

National Conference on
Urban Mobility—Challenges, Solutions, and Prospects
IIT Madras

Real Time Traffic Counting System using Video Image Processing

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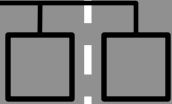
Introduction

- One of the many projects sponsored by Department of Information Technology, Govt. of India, under INTRANSE
- Research Team:
 - Dept of Civil Engg., IITB: Prof. Tom V. Matthew, Prof. Gopal R. Patil, Prof. K V K Rao
 - Dept. of Electrical Engg., IITB: Prof. Harish Pillai, Prof. Subhashis Chowdhary
 - CDAC: Mr. V Muralidharan, Mr. Ravi Kumar, and Mr. Satheesh G



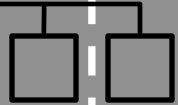
Introduction

- Goal: To develop a Real-Time system for Counting, Classifying, and Monitoring for Indian road traffic
- Objectives
 - Developing video-image based system to detect, count, and classify vehicles
 - Customizing the Loop detectors for Vehicle count and classification in Indian traffic condition which is heterogeneous and with limited lane discipline



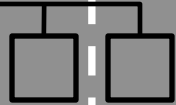
Traffic Detectors

- Traffic detectors can be
 - In-roadways: embedded in the pavement or placed on the road surface (Eg. Inductance loops)
 - Over-roadways: above the pavement or alongside of the roadway (Eg. Video cameras)



Types of Detectors

- In-roadway detectors
 - **Inductive loop detectors**
 - Magnetic sensors
 - Pneumatic tubes
 - Piezoelectric sensors



Types of Detectors

- Over-roadway detectors
 - **Video image processors**
 - Microwave radar sensor
 - Infrared sensors
 - Laser radar sensors
 - Ultrasonic sensors
 - Radio frequency identification (RFID) tags
 - Global positioning system (GPS)



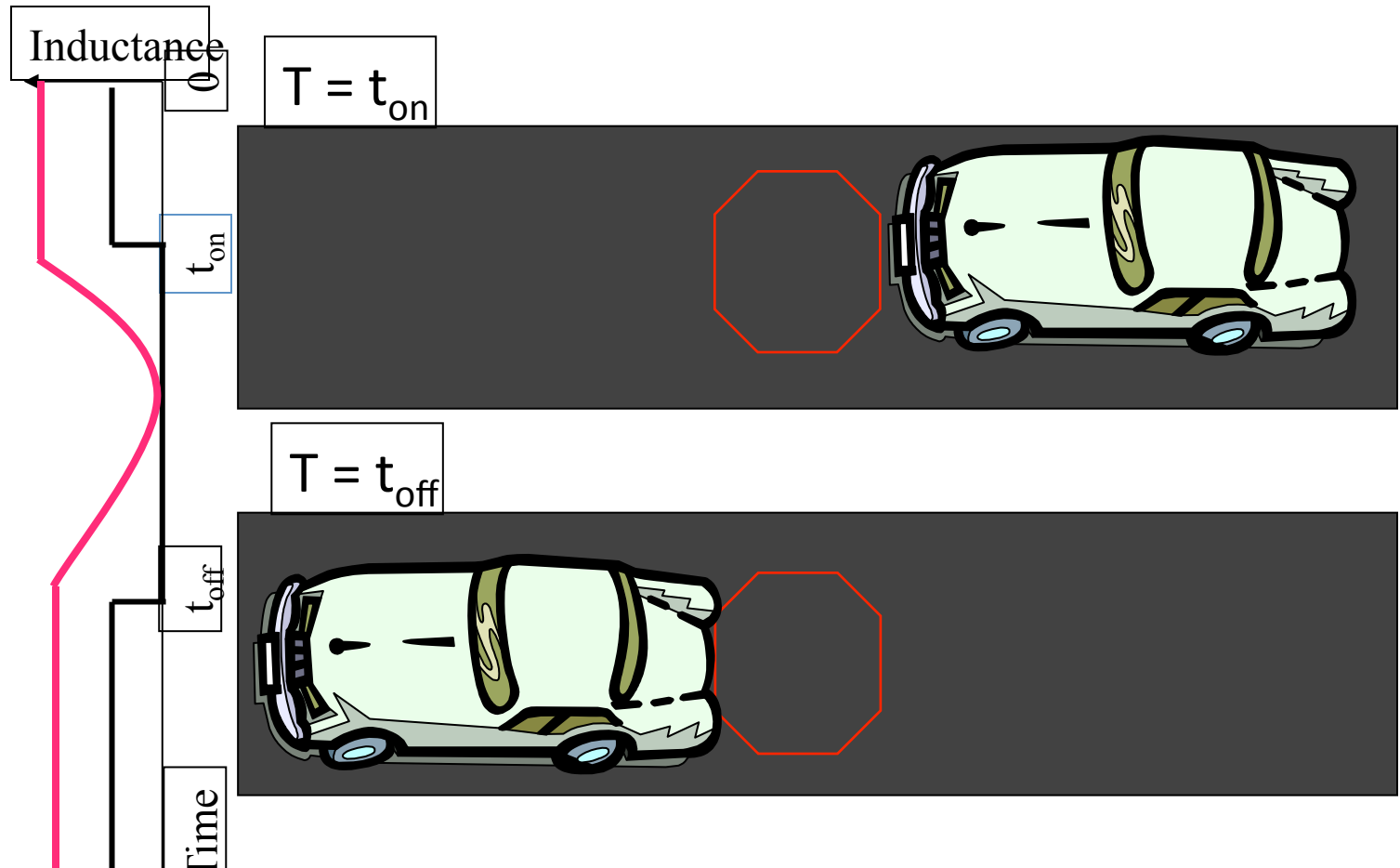
Inductive Loop Detector for Traffic Data

