Railway disaster prevention system using gis and gps essay sample

Railway industry has a valuable role in economic development of each country . India's massive rail network is hit by an average of 300 accidents a year. Accident management in railway decision making has to consider the following two issues to avoid or mitigate the damages: (i) accident prevention and development of an alarming system to predict and alarm before the occurrence of accidents. (ii) reduction of negative effects of accidents after its occurrence through proper emergency and management services. To achieve the above-mentioned objectives, necessary steps have been taken to simulate train movement, accidents and rail accident management system. The major problems in the simulation include, (i)the lack of appropriate information, (ii)the problem of making real accident scene environment due to human and cost issues and (iii) problems in performing a comprehensive test on the system.

CURRENT TRAIN ACCIDENT SENARIO IN INDIA : 150 years after it first chugged on course of a glorious ongoing journey, Indian Railways bears a rather dual distinction today. It is the second largest rail network under one management but with a record number of accidents. From a ' Puffing Dragon' to ' Electrical Giant on rail' and then a lifeline to the country, Indian Railways has come a long way but its infrastructure and the system has not. It has been killing people regularly, thanks to antiquated infrastructure, ill maintenance, and worst of all — HUMAN ERROR, blamed for two-thirds of about an estimated 400 " consequential" rail accidents that take place in a year. Last year accounted for 460 accidents. Twenty-five of them were collisions. No wonder, the slow modernisation of Indian Railways has made foreign media often dubs it as a rolling railway museum attracting nostalgic

train buffs from all over the world, says MK Mishra, former member of Indian railway board. © GIS Development

Map World Forum

Hyderabad, India

But the Secretary Railway Board R K Singh differs. " The Accident Collision Device and Railways Vision 2050 projects besides a host of new safety provisions will soon give enough answers to the sceptics," he said. A Railway Ministry survey has found alcoholism among field staff to be a major cause of human error leading to mishaps, and suggested breathalyser tests and random checks for the staff among other measures, says CM Khosla, another ex-member of the Board. Statistics show that 76 per cent of the accidents take place because of derailments following human error, track problems or adverse weather conditions. Collisions lead to about eight per cent of the mishaps. In 1968 the Railway Board in response to the Railway Accidents Inquiry Committee set a target of 0. 36 as the number of collisions per MTK. But the figure remains for the books. Railway Ministry, after all, has now woken up to the urgent need to stem the rot in the 66, 800-miles long network that transports over 13 million people and tons of goods each day through over 13, 000 trains across India. The Railway Budget 2002-2003 has made special provisions for safety of the passengers.

It has planned Rs 17, 000 crore Special Railway Safety Fund (SRSF) to replace age-old assets in next six years. Under the move, about 17, 000 km of track will be renewed, over 3, 000 bridges rebuilt and signal gears will be replaced at about 1000 stations. There are over 120, 000 steel bridges, a lot

of which are ageing and accident-prone. The ever-surging traffic makes the railways all the more vulnerable to accidents. The Railway Minister Nitish Kumar has further announced introduction of 25 new trains and 16 inter-city train services to be called as Jan Shatabdi Express. The red tape has added to problem. Railway safety recommendations are seldom implemented fully, if at all. Statutory probe by Commissioner of Railway Safety is ordered after almost every mishap but action is usually taken against low-level officials, most of them scapegoats. Sometimes, bizarre theories are expounded for the accidents. When the Trivandrumbound Island Express from Bangalore plunged into Quilon river in 1989, killing 107 people, the probe concluded that the accident was due to a ' freak typhoon' that hit in the split-seconds when the train crossed the river bridge.

Hyderabad, India

Experts say that though most of the rail accidents in India were avoidable, the mishaps will inevitably occur in such a mammoth and old system, built by the Britishers during the Raj. Intelligent investment in technology and equipment is the key to safe rail travel, they say

INTRODUCTION TO GIS & GPS SYSTEM :

A number of locating and positioning sciences and technologies have been employed to efficiently handle railway accidents. Among them geospatial information system (GIS) as a locating and global positioning system (GPS) as a positioning system have been highly considered as highly efficient.

