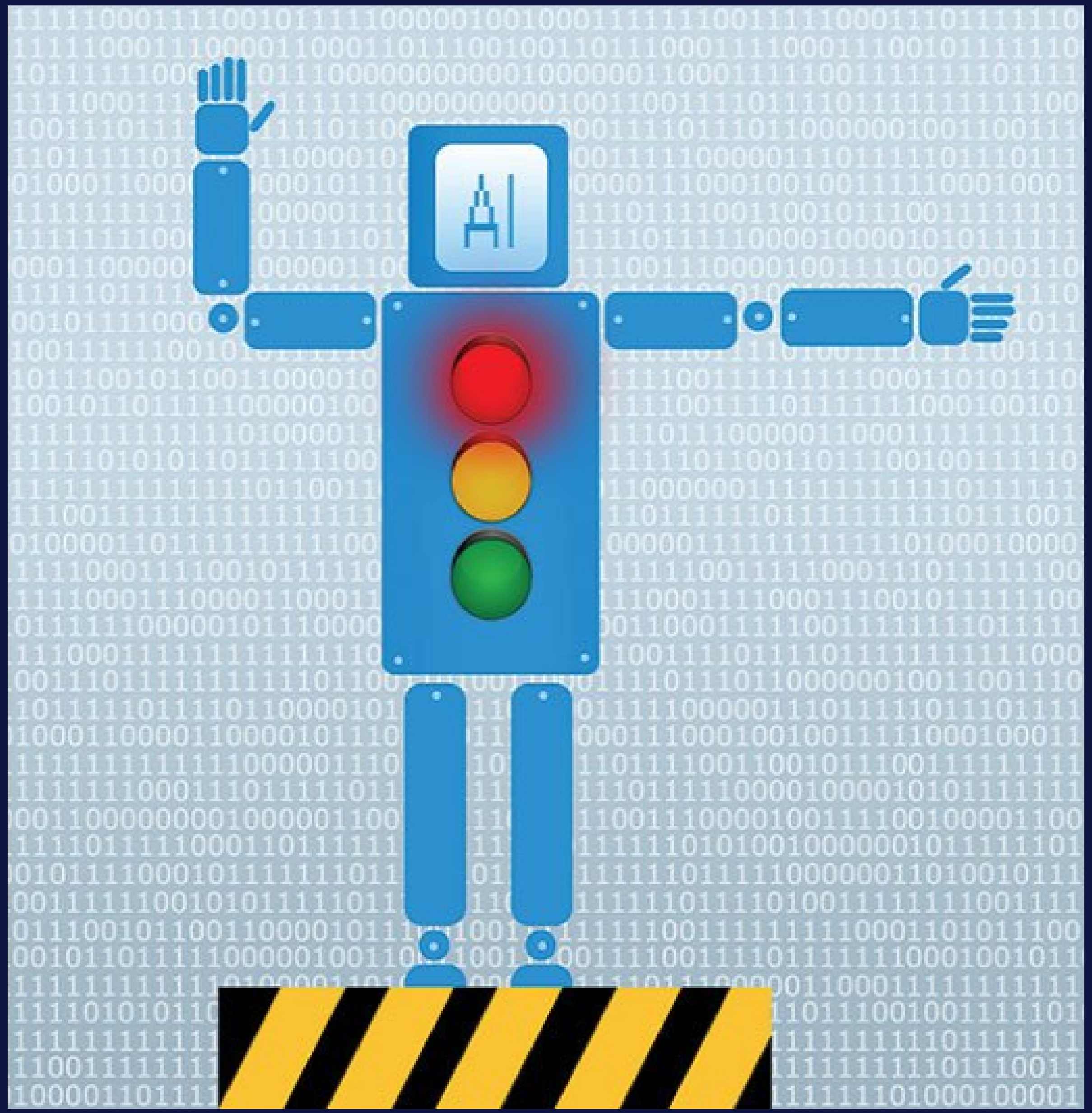
Smart Control of Traffic Light using Artificial Intelligence