- The most commonly used sensors in traffic management applications
- Loops are installed in a variety of shapes such as squares, rectangle, circular, diamond and octagonal
- Output: presence, classification, speed, gap
- **Pros:** Mature, well understood technology, flexible design, insensitive to inclement weather, high accuracy
- **Cons:** Installation requires pavement cut, wire loops are subject to stresses of traffic and temperature, pavement repair can damage the loops



Change in Inductance

Loop inductance decreases when a car is on top of it.



Source: Steve Muench, CEE 320 lectures, University of Washington

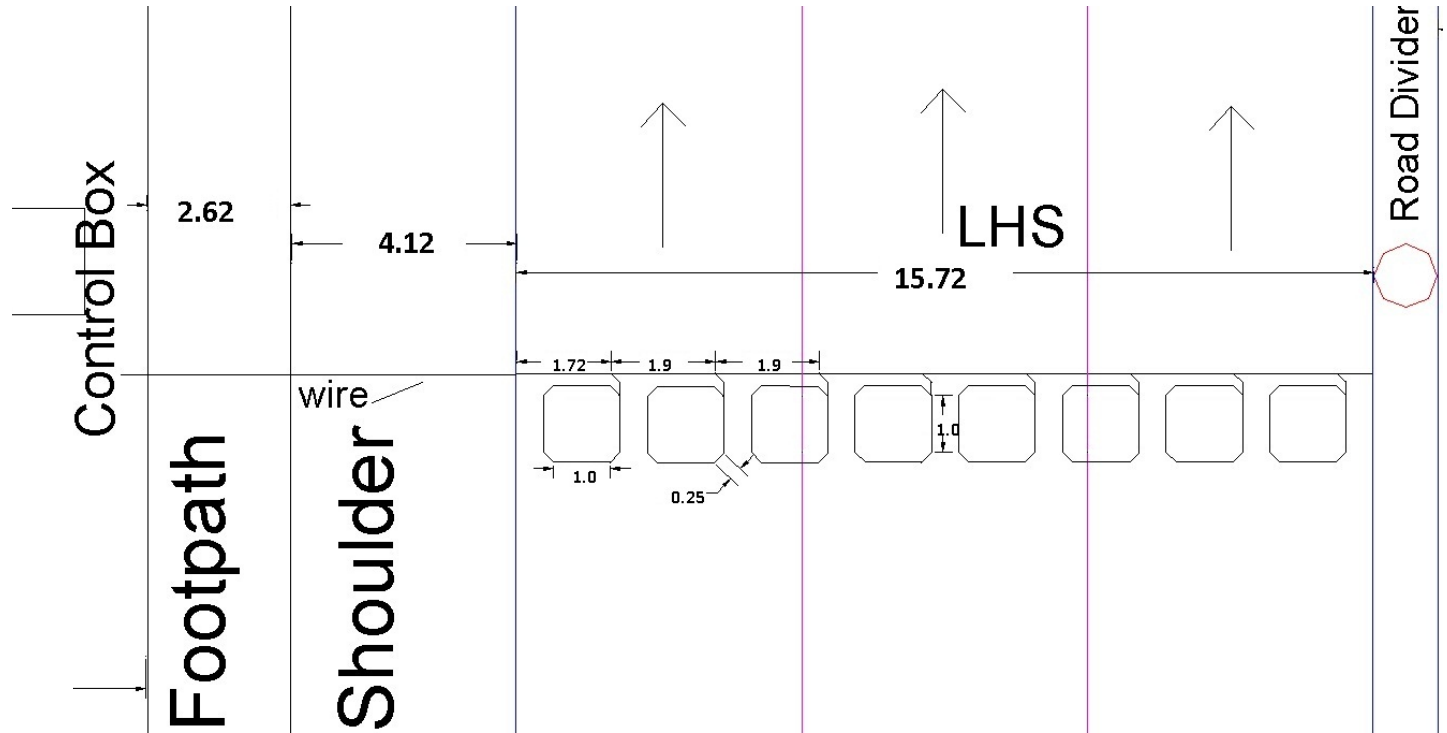


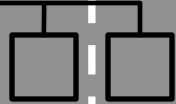
Site Installation

- Installation at two pilot sites : Mulund and IITB campus (two-lane undivided roads)
- The main site is Jogeshwari-Vikroli Link Road (JVLR), the third most congested corridor in Mumbai



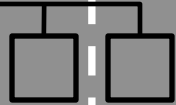
Main Site outside IIT Bombay Loop Configuration





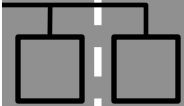
Vehicle Counting Results

- Actual number of vehicles identified by analyzing the video : 490
