



## **IRF WORLD ROAD MEETING 2017**

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### **An Approach Towards Automated Estimation of Pavement Condition Index (PCI) For PMGSY Roads using Pavement Videos**



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# Presentation Outline

- Introduction
- Current PCI Rating Methodology For PMGSY Roads
- Proposed PCI Rating Methodology
  1. Video Data Collection using PARSS-2016
  2. Video Data Processing using AutoDistress & Estimation of PCI Rating
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- Performance Evaluation of the Method
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## Introduction

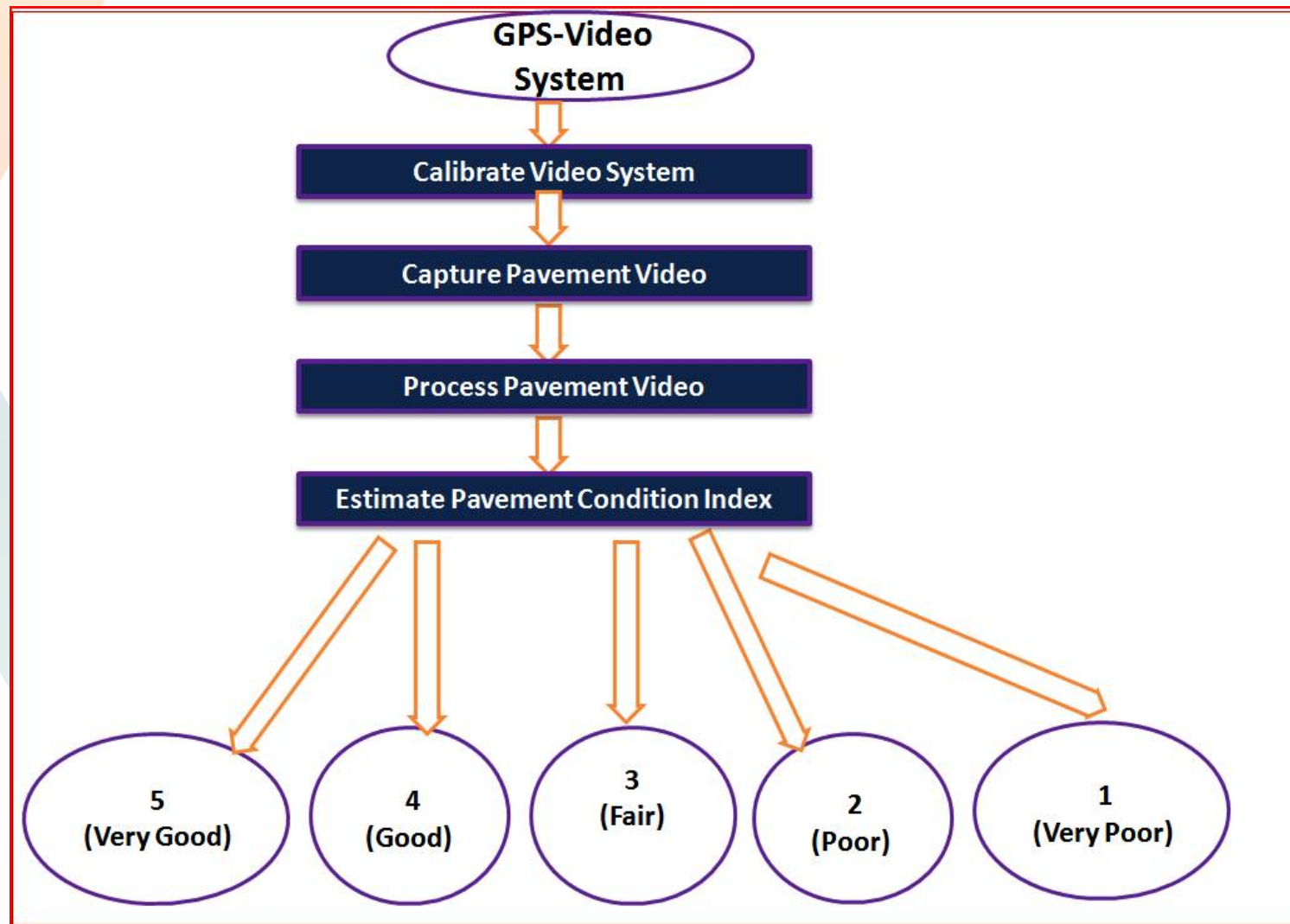
- PCI rates the condition of the surface of a road network in terms of a numerical rating
- PCI is used to (a) identify maintenance, rehabilitation and / or up-gradation needs, (b) monitor pavement condition, (c) develop road maintenance budgets, (d) evaluate pavement materials and designs
- In current practice, PCI is determined manually by arithmetic mean value of three different ratings for each km of PMGSY road sections. This is subjective and time consuming.
- This paper presents an automated method for estimation of PCI using pavement videos

