Effect of Light to Sort Object that are Transparent, Translucent, and Opaque

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Abstract - **The main aim of this project is to develop an object sorting machine that can sort transparent, translucent and opaque objects under differential light conditions. In this project, a prototype was built to demonstrate the proposed system. The functionality of the proposed project was assessed by the detection of different types of objects, under differential light conditions, the sorting of objects per its category and finally by the counting number of detected objects in each category. It is observed, that the project could function per the objectives set. The time taken for a one object to get sorted under both bright and darker condition took 5 seconds. The project could maintain its consistency in sorting object effectively with minimal errors.**

Index Terms - **Software Define Radio, Open-Source Software, RF Network Characterization, S-parameters measurement**

1. Introduction

An industry that needs to manage object sorting or partitions, confronts requirements in the sense of isolating diverse sorts of objects in one system, particularly when the system works under differential lighting conditions. The sorting machine that is created will totally modernize the sorting of objects and control process, and improve the working state of the framework under differential light conditions.

To sort objects that are transparent, translucent and opaque, it is important to ensure the object detection works efficiently (Wahab & Hussain, 2012) proposed the idea to develop a plastic object sorting machine by using image processing technique.

Saifudeen et al. (2015) proposed an automatic sorting machine using colour sensor and PIC microcontroller to detect the objects. Worker exhaustion on mechanical production systems can bring about diminished performance, and cause challenges in keeping up item quality. Sanjay & Prakash (2015) proposed an object sorting mechanism that functions based on field programmable gate array (FPGA). The problem statement for the task is to develop the sorting mechanism prototype which can be utilized to decrease the work load of workers and in addition to lessen the time spent in examination of the objects, during their assembling.

The main research problem is to identify the suitable sensor that can identify object that falls under transparent, translucent and opaque category. Another research problem found is that different type of sensors has different type of sensing capabilities and can work only under certain light conditions. The final research problem is the object sorting cannot be done at night, only during day as different light condition factors involved.

The Arduino based stepper and servo motor sorting machine would be a machine that is completely automated and sort object that are transparent, translucent and opaque under differential light conditions. This system is different with the regularly used conveyor based object sorting in industry that utilizes PLC and pneumatics. This framework can change the idea of conveyor sorting with PLC and pneumatics, by supplanting pneumatics with the utilization of motors and PLC with Arduino which is less expensive.

Other than that, this system concentrates on guaranteeing that the object sorting should be possible under differential light conditions, as many companies/industries runs their operation day and night. The primary explanation behind this system is to plot the utilization of a mechanized object sorting system using sensors, motors and microcontrollers. In this project, the decision of Arduino programming and the determination of appropriate sensors are significant, remembering the final objective is to satisfy the need of this project outline.

2. Materials and Methods

The object sorting machine functions within a closed loop design that uses the sensor's feedback that is applied in the system and deliver the required values and outputs to continue the process. Figure 1 shows the overall working principle of the project.

The system starts with the initialization of the LCD screen once the Arduino is powered up, the LCD screen displays a welcome message, and later, shows up 4 types of object on the screen, which are; transparent, translucent, opaque and others. As there is no detection of objects recorded at this stage, all the values for each type of object will be displayed as 0.

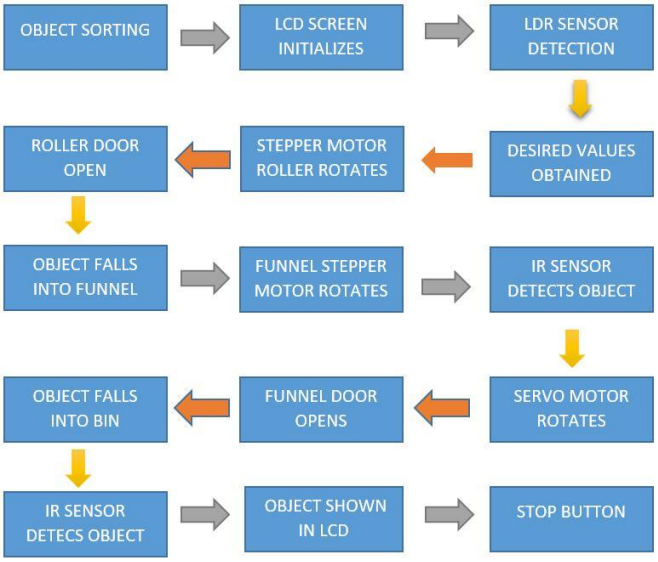

Figure 1: Workflow of Sorting Machine

The LDR sensor receives a constant light source from the laser module. When an object is placed along the sensor, the objects breaks the light source of the sensor, hence, there is a change of value happens within the LDR sensor. These changes in value differs per the type of object that breaks the barrier of light. These changes of values are the one that determines the type of object, whether the value falls under the range of transparent, translucent, opaque or other type of objects. Once the object is detected, a desired value is gained based on the type of object.

