OBSTACLE DETECTION SYSTEM

FOR RAILWAYS

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(09/8718)

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

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DECLARATION BY THE CANDIDATE

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ABSTRACT

Trains are one of the oldest transportation systems used in the world. The first steam locomotive was built by Richard Trevithick and first commercial use was on the narrow gauge Middleton Railway in Leeds in 1812. There onwards with the development of railway transportation, locomotives improved in design from steam, diesel powered, electric and to hybrid during two centuries. With the development, more economical high speed locomotives have been introduced to the world.

Every transportation system consists of advantages and disadvantages to the public. The accidents are the most disadvantageous gain from the transportation systems. The railway transportation is one of the conventional system subjects to many accidents annually in most of the countries. High speed locomotives, insecure railway crossing, impatience vehicle drivers and animals are some factors to increase the railway accidents time to time. Comparatively to other transportation systems, accident preventive methods of locomotives are not in best use due to following reasons;

1. Noticing an obstacle on the railway at the correct time.
2. Identifying the braking distance for sufficient braking.
3. Limitation of braking due to derailing of locomotives from the railway.
4. Braking methods used are conventional types due to its complexity.

Therefore, there is a necessity for improving accident preventive methods in locomotives and image based obstacle detection system with driver assisting capabilities is proposed in this research. The objectives of this research are;

1. Design and development of a driver assisting interface with sensing mechanism to detect an obstacle and obtaining minimum distance to stop the locomotive.
2. Development of the overall system and validation.

The prototype comprises with two web cams, personal computer, arduino (UNO) hardware, and a servo motor.

One web camera (side camera) will be mounted to the side window of the locomotive cabin to capture images perpendicular to locomotive motion and the other camera (front camera) will be mounted on the front of the engine focusing the railway and will change its yaw angle by the servo motor connected through controller (arduino (UNO)) hardware to the personal computer.

Further, the front camera detects obstacles using a MATLAB program installed in the personal computer. The detection will be declared by beeping of an audible alarm where driver will be acknowledged the danger of hitting the obstacle instantly and by braking manually, the deceleration can be measured by another MATLAB program by processing the images taken by side camera and yaw of the front camera will be adjusted automatically. Increasing the braking gradually to move the obstacle from the danger zone to the safe zone shown in the front camera images and muting the audible alarm automatically, the locomotive can be stopped without hitting the obstacle.

The system was tested to a normal vehicle and to certain extent of trains since the limitations in testing the system in locomotives in Sri Lanka Railways and found to be satisfactory.

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
A.H.V.D	Horizontally- Vertically Different Powered
a	Acceleration (m/s^2)
B.G.	Broad Gauge
CCTV	Closed- Circuit TeleVision
COM	Communication Port
CPU	Central Processing Unit
C1	Factor to convert kmph to m/s (C1= 0.27777777777778)
E	Global Energy Functional
F	Focal Length
FOE	Focus of Expansion
GND	Ground
GPRS	General Packet Radio Service
HDTV	High Definition TeleVision
h	Hieght of the front camera center to ground level
ICSP	In- Circuit Serial Bus
I_t	Derivative of the image intensity along time
I_x	Derivative of the image intensity along x axis
I_y	Derivative of the image intensity along y axis
K	To convert radian angle to degree angle (K = 57.29577951)
LPT	Line Print Terminal

LIST OF ABBREVIATIONS

Abbreviation	Description
l	Length from Front Camera Center to considered Sleeper
N	N^{th} frame
n	n^{th} frame
P	Principle Point
PWM	Pulse With Modulation
RAM	Random Access Memory
R'G'B'	Additive color module, Red, Green & Blue
s	s^{th} distance where V=0
U	Velocity of an object at the starting of s^{th} distance
USB	Universal Serial Bus
u	Horizontal optical flow
V	Velocity of an object at s^{th} distance
v	Vertical optical flow
w	Speed of the Locomotive
YUY2	FOURCC Code for identifying a digital, color- difference component video picture format
Y'	Component of Gamma corrected R'G'B'

LIST OF APPENDICES