IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 7, July 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 9, Issue 7, July 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0907075 |

Traffic Pal-Smart Traffic Controller

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ABSTRACT: Traffic Congestion Is A Severe Problem In Most Cities Across India And The World. Therefore, The Paper Proposes An Automated System With Decision Making Capabilities Based On Density Of The Traffic At Any Junction. Present Day Traffic Signaling Systems Have A Fixed Time And Operate For A Fixed Duration Even When The Road Is Completely Empty Or It Has A Kilometer Long Traffic Jam. A Lot Of Times It Has Been Noticed In These Scenarios Where The Violation Of Traffic Rules Was A Common Sight Such As Riders Without Helmets, Skipping Red Lights, Over Speeding Etc.

These Violators Were Caught By The Traffic Police Putting Them At High Risk Of Accidents Due To High Density Of Traffic. Thus, The Proposed Work Is Motivated Towards Helping Traffic Police Force By Developing "Traffic Pal", An Intelligent System That Will Control The Traffic Based On Density Flow And Keep A Check On Riders Without Helmets And The People Bouncing Signals. The Smart System Will Also Capture The Number Plate Details And Send It To The Nearest Police Station Where It Can Be Maintained By Them In A Database.

KEYWORDS: Traffic automation, Helmet Detection, Signal Bouncing Detection, Violations, Number Plate Detection, Traffic Density, Yolo.

I. INTRODUCTION

Traffic Congestion Is The Condition In Transport, Characterized By Long Vehicle Queues, Slower Speed And Long Wait Times While Commuting. It Can Be Caused Due To Narrow Roads, Bad Condition Of Roads, Excessive Flow In One Route, Peak Hours Of Travel And Other Such Factors. In Recent Years, Busy Cities All Over The World Are Looking For A Solution To This Problem. Although Conventional Traffic Lights Regulate The Traffic To An Extent, It Is Not The Optimized Solution. In This Project We Would Like Todesign An Automated Density-Based Trafficcontroller That Will Aid In Solving Traffic Congestion.
Many Times We Observe People Violating The Traffic Rules By Bouncing The Red Light, Over Speeding, Not Wearing Helmets, Etc. This Not Only Affects Them, But Can Put The Other Commuters Also At Risk Of Accidents. We Are Also Seeking To Address This Issue By Automating The Checking Of Violation Of Rules.

The Major Contributions Of The Proposed Work Are,

(I) Automatically Control The Duration Of The Traffic Signal Based On The Traffic Density At That Signal,

(Ii) Detect The Number Plate Of The Vehicles That Bounce The Signal,

(Iii) Detect The Number Plate Of The Vehicles With Drivers Not Wearing Helmets.

The Rest Of The Paper Is Structured As Follows. Section 2 Provides A Review Of State Of The Art Techniques. Section 3 Presents The Methodology Used. The Results Of The Work Are Presented In Section 4 And Finally Section 5 Concludes The Paper.

II. LITERATURE SURVEY

The Review Of Literature Indicates The Development Of Various Automated Systems For Traffic Control. Chirag Patel [6]Presented A Survey On Automatic Number Plate Recognition System (Anpr). This Workdiscusses About The Use Of Anpr For The Purposes Like Traffic Safety Enforcement, Automatic Toll Collection And Bill Generation, And Automatic Vehicle Parking System. The Authors Have Followed Four Steps In Their Algorithm, 1. Vehicle Image Capture, 2. Number Plate Detection, 3. Character Segmentation And 4. Character Recognition. Multiresolution Technique Is Used In This Literature For Enhancing The Visibility And Clarity Of The Captured Image.

This Work Highlights On The Parameters That Are Used As Prime Factors Are: 1. Plate Size, 2. Plate Location, 3.

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Plate Background And 4. Screw. The Methods That Are Used For Number Plate Detection Are Image Binarization, Hough Transform, Blob Detection, Connected Component Analysis, Mathematical Morphology, And For Faster Detection Of Region Of Interest (Roi) A Technique Called Sliding Concentric Window (Scw) Is Developed And Used.Number Plate Localization Techniques Are Used To Locate The Number Plate For Indian Vehicles. To Detect Multi-Styled Number Plates Four Techniques Are Used,(A) Plate Angle Rotation, (B). Character Line Number, (C). Recognition Models, (D). Character Formats.