- Number of vehicles undetected (no signature was generated) : 25
 - All were two-wheelers
 - Vehicles passed in between two adjacent loops
- Number of vehicles counted by the system: 474
- Counting Accuracy: 96%



Video Image Processing System

- Can output presence, classification, speed
- **Pros:** Monitors multiple lanes; Rich array of data available; Provides wide-area detection; easy to add or modify detection zones
- **Cons:** Performance affected by many factors including fog, rain, snow, vehicle shadows, day to night transition; high installation and maintenance cost



Field Installation





Camera Calibration





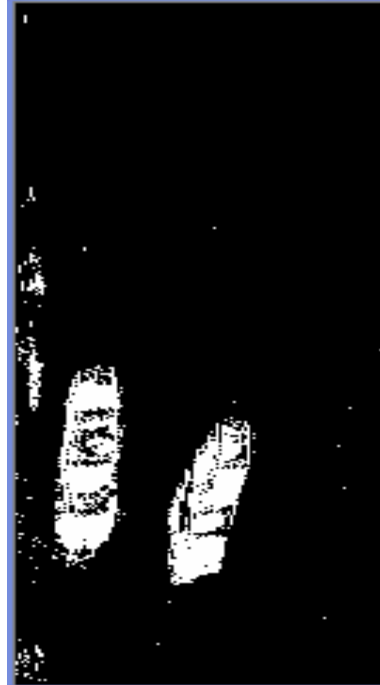
Video Processing for counting



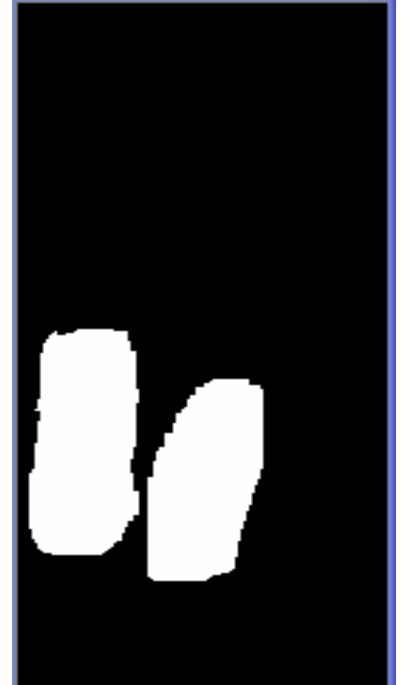
**Original
image**



**Estimated
foreground**



**After
shadow
removal**



**After
morphology**

Real time Vehicle Counting



Count = 391 Frame No = 1000

Detection Window



Vehicle Count Results

	Actual Count	Count by algorithm	Accuracy %
Early Morning	236	273	84.3
Morning	622	699	90.8
Noon	597	531	88.9
Afternoon	613	554	90.4

