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AUTOMATED VISUAL INSPECTION OF DETECTING CRACKS AND OBSTACLES ON RAIL ROAD TRACK USING ROBOT AND AUTOMATIC GATE CONTROL

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ABSTRACT

Today's most of the railroad investigation is manually conducted by track examiners. Practically, it is not easy to investigate the thousands of railway track by trained human examiners. Hence it takes too much time to inspect the defected railway tracks and then inform to the railway authority people. In order to avoid delay and improve the accuracy, we have proposed structure that will automatically investigate the railway cracks and obstacles by using inspection robot, then the system also concludes automatic gate control system. The cracks and obstacles are detected by using sensors in robot, which are then informed to the train driver through the GSM using radio frequency signals. In this proposed system the train can be controlled without driver control when the problem is identified. These detection and controlling methods can be used to prevent the railway accidents.

Keywords: *Railway track inspection, robot control, train control, gate control, Ultrasonic sensor, Infra-red sensor, GSM,GPS,RF transmitter and receiver.*

1. INTRODUCTION

The Indian Railway has the world's fourth largest railway network in the world, next to the United states, Russia and China[3].The railway traverse the length and breadth of the country and carry over 20 million passengers and 2 million tons of freight daily. It is one of the world's largest commercial or utility employers, with more than 1.6 million employees. Unfortunately there have been many accidents involved in the railways due to cracks. Hence these cracks in railway lines have been a perennial problem which has to be addressed with utmost attention due to the frequency of rail usage in India. These cracks and other problems with the rails generally go unnoticed due to improper maintenance and the current irregular and manual track line monitoring that is being carried out. Owing to the crucial repercussions of this problem, this paper presents an implementation of efficient and cost effective solutions that are suitable for large scale application.

In existing system, the same concept is used using LED and LDR sensor assembly. The main drawback of the system is that LED and LDR needs to be exactly aligned opposite to each other to detect the crack, also the environment needs to be controlled to detect the true values from LDR. For this reason we have used ultrasonic and IR obstacles sensor, also our proposed system which includes automatic gate control using PIC microcontroller.

The main objective of the project is to identify the crack or deformation on the railway track using this setup, which can be implemented in live by Railway authorities. The proposed setup would make the inspection and maintenance of railways tracks easier and help them to monitor efficiently by replacing the human inspection which is currently followed. The design of the robot and software related to it are very simple and can be easily adopted by the present system.

2.LITERATURE REVIEW

Recently research and development of rail track inspection have received a great deal of attention to save passengers life. There are some methods based on inspection technology are as follow:

One such method is using Ultrasonic sensor for detecting the biggest obstacles such as rock and trees on the railway track, another method is to detect some cracks or deformation on the railroad track by using Infrared sensor. We proposed the inspection robot which has two sensors which detects the cracks and obstacles on the railroad track and then the intimation is directly send through the train driver using the GSM technology or automatically it will stop the train without driver control. Then our proposed system setup also has the automatic railway gate control using microcontroller which will automatically controls the gate while the train crossing at gate. These three setup which prevents many accidents in the railway department.

The finding of cracks in railway tracks takes time consumption due to physical inspection. It shrinks the

correctness too. This method of design is having limited intelligence and time consuming. TRAIN Accidents are commonly occurs in a country. They are mainly due to bad condition of tracks and absence of monitoring in level crossings Tracks are prone to cracks or expansion of metal plates. It is impossible to identify the obstacles from the train and on identification it is difficult to stop the train suddenly. Then the automatic gate control system presents separately. But we have proposed that gate control system with this automated visual inspection robot.

3.MATERIALS AND METHODS

This paper proposes a cost effective solution to the problem of railway track crack detection utilizing Zigbee communication and PIC control, track damage detection robot, GPS, GSM assembly which tracks the exact location of track damage which then mended immediately so that many lives will be saved. The sensor network is a wireless network formed by a group of sensors deployed in same region, which can be used to measure the air density, temperature , acceleration, etc. sensor scan transmit signal via radio motion. Meanwhile sensor share now minor and economy, they can be organized on a big scale.