## Current PCI Rating Methodology for PMGSY

PCI is determined manually by arithmetic mean value of following three different ratings for each km.

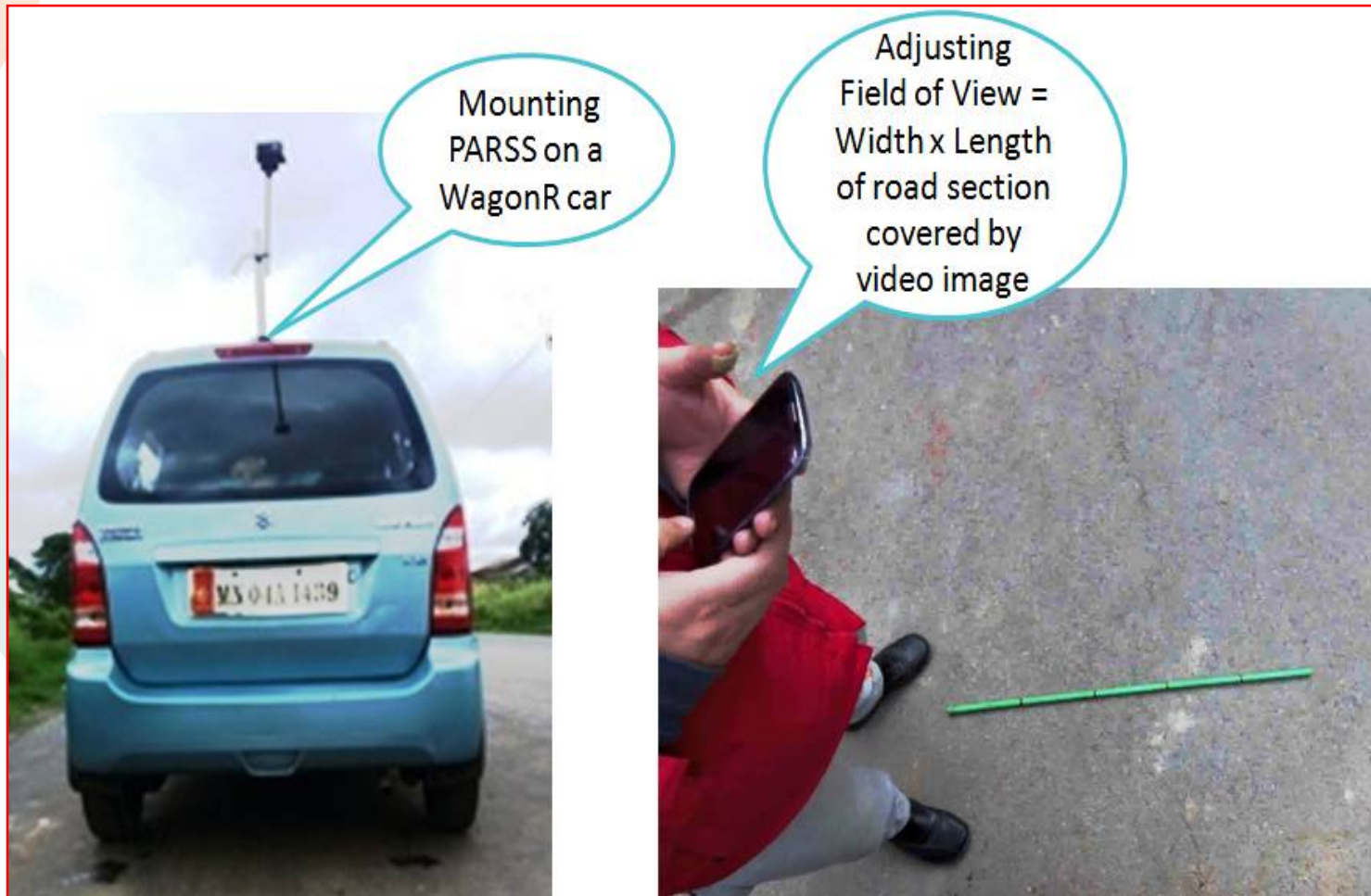
- **Rating based on Visual Inspection (Distress Information):**  
5=no signs of distress, 4=distress in less than 10% length, 3=distress in less than 25% length, 2=distress in less than 50% length, 1=frequent occurrence of distress across carriageway
- **Rating based on Riding Comfort**  
5=smooth n pleasant ride, 4=comfortable, 3=slightly uncomfortable, 2=rough n bumpy, 1=dangerous
- **Rating based on Comfortable Driving Speed**  
5=over 40km/hr, 4=30-40km/hr, 3=20-30km/hr, 2=10-20km/hr, 1=less than 10km/hr

