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Automated Crack Detection of Railway Track

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Abstract: *Train accidents are not as common as road accidents, which is why they are not been showed as a major threat. But unfortunately, when train accident happe ns, it results to serious injuries and fatalities. Most of the time, the accidents occur due to missing track lines and unpredictable bends. So, the idea is to develop a system that can find these faults before any misery happens. The project is based on railway track fault detection, the main goal is to develop a bot that can detect any crack or any unwanted faults in the railway tracks. The bot uses ultra-sonic sensor to detect any crack or missing track lines or any unwanted bends. If any defect is detec ted then the ultrasonic sensor sends a signal to the Arduino UNO board and it then sends a command to the Global System for Mobile Communications (GSM) module and the GSM module sends a call to the control room and sends it respective location using the Global Positioning System (GPS). T hen it activates the relay module and the buzzer starts buzzing. The project is mainly developed to reduce the railway hazards and keep the railway department aware of the present condition of the railway track.*

Background*: The main concept behind this technology is that to protect the lives from any kind of accident due to the derailing.*

Materials and Methods*: The methods and the essential materials used are very simple but with precise measurements. They are properly placed to make the connectivity among the components. The GSM and GPS technology are used here with the fault detection system.*

Results*: The cracks and short gaps are detected here. The message and the phone calls are also made with proper timing.*

Conclusion: *The fault detection system is working properly as a prototype model and is approached to be run in the real time also.*

Key Word*: Arduino UNO, Ultrasonic sensor, GSM Module, Motor driver, GPS module.*

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I. Introduction

The Indian Railways is one of the world’s largest railway networks with more than 1, 15,000 Km of track length on a route of 67,312 Km distributing its reach to almost every part of the country. However, in case of reliability and passenger safety, there are areas where improvements can be done and new technologies can be used to reduce the chances of railway hazards. Because of regular use of railway tracks, cracks are developing on the tracks. Due to lack of regular monitoring of the railway tracks, cracks are getting neglected and this is leading to a huge accident. A recent study showed that more than 25% of the tracks are in need of replacement due to the development of cracks on them. Manual detection of tracks is cumbersome and not fully effective owing to much time consumption and requirement of skilled technicians. So, the idea is to develop a system that can detect the cracks, bends and missing tracks automatically and can inform the railway department about the cracks and its present location so that it is easy to track the bot as well as the cracks or bends.

II. Material And Methods

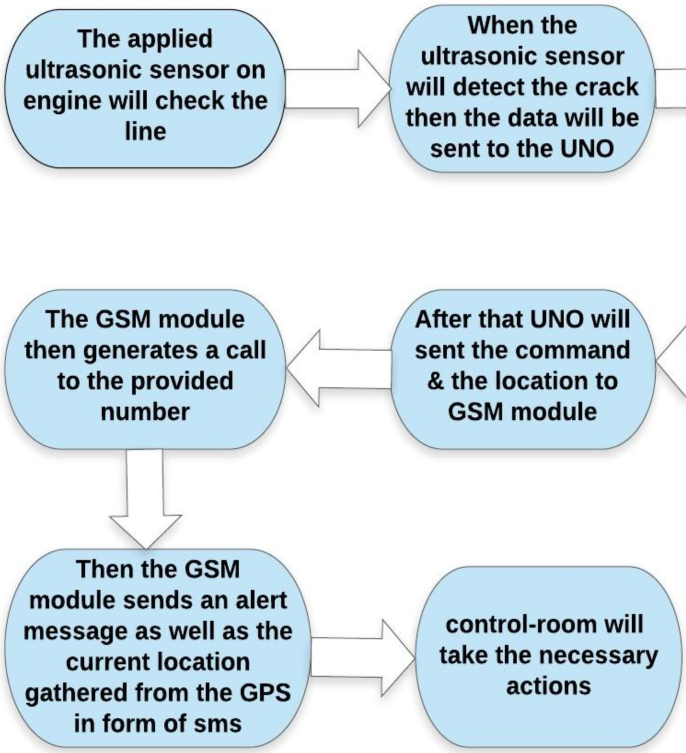

Fig. 1: Block Diagram of the project

The system serves here as an automated railway crack detection system. The bot uses ultra-sonic sensor to detect the cracks, if crack is detected then the Arduino UNO board sends a signal to the motor driver to stop the bot and enable the buzzer. Then the Arduino UNO sends a signal to the Global System for Mobile Communications (GSM) module which sends a call to the number provided to it. The GSM module also sends a message to the provided number that, “crack detected” with its current location using the Global Positioning System (GPS). The GPS is active throughout the process and the values are continuously changing with change in latitude and longitude. The bot stops when it is manually stopped or any crack is detected. The block diagram is shown in the Fig. 1.

