The Citrus Fruit Sorting Device Automatically Based On Color Method By Using Tcs320 Color Sensor And Arduino Uno Microcontroller

Poltak Sihombing 1, Faddly Tommy 2, Sajadin Sembiring 3, Nogar Silitonga 4
1,2,3 Faculty of Computer Science and Information Technology, Universitas Sumatera Utara, Jl. Dr. Mansyur No.9, Padang Bulan, Medan,
4 Faculty of Computer Science, Universitas Methodist Indonesia.

Email: poltakhombing@yahoo.com

Abstract. This research relates to the development of tools for sorting citrus fruits with RGB (Red, Green, Blue, RGB) color method by using TCS3200 color sensor and Arduino Uno Microcontroller to recognize RGB colors of oranges. First of all the citrus fruit that will be sorted is put into one container, then from the oranges container will glide through a hole that has been installed the TCS3200 color sensor. The fruit will be separated by the sensors based on the color of citrus fruit, then the actuator which is driven by the servo motor will separate the citrus fruits based on the color. The citrus fruit will fall into the place according to the citrus fruit color. The results of this study will separate the citrus fruit into three groups.

1. Introduction
The development of science and technology is based on an increasingly intelligent human mindset and its desire to find things that are easier, practical and economical. One of the technology that is widely used today is using sensor and microcontroller technology. Microcontroller is used as a tool that can help human work. So that human work can be done automatically.

Likewise the demand for fruit is increasing along with the improvement in income and awareness of nutrition and health. Demand for citrus fruits also increases sharply, so farmers and traders often need a long time to sort out citrus fruits.

The selection of citrus fruit in Indonesia is still largely manual, namely by using human power. Whereas in developed countries already use sorters that can work automatically, but the price of this sorter is relatively expensive. Therefore, it is necessary to conduct a study by developing an orange fruit sorter which automatically hopes to increase effectiveness and efficiency in sorting citrus fruits.

Orange color is the most important feature for quality classification and sorting of oranges. Usually the yellow color is the best quality because it is sweeter than green or slightly green. Selection of automatic oranges will be a special priority for most citrus farmers. In this context the field of research on the selection of automatic oranges is important for choosing quality oranges.

2. Related Work
Some literature studies related to this research include physical attributes of agricultural materials, volume, mass and area are important parts of determining plant quality [1]. Other related research is using computer machines and image processing techniques and the application of color image analysis to sort fruits by S. Arivazhagan et al. [2]. They managed to make the separation of citrus fruits with
image and color analysis. Another research is with fruit recognition with multiple features using Fuzzy Logic by Monika et al. [3], they explained that to choose quality citrus fruits can be determined with multiple features using Fuzzy. This algorithm managed to do citrus classification. Another study related to the selection of citrus fruits is Sachin Syal et al. [4]. They designed and developed the Intelligent System for Grading of Jatropha Fruit by Its Feature Value Extraction Using Fuzzy Logics. They succeeded in developing fruit extraction using fuzzy logic. Subsequent research by Pragati Ninawe et al. [5]. They made A Completion on Fruit Recognition System Using K-Nearest Neighbors Algorithm. this research succeeded in making fruit recognition using Algorithm K-Nearest Neighbors.

3. Proposed Approach

3.1 Block Diagram

Figure 1 and 2 are block diagrams and a series of tools consisting of several components contained in an orange fruit sorter, consisting of a brief description as follows:

a) Power Supply is a series of components that function to supply electrical energy into the circuit contained in the system.
b) TCS3200 color sensor is a sensor that functions to read orange color and as an input to Arduino Uno.
c) Push Button is a button that functions to temporarily stop all processes that are running and display the total number of fruits that have been sorted.
d) Arduino Uno Microcontroller is a control center module that can receive input from the sensor and provide output.
e) Servo motors are components that function to direct citrus fruits to their respective containers based on their color.
f) 16x2 LCD monitor is a component that functions to display characters with an amount of 32 characters.
3.2 The Circuit Scheme of Heart Detecting
The design consists of 2 main parts namely the design of hardware systems, and design of software systems. The hardware circuit is shown in Fig. 3.

Research to sort citrus fruits based on color by using sensors, Arduino uno microcontroller refers to figures 1 and 2 through the following stages:

a) Layout creation is done by creating a schematic drawing of the circuit using the Proteus 8 ISIS software. Schematic is a series of images that connect components to an electronic circuit;
b) PCB layout is printed on photo paper using a laser printer. The result of printing the layout on the photo paper is then screened over the PCB by means of the surface of the image layout placed above the copper layer on the PCB board, then heated using an electric iron so that the layout on the photo paper attaches to the copper surface of the PCB board;
c) PCB board dissolution uses ferrichloride (FeCl3) solution by inserting the PCB board into ferrichloride (FeCl3) solution to copper on the PCB board which is not covered by a soluble layout image;
d) The PCB that has been dissolved must go through the drilling stage before use. Drilling is done using 0.8 mm drill bit for laying components to be soldered on a PCB board;

e) After the drilling process is complete, the components are placed on the PCB board according to the component laying holes for further soldering;

f) The implementation of the Arduino microcontroller program is made using the C programming language. The software used to create the program is the Arduino editor and compiler. The program file has the extension *.ino the compiled file will be uploaded into the arduino microcontroller. Writing code / script that is embedded in IDE arduino software;