# Proposed PCI Rating Methodology using Pavement Videos



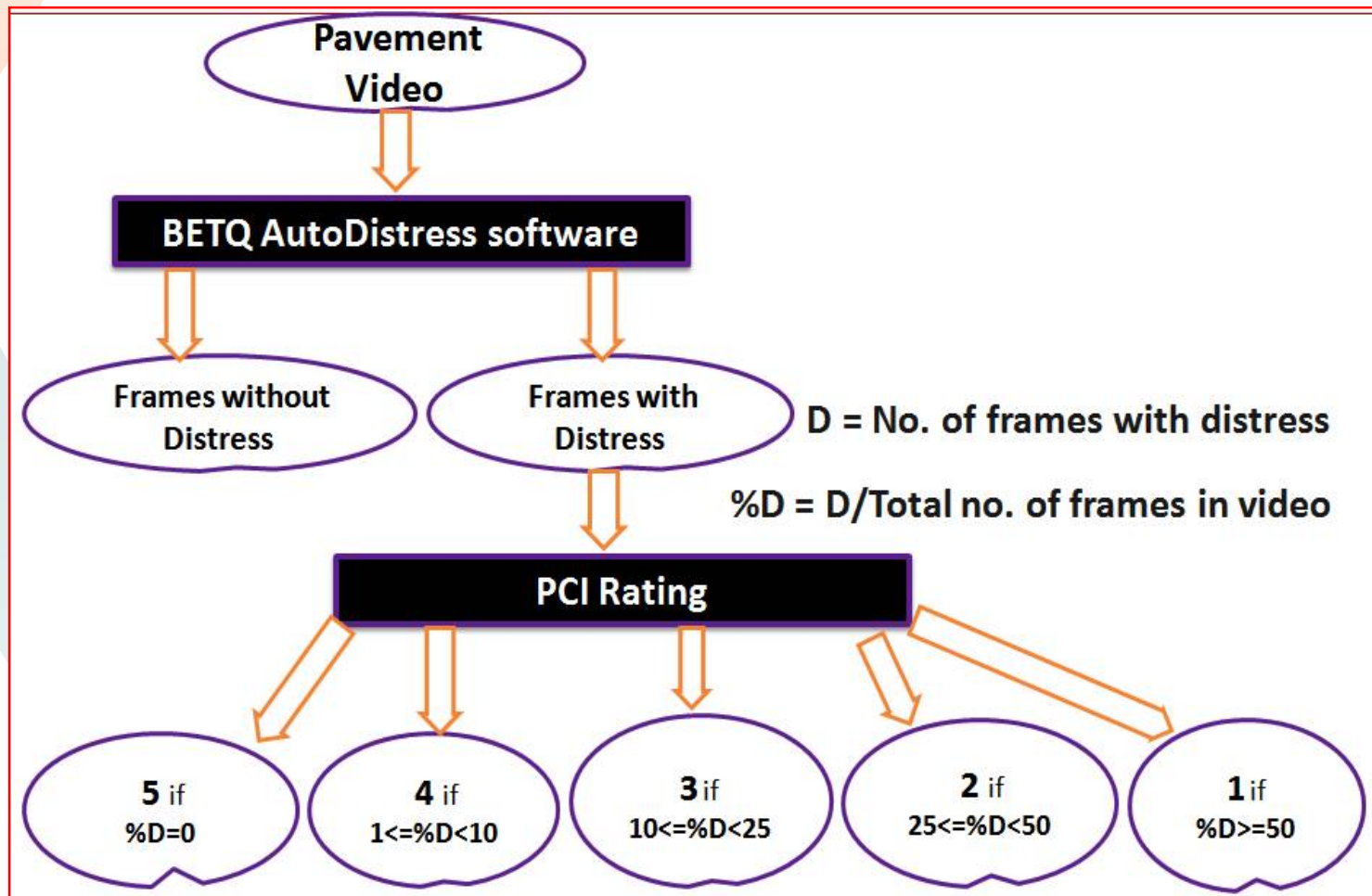
# Pavement Video Data Collection using PARSS

