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Advances in Safety of Load Carrier Vehicles

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ABSTRACT: Rapid developments in the automotive sector and the spread of road network have given rise to generation of intense traffic which has become a serious issue in developing nations. Range of vehicles are sharing the road infrastructure which is designed as per basic physics laws. Load carrier vehicle is a major part of automobile sector and attained a new look in the era of internet of things. The current paper presents various modern trends being incorporated in load carrier vehicles to monitor different vehicles and environmental parameters to ensure road safety.

Authors have extended the scope of study with due consideration to latest technologies used in sensing, environmental perception and interactive driver assistance systems to avoid road accidents due to uneven/over loading of load carrier vehicles in specific. With this kind of challenging efforts, the authors aim to converge important technologies such as automotive-electronics, sensors and mobile communication towards safe operation of load carrier vehicles on road.

I.INTRODUCTION

In the recent past traffic pattern has drastically changed. The number of vehicles on the roads and highways is increased. New technologies have improved the vehicles performance. Usage of internet in all walks of life has given momentum to the transportation industry which has resultedin time bound fast activities that in turn leads to the traffic jams, more accidents and public annoyance. In case of load carrier vehicles ensuring a safety of vehicle itself, the goods inside and the external environment is a demanding task. Systems have been developed to overcome such unforeseen hazards. Due consideration has been given to exchange of information, identification, positioning, instant communication means and preventive mechanisms to avoid accident. The activities identified specific to road transport fall under the subdomains of road safety & network management, road traffic management, load carrier transport management, cross-border transport management, etc [1].

II.LITERATURE SURVEY

In India, there is wide spread rail network, covering more than 7,000 stations over a total route length of more than 65,000 km (40,000 mi) and track length of about 115,000 km (71,000 mi)[2]. The last mile reach is still fulfilled byroad transport. Even today with improved air services also the road transport is highly utilized for long distance load carrier transportation.In summary of recommendations Automotive Mission Plan 2006-2016 have mentioned of few points as –National Road safety board to act as coordinating body to promote road safety, fleet modernization to be encouraged, integration of IT in manufacturing and automotive infotronics to be promoted and continuous investment in transport media such as road, rail, port and power to be encouraged[3].

Automatic vehicle location (AVL) is the preliminary requirement of modern fleet management systems. Logistic support should essentially have accuracy, celerity, efficient and personalization. Accuracy and celerity play a vital role in ensuring the survival and growth of the enterprises[4]. It further emphasizes improvement in the efficiency of the logistics delivery and enhancement in core competence. In addition to location details and instant communication, vehicle safety is vital. Safety monitoring of load carriercan be at vehicle level, or at monitoring center or at times by transport authority. Separatemonitoring infrastructures are the recent trends.For entire monitoring and tracking of vehicle, an inbuilt system uses various battery-powered sensors such as, pressure, temperature, humidity, gas concentration, ionizing radiation levels, etc. These sensors communicate through ZigBee-based Wireless Sensor network[5]. Load/ goods distribution varies from vehicle to vehicle. The acoustical properties of an intermodal container change with respect to load distribution and doors being opened and closed. Thus the ability to monitor the condition of an intermodal container for security purposes has been demonstrated[6]. Numerous methods have been

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experimented to detect hazardous material in the load carrier truck. Suitable safety measures to mitigate the disaster are also mentioned [7,8,9].

Design of dynamic load carrier transportation model comprising of the activities and procedures that present the load carrier carriage from the sender to the receiving point is discussed[10].Further the vehicle parameters such as length, width, load distribution are also of concern for deciding the safety of the vehicle. Take an example of vehicle rollover which can be caused by many factors, such as the turning speed is very high, the turning radius available is too small, the lateral impact of other vehicles, impact of curbs and so on. In aconstrained load carrier vehicle these parameters are of prime importance [11]. Over weight and over size load carriers put challenges for the transport industries as regards the road infrastructure [12]. Similar work onmonitoring of vehicle load can avoid extra burden on vehicle platform and can also get out of accidents which a overloaded vehicle attracts[13].