In this paper, we have used three control sections, which are robot, train and control section. Each track will be monitored by one IR obstacle sensor Ultrasonic sensor, Whenever there is a crack on the track, the IR obstacle sensor senses the crack and activates GPS. The location Latitude and Longitude coordinates of the crack is sent to the pre-defined number with the help of SIM inserted into GMS module. Once the crack has been successfully identified and message is sent, the vehicle moves further on the model path till next crack is detected.

The designed visual inspection robot has been successfully tested on the model track and the detected location has been sent to the phone number which is 2km away from the prototype. This vehicle can be used to detect the track and send GPS coordinates in SMS form to even longer distance provided the GSM signals are intact.

3.1.BLOCK DIAGRAM OF PROPOSED METHODOLOGY

The following figure.1.shows that the train section of proposed system which consists of microcontroller unit that controls all the signal and various control unit involves in our proposed system. The overall function in train section can be controlled with the help of PIC16F877A Microcontroller.

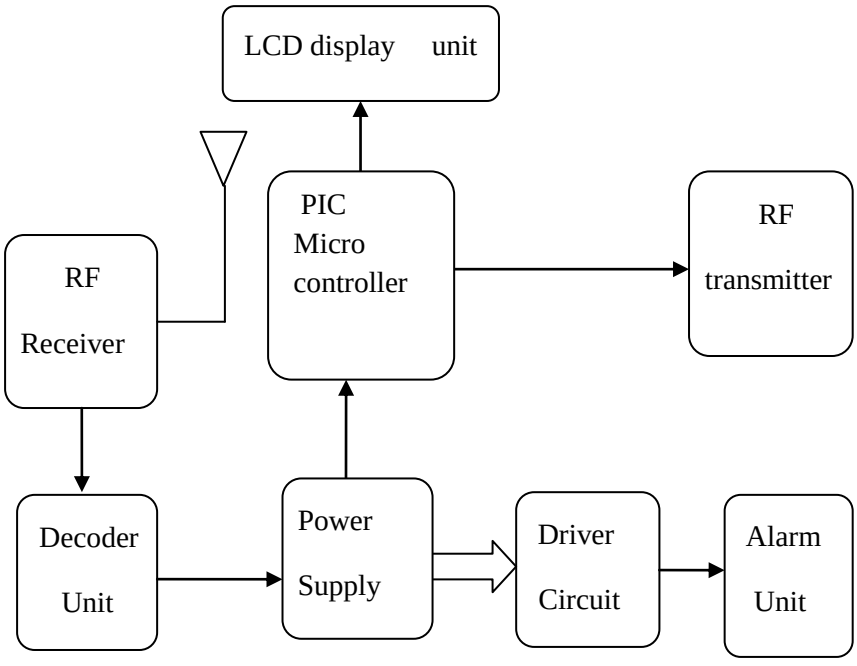

Figure.1.Block of train section

The following figure.2.Shows that the Robot section of our proposed system which consists of microcontroller unit. The main function of the Robot control signal can be programmed with the PIC16F877A Microcontroller that can performs the particular task which depends on the predefined program. It consists of GSM which send SMS through the RF transmitter when the problem is identified.

