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Implementation of Railway Track Crack Detection and Protection

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Abstract: ***In this world people uses various types of transportation system to travel from one place to another place. Mostly they give importance to public transportation for safer journey. At the same time the transport departments check out the safety measures implemented in them. The proposed system is suitable for railways transportation to identify the cracks in the railway tracks earlier and prevent the accidents. In this paper to use crack detection sensor, this will be placed in the train engine. By this, if some crack is detected on the track the train starts to slow and stop at respective point automatically and exact place of crack would be given to control room. Secondly the next cause of accidents is prevented from two trains opposite in same track by using the same sensors fitted in the engine, if the sensor senses the same signal from opposite train then it automatically applies the brake and stops the train at certain distance. The derailment causes several loses in railway accidents. The proposed system introduces Bluetooth based technology, to prevent the trains accident. The Bluetooth device is installed at each front end of the locomotive. If the train starts to derail, automatically signal is breaked and an alert is given to engine driver and on the other emergency brake is applied automatically. The main aim of the work is to avoid the train accidents without manual power***.

Keywords: Magnetic Particle Inspection (MPI), Non Destructive Testing (NDT), Ultraviolet (UV) and Anti-Collision Device (ACD**)**

1. Introduction

The cracks and other problems with the rails generally go unnoticed due to improper maintenance and irregular manual track line monitoring that is being carried out in the current situation. Nowadays system have some limitations, if the bridge or track damaged, that information goes to railway authority people, they notifies and informs to the corresponding trains it will takes more time informing those information.

In the literature survey, the commonly employed rail crack detection schemes in foreign countries are usually ultrasonic or eddy current based techniques which are the reasonably good accuracy in most cases. However, the one characteristic which the above mentioned methods have in common is that they are both expensive, which makes them ineligible for implementation in the current Indian scenario. Also, the ultrasonic can only inspect the core of materials; that is, the method cannot check for surface and near surface cracking where many of the faults are located. 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 [1]. This system is mainly concerned in identifying the cracks in railway tracks and helps to prevent the accidents without manual power. It's not only concentrated on finding damaged tracks but also helpful to find out the derailment and the exact place where it is.

In this technical solutions offered by many companies in the detection of cracks in rails involve periodic maintenance coupled with occasional monitoring usually once a month or in a similar time frame. But the robotics possesses the inherent advantage of facilitating monitoring of rail tracks on a daily basis during nights, when the usual train traffic is suspended. Further, that the simplicity of this idea and easy availability of the components make for implementation on a large scale with very little initial investment [2]. The simplicity of this work ensures robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipments is that they are heavy which poses a practical limitation.

This important disadvantage has been rectified in robotics project as the design is simple and sensible enabling the device to be easily portable. While designing the mechanical parts of the robot, due consideration has been given to the variable nature of the tracks and the unique challenges possessed by the deviations in the Indian scenario. For example, in areas near road crossings the outer part of the track is usually covered with cement. Also, there is always the problem of rocks obstructing the path on the inside parts of the rails. So the specialized wheels that have been provided in robot that has taken into account and are specifically designed to overcome this aforementioned problem. The railway track crack detection is used to detect the crack whiles the train running on the track [3]. The proposed system is used to detect the crack on railway track before 10km.

2. Related Works

The prompt detection of the conditions in rails that may lead to a crack or rather a break now plays a critical role in the maintenance of rails worldwide. The understanding of these mechanisms is constantly improving and the evolution of a range of complementary non destructive testing (NDT) techniques has resulted in a number of tools for us to choose. Among the inspection methods used to ensure rail integrity, the common ones are visual inspection, ultrasonic inspection and eddy current inspection [4]. The ultrasonic inspections are common place in the rail industry in many foreign countries. It is a relatively well understood technique and was thought to be the best solution to crack detection. However, the

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ultrasonic can only inspect the core of materials; that is, the method cannot check for surface and near surface cracking where many of the faults are located. The eddy currents are used to tide over this limitation associated with ultrasonic. They are effectively used to check for cracks located at the surface of metals such as rails. Further, magnetic particle inspection (MPI) is also used in the rail industry but there are a number of problems inherent with this technique, some of which are mentioned [5].

