

Railway Level Crossing Gate Control & Measurement System for Railway Track Condition Monitoring

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ABSTRACT: At present people go for various modes of transportation such as by buses, flights, car, train etc. Out of this majority depend on railway, people opt this because they always seek for the service with more comfort with cheaper rates. As demand for travel by trains raises, railway sector has adopted a lot of safety standards in order to ensure life's of travellers any problems in the same have the capacity to induce major damage to the economy. In spite of this safety measures followed, everyone could see a lot of accidents took happened in this sector; knowingly or unknowingly it may take away lives of many ones. The occurrences of these accidents are mainly because of defects of rails. Now railways are performing fault detection by means of manual inspection, so it will be better if go for an advanced system where Railway track damage status is monitored by using sensors and transfer related information through wireless modules. Because majority of railway accident's prime reason is fault within the track such as occurrence of crack etc. As there need to ensure safety at all related aspects, unmanned railway crossing also need to be taken to account. This problem can be solved by introducing a fully automated system controlling railway level crossing gate more effectively.

KEYWORDS: CCD, EMAT, GSM, GPS, IR, LCD, LDR, LED, NDT, SMS

I. INTRODUCTION

Earlier days railway level crossings had a flagman in a nearby booth that would, on the approach of a train, wave a red flag or lantern to stop all traffic and clear the tracks. Manual or electrical closable gates that barricaded the roadway were later introduced. The gates were intended to be a complete barrier against intrusion of any road traffic onto the railway. Thus, crossing gates, when closed to road traffic, crossed the entire width of the road. When opened to allow road users to cross the line, the gates were swung across the width of the railway, preventing any pedestrians or animals getting onto the line.

In many countries, level crossings on less important roads and railway lines are often "open" or "uncontrolled", sometimes with warning lights or bells to warn of approaching trains. Ungated crossings represent a safety concern; many accidents have occurred due to failure to notice or obey the warning. Level crossings present a significant risk of collisions between trains and road vehicles. To an extend current technologies such as sensors, GSM can be made use in order achieve a control over the railway level crossing gate more effectively which will overcome problems caused by traditional system using manpower.^[2]

Apart from that faults on rails are also a reason for railway accidents. At present railways are using manual methods of fault detection through human inspectors. Taking all this to account it will be necessary to develop a railway track condition monitoring system which is used to find the detection of breakage in the railway track.^[5] The Indian railway (IR) network today has a track length of 1, 15,000 kilometres over a route of 65,000 kilometres and 7,500 stations. It is the fourth largest railway network in the world exceeded only by those of the United States, Russia and China. In 2011, IR carried over 8,900 million passengers' annually or more than 24 million passengers daily and 2.8 million tons of freight daily. Despite boasting of such impressive statistics, the Indian rail network is still on the growth trajectory trying to fuel the economic needs of our nation. Though rail transport in India is growing at a rapid pace, the associated

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safety infrastructures are not up to international standards. To demonstrate the gravity of the problem, official statistics say that there have been 14 accidents in 2011, 15 accidents in 2012. On further analysis of the factors that cause these rail accidents, recent statistics reveal that approximately 90% are due to cracks on the rails either due to natural causes (like high expansion due to heat). So need to be focused on bringing down the accident rate by automatically detecting the cracks on the tracks. ^[1]

II. AUTOMATIC RAILWAY GATE CONTROL SYSTEM ALERT VIA SMS

Automatic railway gate control system is implemented to prevent accidents of the traction system at the railway crossing levels. Nowadays many accidents take place at the railway gate crossing due to uneven crossings, even when the gate is about to close. In general, a railway gate is normally operated by a gate keeper as he receives the information about the arrival of the train. Railway safety is the most crucial aspect of railways all over the world. This is the cheapest mode of transportation all over the world, and therefore, accidents are bound to happen due to carelessness manual operations. Therefore, an automatic railway-crossing-gate controller is used to prevent accidents at unmanned level crossings to provide much needed safety. Such efficient controllers are mostly used in remote areas that often lack the services of a station master or line man at the crossing levels. Automatic gate control system can be implemented using different technologies such as GSM, Bluetooth, and Android. Here are two automatic railway gate control methods involving Android and GSM technologies. ^[5]

