Novateur Publication's
International Journal of Innovation in Engineering, Research and Technology [IJIERT]
ICITDCEME'15 Conference Proceedings
ISSN No - 2394-3696

PROGRESSIVE TRENDS IN ROAD SAFETY OF CARGO VEHICLES

Madhuri Deshmukh
Dept of E & TCVACOE, SarolaBaddi Ahmednagar, India
madhuri_trikande@rediffmail.com
Prof S G Joshi
Dept of E & TC VACOE, Sarola Baddi Ahmednagar, India
sareeka.anr07@gmail.com

ABSTRACT
Ever increasing number of vehicles on road imposes a due concern about road safety on the automobile manufacturers and the users as well. Cargo 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 Cargo vehicles to monitor different vehicles and environmental parameters to ensure road safety.
Authors have extended the scope of study with due consideration to R&D efforts in advanced sensing, environmental perception and interactive driver assistance systems to avoid road accidents due to uneven/over loading of cargo 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 cargo vehicles while negotiating the road.

INTRODUCTION

In the recent past there is a vast increase in the number of vehicles on the roads and highways. The new vehicles come with advanced systems which augment the performance of the vehicle. The era of internet of things has put forward more pressure on the vehicle drivers as all the movements are very crucial and time bound. This results in more accidents that in turn lead to the traffic jams and public inconvenience. Especially in case of cargo vehicles ensuring a safety of vehicle itself, the goods inside and the external environment is a challenging task. Efforts have been taken 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 sub domains of road network management, road safety management, road traffic management, cargo transport management, cross-border transport management, etc [1].

LITERATURE SURVEY

In India, though the rail network traverses through the length and breadth of the country, 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 limitations of rail transport such as time, requirement of road services assistance to reach the last mile; has forced the community to avail the road transport for long distance too. Even today with improved air services also the road transport is highly utilized for long distance cargo 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, 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. Apart from the location details and instant communication, the safety of the cargo is also important. Monitoring of cargo either by a carrier vehicle or a monitoring centre or at times by transport authority by means of special infrastructure are the recent trends in cargo transportation. Load/ goods distribution varies from vehicle to vehicle. The acoustical properties of an intermodal container change with respect to load distribution and doors being open and closed. Thus the ability to monitor the condition of an intermodal container for security purposes has been demonstrated [5]. Research work for entire monitoring and tracking solution for vehicle fleets has been carried out. This aids to check at the same time the

position and the mechanical status of the vehicle, as well as the conditions in the cargo bay. The system exploits battery-powered environmental sensors such as temperature, humidity, pressure, gas concentration, ionizing radiation levels, etc. These sensors communicate through Zig Bee-based Wireless Sensor network [6].Different methods have been experimented to detect hazardous material in the cargo truck. Suitable safety measures to mitigate the disaster are also mentioned [7, 8, 9].

Design of dynamic cargo transportation model comprising of the activities and procedures that present the cargo carriage from the sender to the receiving point is discussed[10].Further the vehicle parameters, design of vehicle, loading parameters are also of concern for deciding the safety of the vehicle. Take a 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, the impact of curbs and so on. In a cargo constrained vehicle these parameters are of prime importance [11]. Over weight and over size cargos put challenges for the transport industries as regards the road infrastructure [12]. Similar work of online monitoring of vehicle load can reduce the destruction of the vehicle and can also avoid a series of accidents which the overloading and lopsided load of truck can give birth to [13].

SCOPE & SYSTEM DESIGN

In depth study of the developments sited above anticipate higher level of safety for the basic parameter of traffic module i.e a vehicle. The present work is a dissertation work, in which at present no vehicle manufacturing/ testing agency is involved. Online monitoring of distributed load in cargo truck along with other vehicle parameters and the road gradients are monitored. The information is available to the driver as well as to the cargo monitoring center. The system will restrict carrying unauthorized loads and overloading the cargo vehicle. It will also facilitate the driver with early warning signals in case the vehicle stability is in danger.

Overall architecture of the system mainly consists of mobile terminal (MT) and monitoring center(MC). The monitoring center is the core module of the system at the cargo monitoring centre. It can be designed to communicate either periodic data or the extremities encountered during the travel. Various parameters monitored are load conditions of the cargo 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 mobile terminal. The system generates warning signal to 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 ECUs.