The surface of the rail or component must first be cleaned of all coatings, rust and so on. To get a sensitive reading, contrast paint must first be applied to the rail, followed by the magnetic particle coating. The same inspection must then be carried out in two different directions at a very slow overall speed. However, in the Indian scenario, the visual form of inspection is widely used though it produces the poorest results of all the methods. It is now becoming widely accepted that even surface cracking. The first conducted a survey of existing technologies for non destructive testing of railroad track and track components. This provided insight regarding which tasks were best suited to vision based inspection for which technology was not already under development [6]. This survey encompassed well established inspection technologies (e.g. ultrasonic rail flaw testing) and more experimental technologies currently under development (e.g. inertial accelerometers).

A variety of machine vision systems have been developed to inspect rail and track, including systems from the University of Central Florida, Georgetown Rail Equipment Company and MER MEC. The University of Central Florida, in association with the Florida Department of Transportation, is developing a machine vision system for the inspection of surface cracks in the rail, missing or misaligned tie plates, presence of fasteners, and improper gauge. Initially, they used a small, self propelled track cart to gather video data and are now adapting the system for use on a high rail vehicle [7].

The downward facing, high frame rate, 640x480 area scan camera is used in combination with strobe lights, lasers, and sun shields to gather the video data. Images are recorded approximately every 1.5 feet, with the exact interval determined using Global Positioning System (GPS) data [8]. Georgetown Rail has developed their AURORA system for inspection of wood ties, rail seat abrasion, presence of fasteners, and improper gauge. This system is mounted on a high rail vehicle and can be operated at speeds of up to 30 mph (48 km/hr). The wood tie inspection includes determination of the size, length and location of cracks, as well as an estimation of tie "roughness" and a measurement of vertical plate cutting. Fastener detection can recognize and catalog cut spikes as well as Pandrol E-lips, Fast Clips and Safe lock clips with 85%-90% accuracy.MER MEC has developed a track inspection system, known as the "Track Surface Detection System", which uses line scan cameras and has three separate modules that can be installed to detect different track defects [9]. The system can be installed on any track vehicle and can be operated at speeds of up to 160 km/hr (99mph). With all three modules installed, the system can detect tie type and movement, inspect and classify rail fastenings and surface defects, measure rail gap, check for ballast irregularities and vegetation and determine the plate condition and the structural condition of several pieces of on track equipment (e.g. transponders for the European Train Control System).

3. Anti - Collision Detector

This work aims to development of highly cost effective anti-collision detector using the implementation of RF and LASER in automation of signals. By this work to avoid train collision by giving necessary signals automatically. It will also detect cracks in the railway tracks. Automatic gate controller is an added feature of this work. It can easily be customized as per requirements and available resources to suit the needs of Indian railways. The idea has been successfully tested and the working prototype can be developed.

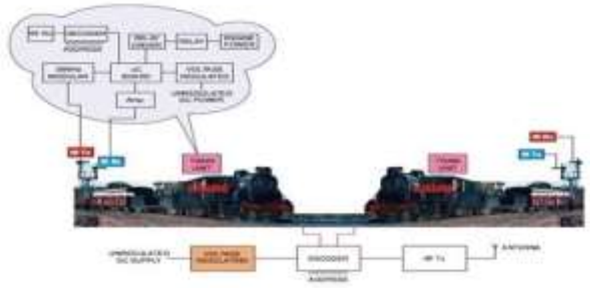

Figure 1 Block Diagram of Anti-Collision Detector

The Figure 1 shows the block diagram of anti-collision detector. The engines of trains are equipped with microcontroller containing all the data and information about all the trains. Practically, in the microcontroller contains the registration nos. of trains. The motor which runs the train is under the control of microcontroller. On the head lamp of engines of train A and train B are added a photo diode and a laser that emits pulses at fixed time intervals. If train B is moving on the same track towards the train A then the laser emitted by the train B will be sensed at engine of train A resulting in microcontroller to stop the motor and thus stopping train. Thus the working of anti-collision detector is based on a bi-directional process [10].

A light emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. When a light emitting diode is forward biased, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light is determined by the energy gap of the semiconductor.