III.SCOPE & SYSTEM DESIGN

Detailed study of the developments sited above has shown higher level of safety for the vehicle which isa basic parameter of traffic module. The present work is a study/dissertation work carried out at college department.The system carries out online monitoring of distributed load in load carrier truck along with other vehicle parameters and the road gradients. The information is available to the driver as well as to the load carrier monitoring center. The system will restrict carrying unauthorized loads and overloading the load carrier vehicle. It will also facilitate the driver with advanced warning signals in case the vehicle loses stability.

System architecture broadlyconsists of mobile vehicle terminal (MVT) and vehicle monitoring center(VMC). The VMC is the core module of the system at the load carrier monitoring centre. VMC receives periodic data and the extremities in parameters metduring the travel. Various parameters monitored are load conditions of the load carrier vehicle along with the vehicle speed, vehicle acceleration, deceleration, gradient /slope being negotiated(i.e. road angle)vehicle tilt, steering angle, vehicle location, etc. The system will give on line on-board feedback to the driver about these parameters in a MVT. The system generates advanced warning signalsfor the driver in case of emergency when threshold limits are exceeded. Modularity in design is a major aspect considered which will assist the specialized configurations of existing and emerging modules and interfaces in subject system as well as the vehicle electronic control units(ECU) in latest automobiles.

System architecture is depicted in figure 1. MVT and VMC communicate through wireless link. In present study GSM is used.

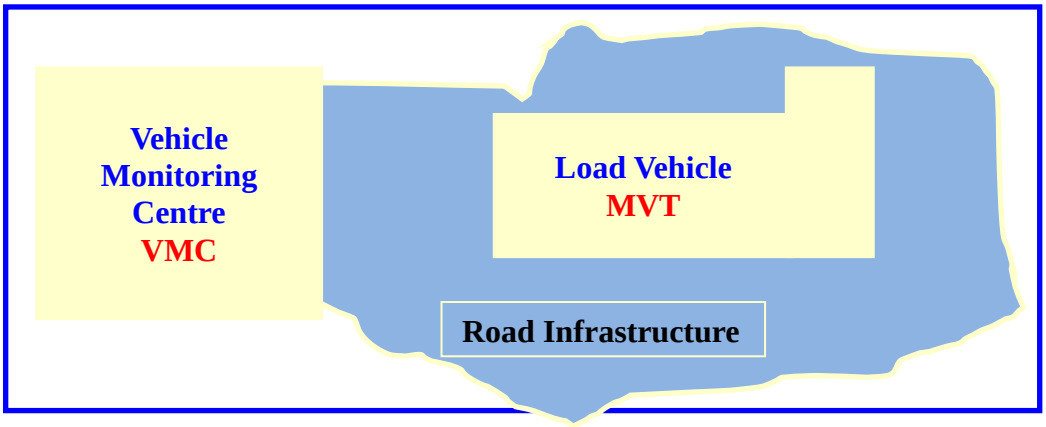

Figure 1: System Architecture

In the present study, the vehicle chassis is a robotic vehicle with four wheels which are coupled to four motors. For simplicity of the project the system processor will only monitor and control the operation of the robotic chassis. The block schematic of the Mobile Vehicle Terminal Monitoring System is shown in figure 2. The system consists of sensors, signal conditioning & data acquisition, GSM modem, GPS, display unit, processor, motors, motion controller, etc.

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i) Various sensors used are load cells mounted beneath the chassis near the four wheels, accelerometer mounted at the centerof chassis for gradient and side slope angles, vehicle speed sensor, GPS, etc.
ii) Suitable signal conditioning is used for all above sensors.
iii) High performance ARM 9 is selected for processing unit considering the actual need of vehicle control and ease of integration with various ECMs.
iv) GSM module, GPS and driver's display are connected through USB
v) Control keys give command to controller for forward, reverse motion of chassis, speed control of motors
vi) DC motors are controlled through PWM motor controller.
vii) Chassis so designed can carry max weight say @10 kg