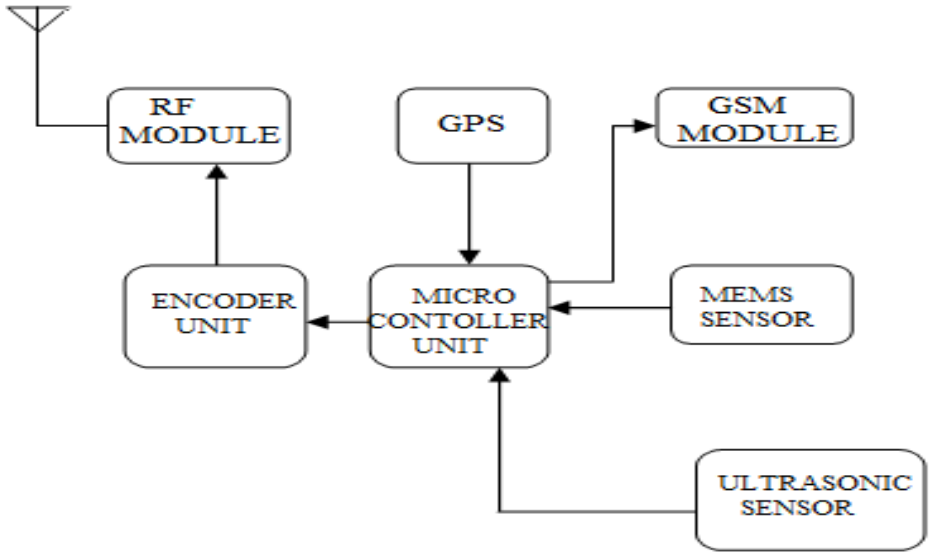

Figure.2.Block of robot section

The following figure.3.shows that the gate section of our proposed system. In gate control unit which consists of Microcontroller unit which automatically controls the gate signals which depends on the predefined program. The gate section also concludes driver unit and alert unit which alerts while train crossing the gate.

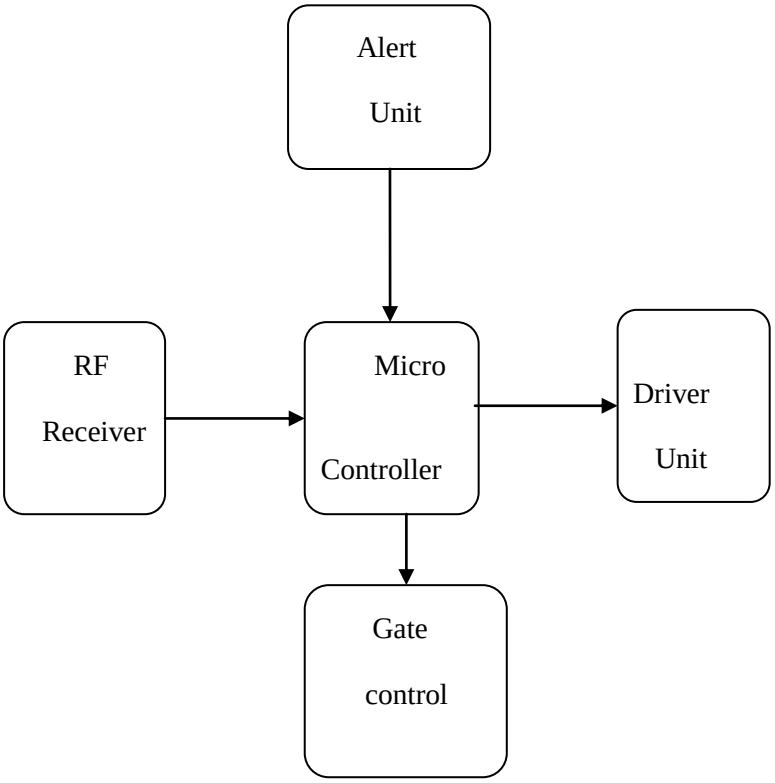

Figure.3. Block of gate control section

3.2. THE HARDWARE SYSTEM

MICROCONTROLLER:

This section forms the control unit of the whole project. This section basically consists of a Microcontroller with capacitors, Reset circuitry, pull up resistors (if needed) and so on. The microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written. PIC16F877A is a family of modified Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller. This feature a 14-bit wide code memory and consists of 40 pins.

SENSORS

IR Obstacle sensor: This sensor is a short range obstacle detector with no dead zone. It has a reasonably narrow detection area which can be increased using the dual version. Range can also be increased by increasing the power to the IR LEDs or adding more IR LEDs. The photo below shows my test setup with some IR LED's (dark blue) as a light source and two phototransistors in parallel for the receiver. You could use one of each but I wanted to spread them out to cover a wider area. This sensor mainly used to detect cracks or deformation on rail road track. It has a range of about 10-15cm (4-6 inches) with my hand as the object being detected.