The LEDs are often small in area (less than 1 mm^2), and integrated optical components may be used to shape its radiation pattern. The LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability [2]. The LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output. The light emitting diodes are used in applications as diverse as replacements for aviation lighting, automotive lighting particularly brake lamps, turn signals and indicators as well as in traffic signals. The advantages of LEDs mentioned above have allowed new text and video displays and sensors to be developed, while their high switching rates are also useful in advanced communications technology. Infrared LEDs are also used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances. The Figure 2 shows the Infrared rays with wavelength.

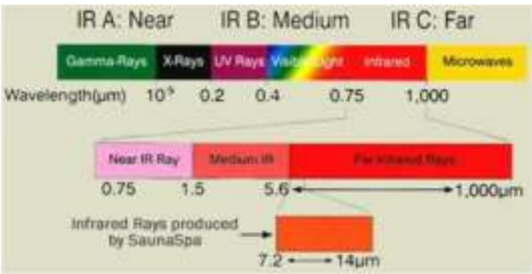

Figure 2 IR Rays

Figure 3 shows the Infrared (IR) light electromagnetic radiation with a wavelength between 0.7 and 300 micrometers, which equates to a frequency range between approximately 1 and 430 THz. The IR wavelengths are longer than that of visible light, but shorter than that of terahertz radiation microwaves. The bright sunlight provides an irradiance of just over 1 kilowatt per square meter at sea level of this energy, 527 watts is infrared radiation, 445 watts is visible light, and 32 watts is ultraviolet radiation. The objects generally emit infrared radiation across a spectrum of wavelengths, but only a specific region of the spectrum is of interest because sensors are usually designed only to collect radiation within a specific bandwidth [11].

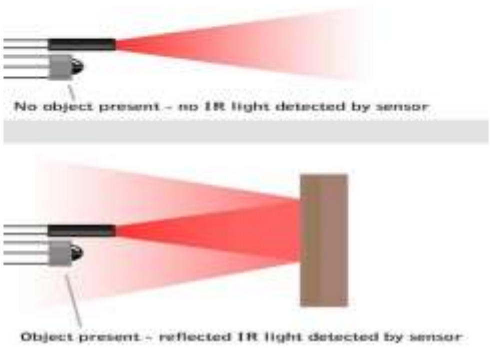

Figure 3 IR Sensor

The detection of cracks can be identified using ultraviolet (UV) rays with the UV transmitter and receiver. The UV receiver is connected to the signal lamp and it will acts as sensor. The CAN controller is connected to the main node and it sends the information via GSM and transmits the message to engine and to the nearest station. The UV radiation is electromagnetic radiation of a wavelength shorter than that of the visible region, but longer than that of soft X-rays. It can be subdivided into near UV (380 – 200 nm wavelength) and extreme or vacuum UV (200–10 nm). When considering the effects of UV radiation on human health and the environment, the range of UV wavelengths is often subdivided into UVA (380– 315 nm), also called long wave or "backlight"; UVB (315–280 nm), also called medium wave; and UVC (280 -10 nm), also called short wave or "germicidal”. The name means "beyond violet" (from Latin ultra, "beyond"), violet being the colour of the shortest wavelengths of visible light. Some of the UV wavelengths are colloquially called black light, as it is invisible to the human eye. The gun emits ultraviolet radiation in the UVA, UVB, and UVC bands, but because of absorption in the atmosphere's ozone layer, 99% of the ultraviolet radiation that reaches the earth surface is UVA. Some of the UVC light is responsible for the generation of the ozone [12].

The ordinary glass is transparent to UVA but is opaque to shorter wavelengths. Silica or quartz glass, depending on quality, can be transparent even to vacuum UV wavelengths. The onset of vacuum UV, 200 nm, is defined by the fact that ordinary air is opaque below this wavelength. This opacity is due to the strong absorption of light of these wavelengths by oxygen in the air. Pure nitrogen less than about 10 ppm oxygen is transparent to wavelengths in the range of about 150– 200 nm. This has wide practical significance now that semiconductor manufacturing processes are using wavelengths shorter than 200 nm. By working in oxygen free gas, the equipment does not have to be built to withstand the pressure differences required to work in a vacuum [13].