The change of value of the LDR sensor, triggers the stepper motor to rotate. The rotation of this stepper controls the door opening of the roller mechanism. When the door opens, there is a gap between the door and the roller, hence, the object falls directly into the funnel compartment.

Previously it is mentioned that the LDR value determines the type of object. These values obtained influences the stepper motor that is now attached with the funnel compartment. Based on these value, the motor rotates by certain steps, to a specified angle. These angles/steps verified is positioned according to the bins that are placed below the funnel compartment, hence, this allows the object to fall directly into the bin category the objects belong into.

In the funnel compartment, there is an IR sensor placed to detect the presence of the object. This sensor controls the servo motor that controls the funnel door mechanism. When the IR sensor detects the object, the servo motor rotates and opens the door, allowing the object to fall into the bin. It is ensured the rotation of the servo motor doesn't turn exactly after the IR sensor detection. This is because, a certain time is needed for the funnel that is controlled by the servo motor to rotate to the desired angle first. If the servo motor rotates earlier, then the object will fall quicker even before the funnel reaches the desired angle. There is a delay included in the servo and IR programming to ensure right type of servo motor rotation.

After the servo door mechanism opens, the object now falls into the bin. There are four IR sensors placed at each of the bin. These IR sensors detects each object that falls into the bin. As each type of object is detected, the LCD screen displays the number of object in each bin.

Finally, a stop button is added as a safety feature that will shut off all motor when pressed. Should any mishap occur, this will be the primary safety feature in this system.

3. Results and Discussion

The development of both the hardware and software are combined to complete the object sorter machine as shown in Figure 2. For this session, translucent object was sorted. The object was placed at the roller compartment. Once the object is detected it falls into the funnel compartment. Later, funnel door opens, and the object falls into the desired bin. The sorting process happens continuously without any disruptions. The object sorting results are displayed both in LCD display and the GUI display. For the simulation setup, the Arduino is integrated with Lab VIEW through LIFA serial protocol.

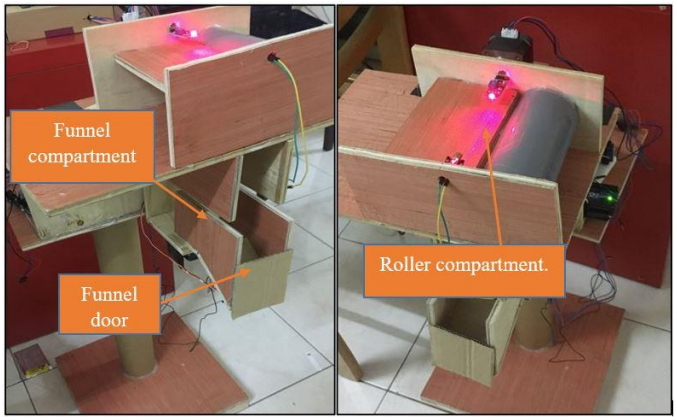

Figure 2: Hardware build

From the GUI, the gauge indicates the percentage of light permittivity by the LDR sensor, in this case, the object detected was translucent which has 8.65% of permittivity of light. Since the detected object is translucent, the translucent icon lights up in green as shown in Figure 3. The blue icon shows the funnel rotation direction to the specified bin. In this case, the funnel rotates to translucent object bin, since the detected object is translucent.

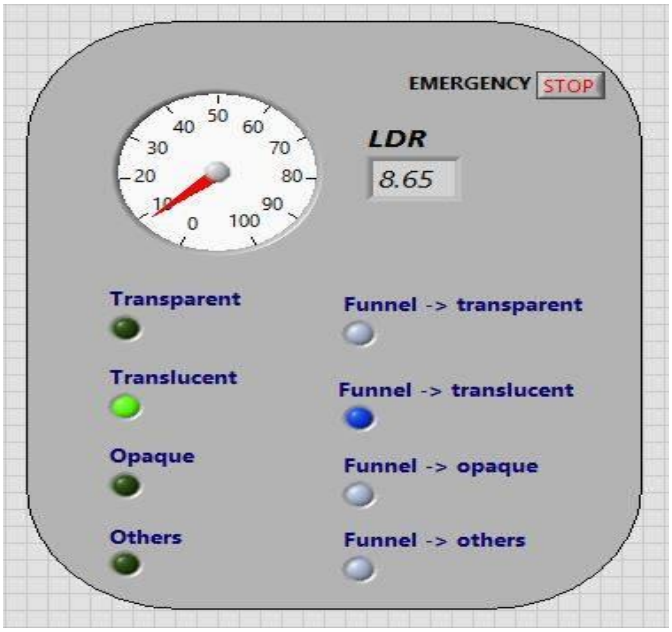

Figure 3: GUI display

The LDR values for each object differs depending on the permittivity of light through the object. These values can be specified into specific ranges to categorize objects into transparent translucent and opaque. Theoretically the values received should remain the same for the exact same object. However, during repetitive LDR sensor start-ups under the same calibration, these values change for the same type of objects. If the LDR value of a transparent object is 50, after the LDR is disconnected and then connected again, the value may change up to 80. This is an important discrepancy as changes in value of the same type object will affect the sorting process.