Ultrasonic sensor: The ultrasonic ranging module HC-SR04 provides 2cm-400cm non-contact measurement function ,the ranging accuracy can reach to 3mm. The frequency range for ultrasonic sensor is 40 to 250 MHZ. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

1.Using IO trigger for at least 10us high level signal.

2.The Module automatically sends eight 40kHz and detect whether there is a pulse signal back, the ultrasonic sensor can be used to sense the biggest obstacles on the railroad track, which is fitted in the inspection robot.

PHOTO DIODE: The amount of current passed through the photodiode is directly proportional to amount Photodiode is alight sensitive semiconductor diode which converts the light energy into voltage or current based on the mode of operation. In general Photodiodes are operated in reverse bias condition. The clear Photodiode can detect visible and IR rays to limit the Photodiode to detect only IR rays a black cutting is applied to the glass of the Photodiode. The photodiode allows the current to pass through it if the photodiode is exposed to IR rays and it doesn't allow current to pass through it if no IR rays falls on of IR rays falls on it.

GPS: Global Positioning System tracking is a method of working out exactly where something is. A GPS tracking system, for example, may be placed in a robot, on a cell phone, or on special GPS devices, which can either be a fixed or portable unit. GPS works by providing information on exact location. It can also track the movement of a vehicle or person. So, for example, a GPS tracking system can be used by a company to monitor the route and progress of a delivery truck, and by parents to check on the location of their child, or even to monitor high-valued assets in transit.

GSM: An embedded system is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it Controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service.

3.3. THE SOFTWARE SYSTEM

Introduction to C Programming For Embedded Systems

C used for embedded systems is slightly different compared to C used for general purpose (under a PC platform) Programs for embedded systems are usually expected to monitor and control external devices and directly manipulate and use the internal architecture of the processor such as interrupt handling, timers, serial communications and other available features. There are many factors to consider when selecting languages for embedded systems examine and utilise

Software supports to this programmer

There is several software that support this PIC programmer such as WinPic800, ProPIC18 etc. On behalf of each software can support altered devices. At times GPS data is not available in shadow zone; however this is taken care by supplementing with Dead Reckoning Devices Protection at level crossings is possible only when the train and the level crossings are fitted with ACDs, by this method. At times the Track side equipment may become targets of vandalism. Therefore, these are long sequences of invalidated frames where we can lose some gauge results. Our system included the feature that, if the measure is overturned, the gap in gauge data was displayed so the track operator could choose to verify the gauge manually.

Rail detection experiments

Since rail gauge measurement is straightforward as long as we locate the rail in images, we concentrated our experiments on rail detection. Rail detection performance was evaluated on dataset group 6,which holds nine rail videos reserved from different tracks. The total number of rail images in these videos is 11900. All videos share the same common properties. They were taken using both shield and strobe lights, the position of opinion was straight, and the rise level of the features in view as appropriate for our method. Some input videos were not fit for our experiments.

4.RESULT AND DISCUSSION

In our proposed system all modules done successfully which shows clearly about what all are the modules involved and how they can be controlled with the help of microcontroller in embedded system technology. Thus the proposed system which implemented in real time in railway applications which prevents many accidents involved in railway maintenance and to save passengers life.