Some other scientific instruments, such as circular dichroism spectrometers, are also commonly nitrogen purged and operate in this spectral region. Soon after infrared radiation had been discovered, the German physicist Johann Wilhelm Ritter began to look for radiation at the opposite end of the spectrum, at the short wavelengths beyond violet. In 1801 he used silver chloride, a light sensitive chemical, to show that there was a type of invisible light beyond violet, which he called chemical rays. At that time, many scientists, including Ritter, concluded that light was composed of three separate components: an oxidising or calorific component (infrared), an illuminating component (visible light), and a reducing or hydrogenating component (ultraviolet). The unity of the different parts of the spectrum was not understood until about 1842, with the work of Macedonia Melloni, Alexander-Edmond Becquerel and others. UV Light has many uses [14].

In Derailment cases if the distance of two compartments is increases then signal (Bluetooth) automatically cut off. This Bluetooth are fixed at both phases front and back of each compartments. Once the signal breaks, Automatic emergency brakes are applied. This technique can also be used to alert the driver by using some kind of alarm. Some times in midnight then the engine driver cannot notice the red signal in the railway signal. So in this situation our technique will be used to avoid the accident by alerting the driver at the time of red signal. The sensors which are capable of detecting the crack is ultrasonic metal detecting sensors. Which are to be placed on both sides of the engine, but due to its cost the test model is designed using IR and normal ultrasonic sensors [9], [15].

The tracks are enabled with encoders and RF transmitters. A uniform track is said to be maintained if current keeps on flowing between the encoders. The transmitter will transmit RF signals as long as the current is continuous. A receiver circuitry containing a decoder is involved on the engine of train. The receiver is connected to the microcontroller which controls the functioning of the train. If due to some unavoidable reasons, a crack is introduced in the track then the current flowing between the encoders will no more be continuous. This will stop transmitter to transmit RF signals and hence no signal will be received by the receiver of the engine leading to which the microcontroller will stop the train. The microcontrollers used in anti-collision detector and crack detector are same. These modules are now widely and cheaply available with the operating frequency of 433 MHz [16]. The transmitter module accepts serial data. The encoder IC takes in parallel data at the TX side packages it into serial format and then transmits it with the help of a RF transmitter module. At the RX end, the decoder IC receives the signal via the RF

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receiver module, decodes the serial data and reproduces the original data in the parallel format. In Figure 4, The TX433 wireless RF transmitter uses on/off keying to transmit data to the matching receiver, RX433. The data input “keys” the saw resonator in the transmitter when the input is +3 volts or greater, AM modulating the data onto the 433 MHz carrier. The data is then demodulated by the receiver, which accurately reproduces the original data [17]. The data input is CMOS level compatible when the unit is run on +5 volts.

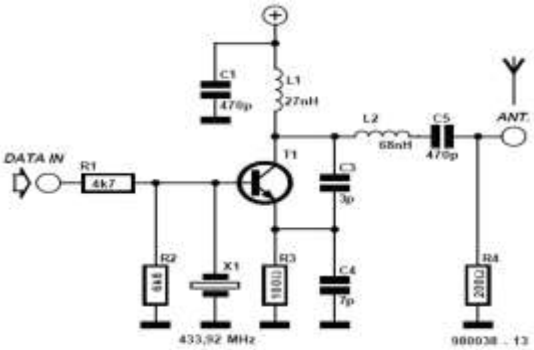

Figure 4 433 MHz Transmitter

The receiver shown in Figure 5, it contains just one transistor. It is biased to act as a regenerative oscillator, in which the received antenna signal causes the transistor to switch to high amplification, thereby automatically arranging the signal detection. Next, the raw demodulated signal is amplified and shaped up by op-amps. The result is a fairly clean digital signal at the output of the receiver. The logic high level is at about 2/3 of the supply voltage, i.e., between 3 V and 4.5 V. The range of the simple system shown in Figures is much smaller than that of more expensive units, mainly because of the low transmit power approximately 1 mW and the relative insensitivity and wide band nature of the receiver [18]. Moreover, amplitude modulated noise is not suppressed in any way.

An RFID system consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the RF circuitry and information to be transmitted. The PIC is the abbreviation for programmable interface circuit. It is a CMOS 8bit RISC microcontroller. There are only 35 single word instructions to learn. Operating speed: DC - 20 MHz clock input. The memory details are: Up to 8K x 14 words of FLASH Program Memory, Up to 368 x 8 bytes of Data Memory (RAM) and Up to 256 x 8 bytes of EEPROM Data Memory [19].