Character Segmentation Is Done By Cropping The Image And Using Bicubic Interpolation And Then Subjecting It To Scw For Segmentation. Later Ann, Template Matching And Other Optical Character Recognition (Ocr) Tools Are Used For Character Recognition.

The Results Of This Paper Is Good In Terms Of The Output Of The Ann And So (Self-Organizing) Recognition, But The Output Of Ocr Had A Lot Of Scope For Improvement.

Hence, The Proposed System Is Motivated Towards The Improvement In The Efficiency Of Ocr Model Instead Of Redesigning The Entire Technique. Further We Propose To Reduce The Latency Which Is 50ms In This Literature By Introducing Image Analysis Step That Will Exclude Intermediate Steps If The Illumination And Orientation Of The Number Plates Are Ideal By Default.

O Younis [1]Developed Cyber-Physical Systems For Dynamic Traffic Light Control At Road Intersections.Handling Road Congestion Or Traffic Flow Has Been An Everlasting Issue In The Transportation Segment. Civil Engineering Has Focused Majorly On Laying Concrete Roads, Widening And Increasing Lanes As A Solution To This Problem. The Above-Mentioned Paper Has Addressed This Issue With A Rather Different Approach.

In This Paper, It Is Observed That, With The Help Of A Microprocessor And Sensors, The Traffic Density Is Measured. The Traffic Lights Are Then Controlled With This Density Information. This Paper Also Takes Into Account The Condition Of The Road For Changing The Traffic Lights.

Three Impactful Features Of This Paper Are That (A). It Is A Practical Framework Which Can Be Employed For Traffic Control As It Covers Different Traffic Models. (B). The Algorithm Used Results In Low Overhead And Fast Processing Speeds. (C). Through Simulation, The Actual Efficiency Of This System Can Be Verified.

Though [2]Paper Has Many Features, We Would Like To Add Some More Features That Are Missing Such As Helmet Detection And Signal-Jump Detection Which Serve As A Safety Measure.

Siebert[5]Presented A Deep Learning Method For Detecting Motorcycle Helmet. This Paper Is About Developing An Algorithm For The Automated Registration Of Motorcycle Helmet Usage From Video Data Using Deep Learning Approach In Developing Countries Where Motorcycles Are Primary Means Of Commute And Carelessness Of Not Wearing Helmets Causes Fatalities During Accidents. In This Paper It Is Noticed That That The Whole Process Is Divided Into 3 Major Phases;Data Set Creation, Training The Algorithm With The Validation Data Set, Comparing The Algorithm Results With Human Observations. The Data Set Creation And Pre-Processing Is Done By Sampling Videos And Annotating The Defaulters. In The Process Of Training, The Validation In Predicting Helmet Use Is Tested On Data That The Algorithm Has Not Seen Before, The So-Called Test Set.

One Of The Most Prominent Feature Of This Paper Is That Retina-Net Was Used For Helmet Detection Task Over R-Cnn To Reduce The Time Latency At The Cost Of Accuracy.

The Verification Of The Algorithm By Comparing With Human Observation Was Done By Counting The Defaulters Manually And Then Comparing With The Results Obtained From The Model. However, The Discrepancies Found Between The Two Findings Were Of High Magnitude At Certain Time Intervals And Certain Regions. The Highest Duration Where The Discrepancy Was Noticed Was Almost For 15 Minutes Which Is Noticeably Large.

The Methodology Used To Build This Model Was Notable, But We Propose To Add On And Improve Many Other Factors For Improvisation By Using Yolo V3 To Attain The Same Functionality.