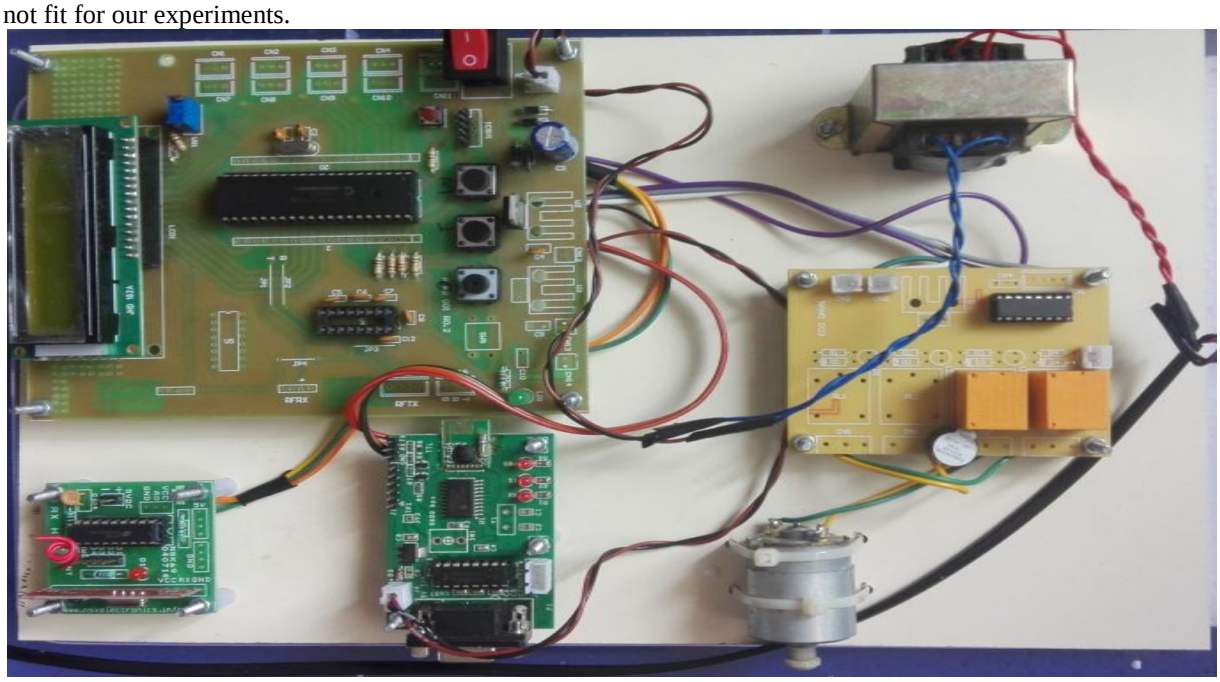

Figure.4.Snapshot for design of the train control section

The following figure.4.shows that train section in which the train was running normally, when the problem is identified the intimation is comes from the robot then the train can be automatically stopped without driver control.

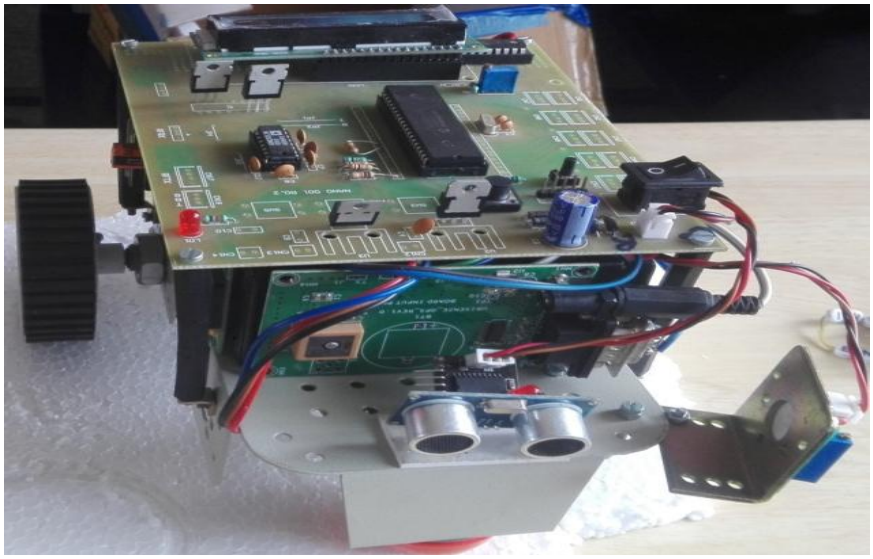

Figure.5.Snapshot of our designed robot control section

In the above figure.5.shows that robot section all the units are can be controlled with the help of PIC microcontroller. The infrared and ultrasonic sensor is fitted on the front side of the robot which will detect cracks and obstacles on the rail track. Then the intimation send through SMS using GSM, then the robot can be stopped.