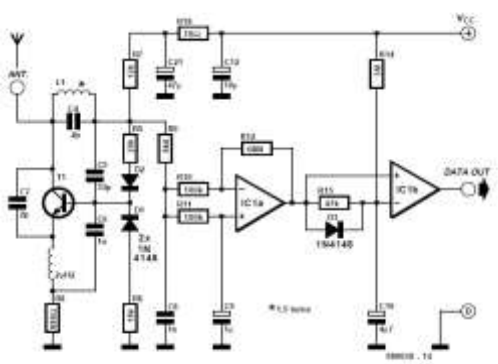

Figure 5 433 MHz RF Receiver

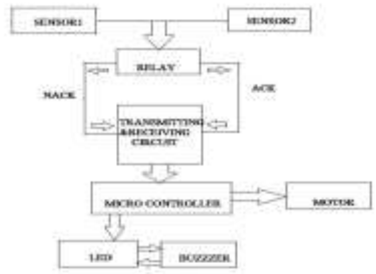

Figure 6 Block Diagram of Proposed Model

In Figure 6 shows the block diagram of proposed model, the sensors plays as input receiving device they provide positive acknowledgement when there is proper continuity in track and if no object is detected. Once if any of the above mentioned condition is missing then it starts to provide negative ack. As it is coded in microcontroller, on receiving negative acknowledgement, it stops the train kit and enables the LED and Buzzer [20]. The Head-on collision is used to avoid the train accident on the same track. If the train comes on same track when the detection sensor sense the signal is "0" means there is no interrupt on the railway track. If the signal is "1", it can identify some interrupt and it will monitor into the controller room, then the train will be stop and avoid the two train accident on the same track. The derailment means, if the distance of two compartments is increases then signal automatically cut off. The signal sensing unit can be used to alert the driver by using some kind of alarm. Some times in midnight then the engine driver cannot listen the red signal in the railway signal. So in this situation our technique will be used to avoid the accident by alerting the driver at the time of red signal. As per the system we can early identify the place and station information whiles us travelling in the train. This kind of in formations will be announced or displayed in the train. The necessary information will be already feeded in the system. According to the distance the information will be delivered to the passengers [21].

The safety violations due to human errors or limitations and equipment failures occasionally result in Train collisions. The anti-collision device (ACD) network is an onboard train collision prevention system. The ACD is a self acting microprocessor based data communication device. When installed on locomotives along with an auto braking unit (ABU), guard vans, stations and level crossing gates both manned and unmanned, the network of ACD systems prevents high speed collisions in midsections, station areas and at level crossing gates. The ACD uses both radio frequency and laser technology whereby a train is automatically brought to a halt if the track ahead is not clear. The train starts braking 3 kms ahead of a blockade. Due to natural or manual reasons, the tracks are found to be cracked which can lead to accidents. The project is able to detect the cracks in railway tracks [22], [23].

Now a days, India is the country which having world largest railway network. Over hundreds of railways running on track every day. As railway has straight way running as well as it has somewhat risky and dangerous as per as general public and traffic concern. As we know that it is surely impossible to stop the running train at instant is some critical situation or emergency arises. Therefore at the places of traffic density, suburban areas and crossings there is severe need to install a railway gate in view of protection purpose.

Obviously at each and every gate there must be a attendant to operate and maintain it. In view of that, if we calculate the places of railway crossings and such places where it would to be install and overall expenditure [24], [25].

The existing technical solutions offered by many companies in the detection of cracks in rails involve periodic maintenance coupled with occasional monitoring usually once a month or in a similar timeframe [26], [27]. The proposed system have the inherent advantages of facilitating monitoring of rail tracks on a daily basis during nights when the usual train traffic is suspended. The proposed system has simple and easy availability of the components to implement the large scale with low initial investment. The simplicity of the proposed system ensures robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipments is that they are heavy which poses a practical limitation. However, this important disadvantage has been rectified in this work as the design is simple and sensible, enabling the device to be easily portable. While designing the mechanical parts of the robot, due consideration has been given to the variable nature of the tracks and the unique challenges posed by the deviations in the Indian scenario. For example, in areas near road crossings the outer part of the track is usually covered with cement. Also, there is always the problem of rocks obstructing the path on the inside parts of the rails. The specialized wheels that have been provided in this robot have taken this into account and are specifically designed to overcome the aforementioned problem.