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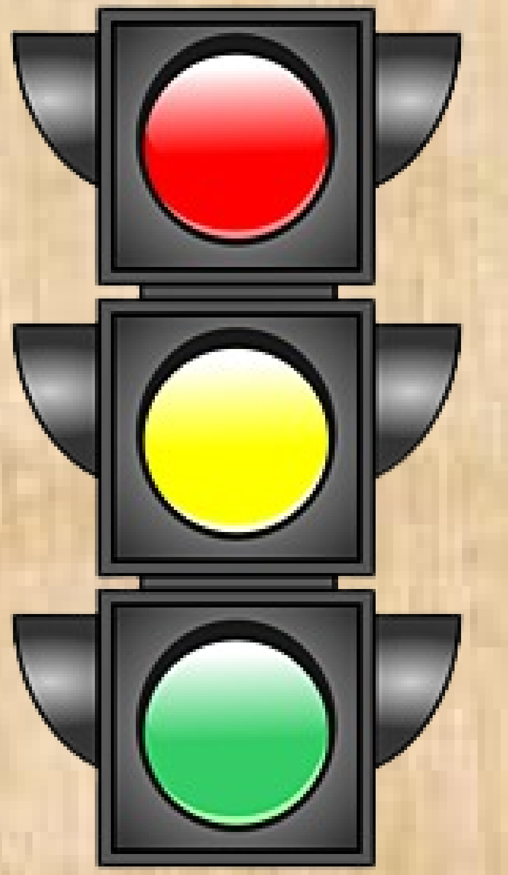
INTRODUCTION

- Traffic Lights are vital part of our roads. We encounter
them everyday in our lives. But what about its management isn't it necessary?

- So to be safe and reach our destination on time we
require an optimum traffic management system.



- With the increasing number of vehicles in urban areas, many road networks are facing problems with the capacity drop of roads and the corresponding Level of Service.

- Many traffic-related issues occur because of traffic control systems on intersections that use fixed signal timers.

- So to be safe and reach our destination on time we require an optimum traffic management system.

Existing solution and their drawbacks

- Manual Controlling : As the name suggests, it requires manpower to control the traffic. The traffic police are allotted for a required area to control traffic. The traffic police carry signboard, sign light, and whistle to control the traffic.

- Drawback : In a country like India with extreme climate in some regions its not always feasible for Traffic police to monitor traffic. As there is poor strength of traffic police, we cannot have them controlling traffic manually in all areas of a city or town.

- Conventional traffic lights with static timers: These are controlled by fixed timers. A constant numerical value is loaded in the timer. The lights are automatically switching to red and green based on the timer value.

- Drawback : Static traffic controlling uses a traffic light with a timer for every phase, which is fixed and does not adapt according to the real-time traffic on that road. This may result in a long waiting queues for a lane with high vehicle density.

- Electronic Sensors: Another advanced method is placing some loop detectors or proximity sensors on the road. This sensor gives data about the traffic on the road. According to the sensor data, the traffic signals are controlled.

- Drawback: Sophisticated sensors are required ,therefore cost increases the budget and also due to lower coverage of these sensors the no of sensors required also increases.

Hypothesis

- Our proposed system takes an image from the CCTV cameras at traffic junctions as input for real-time traffic density calculation using image processing and object detection.