- **PARSS: Portable Automated Road Survey System** developed indigenously by BETQ Data Analytics Pvt. Ltd., India



## Pavement Video Data Processing using AutoDistress & Estimation of PCI Rating

- **AutoDistress:** Software from BETQ Data Analytics Pvt. Ltd. for automated detection and analysis of distresses from road surface video clips (Reference No.4)



# Results / Reports

- Frame-wise report generated automatically by AutoDistress

	A	B	C	D	E	F	G	H	I	J
1	Start of Report Generation....									
2	Date : 3-8-2016									
3	Time : 7:43:37									
4	File PathC:\Users\betq\Desktop\Pavement-XE-Mayailambi-WagonR\0047.avi									
5										
6	Chainage(m	Frame Count	Frame Type (D=	Object Area(sq m)	Area Extent(%)					
7	2	1	D	0.012118	0.29585	<b>Overall information:</b> Total No. Of Frames=552 Frames with Distress=91 Frames without Distress=461 % Of Frame With Distress=16.485507 Distress Area(sq m)=0.933535 PCI=3 End of Report Generation.... Date : 3-8-2016 Time : 7:47:31				
8	4	2	D	0.016398	0.400342					
9	6	3	D	0.013095	0.319702					
10	8	4	D	0.018212	0.444629					
11	10	5	D	0.018277	0.446216					
12	12	6	D	0.019262	0.470264					
13	14	7	D	0.012088	0.295117					
14	16	8	D	0.007515	0.183472					
15	18	9	D	0.012991	0.317163					
16	20	10	D	0.02286	0.558105					
17	22	11	D	0.013402	0.327197					
18	24	12	N	0.002075	0.050659					
19	26	13	N	0.000304	0.007422					
20	28	14	N	0.000584	0.014258					
21	30	15	N	0.000735	0.017944					
22	32	16	N	0.002385	0.058228					
23	34	17	N	0.000632	0.01543					
24	36	18	N	0.000476	0.011621					
25	38	19	N	0.000414	0.010107					
26	40	20	N	0.000927	0.022632					
27	42	21	N	0.001598	0.039014					
28	44	22	N	0.001996	0.04873					
29	46	23	D	0.004982	0.121631					
30	48	24	D	0.004971	0.121362					
31	50	25	D	0.00506	0.123535					