4. CONCLUSION

In this work, the crack on the track, face to face collision and de-railment, all these occurrences are sensed automatically and accidents are prevented, here testing has been carried out by established models and simulation has been done by Keil uVision4. The both face to face collision and crack on track are detected 4-5km before by the continuous monitoring of ultrasonic metal detecting sensors which are fixed at the engines, and once detected the train automatically applies brake to stop and even pantographs could be disengaged. But, the de-railment could be controlled by detecting not presences of next compartment. Then an alert is given to driver and automatic emergency brake control is applied. If this system is brought in railways, the accidents could be controlled and the place of damage could be sent automatically to control room and since its completely automated system this can be used in village areas by which man power is reduced and time is saved.

References

[1] J. Banuchandar, V. Kaliraj, P. Balasubramanian, S.Deepa, N.Thamilarasi, “Automated Unmanned Railway Level Crossing System”, International Journal of Modern Engineering Research, Vol.2, Issue.1, pp. 458-463, 2012.

[2] G. Vidhya Krishnan, R.Nagarajan, T. Durka, M.Kalaiselvi, M.Pushpa and S. Shanmuga priya, "Vehicle Communication System Using Li-Fi Technology," International Journal of Engineering And Computer Science (IJECS), Volume 6, Issue 3, pp. 20651-20657, March 2017.

[3] P.Navaraja,” Crack Detection System for Railway Track by Using Ultrasonic and PIR Sensor” IJAICT Volume -1, Issue-1, May 2014.

[4] A.Mahendran, K.Muthulakshmi and R.Nagarajan, “Triangular Multicarrier SPWM Technique for Nine Level Cascaded Inverter,” International Journal of Scientific & Engineering Research, Vol.4, No.5, pp. 269-275, May-2013.

[5] Steven. V, Sawadisavi, J. Riley Edwards, Esther Resendiz, John M. Hart, Christopher P. L. Barkan and Narendra Ahuja, “Machine-Vision Inspection of Railroad Track,” Proceedings of 88th Annual Meeting of the Transportation Research Board, 2009.

[6] Dr.R.Nagarajan, S.Sathishkumar, K.Balasubramani, C.Boobalan, S.Naveen and N.Sridhar. “Chopper Fed Speed Control of DC Motor Using PI Controller,” IOSR-Journal of Electrical and Electronics Engineering (IOSR-JEEE), Volume 11, Issue 3, Ver. I, pp. 65-69, May – Jun. 2016.

[7] V.Saravanamoorthy, G.N.Murugananthan,“ Automatic Identification of Obstacles And Crack Sensing Scheme In Rail Tracking System,” IJARECE, Volume 4, Issue 1, January 2015.

[8] J.Chandramohan, R.Nagarajan, M.Ashok kumar, T.Dineshkumar, G.Kannan and R.Prakash, “Attendance Monitoring System of Students Based on Biometric and GPS Tracking System,” International Journal of Advanced Engineering, Management and Science (IJAEMS), Vol-3.Issue-3, pp. 241-246, Mar. 2017.

[9] R.Prabhu, R.Nagarajan, N.Karthick and S.Suresh, “Implementation of Direct Sequence Spread Spectrum Communication System Using FPGA,” International Journal of Advanced Engineering, Management and Science (IJAEMS), Vol-3.Issue-5, pp. 488-496, May. 2017

[10] R.Nagarajan, J.Chandramohan, R.Yuvaraj, S.Sathishkumar and S.Chandran, “Performance Analysis of Synchronous SEPIC Converter for a Stand-Alone PV System,” International Journal of Emerging Technologies in Engineering Research (IJETER), Vol. 5, Issue - 5, pp. 12-16, May-2017.

[11] J.Chandramohan, R.Nagarajan, K.Satheeshkumar, N.Ajithkumar, P.A.Gopinath and S.Ranjithkumar, "Intelligent Smart Home Automation and Security System Using Arduino and Wi-fi," International Journal of Engineering And Computer Science (IJECS), Volume 6, Issue 3, pp. 20694-20698, March, 2017.