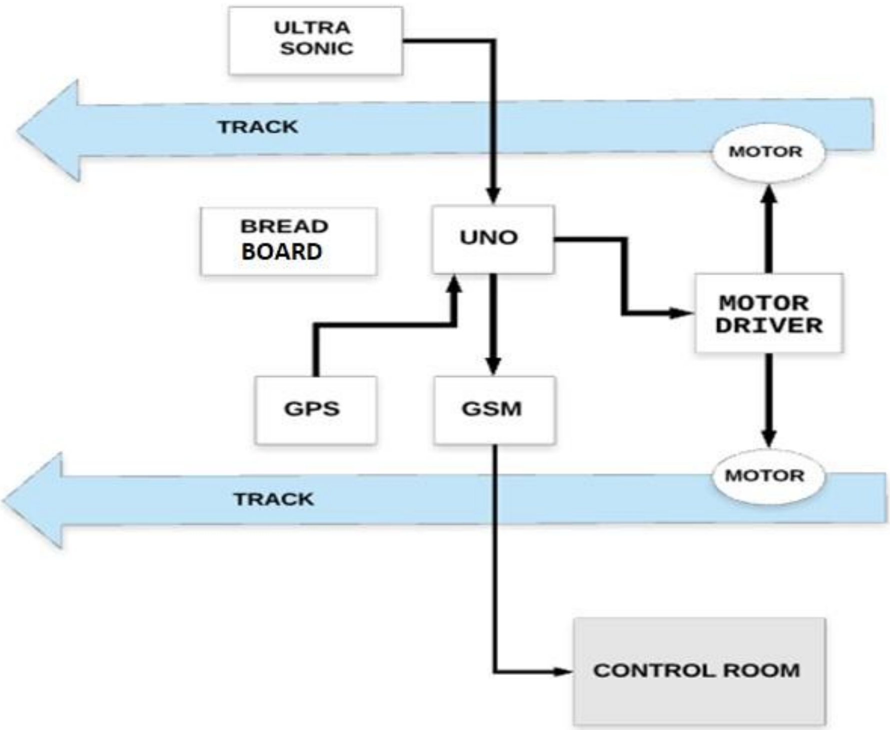

Fig. 2: Workflow of the prototype model

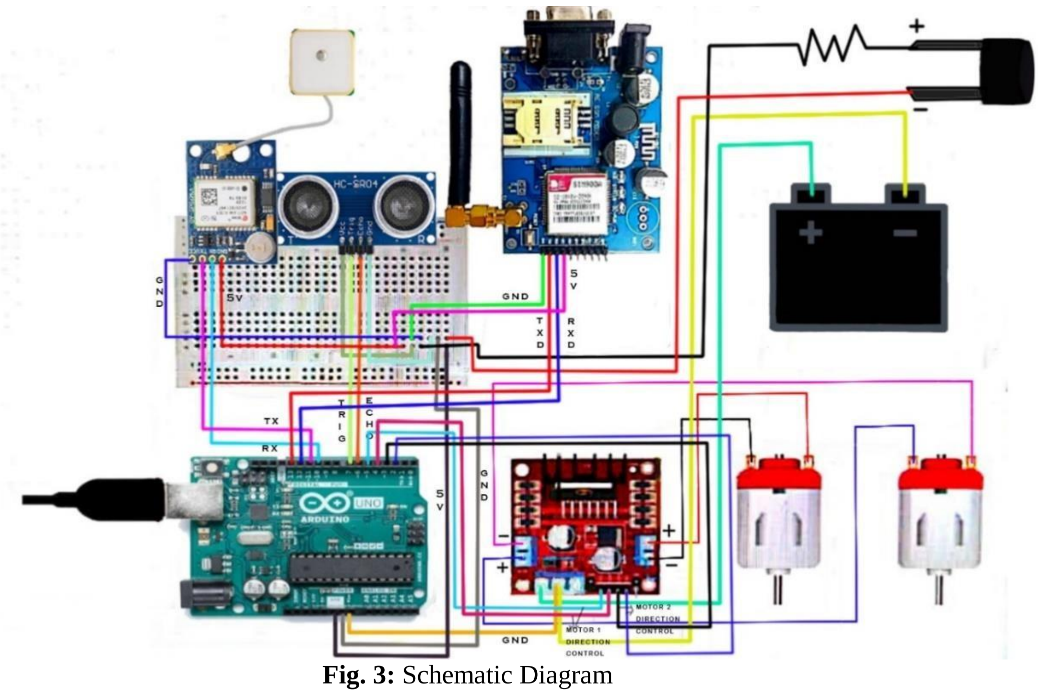

Fig. 3: Schematic Diagram

The workflow of the prototype model and the schematic diagram are shown in the Fig. 2 & 3 respectively. The above figure describes the connections required for the prototype to be built. The Arduino UNO has serial connections of Ground and V_{CC} with the bread board as it helps the connection to be supplied for the whole circuit. The ultrasonic sensor's V_{CC} pin is connected with the 5V of power supply and similarly the Ground pin is also connected with the bread board's Ground. The TRIG and ECO pins are connected with the digital pin of the Arduino UNO board. For the GSM module, the Ground and V_{CC} pins are connected with the bread board's Ground and 5V (V_{CC}) supply using series connections and the T_XD and R_XD are connected with the digital pins of the Arduino UNO board. The GPS module is similarly connected with the board having its

Ground and V_{CC} connected with the bread board's V_{CC} and Ground, i.e. with the Arduino UNO board's Ground and V_{CC}. For the motor driver, the motor terminal 1 & 2 are connected with the left and right motors and the driver voltage input is connected with the positive terminal of the battery and the common ground is connected with the ground pin of the Arduino UNO board. The IN1, IN2, IN3 & IN4 are connected with the digital pin of the UNO board for direction control. IN1 & IN2 are used for Motor 1 direction control and IN3 & IN4 are used for Motor 2 direction control.