The discrepancy in this change of value must be sorted out to ensure the development of the proposed system can be carried on smoothly. LDR sensor involves, the input of voltage, calibration of range, Arduino programming, and light sensibility. The sources of discrepancy can be from any of this conditions.

LDR sensor requires calibration of range for the lights permittivity. This could be the major source of error as wrong calibration might affect the consistency of output values. Thus, the LDR sensor is calibrated gradually to see if calibration could solve the error.

False programming could affect the output values or the display of values, hence this could be a possible source of error. Few programming is done to get the output values of the LDR values and compared to one another to see how programming effects the LDR readings. The surrounding condition can play a role for the source of error as the LDR is a light dependent sensor. Certain surrounding light conditions may affect the sensor to behave abnormally due to the light permittivity.

The LDR sensor is tested under differential lighting conditions to see if this error occurs under different environment. LDR sensor is built mostly from composite materials. This could be a possible source of error as the initial reading can regularly change due to the nature of substances in the sensor. A different LDR sensor is tested to see if the type of sensor used, or adjust obtained value in the programming gradually to suit the purpose of the project. Work aims to minimize a lot on the cost and complexity of the measurement hardware. Furthermore, the signal post-processing and the display tools are applied by using scikit-rf open source at no additional cost. In this section, we describe the proposed measurement system and its critical components of measuring S-parameters, which integrates an RF component, some cables and the DUT. The selected DUT is one port passive LTE dipole antenna. The topology structure described in this paper is aimed for S11 only to cover the scope of study.

4. Conclusions

The object sorter that can sort transparent, translucent and opaque object under differential lighting condition has been successfully constructed and built per the purpose of the project. The project can only be recognized as successful based on the project objectives that has been accomplished. Only after that the intent of project can be conquered.

The system had been able to differentiate different type of materials and identify whether the objects fall into transparent, translucent and opaque category. This was achieved by the usage of LDR sensor to detect and identify the values each object delivers. These values gained enable the objects to be determined under which category the object falls, as the values differ as per the type of objects.

The system was able to operate under bright, medium and darker surrounding conditions without affecting the sorting process or functionality of the project. This was achieved by the implementation of the laser module with the LDR sensor, ensuring the LDR sensor receives a continuous stream of stable light source that overtakes the surrounding light condition.

Moving on, the system was able to sort the detected objects as per its type in their respective bins. This feature is achieved through the integration between the LDR output values and stepper motor. The different range of values is set to change the motor positioning at different angles, ensuring the object falls at the desired angles at their respective bins.

The objects that fall under each bin should be counted and displayed in an orderly manner. This feature is achieved through the usage of IR sensor and LCD

display. The Arduino programming is done for each IR sensors to detect and count the number of objects, and the result is displayed in a 20X4 LCD screen display in the prototype.

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References

Abbasgolipour, M., Khyani, A. and Mohtasebi, S.S. (2012). Sorting raisins by machine vision system. International Journal of Computer Applications, pp.49-62

Agaskar , Vinod., G, Kamal, L. and Mesh Rahul, U. (2015). Object Sorting Using Conveyor Belt. International Journal of Science and Advanced Technology, vol. 37, no. 9, pp. 714-272.

Board of Engineers Malaysia (2016) Guidelines for Code of Professional Conduct.[Online]June 2004. Available from: http://www.bem.org.my/v3/codes_conduct.pdf [Accessed: 7th October 2016].

Devalla, V., Singh, D.R., Mondal, A. K. and Kaundal, V. (2012). Development of Object Recognition and Sorting Robot for Material Handling in Packaging and Logistic Industries. International Journal of Science and Advanced Technology, vol. 2, no. 9, pp. 65-85.

Dhanoj, M., Reshma, K.V., Sheeha, V. and Marymol, P. (2015). Colour sensor based object sorting robot using embedded system. International Journal of Advanced Research in Compute and Communication, pp. 145-168.

Jeshwin, K. and Darwin, P.C. (2015.) Automatic Sorting Machine using PIC microcontroller. International Journal of Science and Advanced Technology, 12(7). P77-98.

Jimoh, K., Ajayi, A. and Ayilara, O. (2014). Intelligent Model for Manual Sorting of Plastic Wastes. International Journal of Computer Applications, vol. 36, no. 2, pp. 76-90.

Joshua, K. and Blatra, P. C. (2015.) Automatic plastic sorting using image processing. International Journal of Science and Advanced Technology, vol. 16, no. 7, pp. 27-30.

Khin Moe, Abdul Wahid, L., Jahid, C. and Hakeem, U. (2015). Automation of object sorting using an Pick and Place Robotic Arm. International Journal of Science and Advanced Technology, vol. 16, no. 8, pp. 245-252

Kapil, K. and Deshmukh, S. (2015). Automation of product sorting machine by using microcontroller. International Journal of Electronics and Technical Research, pp. 119-124.