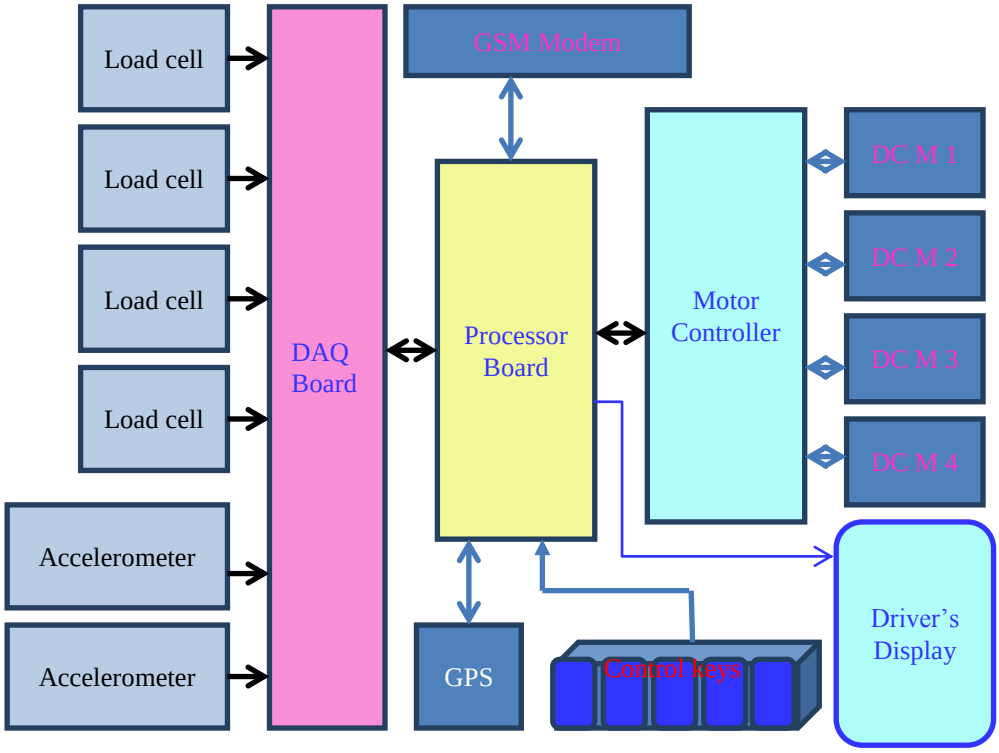

Figure 2: Block schematic of Mobile Vehicle Terminal Monitoring System

Development work carried out in the study is put forward as figure 3&4 are the photographs of chassis and the system circuit board and figure 5 shows the design of processor ARM9 board along with DAQ and the motor control circuits.

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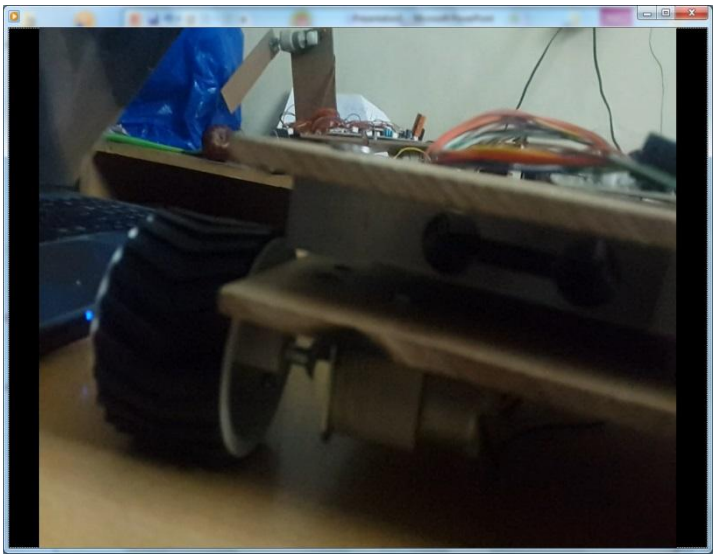