III. Results

The Table 1 shows the functioning of the prototype. Here the measurement of the distance is done from the ultrasonic sensor to the handmade railway track using the serial monitor output, which is nearly 3cm. As the logic says if the distance between the ultra-sonic and railway track is greater than 3cm then the bot implies as "crack detected" and provides the GPS link where by clicking on it we can simply get the location of the crack found. It is just a prototype version of the model so the distance is lesser. When the project will be implemented on real life train lines then the distance may vary and increase as per situation.

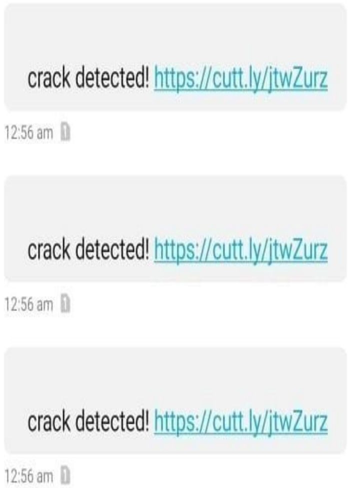

Fig. 4: SMS alert with GPS location

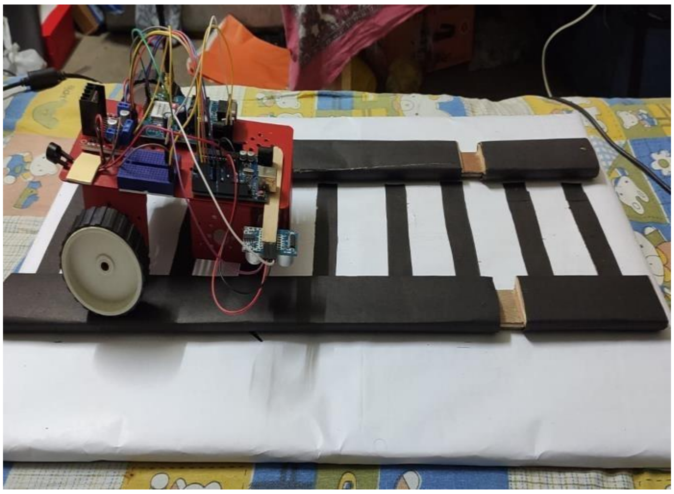

Fig. 5: Prototype model

Fig. 4 is a snapshot of the SMS and location alert which is received when the bot detects any crack or unwanted bends. Here it is seen that SMS alert as well as the current location has been sent and also a call is being transferred. In Fig. 5 the demonstration of the prototype model is present which has been built to detect the cracks and it is also seen that railway tracks are made with the help of wooden ply. As seen, an intentional gap has been made to test the working of the bot. The tracks are mounted on a cardboard and black paper has been wrapped around the wooden plies to make it more likely.

