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B.Tech –ECE
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LDR Logic-Based Color Detection and Sorting System

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PROBLEM STATEMENT

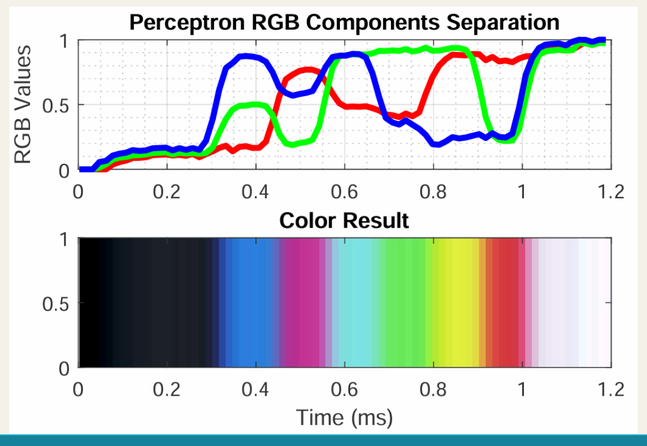
In industrial and laboratory environments, automated color detection and sorting of objects is often performed using microcontroller-based systems, which require programming, firmware, and complex software integration. Such reliance on microcontrollers can increase system cost, complexity, and power consumption, and may limit reliability in harsh or resource-constrained environments.

The challenge addressed in this project is to design and implement a real-time, microcontroller-free color detection and sorting system capable of accurately identifying and classifying multiple colors—specifically Red, Green, Blue, Cyan, Yellow, Magenta, and White—using only analog and digital electronic components. The system must operate autonomously, converting reflected light from objects on a conveyor belt into digital signals, and then driving mechanical actuators to sort objects into corresponding bins with precise timing, all without software or embedded programming.

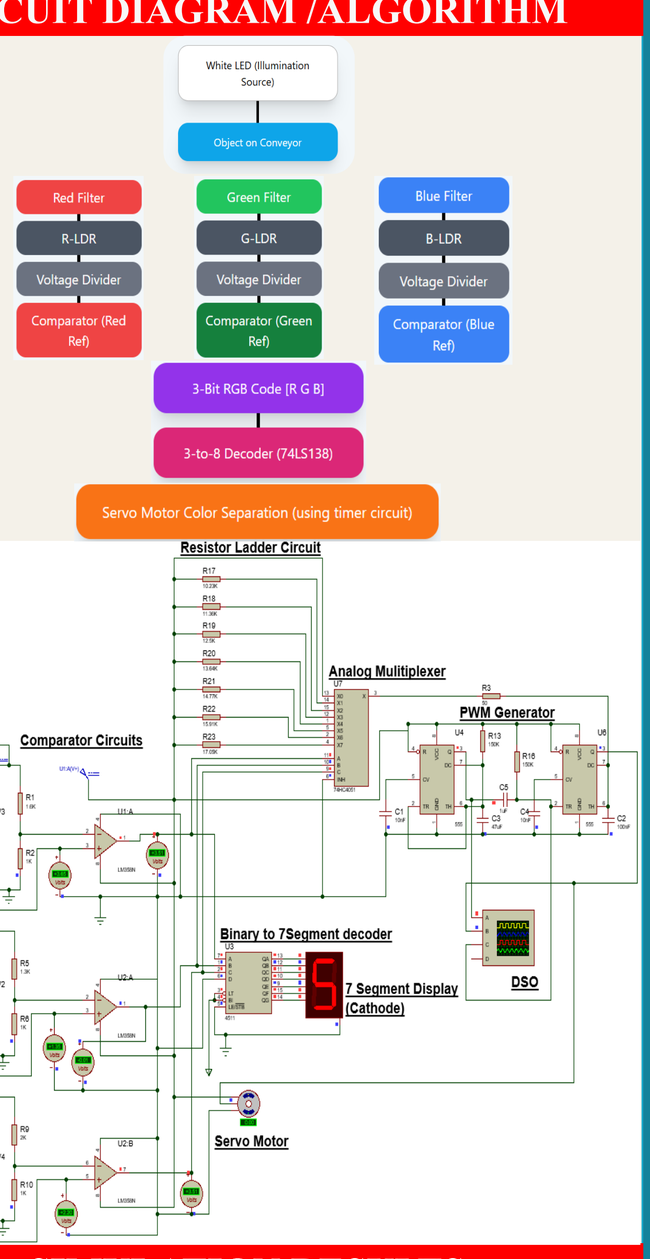
This problem requires integrating optical sensing, signal conditioning, voltage comparison, digital logic decoding, and actuator control into a cohesive system that is reliable, low-cost, and capable of real-time operation.

APPROACH / DESIGN/ METHODOLOGY

- **Illumination:** A high-intensity white LED provides uniform lighting for objects on a motorized conveyor belt.
- **Optical Sensing:** Three LDRs behind Red, Green, and Blue filters detect reflected light to isolate RGB components.
- **Analog Signal Conversion & Conditioning:** LDR resistance changes are converted to analog voltages via voltage dividers.
- **Threshold Detection:** Comparators compare conditioned signals against reference voltages to produce digital outputs for each color.
- **Digital Decoding:** The 3-bit RGB code from comparators is decoded via a 3-to-8 line decoder to identify one of eight colors.
- **Actuation & Sorting:** A 180° servo with 1:2 gearing rotates the top platform 360° to align the correct bin with the conveyor for sorting.
- **Timing Control:** A 555 timer-based monostable circuit synchronizes object position with servo motor rotation.



