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The 1st International Conference on Information Technology and Security (IC-ITechs)

November 27, 2014

Editors & Reviewers:

Tri Y. Evelina, SE, MM Daniel
Rudiaman, S.T, M.Kom Jozua
F. Palandi, M.Kom

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GREETINGS

Head of Committee IC-Itechs

For all delegation participants and invited guest, welcome to International Conference on Information Technology and Security (IC-Itechs) 2014 in Malang, Indonesia.

This conference is part of the framework of ICT development and security system that became one of the activities in STIKI and STTAR. this forum resulted in some references on the application of ICT. This activity is related to the movement of ICT development for Indonesia.

IC-Itechs aims to be a forum for communication between researchers, activists, system developers, industrial players and all communications ICT Indonesia and abroad.

The forum is expected to continue to be held continuously and periodically, so we hope this conference give real contribution and direct impact for ICT development.

Finally, we would like to say thanks for all participant and event organizer who involved in the held of the IC-Itechs 2014. We hope all participant and keynote speakers got benefit from this conference.

LIST OF CONTENT

Predict of Lost Time at Traffic Lights Intersection Road Using Image Processing

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Abstract

There are three lamps in traffic lights, green, red, and amber. The amber lamp is a sign for driver as preparing to move when they are stopping because the red lamp turn on, and as emptying vehicles when the phase of traffic lights turn on green, and the moment is called as lost time. Generally, the amber time is regulated manualyl and constant, but the fact that lost time is not constant. By using CCTV IP IR we can determine speed of vehicle, so we can calculate lost time in real time. The sequence of method is used in this paper to predict and determine speed of vehicle : formulation determination to convert distance on image into actual distance in unit meter; pattern recognition of vehicles, in this research using previous research; time depth determination of the first capturing traffic until the second capturing; speed calculation of each vehicles types, and average of vehicles speed; calculation of lost time. The result of the algorithm aplying show that system can predict the speed of the vehicle, by using velocity formulation the system can determine lost time in automatically.

Keywords: *lost time of traffic lights, convertion pixel into meter, image processing*

1. INTRODUCTION

There are three lamps in traffic lights, green, red, and amber. The amber lamp is a sign for drivers as preparing to move when they are stopping because the red lamp turn on, and as emptying vehicles when the phase of traffic lights turn on amber, and the moment is called as lost time. The emptying time is time which is used by driver get across toward the destination of intersection lane. As description, the green lamp of lane phase A turn on during 25 seconds, on the end of green lamp there are a lot of vehicles move to overpass from lane phase A to lane phase B, This is assumed that when there is precisely turnover from the red lamp to amber lamp, there are not vehicles to go across toward lane phase B, so the aglow amber lamp is only used by emptying of vehicles from lane phase A. Bonneson (2009), that time tolerance is used to empty by vehicles only 1 second, if the actual time of emptying is 4 seconds, so the time total is 5 seconds. In this case mean that amber lamp will turn on during 4 seconds, and the following 1 second will be used by protection in order to no vehicles which crash.

2. RESEARCH METHOD

Until now, Schoepflin etall (2003), the determination of the amber lamp of each phase is configured by the observation result, but this is still using fixed time, whereas the time is used for emptying of vehicles is not constant, time of amber lamp that is required to emptying vehicles is appropriate with the vehicles queuing dense and the average of vehicles speed. Base on the observation result is known that the average of vehicles speed is influenced by density of traffic and type of vehicles, more number of heavy vehicles and denser traffic will cause to decrease average of vehicles speed.