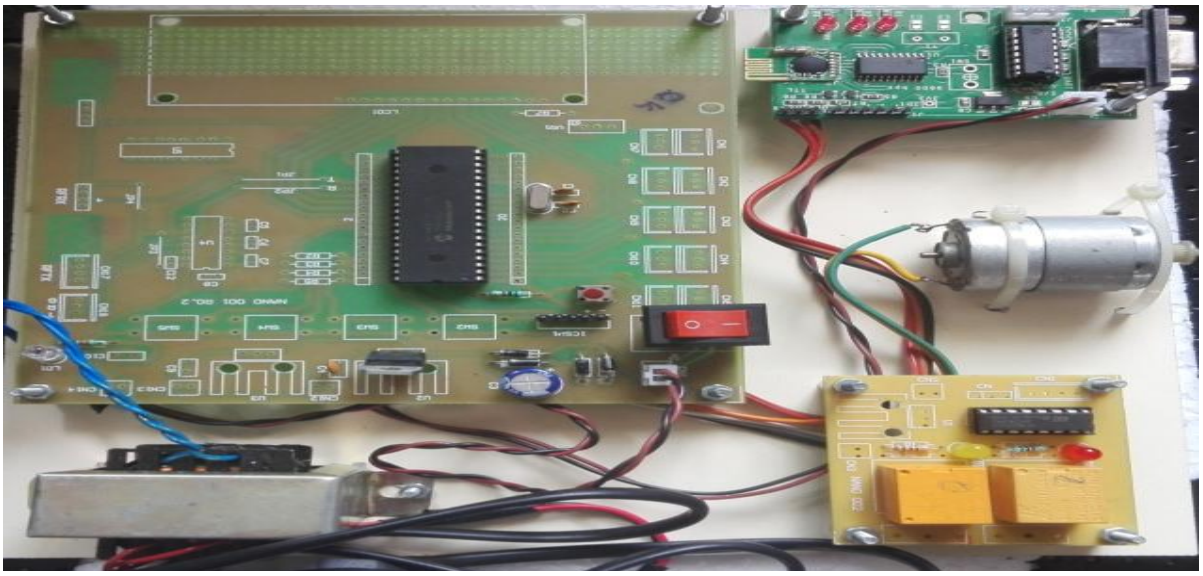

Figure.6.Snapshot of designed gate control section

In this following figure.6. is the gate control section,the gate can be automatically closed while train running on the gate and the gate can be closed after train crossing the gate. These all can be controlled in train section with help of zigbee communication by using embedded technology.

5.CONCLUSION

By using this automated visual inspection robot for purpose of railway track inspection and crack detection, it will have a great impact in the maintenance of the tracks which will help in preventing train accidents to be a very large extent. The regions where manual inspection is not possible, like in deep coal mines, mountain regions and dense thick forest regions can be easily done using this robot. By using this robot for the purpose of Railway track inspection and crack detection and automated SMS will be sent to pre-defined phone number whenever the vehicle sensors detected any crack, obstacles and deformation. This will help in maintenance and monitoring the condition of railway tracks without any errors and thereby maintaining the tracks in good condition, preventing train accidents to very large extent.

Railway track crack detection automated visual inspection robot is designed in such a way that it detects the cracks, obstacles or deformities on the track which when rectified in time will reduce train accidents. The addition of automatic gate control is an added advantage, which also helps and reducing the delay time.

The idea of automating the process of railway gate operation in level crossings has been undertaken. The response of which is the reduction of accidents within the gate. This mechanism, gate keeper presence is not required. Microcontroller performs all the operations like sensing, software coding and closing etc. The mechanism works on a simple principle and there is not much of complexity needed in the circuit. The existing system which presents with our proposed system is the main advantage.

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