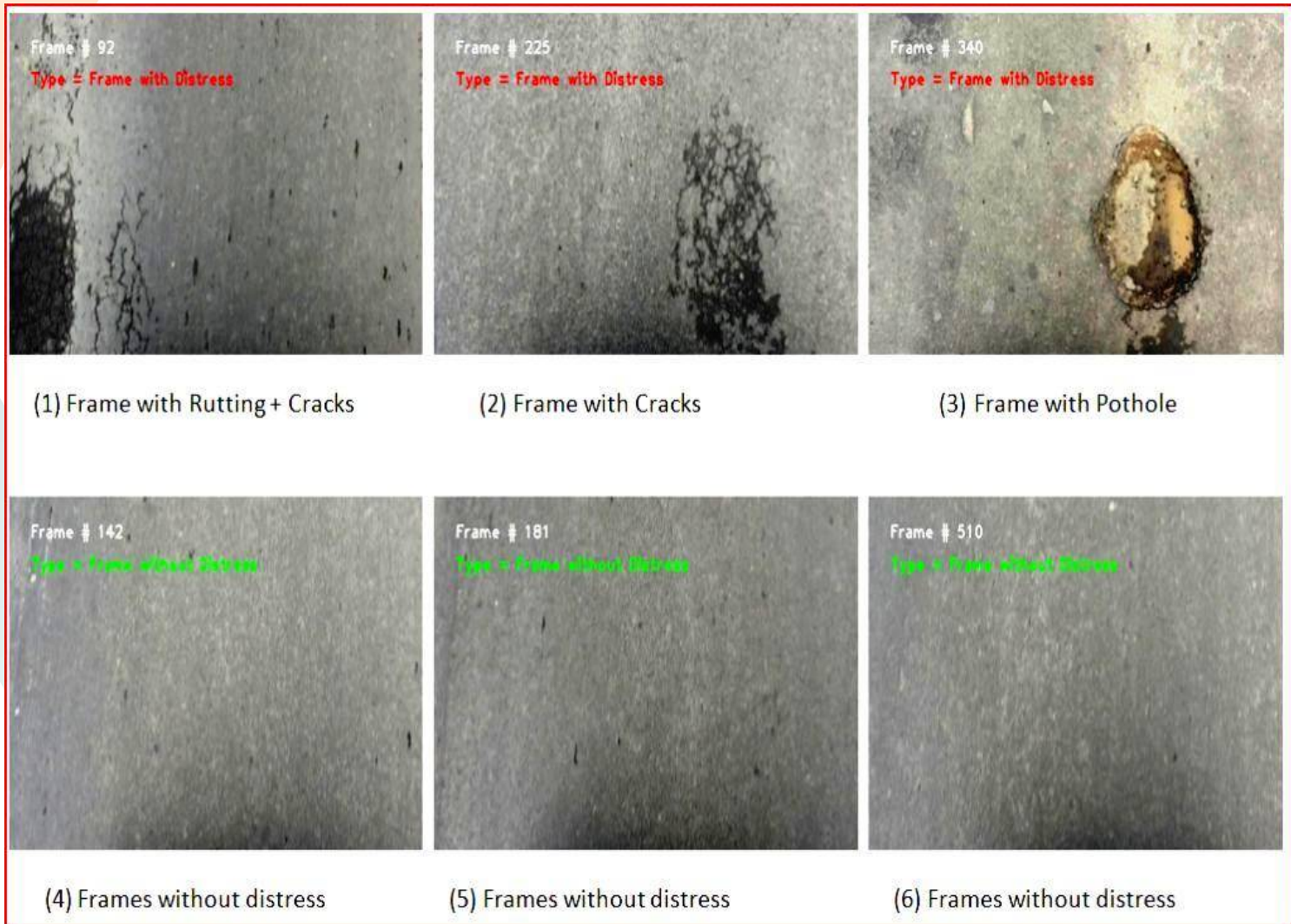
# Results / Reports

- 100m-wise report generated automatically by AutoDistress

	A	B	C	D	E	F
1	Start of Report Generation....					
2	Date : 3-8-2016					
3	Time : 7:43:37					
4	File PathC:\Users\betq\Desktop\Pavement-XE-Mayailambi-WagonR\0047.avi					
5						
6	Km	Frame Nos.	Frames with Distress	Distress Area(sq m)	Extent(%)	PCI
7	0.1	01 to 50	31	0.279375	62	1
8	0.2	51 to 100	3	0.047637	6	4
9	0.3	101 to 150	5	0.030331	10	3
10	0.4	151 to 200	3	0.021039	6	4
11	0.5	201 to 250	9	0.051064	18	3
12	0.6	251 to 300	2	0.009884	4	4
13	0.7	301 to 350	2	0.04518	4	4
14	0.8	351 to 400	15	0.269126	30	2
15	0.9	401 to 450	11	0.103732	22	3
16	1	451 to 500	8	0.059312	16	3
17	1.1	501 to 550	2	0.016855	4	4
18						
19	Overall information:					
20						
21	Total No. Of Frames=552					
22	Frames with Distress=91					
23	Frames without Distress=461					
24	% Of Frame With Distress=16.485507					
25	Distress Area(sq m)=0.933535					
26	End of Report Generation....					
27	Date : 3-8-2016					
28	Time : 7:47:31					
29						