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III. PROPOSED METHODOLOGY

This Section Describes The Methodology Of Proposed System.
The Model In Fig 1 Shows The Actual Implementation Design Of Our Project. Live Footage Is Captured At The Signal And Is Fed To The Processor, The Processor Then Feeds The Same Live Feed To The Signal Bounce Detection System (Line Crossing Detection) And Helmet Detection Systems. Both The Mentioned Systems Detect The Vehicles That Have Broken The Respective Rules And Feed Them To The Number Plate Detection System That Detects The Number Plate Of Such Vehicles And Records Them And Sends The List As Sms To The Nearest Traffic Police Station.
The Proposed Method Has Four Subsections,

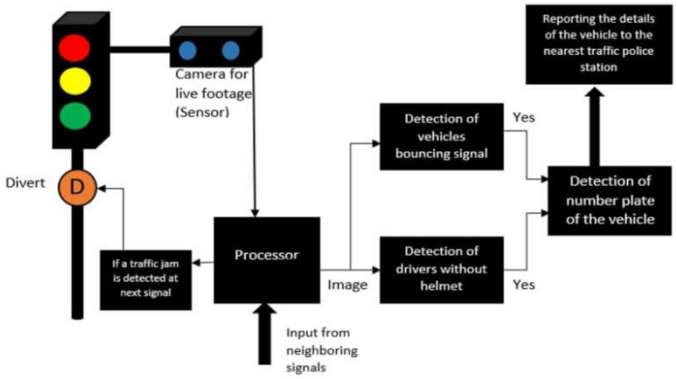

Fig. 1 Block Diagram

3.1 Helmet Detection

In This Section, Opencv Is Used To Implement Yolo Algorithm.
1. Installing Dependencies
Following Things Are Needed To Execute The Code:
Python 3.6
Numpy
Opencv Python
2. To Use Yolo Via Opencv, Three Files Are Required- 'Yolov3.Weights','Yolov3.Cfg'and "Coco.Names" (Contains All The Names Of The Labels On Which This Model Has Been Trained On). The Script Requires Four Input Arguments.

- Input Video
- Yolo Config File
- Text File Containing Class Names
- Pre-Trained Yolo Weights From This Website Called Https://Pjreddie.Com/Darknet/Yolo/

Weights And Biases Are The Learnable Parameters Of Your Model. The Values Of These Parameters Before Learning Starts Are Initialized Randomly (This Stops Them All Converging To A Single Value). Then When Presented With Data During Training, They Are Adjusted Towards Values That Have Correct Output.
A. Read The Input Video And Get Its Width And Height.
B. Read The Text File Containing Class Names In Human Readable Form And Extract The Class Names To A List.
C. Generate Different Colors For Different Classes To Draw Bounding Boxes.
It Is Quite Simple To Build The Model.
The **Model Option** Asks You To Specify What Model You Want To Use. The **Load Option** Is For Specifying Which Weight File You Want To Use. The **Threshold Option** Is The Bottom Line Of Confidence Probability Value For Keeping Detected Objects.

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Fig. 2 Helmet Detected On One Person.

There Are Few Detection Errors Of The Model.
The Helmets Of Incomplete Shapes And Small Sizes Are Hard To Recognize.
Performance Lags When The Images Are Not Very Clear, The Helmets Are Too Small, And The Background Is Too Complex.

3.2 Line Crossing Detection

Contour Detection Is Used With Thresholding For Line Crossing Detection To Detect The Vehicles That Cross The Stop Line During A Red Signal. Fig. 3

The Algorithm For Line Crossing Selection Is As Follows:

a. Apply Frame Differencing On Every Pair Of Consecutive Frames
b. Apply Image Thresholding On The Output Image Of The Previous Step
c. Perform Image Dilation On The Output Image Of The Previous Step
d. Find Contours In The Output Image Of The Previous Step
e. Shortlist Contours Appearing In The Detection Zone
f. Save Frames Along With The Final Contours

Fig.3 Detection Of Signal Jump

3.3 Number Plate Recognition

Number Plate Detection Is Performed Using Pytesseract Optical Character Recognition Library.