" A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps." ESRI Components of GIS Hardware : Hardware comprises the equipment needed to support the many activities of GIS ranging from data collection to data analysis. eg. web-enabled GIS, web servers, digitizer, GPS data logger to collect data in the field. Software : software is essential for creating, editing and analyzing spatial and attribute data, therefore these packages contain a myriad of GIS functions inherent to them. eg. ArcView, ArcInfo , Erdas, ILWIS, Geomatica, etc. Data : Data is the core of any GIS. There are two primary types of data that are used in GIS. A geodatabase is a database that is in some way referenced to locations on the earth. Geodatabases are grouped into two different types: vector and raster. Coupled with this data is usually data known as attribute data. Documentation of GIS datasets is known as metadata.

People : Well-trained people knowledgeable in spatial analysis and skilled in using GIS software are essential to the GIS process.

GIS is the science and technology of spatial and attribute information integration and can be efficiently used to monitor and manage railway accidents .

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U. S. Department of Defense. GPS was originally intended for military applications,

but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS.

How it works GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more.

The GPS satellite system The 24 satellites that make up the GPS space segment are orbiting the earth about 12, 000 miles above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are travelling at speeds of roughly 7, 000 miles an hour. Here are some other interesting facts about the GPS satellites (also called NAVSTAR, the official U. S. Department of Defense name for GPS): © GIS Development

The first GPS satellite was launched in 1978. A full constellation of 24 satellites was achieved in 1994. Each satellite is built to last about 10 years. Replacements are constantly being built and launched into orbit. A GPS satellite weighs approximately 2, 000 pounds and is about 17 feet across with the solar panels extended. Transmitter power is only 50 watts or less.

What's the signal? GPS satellites transmit two low power radio signals, designated L1 and L2. Civilian GPS uses the L1 frequency of 1575. 42 MHz in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains. A GPS signal contains three different bits of information — a pseudorandom code, ephemeris data and almanac data. The pseudorandom code is simply an I. D. code that identifies which satellite is transmitting information. You can view this number on your Garmin GPS unit's satellite page, as it identifies which satellites it's receiving. Ephemeris data tells the GPS receiver where each GPS satellite should be at any time throughout the day. Each satellite transmits ephemeris data showing the orbital information for that satellite and for every other satellite in the system. Almanac data, which is constantly transmitted by each satellite, contains important information about the status of the satellite (healthy or unhealthy), current date and time. This part of the signal is essential for determining a position. Sources of GPS signal errors : Factors that can degrade the GPS signal and thus affect accuracy include the following:

Ionosphere and troposphere delays — The satellite signal slows as it passes through the atmosphere. The GPS system uses a built-in model that calculates an average amount of delay to partially correct for this type of

error. Signal multipath — This occurs when the GPS signal is reflected off objects such as tall buildings or large rock surfaces before it reaches the receiver. This increases the travel time of the signal, thereby causing errors. Orbital errors — Also known as ephemeris errors, these are inaccuracies of the satellite's reported location. Number of satellites visible — The more satellites a GPS receiver can " see," the better the accuracy. Buildings, terrain, electronic interference, or sometimes even dense foliage can block signal reception, causing position errors or possibly no position reading at all. GPS units typically will not work indoors, underwater or underground. Satellite geometry/shading — This refers to the relative position of the satellites at any given time. Ideal satellite geometry exists when the satellites are located at wide angles relative to each other. Poor geometry results when the satellites are located in a line or in a tight grouping

EXISTING TECHONOLGY IN INDIA : The existing conventional signaling system most of the times relay on the oral communication through telephonic and telegraphic conversations as input for the decision making in track allocation for trains. There is large scope for miscommunication of the information or communication gap due to the higher human interference in the system. This miscommunication may lead to wrong allocation of the track for trains, which ultimately leads to the train collision. The statistics in the developing countries showing that 80% of worst collisions occurred so far is due to either human error or incorrect decision making through miscommunication in signaling and its implementation.