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

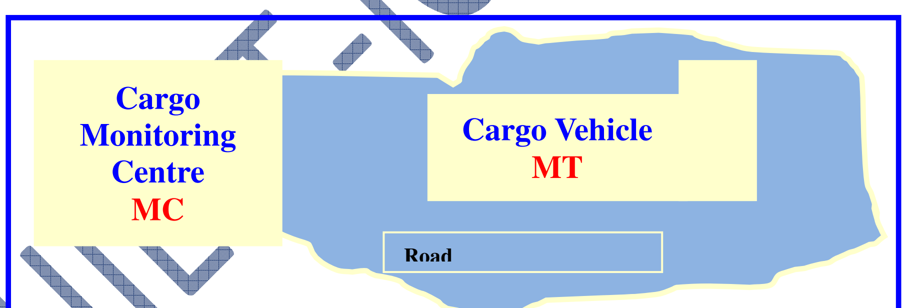

Figure 1: System Architecture

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 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.

i) Various sensors used are load cells mounted beneath the chassis near the four wheels; accelerometer mounted at the center of chassis for gradient and side slope angles, vehicle speed sensor, GPS, etc.
ii) Suitable signal conditioning is used for all above sensors.

ISSN No - 2394-3696

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

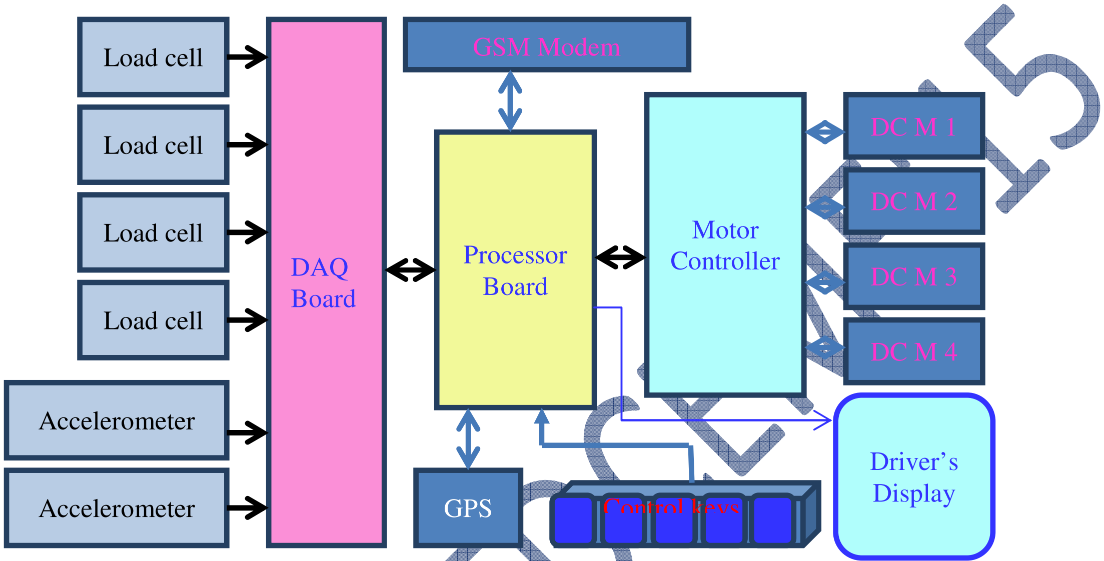

Figure 2: Block schematic of Mobile Terminal Monitoring System

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.