(a) Railway Level-Crossing Gate Operation Remotely by an Android Device

This method is to control railway level-crossing gate through an Android application by the station master. This system uses Android application device for opening and closing the level-crossing gate, remotely. Remote operation can also be achieved by any smart phone or tablet with an Android-OS with a Graphical User Interface, based on Touch Screen Operation. This system uses a microcontroller as the heart of the project, and is programmed in such a way that any control signal from the Android phone controls the motor for operating the gate. ^[5]

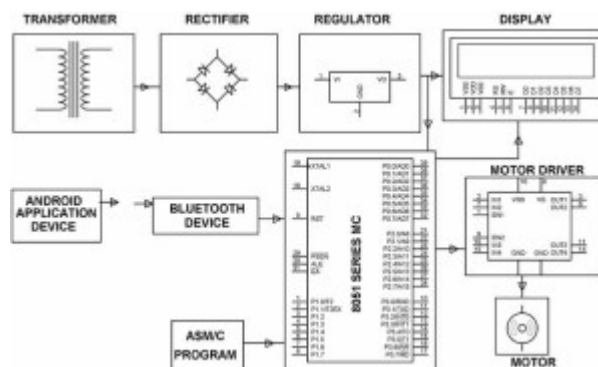


Fig. 1.1 Block Diagram for Railway Level-crossing Gate Operation

A Bluetooth device is interfaced with this system to achieve remote operation. Station master or driver of a train can send a command from the Android application, and therefore, the Bluetooth on the mobile phone sends the signals to the Bluetooth device attached to a control circuit. At the receiver side, this Bluetooth device receives these signals and sends them to the microcontroller. Therefore, based on the microcontroller's program, it sends the signals to the motor driver to operate the motor. For the operation of the motor in both the clockwise and anti-clockwise directions, a motor driver is used. This system displays the message in response to the commands given by the Android applications, such as opening and closing of the gate, in the LCD.

(b) Railway Level-Crossing Gate Control through GSM

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Similar to the above system, but it is implemented by using GSM technology. In this system, the railway level crossing gate is controlled by an SMS sent by the station master or the driver to the control area.

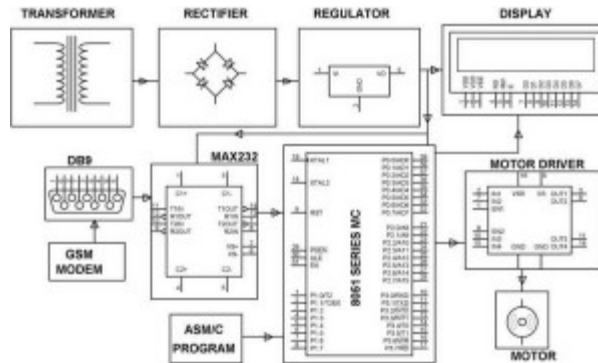


Fig. 1.2 Block Diagram for Railway Level-crossing Gate Control through GSM

The system has a GSM modem interfaced with a control system. When a driver or station master sends an SMS ‘open’ to the GSM modem it receives that SMS and sends it to the microcontroller. The microcontroller acknowledges these signals and sends the command signals to the motor driver IC, which controls the direction of the motor for opening and closing the gate. Therefore, this IC sends a clockwise signal to the motor to open the gate and the status gets displayed on the LCD. In the same way, to close the gate, another SMS needs to be sent to the microcontroller. Therefore, the motor driver drives the motor in anticlockwise direction after receiving the corresponding signals from the microcontroller.

III. MICROCONTROLLER BASED STOUT ROBOT WITH AUTOMATIC CRACK DETECTION IN RAILWAY TRACKS USING LED-LDR ASSEMBLY

Here principle involved in crack detection is the concept of LDR(Light dependent Resistor). In the proposed design, the LED will be attached to one side of the rails and the LDR to the opposite side. During normal operation, when there are no cracks, the LED light does not fall on the LDR and hence the LDR resistance is high. Subsequently, when the LED light falls on the LDR, the resistance of the LDR gets reduced and the amount of reduction will be approximately proportional to the intensity of the incident light.