*Taken on an average of 15 minute duration



Vehicle Classification Results

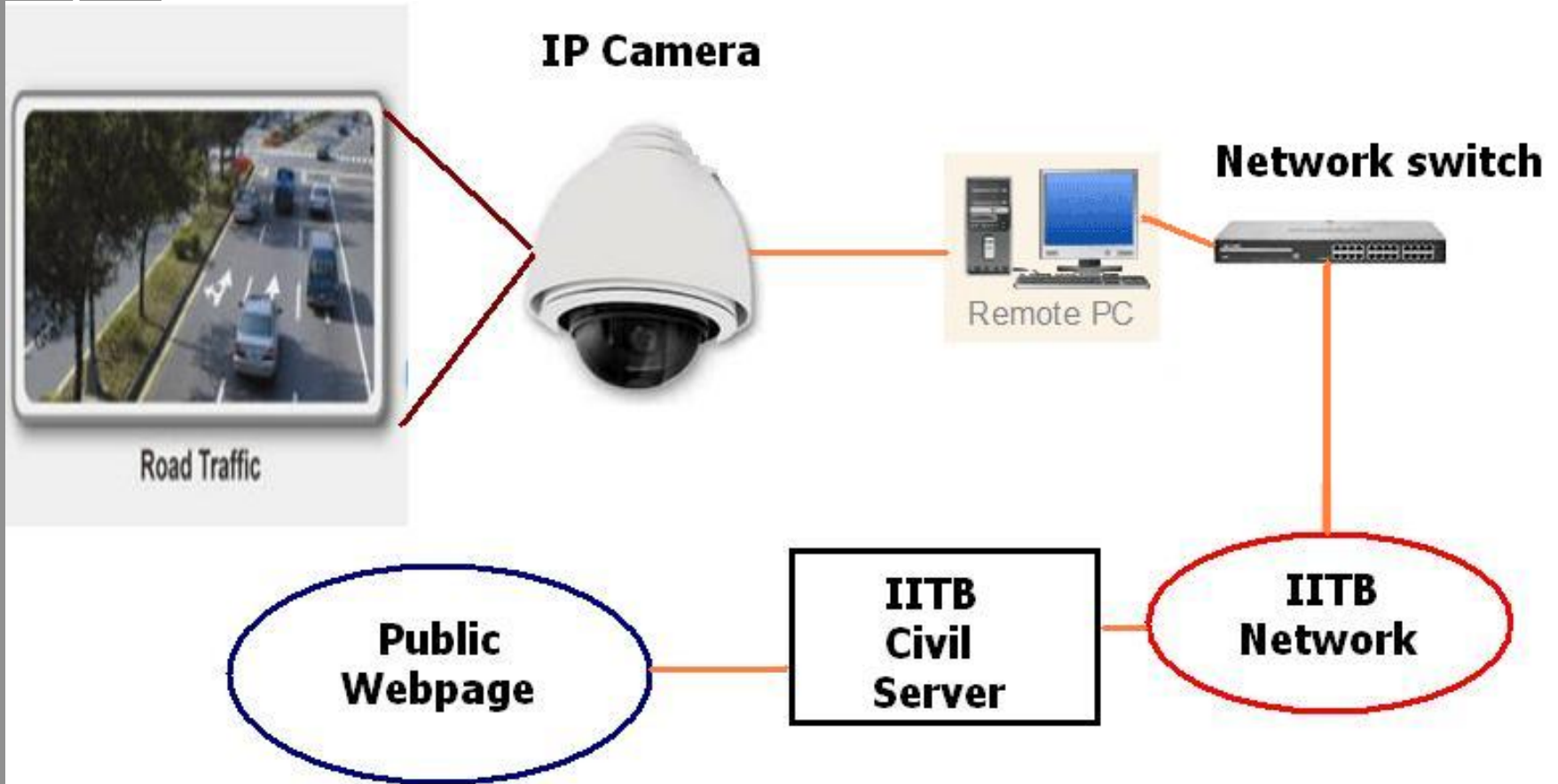
	HMV	LMV	3-wheeler	2-wheeler
HMV	280	110	8	20
LMV	56	2604	66	32
3-wheeler	88	205	505	133
2-wheeler	15	50	18	490

Accuracy = 82.8 %

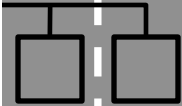
*Taken on an average of 1 hour duration



Real-time Traffic Analyzer and Classifier (RTrAC)



