink, "Muscle water and electrolytes following varied levels of dehydration in man," vol. 40, no. 1, 2018. [9] A. Klein et al., "Hydration biomarkers in free-living adults with different levels of habitual fluid consumption," pp. 1678–1687, 2013. [10] S. N. Thornton, "Physiology & Behavior Thirst and hydration : Physiology and consequences of dysfunction," *Physiol. Behav.*, vol. 100, no. 1, pp. 15–21, 2010. [11] D. C. Garrett et al., "Engineering Approaches to Assessing Hydration Status," vol. 3333, no. c, 2018. [12] B. D. Altinsoy, O. B. Ozakpinar, B. Gurbuz, P. Rayaman, I. Ocsoy, and U. S. Gurer, "Green synthesis and characterization of silver nanoparticles using the fungus *A. Niger* and bioactive potential against microorganisms and cancer cells," *Lat. Am. J. Pharm.*, vol. 37, no. 5, pp. 979–986, 2018. [13] C. J. Hall and A. M. Lane, "Effects of rapid weight loss on mood and performance among amateur boxers," *Br. J. Sports Med.*, vol. 35, no. 6, pp. 390–395, 2001. [14] "Design and Implementation of Microcontroller Based Calculator," *J. Comput. Biosci. Eng.*, vol. 1, no. 2, pp. 31–35, 2014. [15] T. Miyake et al., "Low urine pH is associated with non-alcoholic fatty liver disease: A community-based cross-sectional study," *Intern. Med.*, vol. 57, no. 19, pp. 2799–2805, 2018. [16] E. M. Worcester, K. J. Bergsland, D. L. Gillen, and F. L. Coe, "Mechanism for higher urine pH in normal women compared with men," *Am. J. Physiol. - Ren. Physiol.*, vol. 314, no. 4, pp. F623–F629, 2018. [17] R. Z. Amani, R. Maulana, and D. Syauqy, "Sistem Pendeteksi Dehidrasi Berdasarkan Warna dan Kadar Amonia pada Urin Berbasis Sensor TCS3200 Dan MQ135 dengan Metode Naive Bayes," vol. 1, no. 5, pp. 436–444, 2017. [18] A. A. S. Gunawan, D. Brandon, V. D. Puspa, and B. Wiweko, "Development of Urine Hydration System Based on Urine Color and Support Vector Machine," *Procedia Comput. Sci.*, vol. 135, pp. 481–489, 2018. [19] K. Samu and B. Thamó, "Internet based light quality measurement," *Recent Innov. Mechatronics*, vol. 4, no. 1, pp. 4–8, 2017. [20] Texas Advanced Optoelectronic Solutions Inc., "COLOR LIGHT-TO-DIGITAL CONVERTER with IR FILTER End Products and Market Segments Texas Advanced Optoelectronic Solutions Inc . COLOR LIGHT-TO-DIGITAL CONVERTER with IR FILTER," datasheet, no. 972, p. 2, 2012. [IJEEMI, Vol. 2, No. 2, August 2020, pp: 87-94 DOI: 10.35882 /ijeemi.v2i2. 5 ISSN: 2656-8624](#) [IJEEMI, Vol. 2, No. 2, August 2020, pp: 87-94 DOI: 10.35882 /ijeemi.v2i2. 5 ISSN: 2656-8624](#) [IJEEMI, Vol. 2, No. 2, August 2020, pp: 87-94 DOI: 10.35882 /ijeemi.v2i2. 5 ISSN: 2656-8624](#) [IJEEMI, Vol. 2, No. 2, August 2020, pp: 87-94 DOI: 10.35882 /ijeemi.v2i2. 5 ISSN: 2656-8624](#) [IJEEMI, Vol. 2, No. 2, August 2020, pp: 87-94 DOI: 10.35882 /ijeemi.v2i2. 5 ISSN: 2656-8624](#) [IJEEMI, Vol. 2, No. 2, August 2020, pp: 87-94 DOI: 10.35882 /ijeemi.v2i2. 5 ISSN: 2656-8624](#)

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