[12] Saijyothsna1.T, P. Umamaheswari, “Collision Avoidance of Trains by Creating Mutual Communication Using Embedded System,” Vol. 2, Issue 7, July 2014.

[13] R.Nagarajan and M,Saravanan, “A Carrier - Based Pulse Width Modulation Control Strategies for Cascaded Multilevel Inverter,” International Review on Modeling and Simulations (IRMOS), Vol 6.No1, pp-8-19, Feb. 2013.

[14] R Rameshkumar and R Nagarajan, “Sine Multicarrier SPWM Technique for Seven Level Cascaded Inverter,” CiiT-Programmable Device Circuits and Systems. Vol. 5, Issue- 6, 2013.

[15] Ramesh.S, “Detection of Cracks and Railway Collision Avoidance System,” International Journal of Electronic and Electrical Engineering, Volume 4, Number 3, pp. 321-327, 2011.

DOI: 10.18535/ijecs/v6i5.47

[16] M.Padmavathi and R.Nagarajan, “Smart Intelligent ATM Using LABVIEW,” International Journal of Emerging Technologies in Engineering Research (IJETER), Volume 5, Issue 5, pp. 41- 45, May-2017.

[17] S.Suresh, R.Nagarajan, L.Sakthivel, V.Logesh, C.Mohandass and G.Tamilselvan, “Transmission Line Fault Monitoring and Identification System by Using Internet of Things,” International Journal of Advanced Engineering Research and Science (IJAERS), Vol - 4.Issue - 4, pp. 9-14, Apr- 2017.

[18] R.Nagarajan, R.Yuvaraj, V.Hemalatha, S.Logapriya, A.Mekala and S.Priyanga, "Implementation of PV - Based Boost Converter Using PI Controller with PSO Algorithm," International Journal of Engineering And Computer Science (IJECS), Volume 6, Issue 3, pp. 20479-20484, March, 2017.

[19] R.Nagarajan and M,Saravanan. “Performance Analysis of a Novel Reduced Switch Cascaded Multilevel Inverter,” Journal of Power Electronics, Vol.14, No.1, pp. 48-60, Jan.2014.

[20] Ms. C. Hemalatha, Mr. R. Nagarajan, P. Suresh, G. Ganesh Shankar and A. Vijay, “Brushless DC Motor Controlled by using Internet of Things,” IJSTE - International Journal of Science Technology & Engineering, Volume -3.Issue-09, pp. 373-377, March-2017.

[21] R.Nagarajan and M,Saravanan “Staircase Multicarrier SPWM Technique for Nine Level Cascaded Inverter,” 2013 International Conference on Power, Energy and Control (ICPEC), IEEE Press, pp-668-675. 2013.

[22] C.V. Harii, J.V. Jojish, S. Gopi, V. P. Felix and J. Amudha, “Mid-point Hough Transform: a fast line Detection Method”, Annual IEEE India Conference, pp.1-4, 2009.

[23] R.Nagarajan, S.Sathishkumar, S.Deepika, G.Keerthana, J.K.Kiruthika and R.Nandhini, "Implementation of Chopper Fed Speed Control of Separately Excited DC Motor Using PI Controller", International Journal of Engineering And Computer Science (IJECS), Volume 6, Issue 3, pp. 20629-20633, March, 2017.

[24] John R. Smith and Shih-Fu Chang, “Tools and Techniques for Color Image Retrieval,” Proceedings of Storage and Retrieval for Image and Video Databases, Vol. 2670, pp. 426-437, 1996.

[25] R.Nagarajan, J.Chandramohan, S.Sathishkumar, S.Anantharaj, G.Jayakumar, M.Visnukumar and R.Viswanathan, “Implementation of PI Controller for Boost Converter in PV System,” International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE). Vol.11, Issue.XII, pp. 6-10, December. 2016.

[26] Vijayakumar .K, S.R. Wylie, J. D. Cullen, C.C.Wright, and A.I. AIShamma, “Non Invasive Rail Track Detection System Using Microwave Sensor,” Journal of App. Phy., 2009.

[27] R.Nagarajan and M, Saravanan, “Comparison of PWM Control Techniques for Cascaded Multilevel Inverter” International Review of Automatic control (IRACO), Vol.5, No.6, pp. 815-828. Nov. 2012.

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