To obtain prediction of vehicles average speed during emptying in this research uses image processing method, this is the following steps:

- formulation determination to convert distance on image into actual distance in unit meter .
- pattern recognition of vehicles, in this research using previous research.
- time depth determination of the first capturing traffic until the second capturing.
- speed calculation of each vehicles types, and average of vehicles speed.
- calculation of lost time

2.1 Distance Conversion Formulation from Unit Pixel to Unit Meter

To convert distance in pixel unit into meter unit need observation, take data, and do experiment, this is the following steps:

-determine height of CCTV camera

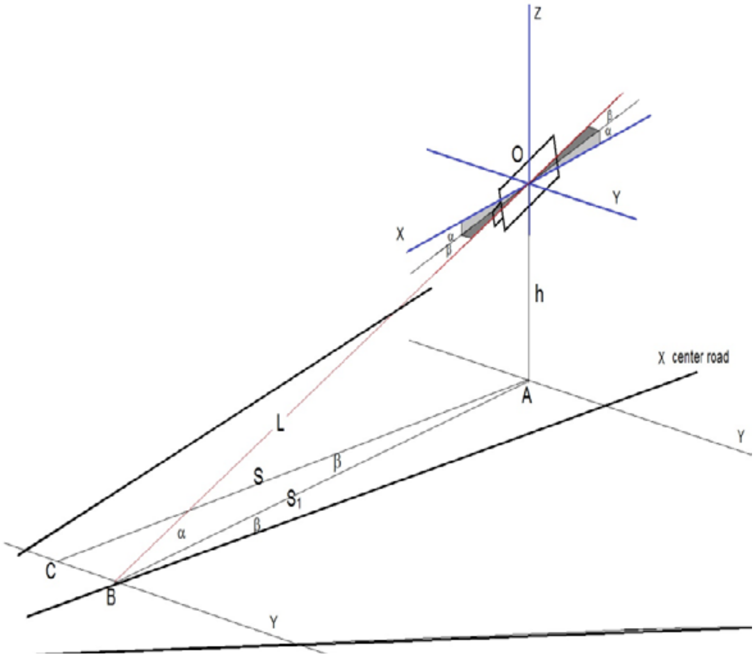
-determine slope and tilt angle CCTV

-measure the farthest and the closest distance in CCTV coverage

- determine the formulation of distance conversion

- determine distance scale from pixel to meter.

In this observation CCTV camera is placed right next to traffic lights in each road phase, this is shown on picture (1).



Picture (1) CCTV Geometry and Projection on Roadway

by :

α angle	:	angle between CCTV axis horizontal and vertical, generally is called tilt.
β angle	:	angle between CCTVaxis horizontal (X) and vorizontal (Y), generally is called slope.
h	:	height of CCTV camera to road.
L	:	distance from CCTV camera to target object
S1	:	distance from A node to B node
S	:	distance from C node to A node.

The value of α, β, and h will be obtained from observation, on picture (1) that A node is CCTV projection to road surface. If we have got the whole value from CCTV geometry, so we will be able to determine distance between object target with A node (S), this is the formulation;

$$L = \sqrt{(Y_B^2 - Y_O^2) + (X_B^2 - X_O^2)}$$
$$S_1 = L.Cos(\propto)$$
$S = \frac{S_1}{Cos(\beta)}$, sehingga diperoleh sebuah persamaan bahwa:
$$S = \frac{Cos(\propto)\sqrt{(Y_B^2 - Y_O^2) + (X_B^2 - X_O^2)}}{Cos(\beta)} \quad (1)$$
The formulation (1) is used to determine distance between target object with projection CCTV Camera to road surface in pixel unit, in this case that image dimension is only 2 D, the influence of tilt angle can be ignored, so value of α angle is 0. The next we will determine distance scale from pixel to meter, this is the following steps:

a. Capture object target on the road
b. Measure the actual distance between node camera projection to object target in meter unit.
c. Measure distance on image between node camera projection to object target in pixel unit.
d. Do step a – c at least 10 times for different distance
e. Make graphic to relation between the actual distance to image distance in pixel
f. Find the relationship

The implementation of the above step is done observation by measuring the actual distance of road in meter unit and measuring image distance in pixel unit, the result is shown at table (1) below :