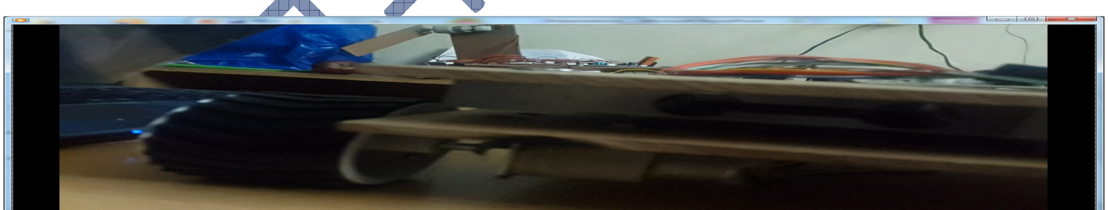

Figure 3: Photograph of Vehicle Chassis

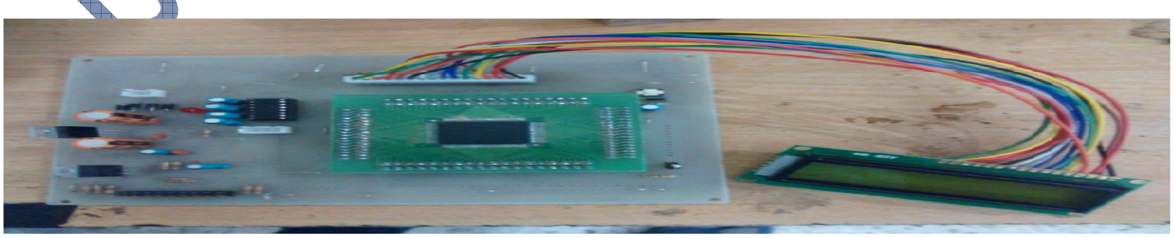

Figure 4: Photograph of Circuit Board

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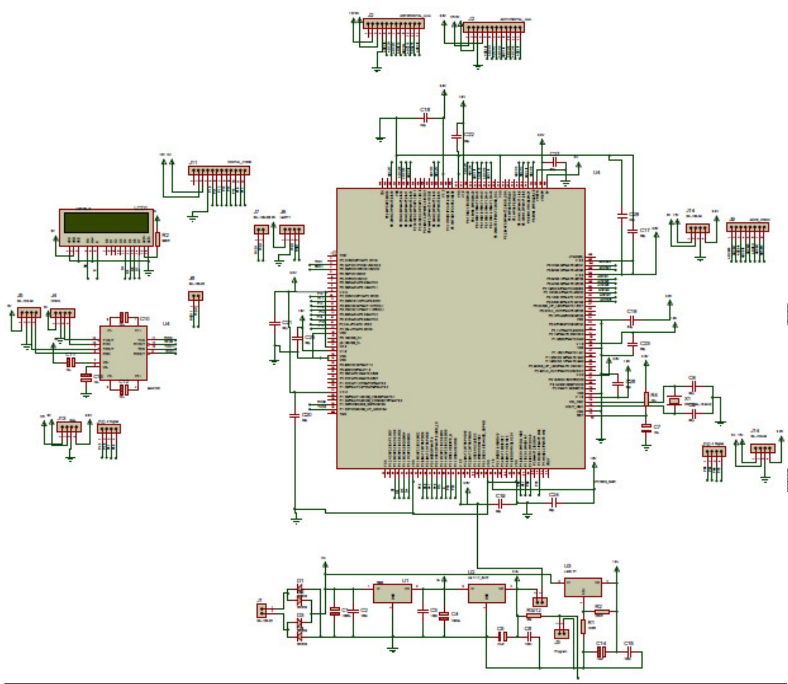

Figure 5: Design of Processor Board ARM9

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 cargo MC. Periodic communication of vehicle location, loads, speed is communicated to both MT and MC. Figure 6 – depicts various test results on two line LED display.

Figure 6: Test Results

The result communicated to MC can be assessed on cell phone mobile SMS. Figure 7 shows the photograph of system output on mobile PC and figure 8 depicts sms on cell phone. It is an integrated display consisting of load distribution, vehicle tilt, threshold warnings, location and Google map.

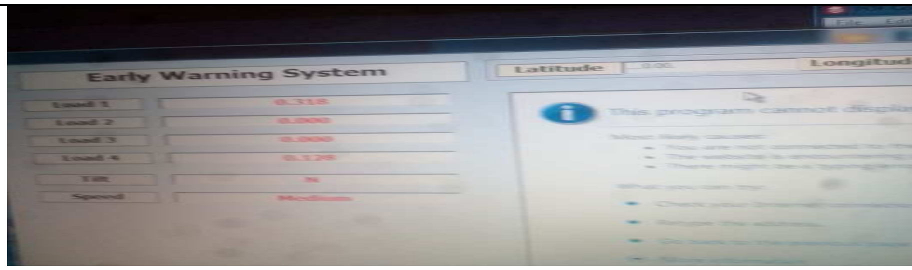

Figure 7: System Output on Mobile PC

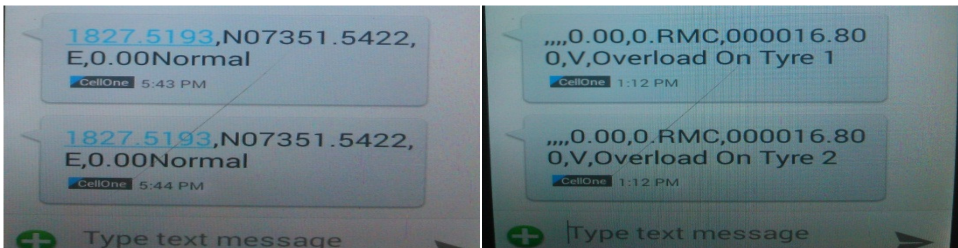

Figure 8: SMS on Cell Phone

CONCLUSION

In this paper we have demonstrated a complete system for tracking and monitoring a cargo vehicle from a cargo monitoring centre. 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 .Cargo monitoring centre is also updated from time to time which ensures the safety and improves reliability of transportation services.

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