# Results / Reports

- Examples of video frames processed by AutoDistress



## Performance Evaluation of the Method

- The proposed method has been tested using a PARSS-2016 mounted on a WagonR car for automated data collection and AutoDistress software installed in a Laptop for automated data processing.
- AutoDistress software was able to retrieve frames with distress out of a video clip having 552 frames with accuracy up to 94%. The total no. of false detections in *frames with distress* and *frames without distress* folders are 15 & 18 frames respectively.
- The average processing time taken per frame by AutoDistress was found to be 0.38 seconds while each frame took around 90 seconds when analyzed manually (frame by frame basis).

## Conclusions

- In this paper, a new methodology for automated estimation of PCI using pavement videos for PMGSY roads is proposed.
- The test results indicated that the proposed methodology has a significant capability in estimating PCI automatically.
- Compared to manual method for PCI data survey, use of portable video imaging based system is found to be more objective, speedy & accurate and gives a powerful and effective data collection and visualization whenever / wherever required.
- In future, the presented methodology will be extended to three point numerical ratings of pavement condition for PMGSY roads viz. 1 (Poor), 2(Fair) and 3(Good).

## References

1. Pavement Condition Index 101, Hawaii Asphalt Paving Industry, <http://hawaiiasphalt.org/wp/wp-content/uploads/PCI-101.pdf> , Accessed July 12, 2017.
2. ToR for PCI Verification, National Rural Roads Development Agency, <http://pmgsy.nic.in/circulars/VPD.pdf>, Accessed July 12, 2017.
3. Portable Automated Road Survey System (PARSS-2016), Betq Data Analytics Private Limited, <http://www.betqdata.com/products>, Accessed July 12, 2017.
4. H. Lokeshwor, L.K. Das, and S. Goel. Robust Method for Automated Segmentation of Frames with/without Distresses from Road Surface Video Clips. American Society of Civil Engineers: Journal of Transportation Engineering. No.140 (1), 2014, pp.31-41. [https://doi.org/10.1061/\(ASCE\)TE.1943-5436.0000564](https://doi.org/10.1061/(ASCE)TE.1943-5436.0000564).
5. H. Lokeshwor, L.K. Das, and S.K. Sud. Method for Automated Assessment of Potholes, Cracks and Patches from Road Surface Video Clips. Elsevier: Social and Behavioral Sciences, No.104, 2013, pp.312–321. <https://doi.org/10.1016/j.sbspro.2013.11.124>.



PRADHAN MANTRI GRAM SADAK YOJANA  
RURAL DISTRICT

NAME NH-39 to (NSAM)  
Total Length: 3.00 km.  
Culvert: 4 nos

Details of Road Pavement



1. Earthwork in Embankment.
2. Gravel Sub base: 150mm. thick.
5. W.P.M in 2 Layers: 150mm. thick.
4. Bitumnu: 20mm. thick.

PRADHAN MANTRI GRAM SADAK YOJANA

From NH-39 to (NSAM) PACKAGE NO MNO-842 (Phase-X)  
Length: 3.00 km.  
5 Year Maintenance Cost: Rs. 11 25 462.45  
Work: Commencement: 12-12-2015 Completion: 11-12-2016  
Maintenance:  
Name of Contractor: Shri M. Babu S. (Special Class Contractor)  
Work Executed By: MNRDA, Government of Manipur  
PROJECT FUNDED BY MINISTRY OF RURAL DEVELOPMENT  
GOVT. OF INDIA

ROAD FROM  
NH-39 to Okram

THANK YOU

SEEING IS BELIEVING