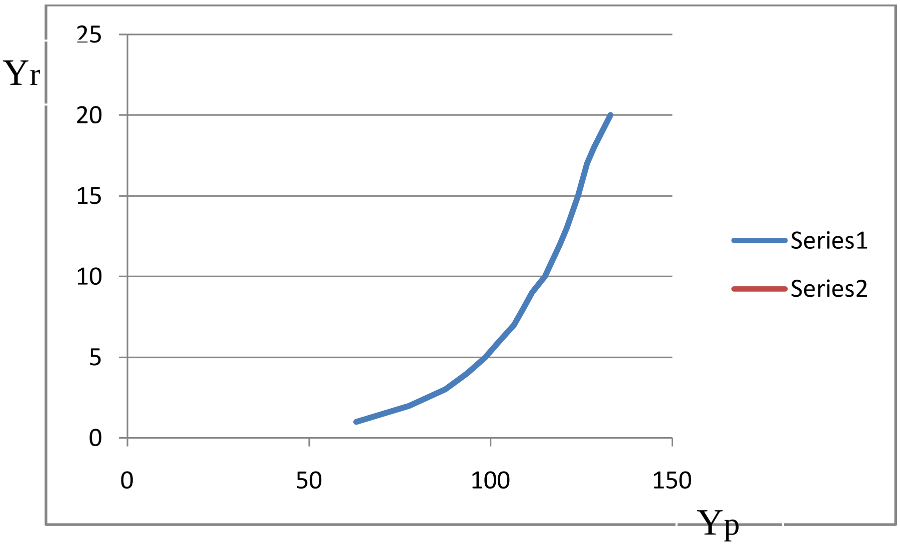
Table (1) Result of Data ObservationThe Actual Distance and Image Distance

x1	x2	ΔX (pixel)	y1	y2	ΔY	Yp(pixel)	Yr (meter)
75	156	81	154	156	155	63	1
75	142	67	140	141	140.5	77.5	2
75	129	54	131	130	130.5	87.5	3
74	124	50	125	124	124.5	93.5	4
73	117	44	120	119	119.5	98.5	5
74	116	42	116	115	115.5	102.5	6
74	112	38	112	111	111.5	106.5	7
74	111	37	109	109	109	109	8
73	107	34	107	106	106.5	111.5	9
74	105	31	103	103	103	115	10
73	103	30	101	101	101	117	11
73	100	27	99	99	99	119	12
73	97	24	97	97	97	121	13
73	95	22	94	94	94	124	15
73	93	20	91	92	91.5	126.5	17
73	91	18	89	90	89.5	128.5	18
72	84	12	85	85	85	133	20

by :

x1	:	the first end of object target on image X axis
x2	:	the second end of object target on image X axis
ΔX	:	distance of object target on image
y1	:	the first end of object target on image Y axis
y2	:	the second end of object target on image Y axis
ΔY	:	average of object position
Yp	:	average distance of object on CCTV projection to Y axis in pixel
Yr	:	distance of object on CCTV projection to Y axis in meter unit (actual distance).

To get relationship formulation between image distance in pixel (Yp) with actual distance in meter (Yr), so the first step is making graphic Yr vs. Yp, the result is obtained :