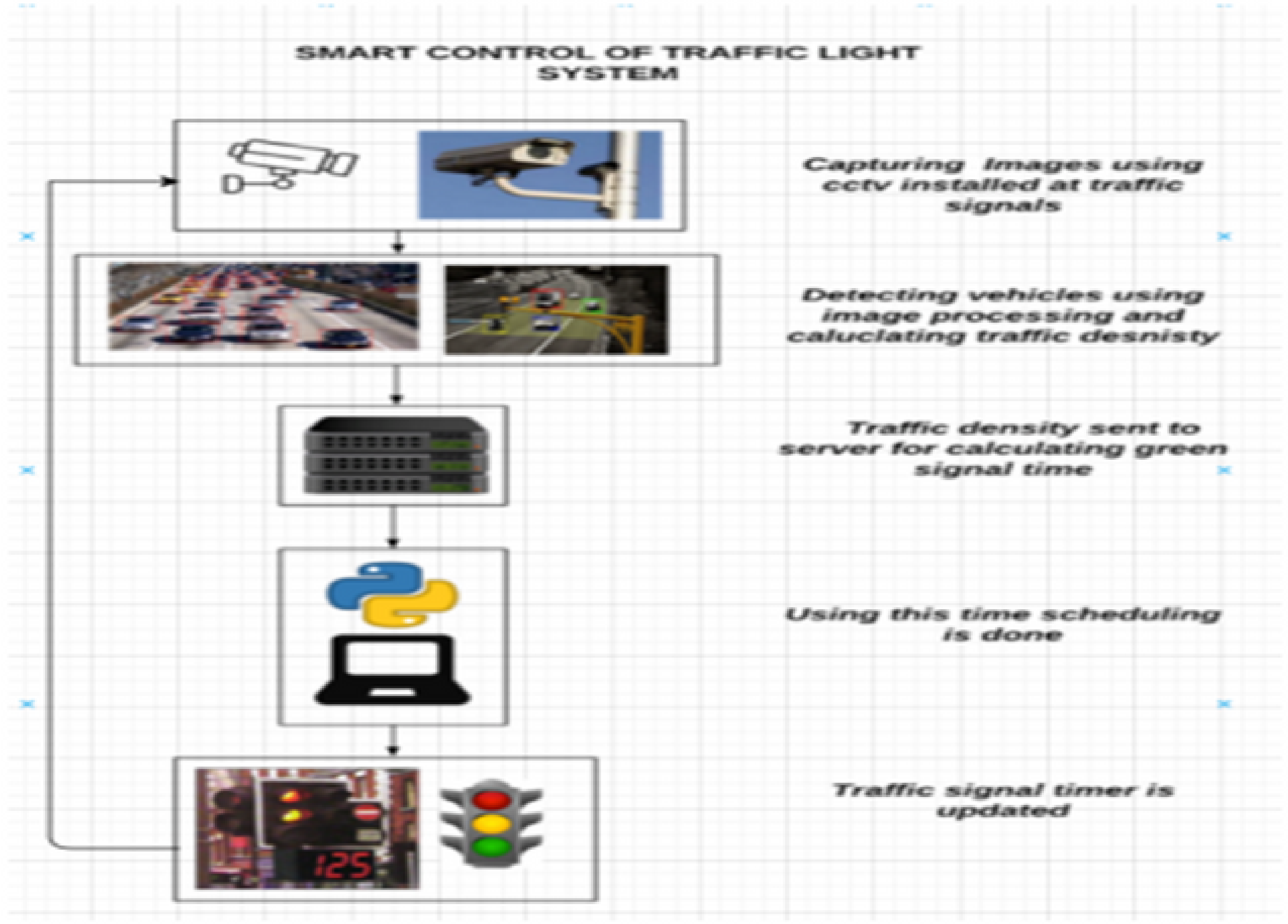


Fig. 1. Proposed System Model

Vehicle Detection Module

Fig. 2 shows test images on which our vehicle detection model was applied. The left side of the figure shows the original image and the right side is the output after the vehicle detection model is applied on the image, with bounding boxes and corressponding labels