The Algorithm Is As Follows:
a. Image Is Imported From The Respective Source (Helmet Detection Or Signal Jump Algorithms)

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b. Color Image Is Converted To Greyscale (Fig. 3)
c. Edge And Contours Are Detected Using Canny Edge Detection Algorithm (Fig. 4)
d. Image Of Number Plate Is Displayed (Fig. 5)
e. The Image_To_String Function Converts The Number Plate Image To Text And Displays It (Fig. 6)
f. The Same Text Is Then Appended To The Record File (Text File That Contains The Details Of All The Law Breaking Vehicles)

Fig. 4 Traffic Density Detection Circuit

Fig. 5 Contour Detection

Fig. 6 Cropped Image Of Number Plate

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License Plate Recognition

Detected license plate Number is: MH 20 EE 7601
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Fig. 7 Display Of Detected Number Plate On Output Console

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3.4 Traffic Density Detection

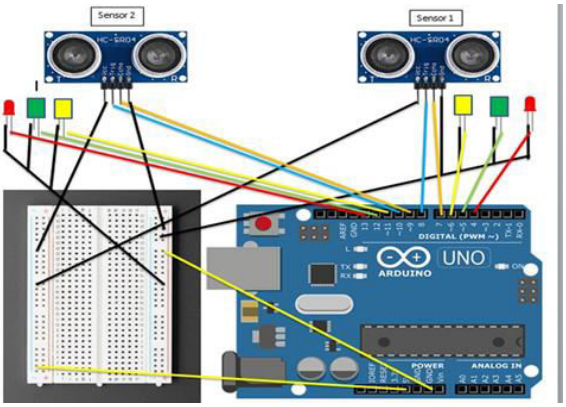

Fig.8 Traffic Density Detection Circuit

This Subsystem In Fig.8 Has A Capability Of Varying The Duration Of Red And Green Signals Of Various Traffic Lights In A Signal Based On Density Of The Traffic Present At Each Lane.

The Subsystem Is Implemented Using An Arduino Microcontroller And Ultrasonic Sensors And We Have Used Resistors And Colored Leds To Replicate Traffic Signals.

In This Project,Two Lanes Are Considered,

- If The Lane 1 Has Traffic Queue Distance > Distance Between Sensor And Traffic Line (Congestion) And If The Lane 2 Has Traffic Queue Distance < Distance Between Sensor And Traffic Light For Lane 1 Turns Green Till The Congestion Is Cleared

- If The Lane 2 Has Traffic Queue Distance > Distance Between Sensor And Traffic Line (Congestion) And If The Lane 1 Has Traffic Queue Distance < Distance Between Sensor And Traffic Line And Traffic Light For Lane 2 Turns Green Till The Congestion Is Cleared

- If Both Lanes Have Traffic Queue Distance > Distance Between Sensor Or Traffic Queue Distance < Distance Between Sensor And Traffic Line The Traffic Signals Work Using Time Based Control

IV. CONCLUSION

In This Paper, A Survey On The Existing Technology To Monitortraffic Is Discussed. It Is Clear From The Survey That The Present Technologies Have Different Accuracies, Cost And Different Methods Of Deployment. All The Scopes Of Development Are Also Discussed In The Survey. The Adoption Of A Specific Technology Dependson The Type Of Application Requirement. This Paper Also Offers A Solution For Density Detection And Clearance. A Lot Of Research Is Being Conducted For Building Traffic Density Controller And Parallelly Detecting The Traffic Rule Violators. The Total Integrated Run Time Of The System Is Close To 8 Seconds Post Booting.

V. APPLICATIONS OF TRAFFICPAL

1. Good Alternative For Traffic Police In Highly Polluted Places.
2. Can Be Used As Automated Surveillance Unit

VI. RESULTS

The Proposed Model Contains 4 Sub-Systems, Line Crossing Detection, Number Plate Recognition, Helmet Detection And Traffic Density Detection, The Results For These Subsections Are Shown Below

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6.1 Line Crossing Detection

The Line Crossing Detection Works Based On The Lane End Line Visible On The Image, In This Case It Is The Blue Line, It Is Also Called The Stop Line, When The Signal Is Red, The Vehicles Have To Ideally Stop Behind This Line, So The Algorithm Detects The Vehicles That Cross This Line

Fig. 9signal Bounce Detection

6.2 Number Plate Detection

The Number Plate Detection Is Performed On The Images Of The Vehicles That Are Obtained From Helmet Detection And Number Plate Detection Sub-Systems, Once The Number Plate Is Detected, It Is Displayed On The Output Console Screen As Well As Recorded In A File Which Is Later Sent To The Nearest Traffic Police Station Via Sms.