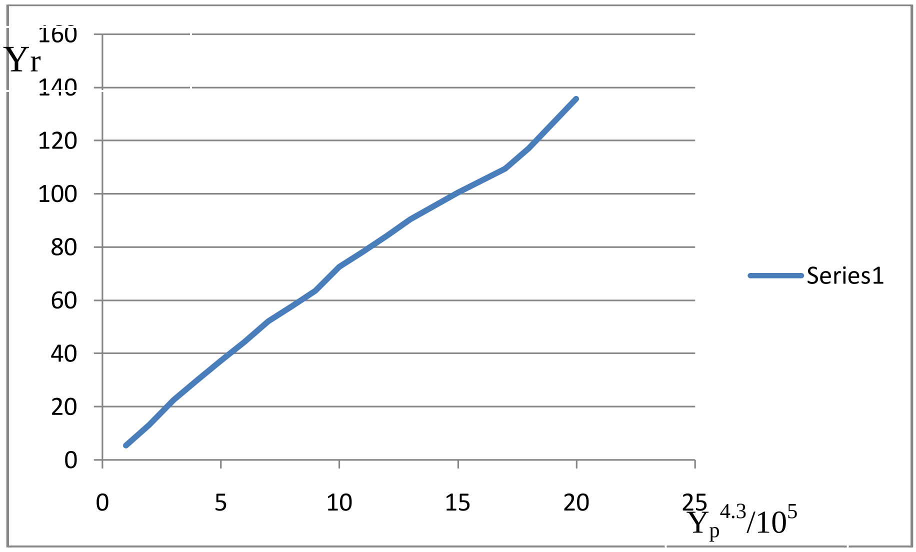


Picture (2) Graphic relationship between Yr and Yp

Picture (2) shows that relationship graphic between Yr and Yp refer to exponential relation, by using numerical model is obtained formulatian :

$$Yr \approx \frac{Y_p^{4.3}}{10^5}$$

If the formulation is implemented into graphic wil be got linier relation which is shown by picture (3)



Picture (3) Relation Graphic Yr with $Y_p^{4.3}/10^5$

From picture (3) graphic can be determined the constanta value of tg(θ) as constant comparison, from calculaiton is obtained that tg(θ) = 0.154155, so the formulation can be wroten:

$$Yr = 0.154155\frac{Y_p^{4.3}}{10^5} \qquad (2)$$

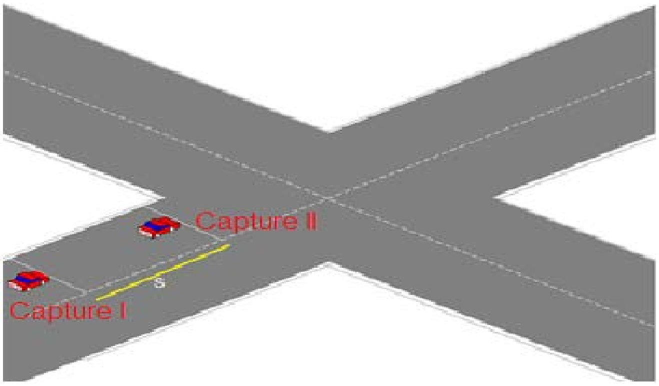
2.2 Pattern Recognition of Vehicles

Yoyok (2011), the aim of pattern recognition is to get the same object target when is done to first capture and second capture, so we can predict of true speed target. In this research is using the algorithm which is resulted in 2011 by outhor. This is the global algorithm :

- Capture vehicles traffic
- Separate vehicles from background using XOR logik
- Do edge detection
- Do training process using JFBR method
- Do weight process
- Do examination process by using JFBR method

2.3 Speed Determination of Vehicles

By assuming that the road intersection are 4 phases, and the combination image between first capture with second capture is shown to picture (4), and each capture is done buffering of system time;



Picture (4) Combine between Capture I and Capture II

By subtracting system time on second capture with system time on the first capture, t = t2 – t1. In this case t is time which is required by vehicles as far S.If the first capture is done when the vehicles is right to move toward opposite of lane phase, this mean the first speed of vehicles is zero (v_0 = 0), so the formulation of speed(de-la-Rocha and Palacios, 2011) :

$$S = V_0 \pm \frac{1}{2}at^2$$

$S = \frac{1}{2}at^2$, dan $V_t = at$, by substituting into S, will be obtained

$V_t = \frac{2S}{t}$, dengan V_t : moment speed

S : distance between the first and second capture

t : time is required as the first and second capture

2.4 The Prediction of Amber Lam or*Lost Time*

By doing speed calculation alot of types vehicles (v_1, v_2, ...,v_n), so it will be obtained the average speed of vehicles (v = Σ (v_1, v_2, ...,v_n)/N). If vehicles speed after capturing II is assumed constant so lost time can be calculated using simple formulation :

$$S = v.t$$

$$t = \frac{S}{v}$$

3. RESULT AND DISCUSSION

Some parameters that is got from direct measurement at traffic lights intersection : distance between line stopping and opposite (Ls), width each lane (w), height of CCTV (h), slope (β), tilt (α). This is the data which has been taken at intersection :