3.3. The Flowchart of orange fruit sorting

The working principle of the tool to be made is an orange fruit sorter based on colors that use servo motors and gravity. For how it works citrus fruit is first placed in a container that is above the sorter. Then press the power button to activate the tool, then the orange fruit will go down to the selection place. Before the sensor starts reading the color of the orange fruit, arduino will read the condition of the pause button. If the pause button is in HIGH condition then the entire process will pause and display the number of fruits that have been sorted, if the pause button is in LOW condition then the sorting process will run. If the orange fruit that has been read the sensor is orange, the upper servo will direct the fruit to the left (45 °) and the fruit will fall into an orange container. If the sensor detects citrus fruits greenish yellow, automatically the upper servo will direct the fruit to the right (120 °) and the lower servo to the left (45 °) closes the path to the green container, then the fruit will fall into a greenish yellow container. Then when the sensor detects citrus fruits in green, the upper servo automatically directs the fruit to the right (120 °) and the lower servo to the left (45 °) closes the greenish yellow container so that green citrus fruits will enter the green container. All fruits that have been sorted are also calculated the total number of each color, making it easier to calculate citrus fruits that have been sorted.

![Flowchart](image)

Figure.4 the Flowchart of Orange Fruit Sorting
4. The System Test and Result
The system tests are carried out to determine whether the TCS3200 color sensor circuit can run properly and can display RGB values on the LCD and Serial Monitor. The test is done by connecting the color sensor output pin on the arduino analog pin (A0, A1, A2, A3, A4). In the testing phase this is done using orange fruit that is orange. The citrus fruits are placed just above of the color sensor then they will read the RGB (Red, Green and Blue) data values on the LCD and Serial Monitor. The tests are carried out to determine whether the servo motor circuit can run well and can receive orders from the Arduino to the citrus fruits to the right and left in accordance with the specified container. To apply citrus fruit sorting equipment according to this research, which is assembled involves several sensors that are able to detect yellow (ripe) orange, yellowish green (almost mature) and the color is still green (immature). The overall system mechanism refers to Figures 1, 2,5 and 6.

Figure 5. The LCD Monitor of Arange Fruits

Figure 6. The Result detection Platform

5. Conclusions
Based on the results of the analysis, design and implementation that has been done above, some conclusions are obtained as follows: TCS3200 color sensor can detect the orange fruit color very well. In this study the color sensor is very influential on the surrounding light, so it is necessary to do three stages of automatic calibration in the color reading stage. The sorting process starts from the fruit color reading, then directing the fruit to the appropriate container and returning to the starting position consume the time below of 220 ms for one orange fruit.

References
[1] M. Khojastehnazhand, M. Omid* and A. Tabatabaeefar, “Development of a lemon sorting system based on color and size”, in African Journal of Plant Science Vol. 4(4), April 2010, pp. 122-127. Online at http://www.academicjournals.org/ajps, ISSN 1996-0824.
[2] S.Arivazhagan, R.Newlin Shebiah, S. Selva Nidhyanandhan, L.Ganesan, “ Fruit Recognition...
using Color and Texture Features”, Journal of Emerging Trends in Computing and Information Sciences vol. 1, no. 2, 2010, pp. 90 – 94. EGISSN 2218-630.

[3] Monika Sharma [1], Vibhuti P N Jaiswal [2]. Amit Goyal, “Fruit Recognition with Multiple Features using Fuzzy Logic”, IJCSC Vol. 4, No. 2 Sept. 2013 pp.99-115. ISSN-0973-7391.

[4] Sachin Syal, Tanvi Mehta, Priya Darshni, “Design & Development of Intelligent System for Grading of Jatropha Fruit by Its Feature Value Extraction Using Fuzzy Logics”, International Journal of Advanced Research in Computer Science and Software Engineering Vol. 3, No. 7, July 2013 ISSN: 2277 128X.

[5] Pragati Ninawe, Mrs. Shikha Pandey, "A Completion on Fruit Recognition System Using K-Nearest Neighbors Algorithm”, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Vol. 3, No. 7, July 2014, pp. 2352 – 2356. ISSN: 2278 – 1323.

[6] Delta Electronic,. M1632 Module LCD 16x2. Datasheet Electronic : 1-6. http://www.braude.ac.il/files/departments/electrical_electronic_engineering. 2016.

[7] TAOS, (2009). TCS3200, TCS3210 Programmable Color Light-to-Frequency Converter. Datasheet Electronic : 1-14. (Online). http://www.dfrobot.com/image/data/SEN0101/TCS3200%20TCS3210.pdf

[8] Chandra Sekhar Nandi, Biplab Tudu, and Chiranjib Koley, ”An Automated Machine Vision Based System for Fruit Sorting and Grading”, IEEE Sixth International Conference on Sensing Technology (ICST) 978-1-4673-2248-5/12, 2012. Page(s): 195 – 200.

[9] Trung Pham, Per Bro and José Luis Troncoso, In “Fuzzy Analysis of Color Images of Fruits”. IEEE 2nd International Conference on Information Science and Engineering (ICISE), 2010, pp. 3714 – 3717. DOI: 10.1109/ICISE.2010.5689230.