<http://www.civil.iitb.ac.in/rtrac/#>



RTrAC Interface



RTrAC

Real-time Traffic Analyser and Classifier

HOME

ABOUT

GALLERY

HOW IT WORKS

RESOURCES

FEEDBACK

Authorized Login



Kanjikottamale III Peraiat 2012-07-12 11:54:00

Time stamp	Vehicle Count (for 5 min)	Two Wheeler	Three Wheeler	Light Vehicles	Heavy Vehicles	Average Velocity (km/h)	Congestion Status
2012-07-12 11:50:07	254	62	62	160	60	24.00	A
2012-07-12 11:55:16	290	50	60	116	64	25.15	
2012-07-12 11:40:01	225	34	42	90	29	27.01	
2012-07-12 11:25:16	207	42	61	144	50	29.00	B
2012-07-12 11:20:19	220	42	20	101	40	20.00	
2012-07-12 11:25:02	240	40	31	94	45	24.69	B
2012-07-12 11:20:00	217	60	34	79	31	27.60	
2012-07-12 11:15:09	266	44	46	127	29	26.34	B
2012-07-12 11:10:14	276	61	67	107	61	29.29	
2012-07-12 11:20:02	221	59	50	140	55	28.50	C
2012-07-12 11:30:12	401	60	29	222	90	24.40	
2012-07-12 10:55:02	292	66	61	171	74	24.10	

Legend

Criteria	Category	Colour
Count < 675 (Low Traffic)	A	Low green
675 < Count < 900 (Normal Traffic)	B	Bright Green
900 < Count < 1125 (Medium Traffic)	C	Yellow
1125 < Count < 1250 (High Traffic)	D	Red Orange
1250 < Count < 1500 (Very High Traffic)	E	Reddish
Count > 1500 (Stop and Go Traffic)	F	Dark Red

*Disclaimer: RTrAC produces accurate results from



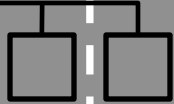
Features of RTrAC

- Real-time Vehicle Count
- Average Speed estimation
- Real-time Vehicle classification into four categories: 2-wheeler, 3-wheeler, light vehicles, heavy vehicles
- Public interface for processed data
- Report generation for day, week, and month long data



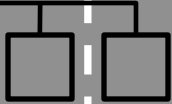
Report from RTrAC

Time (from)	Time (till)	Vehicle Count	Two-Wheeler	Three-Wheeler	LMV	HMV	Average Speed
2012-07-10 11:24:33	2012-07-10 11:30:00	207	27	15	128	37	28
2012-07-10 11:30:15	2012-07-10 12:30:00	3,571	707	354	1,810	700	15
2012-07-10 12:30:15	2012-07-10 13:30:00	4,064	824	442	1,960	838	14
2012-07-10 13:30:00	2012-07-10 14:30:00	5,338	1,084	530	2,686	1,038	15
2012-07-10 14:30:08	2012-07-10 15:30:00	6,104	1,193	603	3,016	1,292	15
2012-07-10 15:30:07	2012-07-10 16:30:00	5,916	1,205	649	2,884	1,178	16
2012-07-10 16:30:02	2012-07-10 17:30:00	6,492	1,299	1,079	2,927	1,187	27
2012-07-10 17:30:10	2012-07-10 18:30:00	6,570	1,272	1,115	3,058	1,125	25
2012-07-10 18:30:20	2012-07-10 19:30:00	2,856	534	507	1,224	591	27
2012-07-10 19:30:02	2012-07-10 20:30:00	1,158	225	217	509	207	32
2012-07-10 20:30:22	2012-07-10 21:30:00	2,731	449	507	1,299	476	27
2012-07-10 21:30:05	2012-07-10 22:30:00	7,201	1,300	1,327	3,262	1,312	24
2012-07-10 22:30:07	2012-07-10 23:30:00	421	82	72	180	87	34
2012-07-10 23:30:24	2012-07-11 00:30:00	195	38	28	94	35	36



Future Work

- Improve the algorithm to work in night and all weather conditions
- Include live video stream for public view
- Stop vehicle detection and accident detection
- Traffic jam prediction
- Lane closure and construction work detection
- License plate recognition system to be embedded in the algorithm
- Mobile alerts for public based on traffic predictions



Thank You

Questions ????

Comments ????