Figure 3: Photograph of Vehicle Chassis

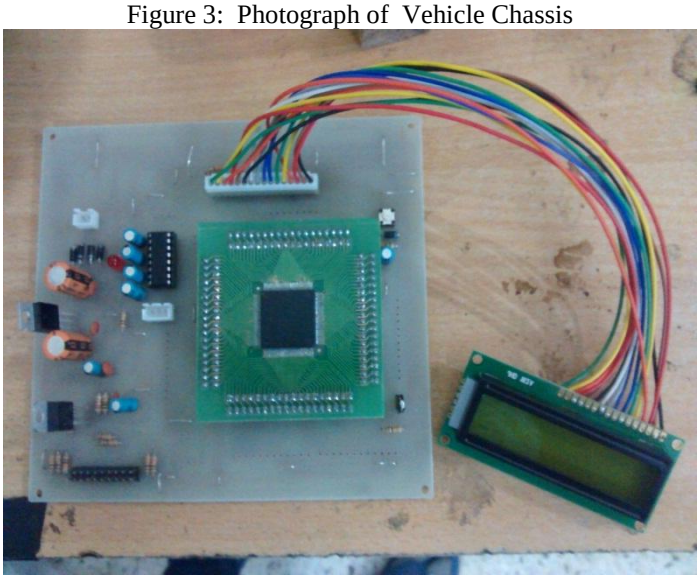

Figure 4: Photograph of Circuit Board

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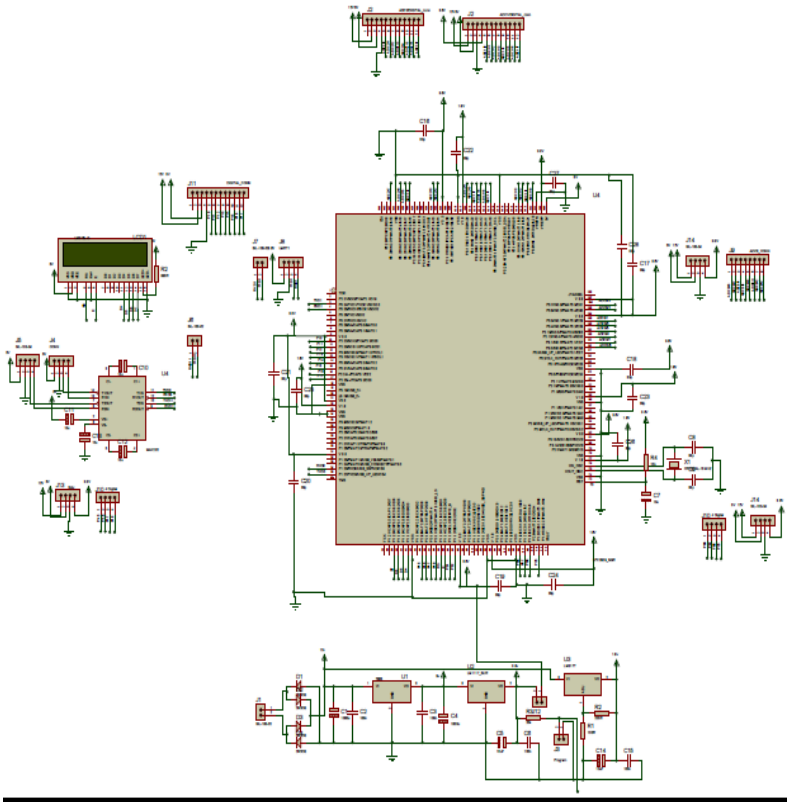

Figure 5: Design of Processor Board ARM9

IV.RESULT

The chassis is put to varying loading conditions. System monitors and displays the load on individual load cells i.e. on all four wheels. Threshold limits are set for overload and suitable message is communicated to the driver and the load carrierVMC. Periodic communication of vehicle location, loads, speed is communicated to both MVT and VMC. Figure 6 – depicts various test results on two line LED display.

The result communicated to VMC can be assessed on cell phone mobile SMS. Figure 7 shows the photograph of system output on mobile PC which can be configured as Driver's Display and figure 8 depicts SMS on cell phone. It is an integrated display consisting of load distribution, vehicle tilt, threshold warnings, location & google map.