Table no 1: Output result of the detected crack

Ultrasonic sensor output (in distance)	Serial monitor output
3cm	Detecting Creak
4cm	Crack Detected, https/.... (location)
5cm	Crack Detected, https/.... (location)

IV. Discussion

In near future, the main goal would be to upgrade the innovative work to a great level and to remove as many flaws as possible. The project in future will be able to distinguish between deep and small cracks and will also be able to measure the length of the cracks. The bot would only stop moving until & unless there is any missing track line or severe crack. The bot will also follow the guidelines and signals like any other train. The bot will stop at 'STOP' signal and will also stop at 'RED' light and will pass through when it is 'GREEN' light. These functions are achievable through the help of OpenCV from HAAR Cascade Classifier technology and the components required for this are Raspberry Pi and two cameras. The Raspberry Pi then will work as the brain of

the crack or gap detection system where our ultra-sonic sensor will be there just to detect the crack and the camera beside it will do the main job of classifying the cracks into the categories. The bot can be stopped when needed by providing the
'RED' signal. The bot will literally be made smart just by performing few modifications. The bot will be able to ignore the track changing gaps and avoid itself from stopping. It will also avoid the gaps that are intentionally created to expand during extreme heat so that the tracks do not overlap. The components and technology used would be Raspberry Pi, Camera x2, and OpenCV using HAAR Cascade Classifier technology.

V. Conclusion

The project itself speaks about its own value in real life as it saves more than thousands of lives by doing a very important yet unexplored work. After completion of the project the conclusion is that it works each and every time until and unless any network issues with the GSM is there. The project is valuable yet cheap to manufacture and can be implemented in different kinds of railway gauges with minor tweaking.

References

[1]. "Automotive Crack Detection for Railway Track Using Ultrasonic Sensor", S. Sam Jai Kumar, T. Joby Titus, V. Ganesh, V.S. Sanjana Devi, International Journal of Engineering Technology and Computer Research, Volume. 4; Issue 6; November-December; 2016.
[2]. "Implementation of Railway Crack Detection and Monitoring System", V. Elanangai, International Journal of Scientific & Engineering Research, Volume 9, Issue 11, November-2018.
[3]. "Automatic Railway Track Crack Detecting Vehicle", G. Rakesh, Prof. B. Durga Prasad, International Journal of Emerging Technologies and Innovative Research, October 2017, Volume 4, Issue 10.
[4]. "Automatic detection of squats in railway track", Ravi Shankar Shekhar, Purushottam Shekhar, Ganesan P, International Conference on Innovations in Information, Coimbatore, 2015.
[5]. "Obstacle Detection on Railway Tracks Using Vibration Sensors and Signal Filtering Using Bayesian Analysis", Dhiraj Sinha, Farhan Feroz, IEEE Sensors Journal, Vol. 16, Issue. 3, Feb.1, 2016.
[6]. " CRACK DETECTION SYSTEM FOR RAILWAY TRACK BY USING ULTRASONIC AND PIR SENSOR", Prof. P. Navaraja
[7]. Assistant Professor, Journal IJAICT, Volume -1, Issue-1, May 2014.
[8]. "Implementation of Railway Track Crack Detection and Protection" N. Karthick, R. Nagarajan, S. Suresh, R. Prabhu, International Journal of Engineering and Computer Science ISSN, Volume 6 Issue 5 May 2017.
[9]. "Detection of Cracks and Railway Collision", Ramesh.S, International Journal of Electronic and Electrical Engineering, Volume 4, Number 3, pp.321-327,2011.
[10]. "Railway Track Security System: Ankita Jadhav", Pallavi Bhangre ,Snehal Gaikwad, Amol Deshpande, International Journal of Engineering Research & Technology (IJERT), Vol. 4 Issue 03, March-2015.
[11]. "Railway security system based on wireless sensor networks", Kalpana Sharma, Jagdish Kumavat, Saurabh Maheshwari and Neeti Jain, Journal of Computer Applications, Vol 96, June 2014.

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