The real time viewing of actual current positions of the trains at various locations is possible with the continuous tracking of rail traffic with the

Geographic Positional System equipment installed in the trains. The latest developments in the GPS technology will give the positional accuracy of nearly 2m. Practically speaking these accuracy levels may not suffice to locate the train on exact particular track on which the train is actually traveling. But the real time dynamic location information provided by GPS equipment can be utilized as the input for the signaling system to aid as the refinement tool for decision making in allotment of the track for trains. The scope for the human error can be eliminated by effective utilization of integrated system as a cross check measure against the decision of signal and also can be continuously monitor the system even after implementing the decision with reference to the dynamic viewing of the real time movement of the trains on the track.

The proposed system contains two major components of Geographic Information system. The static data contains detailed mapping of the rail net work as a spatial database in GIS platform. The Dynamic data regarding the movement of rail traffic collected through the GPS equipment installed in train, signaling cabin and station supervisor's cabin. The GIS enabled " Rail tracing system" takes the input signals from the near by GPS installed in trains and continuously displays the positions of the trains in the vicinity of the interested area to enable the decision makers of signaling to view the realistic situation. The real time data can be obtained by using internet services and centralized through which all the station are linked. Control Room

Railway Traffic Monitoring using GIS and GPS.

This dynamic viewing of realistic position of the trains avoids dependency of the signaling crew only on the oral communication. Thus the human error in communication can be minimized. For further enhancement of the system the signaling decisions taken by the crew can be crosschecked with the continuous monitoring of real time data available with in the system by any superior prior to implement the decision. This can be done by digitizing the tracks which will help us in locating the real time position of the train, using Arc View Gis software.

ROLE OF GIS IN RESCUE MANAGEMENT:

Locating the site of accident becomes very simpler as inputting the approximate Latitude and Longitude can do it, or the site can be searched by the names of the locations nearby.

The accessibility can be analyzed more realistically with aid of the road net work maps in the vicinity of site of accident. Finding out the required resources becomes simpler, speedy and accurate as the data base contains the information about almost all the resources available like Police, Administration, revenue authorities, medical facilities with details about the number of beds, specialization etc, fire fighting facilities with available infrastructure, and other resources like voluntary organizations and special police forces etc. Finding out optimum routes between different resource locations to accident site. The system also helpful in topographic and demographic analysis to improve the effectiveness in the planning and implementation activities. The system also provides buffer analysis to facilitate effective planning and utilization of the available resources in the

required buffer zones of the affected areas. The system also provides very easy means to add and update the records of the database so that the regular updating can be simpler task.

The system provides continuous monitoring on rescue activities and facilitates dynamic planning of strategies to meet the changing requirements of the rescue activities with respect to the impedance of the implementation of planned strategies.

COST EFFECTIVE : Any technology in the world if it is not cost effective, it has got no relevance. So this technology can be cost if implemented properly. Although this technology have high installation cost initially but : • • • Will reduce the manpower required. Will definitely reduce train accident. And one train accident leads to loss of cores of rupees , which can be saved and be used by government for modernization of railways. Late running of trains can be prevented to large extend. © GIS Development

CONCLUSION : Railway has long been considered as the safest transportation media. Recognizing the need to improve the efficiency of the transportation systems. it is necessary to investigate the accidents and find out speed, cargo tonnage, It is necessary to investigate the accidents and find out the essential methodologies for optimum management of information and resources available in railway rescue operations. The statistics show a huge number of accidents are due to human errors. Therefore, having a systematic way for railway operation management and reduction of human intervention or controlling activities and performances could play a significant role in reducing the number and impact of accidents. Reliable,

accurate, precise, up-to-date and structured geospatial data is the key for decision making. Integration of GIS as a system for optimum acquisition and management of geospatial data and GPS as a reliable means of positioning and navigation could pave the way for an intelligent decision making in railway organizations to prevent or mitigate huge amount of human and economic losses. The developed system has proved to be successful in a number of issues like determination of the best path to get to the accident location and perform emergency services. The system could be installed on a PC or laptop with minimum 64 Mbyte RAM with an AutoCad system which is used as a graphical media. The system has been implemented in a real traffic environment with the ability to answer a number of spatial, non spatial and integrated queries.

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