- distance between line stopping and opposite (Ls) : (40, 35) m
- height of CCTV (h) : 3 m
- slope (β) : 5^0
- tilt (α) : 4^0
- distance between line stopping with projection node of CCTV : 2 m
- distance between stopping line (L_s) : 40 m

The folowwing is coordinate of object :

(X1,Y1) : 162,59

(X2,Y2) : 175,59

(X_{CCTV},Y_{CCTV}) : 169,0

The calculation of distance :

Yp = 252 – 193 = 59 pixel

Yr = $0.154155*59^{4.3}/10^5$

= 65 Cm

By using the above formulation will be obtained the real distance and the real time, as shown table (2)

Table (2) Distance vehicles to projection node of CCTV

No	Group of motorcycle			Group of middle vehicles			Group of heavy vehicles		
	Y (pixel)	Yp (pixel)	t (det)	Y (pixel)	Yp (pixel)	t (det)	Y (pixel)	Yp (pixel)	t (det)
1	103	108	1.6	133	88	0.8	96	125	3.3
2	101	110	1.8	130	91	0.9	93	128	3.8
3	99	112	1.9	126	95	1	89	132	4.2
4	97	114	2.1	123	98	1.1	87	134	4.6
5	94	117	2.2	120	101	1.3	84	137	4.9
6	92	119	2.4	117	104	1.5	81	140	5.4
7	89	122	2.6	114	107	1.7	79	142	5.8
8	85	126	2.8	112	109	1.9	77	144	6

From table (2) can be calculated the prediction of average speed and lost time, as shown table (3)

Table (3) Average speed of vehicles and time of amber lamp

No	Group of motorcycle			Group of middle vehicles			Group of heavy vehicles			Vrata (m/det)	Trata det
	Yr (m)	v (m/det)	t (det)	Yr (m)	v (m/det)	t (det)	Yr (m)	v (m/det)	t (det)		
1	8.544	10.68	3.745	3.542	8.855	4.52	16.02	9.709	4.12	9.748	4.127
2	9.246	10.273	3.894	4.091	9.091	4.4	17.74	9.337	4.284	9.567	4.193
3	9.991	10.517	3.803	4.922	9.844	4.06	20.25	9.643	4.148	10.001	4.005
4	10.781	10.268	3.896	5.626	10.229	3.91	21.6	9.393	4.258	9.963	4.021
5	12.055	10.959	3.65	6.405	9.854	4.06	23.76	9.698	4.125	11.17	2.945
6	12.966	10.805	3.702	7.264	9.685	4.13	26.08	9.659	4.141	11.05	2.991
7	14.431	11.101	3.603	8.209	9.658	4.14	27.72	9.559	4.185	11.106	2.977
8	16.579	11.842	3.378	8.89	9.358	4.27	29.44	9.813	4.076	11.338	2.909

by:

Yr : The actual distance in meter
v : the actual speed in m/sec
t : travel time ofthe vehicle when thecaptureI andII
v_{rata}: average speed of vehicles
t_{rata}: Lost time

4. CONCLUSION

The amber lamp has dual function the first as a sign for drivers as preparing to move when they are stopping because the red lamp turn on, and second as protection so that no vehicles which crash. In order to amber lamp turn on appropriate with condition, so required calculation of actual distance, average speed of vehicles, The result of this research show that the formulation of pixel conversion into meter have good function, and variety time of amber lamp is suitable with average vehicle.

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