CIRCUIT DIAGRAM /ALGORITHM



RESULTS

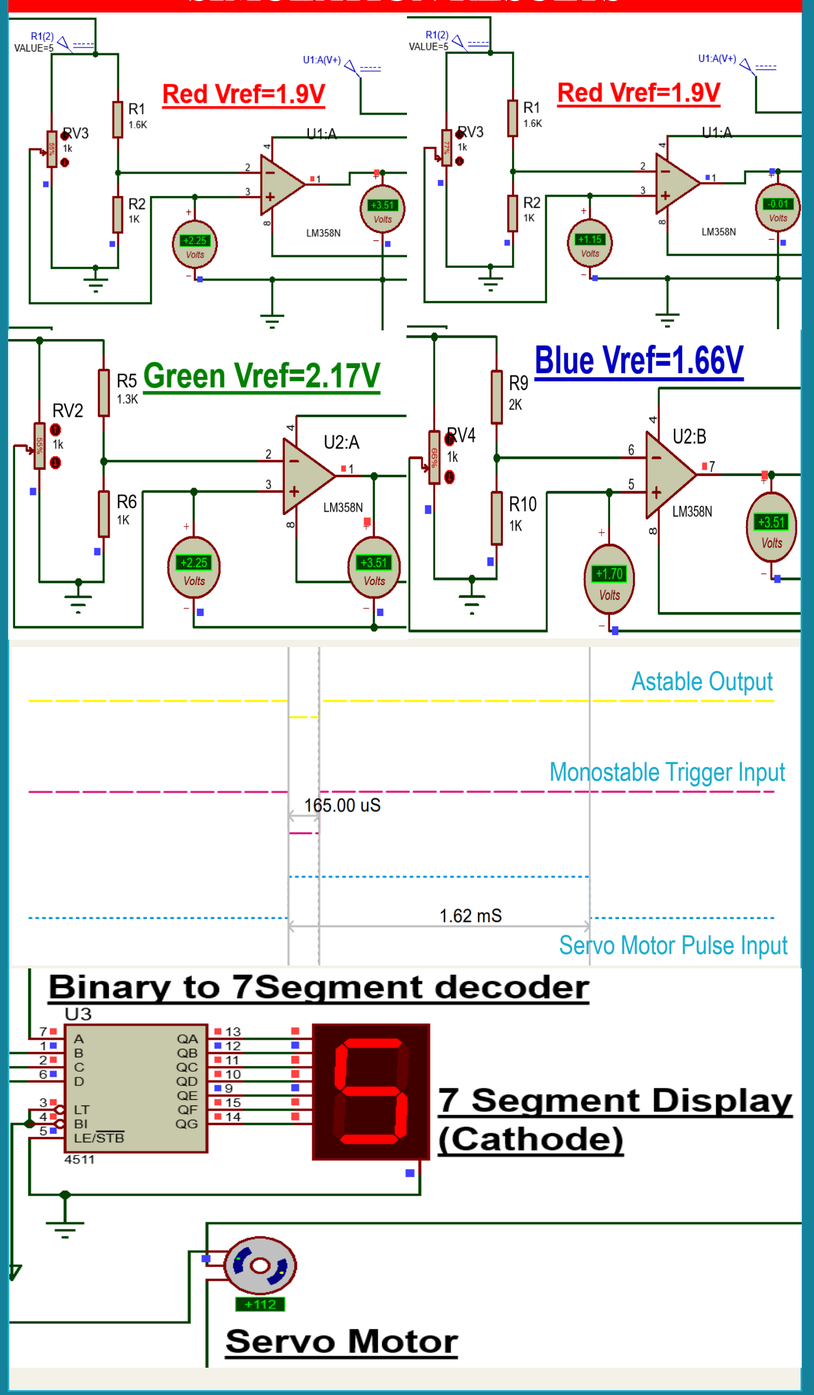
LED Colour	LDR Resistance using Colour Filters:		
	RED	GREEN	BLUE
RED	1.6k	6.8k	9.61k
GREEN	3.37k	1.3k	3.02k
BLUE	4.8k	3.45k	2.07k

LED Colour	V_{REF}
RED	1.90V
GREEN	2.17V
BLUE	1.66V

7 Segment Display Code	Blue	Green	Red	Output	Servo Rotation (°)	Pulse Width (ms)
0	0	0	0	Black	0	1
1	0	0	1	Red	22.5	1.125
2	0	1	0	Green	45	1.25
3	0	1	1	Yellow	67.5	1.375
4	1	0	0	Blue	90	1.500
5	1	0	1	Magenta	112.5	1.625
6	1	1	0	Cyan	135	1.75
7	1	1	1	White	157.5	1.875

Servo Rotation (°)	Pulse Width (ms)	Resistor Values (R)	T = 1.1*(R)*C
0	1	0	1
22.5	1.125	10.23K	1.122
45	1.25	11.36K	1.248
67.5	1.375	12.5K	1.375
90	1.500	13.64K	1.5
112.5	1.625	14.77K	1.628
135	1.75	15.91K	1.749
157.5	1.875	17.05K	1.8755

SIMULATION RESULTS



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