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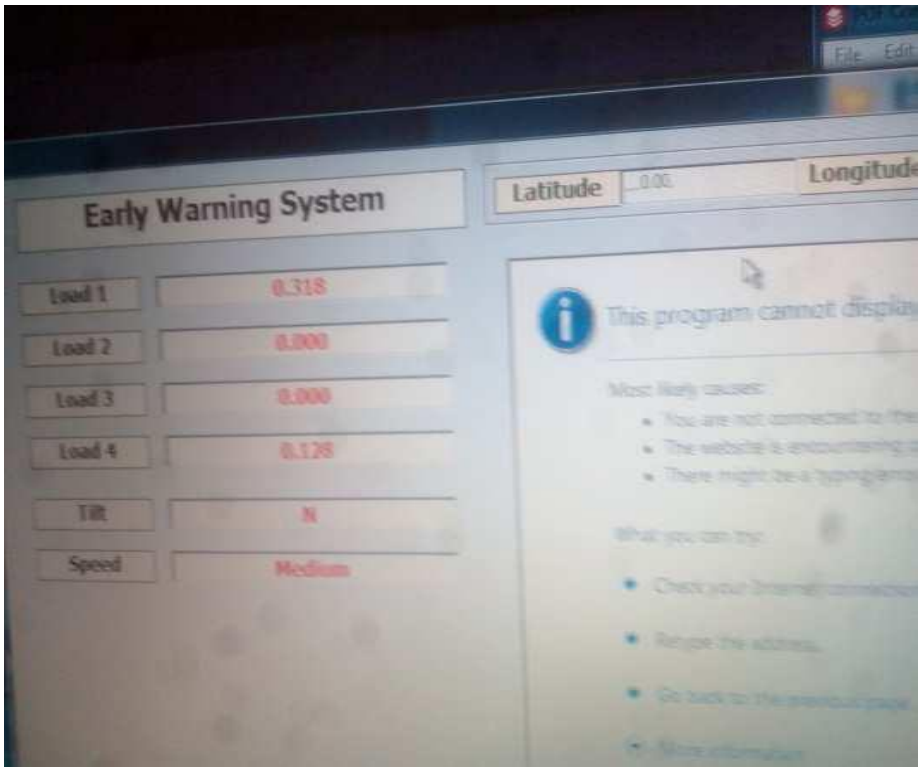

Figure 7: System Output on Mobile PC 'Driver's Display'

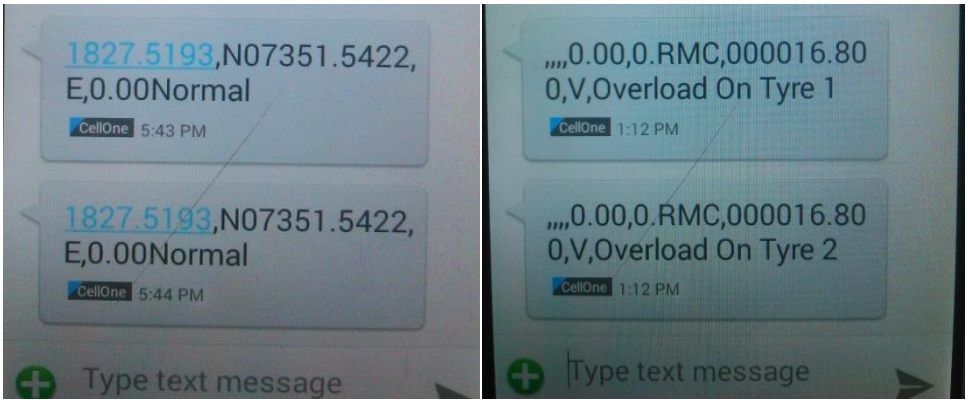

Figure 8: SMS on Cell Phone

V.CONCLUSION

In this paper we have demonstrated a complete system for tracking and monitoring a load carrier vehicle from theVMC. The use of various wireless technologies aids to develop a reliable system. Timely information to driver assists the driver during negotiating a road. Warning signal about overloading, vehicle speed, tilt and side slope alerts the driver in advance which in turn will avoid the accidents.VMC is also updated from time to time which ensures the safety and improves reliability of transportation services.

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