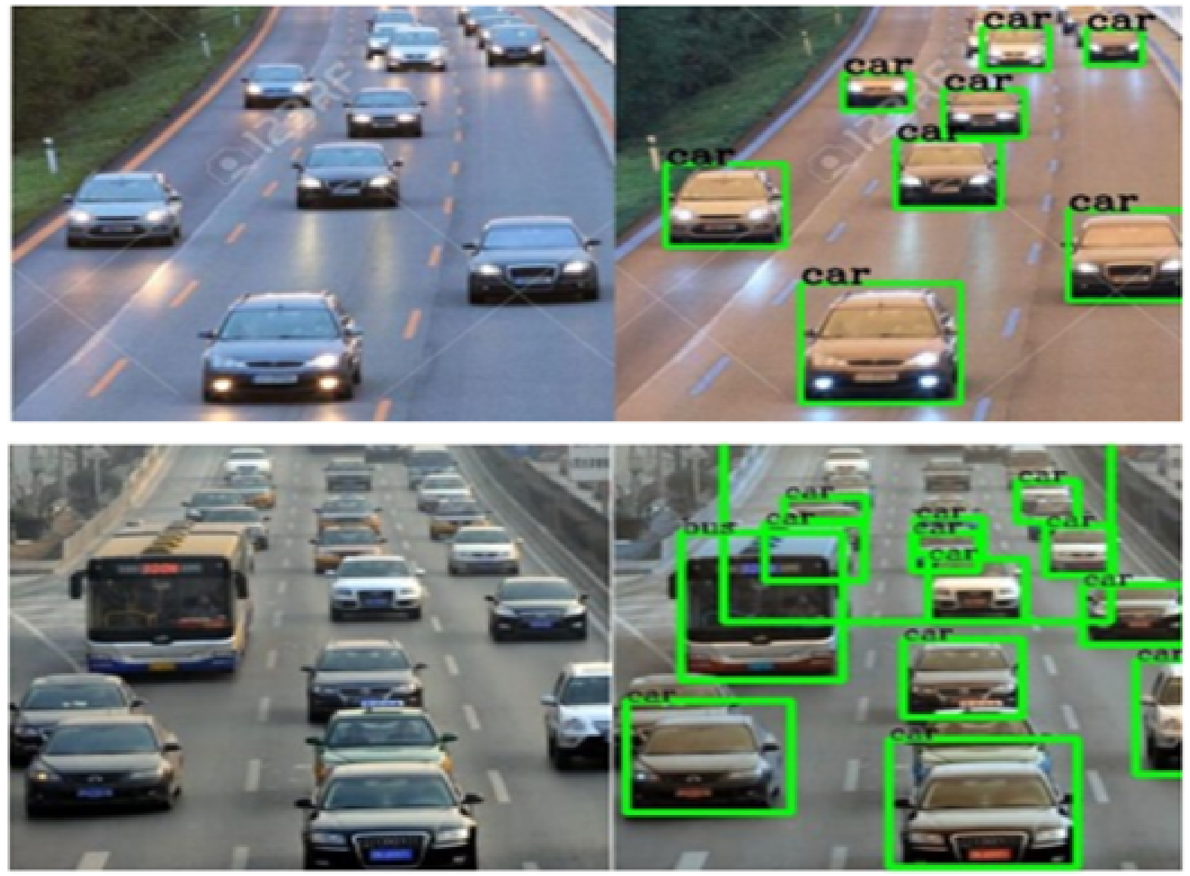


Fig. 2. Vehicle Detection Results

In this module our system recognises the type of vehicle from the cctv using YOLO(you only look once) technique which is based on CNN for performing object detection in real time.

Signal Switching Module

- The Signal Switching Algorithm sets the green signal timer according to traffic density returned by the vehicle detection module, and updates the red signal timers of other signals accordingly.

$$GST = \frac{\sum_{vehicleClass} (NoOfVehicles_{vehicleClass} * AverageTime_{vehicleClass})}{(NoOfLanes + 1)}$$

Simulation Module

- The simulation was developed from scratch using Pygame to simulate real-life traffic. It assists in visualizing the system and comparing it with the existing static system

Simulation Module Results

TABLE I. SIMULATION RESULTS OF CURRENT STATIC SYSTEM

No.	Distribution	Lane1	Lane 2	Lane 3	Lane 4	Total
1	[300,600,800,1000]	70	52	52	65	239
2	[500,700,900,1000]	112	49	48	31	240
3	[250,500,750,1000]	73	53	63	62	251
4	[300,500,800,1000]	74	44	65	71	254
5	[700,800,900,1000]	90	32	25	41	188
6	[500,900,950,1000]	95	71	15	14	195
7	[300,600,900,1000]	73	63	69	24	229
8	[200,700,750,1000]	54	89	10	67	220
9	[940,960,980,1000]	100	10	8	4	122
10	[400,500,900,1000]	81	29	88	37	235
11	[200,400,600,1000]	42	47	54	86	229
12	[250,500,950,1000]	39	52	93	22	206
13	[850,900,950,1000]	74	10	13	17	114
14	[350,500,850,1000]	49	46	69	50	214
15	[350,700,850,1000]	51	64	37	43	195