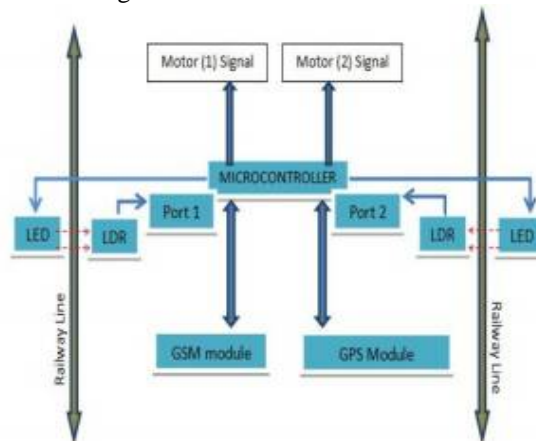


Fig. 1.3 Technical block diagram of railway crack detection [17]

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As a consequence, when light from the LED deviates from its path due to the presence of a crack or a break, a sudden decrease in the resistance value of the LDR ensues. This change in resistance indicates the presence of a crack or some other similar structural defect in the rails. In order to detect the current location of the device in case of detection of a crack, a GPS receiver whose function is to receive the current latitude and longitude data is used. To communicate the received information, a GSM modem has been utilized. The function of the GSM module being used is to send the current latitude and longitude data to the relevant authority as an SMS. The robot is driven by four DC motors. With this current system only latitudes and longitudes of the broken track will only be received so that the exact location cannot be known[18].

IV. CRACK DETECTION SYSTEM FOR RAILWAY TRACK BY USING ULTRASONIC AND PIR SENSOR

This system detect the rail road crack, measuring distance for two rail road and also measure the pursuing human in the railway track. where IR sensor are used for detect the crack in the track and ultrasound sensor measure the distance between the two track and also PIR sensor are used to detect human being pursuing in the track. If any crack are occurred in the track means longitude and latitude of the place are messaged to the nearest station and ultrasonic sensor are measure the distance between the two track if any small variance means they detect and message to the nearest station using GPS and GSM modem. when PIR sensor are detect the human being and animals on the railway track, if any one pursuing on the track means they stop the surveying work after crossing rail road they are detect the track.

The three main components used in the block is IR sensor, Ultrasonic, PIR sensor. IR sensor is used to detect the crack in railway track. Infrared (IR) transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other. When the signal is received by the receiver then it is taken as crack is detected. When the crack is detected the latitude and longitude value is send as a message to nearby station. Passive Infra-Red sensors (PIR sensors) are electronic devices which measure infrared light radiating from objects in the railway track. PIRs are often used in the construction of PIR-based motion detectors. Ultrasonic wave is used to measure the track distance. Then the LCD display is used to view the result.

V. CRACK DETECTION USING RAYLEIGH WAVE-LIKE WIDEBAND GUIDED ULTRASONIC WAVES

Ultrasonic inspection of rails is usually restricted to low speeds of around 20-30mph, which limits the viability of testing many tracks regularly. Furthermore many of the most serious defects that can develop in the rail head can be very difficult to detect using the currently available inspection equipment. One of the reasons for slow inspection speeds using conventional NDT is the need for coupling between the transducer and the track using either liquid or dry coupling materials. EMATs have been used 2,3 or suggested 4 to measure both rail tracks and wheels by other workers and the use of non-contact ultrasonic measurements are still being investigated by a number of international research groups.