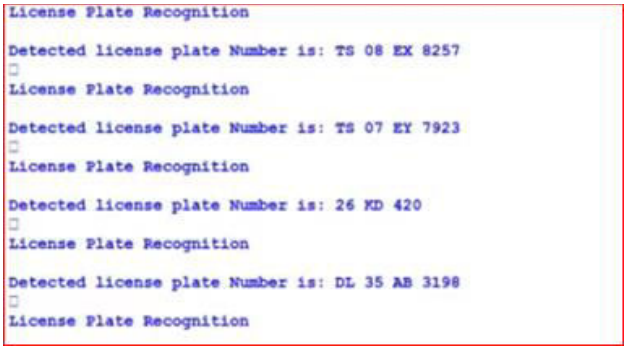

Fig. 10 The List Of Detected Number Plates Displayed On The Output Console

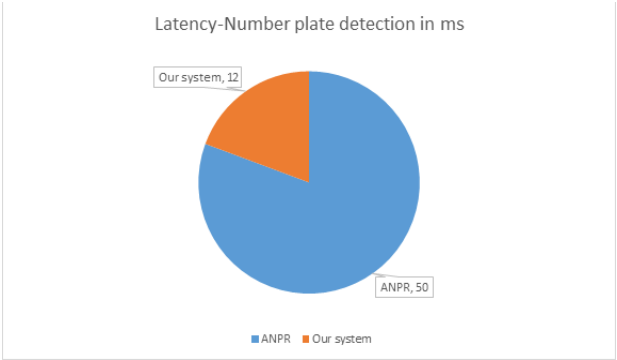

Fig. 11 Improvement Of Latency In Traffic Pal

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

|| Volume 9, Issue 7, July 2021 ||

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6.3 Helmet Detection

Fig. 12 Helmet Detected In Traffic

Fig. 13 Helmet Confidence Value Is Low

Confidence Value Of Person With Helmet Is Very Much Greater Than That Of No Helmet Which Gives Clear Line Of Discrete Detection Between Helmet, Cap, No Helmet, Turban Etc.

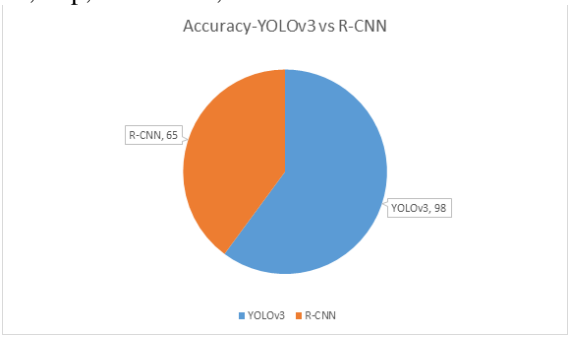

Fig. 14 Accuracy- Yolo Vs. R-Cnn

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6.4 Traffic Density Detection

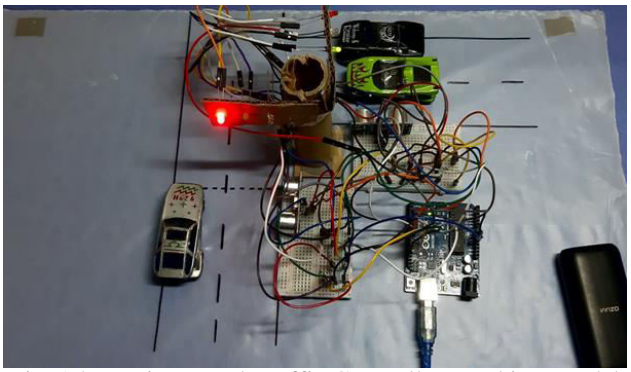

Fig. 15 Density Based Traffic Controller Working Model

The Lane With Less Number Of Cars Has Red Light And Lane With More Number Of Cars Has Green Light.

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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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