TABLE II. SIMULATION RESULTS OF PROPOSED ADAPTIVE SYSTEM

No.	Distribution	Lane1	Lane 2	Lane 3	Lane 4	Total
1	[300,600,800,1000]	87	109	41	50	287
2	[500,700,900,1000]	128	55	49	25	257
3	[250,500,750,1000]	94	50	60	58	262
4	[300,500,800,1000]	89	46	69	59	263
5	[700,800,900,1000]	185	25	23	28	261
6	[500,900,950,1000]	94	118	11	16	239
7	[300,600,900,1000]	87	68	70	33	258
8	[200,700,750,1000]	56	108	19	78	261
9	[940,960,980,1000]	193	6	5	7	211
10	[400,500,900,1000]	97	29	100	34	260
11	[200,400,600,1000]	26	52	67	99	244
12	[250,500,950,1000]	52	75	101	7	235
13	[850,900,950,1000]	154	17	12	18	201
14	[350,500,850,1000]	64	53	80	47	244
15	[350,700,850,1000]	66	82	40	48	236

Observations And Results

- The hypothesis performs better than the current solutions.

- If a uniform distribution is there in all 4 lanes then proposed solution is just better than current.

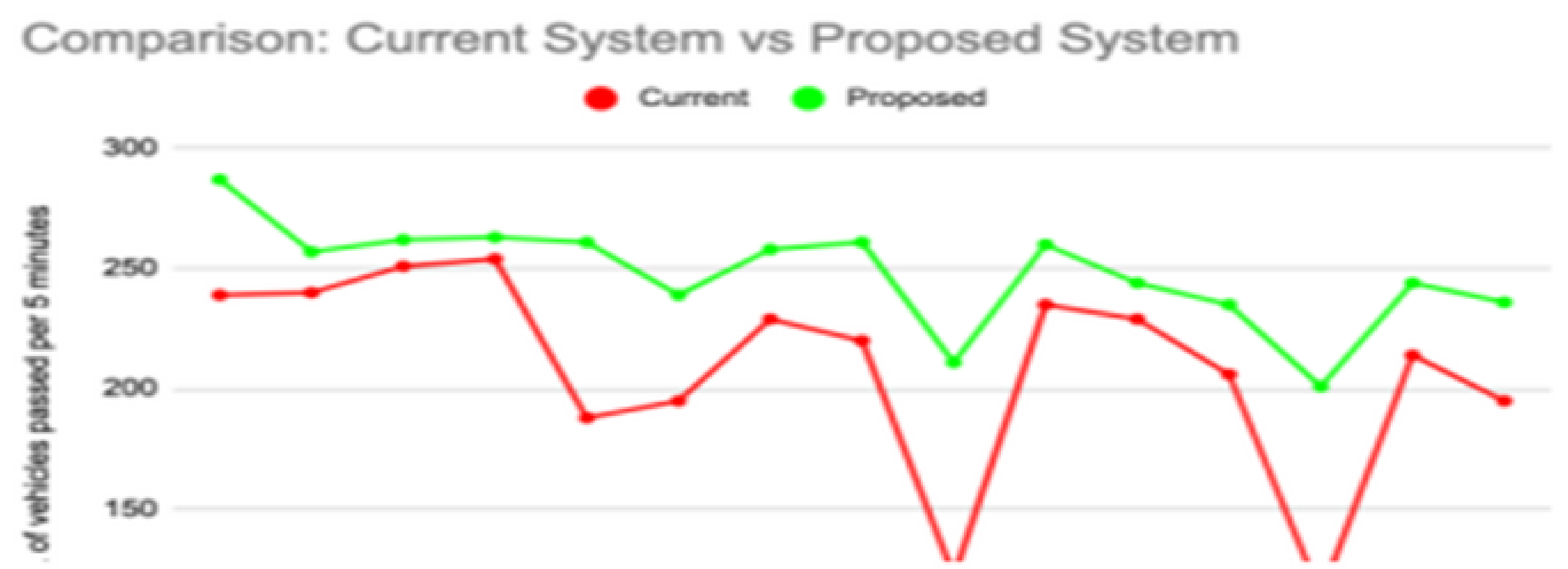


Fig. 4. Comparison of current static system and proposed adaptive system

Conclusion

- So in conclusion the hypothesis works better and manages traffic efficiently then current proposed solutions

Future Work

- This in future may be extended to include real time problems

Thank you