In this method we discuss the use of EMATs on rail for longitudinal and transverse crack defect detection and depth gauging. Ultrasonic surface waves that are similar in behaviour to Rayleigh waves are an obvious candidate for surface breaking crack detection. If a defect lies between the Rayleigh wave generator and detector then it will to some degree block the Rayleigh wave. The amplitude of a Rayleigh wave displacement decays with depth into the sample and most of the energy associated with a particular frequency lies within a depth equal to one wavelength at that frequency. Almost all of the energy lies within a depth corresponding to two wavelengths. The different frequency components will effectively probe to different depths below the sample surface. In a measurement where we attempt to propagate a Rayleigh wave through a region containing a surface breaking crack, the crack depth can be estimated by the amount of Rayleigh wave energy or amplitude that is transmitted through or underneath that region. Closed or partially closed cracks can obviously complicate the analysis and increase the amount of Rayleigh wave energy transmitted through the crack compared to an open crack. The EMATs are held fixed relative to each other providing a constant path difference between them on a flat surface.

VI. COMPOSITE DETECTION SYSTEM

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The composite detection system consists of a laser source, whose beam is collimated by a suited optic lens into a light plane, two 512X512 -pixel CCD cameras for complete optimum observation of the track, a digital processing system per camera, and a supervision system. The laser beam focused by the cylindrical lens as a thin plane enlightens the upper part of the railway track orthogonally to the track surface. The intersection of the plane is therefore the track profile (in the laser beam plane it is a two-dimensional line) which is observed by the CCD cameras. Each digital processing system performs real-time profile filtering and extraction (in the CCD camera geometrical coordinates) by using a composite approach from images of the corresponding CCD camera. Besides, the profile is approximately lying in a linear direction, i.e., cutting the image in stripes. Only one point of the profile belongs to each stripe. This characteristic allows for parallel processing since each stripe can be analyzed independently to reach 10 ms image processing time without affecting the profile accuracy

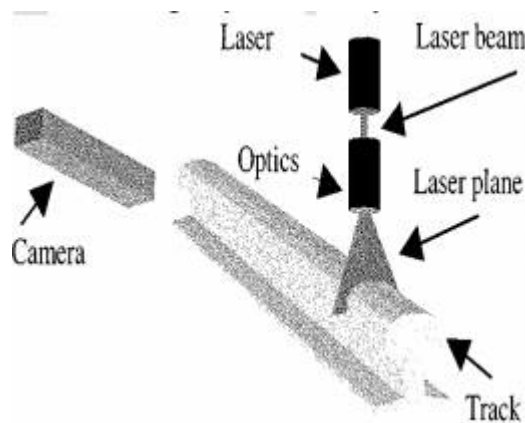


Fig. 1.4 Detection system

In each column of the image localizing the position of the track profile means to find the position of the maximum laser reflection intensity. In the ideal case the intensity distribution along the column is Gaussian. Localizing the maximum implies therefore detecting the position of the expected Gaussian profile with the maximum likelihood. To tackle this application, we tested both traditional filtering techniques with minimum-square approximation and neural network techniques. In the first case, results were quite poor due to the inability of capturing all nonlinearities and distortions. In the second case, the number of pixels to be processed in each column and the variety of the possible maximum light profile positions led to large inaccurate networks that are also difficult to train.

It is worth noting that highly approximate localization of the area of interest in each image is quite trivial for the human observer, even without experience. Track profile localization does not need to take into account all details in the whole column, but only the area around the maximum lighting. Experiments have shown that no information out of a 40-pixel strip centered approximately on the maximum lighting is necessary for accurate reconstruction of the track profile. Besides, this area of interest corresponds approximately to the zone around the highest-intensity Gaussian profile in the column. Such area can be easily found by identifying the maximum correlation of the light profile with the Gaussian reference: correlation can be effectively used. Finer localization of the maximum must deal with all nonlinearities presented above, which are difficult to be captured algorithmically while they are easily described by examples. In the literature, neural networks were proved effective for this kind of task. The Disadvantages of existing system are noise in input images, cost is high, and output is not accurate.

VII. CONCLUSION

From the above information of this system up to now, surely comes to know that it is highly reliable effective and economical at dense traffic area, sub urban area and the route where frequency of trains is more. As it saves some

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auxiliary structure as well as the expenditure on attendant it is more economical than traditional railway crossing gate system. We know that though it is very beneficial but it is also impossible to install such system at each and every place, but it gives certainly a considerable benefit to us, thereby to our nation.

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