Espial of Flaws in Railway Network Using Wireless Sensor Network

K. Vidya[1] **and R. Gayathri**[2]

ABSTRACT

Railway network provides the most crucial mode of social transportation over the world. Many technologies have been developed to prevent railway accidents but still the major accidents occurring in railway network. The scope of sensing technologies has distended quickly, hence the sensor devices becomes more efficient and cheaper. In this paper, to avoid the major accidents due to derailment and obstacles, the conditioning of tracks and tunnels will be continuously monitored by using WSN. The faults in rail tracks will be detected by using an IR Sensor testing methodology and obstacles in tunnels detected by Ultrasonic Sensor, hence it will reduce the manual inspection necessities and maintenances. The sensed data will send to the control room through wireless transceiver and the exact location of fault will be identified by using GPS. To avoid the minor accidents, the footboard travelling will be monitored by using an IR and Camera. The captured image will be passed to the next station control room through E-mail. The proposed work is implemented using an advanced Raspberry pi model with inbuilt ARM microcontroller LPC2138. The main objective of this paper to upgrade the safety and authenticity of railway network, hence this will lead to a vital development of our country.

Keywords: WSN (Wireless Sensor Network), IR Sensor Testing, Wireless Transceiver, GPS, Raspberry Pi, Ultrasonic Sensor, ARM LPC2148.

1. INTRODUCTION

Railway network provides the fast and reliable worldwide transport facility. It plays a key role in improving the infrastructure and economic growth of a country. It is also having the ability of transporting high level of passengers to their destinations daily. Most of the Railway accidents are happened due to derailment and fatalities because of low investments and human errors. Railway network carrying large number of passengers for many times than its capacity so its damages the tracks due to overloading and also the Indian railway network is lagging with new technologies hence there is a more number of chances for human errors, hence this will lead to major accidents. This paper focuses on the implementation of an effective and an efficient solution for railway accidents by using a WSN technology. WSN is a wireless network made of many tiny devices called as sensor and it is used to oversee the physical criterions and environmental conditions. In this paper, to prevent the major and minor accidents, the conditioning of tracks and tunnels will be monitored by using a sensor devices and the IR Sensor testing Methodology is used to detect the faults. The obstacles in tunnels will be detected by using an Ultrasonic Sensor (HCSR04). The sensed information will passed through a Wireless Transceiver (RSM75) to the control room. In Wireless Transceiver, the PIC Microcontroller (PIC16F72) is used to transmit and receive the information and the status will be updated in PC. The foot board travelling in train will be monitored by using a IR sensor and camera and these devices are connected to the advanced technology called Raspberry pi board with an inbuilt ARM Processor LPC2148. The captured image will passed through an E-Mail to the next station by using WLAN. The simulation results will be obtained by using Proteus Design Suite Version 8.0 software and the main programming language used is an Embedded C Language.

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[1] Assistant Professor of EEE, *Email: vidya@veltechmultitech.org,* [2]M.E

[1,2] Department of Electrical and Electronics, Vel Tech Multi Tech, Avadi, Chennai-600062, Tamilnadu, India, *Email: r.gayathri060192@gmail.com*

Sireesha R, Ajay Kumar B and Bharath Kumar B, [1] has proposed the paper Broken Rail Detection System Using RF Technology in 2015–In this paper, they proposed a new design to identify the broken rail by passing a voltage across the rail tracks and information was displayed by LCD in nearest station through RF. The main drawback of this paper is not identifying the exact location of fault by using GPS Technology.

Athanasios ANASTASOPOULOS, BOLLAS and DIMITRIOS, [3] has proposed the paper Acoustic Emission On-Line Inspection of Rail Wheels in 2010 – They demonstrated this concept by placing AE sensors on the tracks to detect the faults on the wheel to show the lower railcar speeds evidences. But this paper does not provide the exact location of the defect and this is the further work of this paper.

K. Srinivasa Reddy and Geetha Reddy, [4] has proposed the paper Advanced Railway Security System (ARSS) Based on ZIGBEE Communication for Track Fault Detection in 2014–They have designed a crack detector robot to detect the defects in the tracks and it gives an alarm when it detects the fault and the information has been send to nearest station through Zigbee. But in this paper the fault is not continously monitored by using ZIGBEE and the exact location of fault is not detected.

Emad Aboelela and Vinod Vokkarane, [6] has proposed the paper Wireless Sensor Network Model for Secure Railway Operations in 2006–They have proposed new approaches to reduce accidents. But in this paper they have deliberated only about the initial technical and scientific approaches to advance the railroad network using WSN and they does not provide any practical solutions to avoid the railway accidents.

2. PROPOSED METHODOLOGY

In existing system, they have taken only a survey about WSN to continously monitor the railway industry to analyze the vehicles defects, machinery and framework of network. They also discussed a brief description about which sensor devices are to be used and what they used for; and they focused on practical engineering solutions. In this paper, a new design methodology is proposed to prevent the railway accidents by detecting
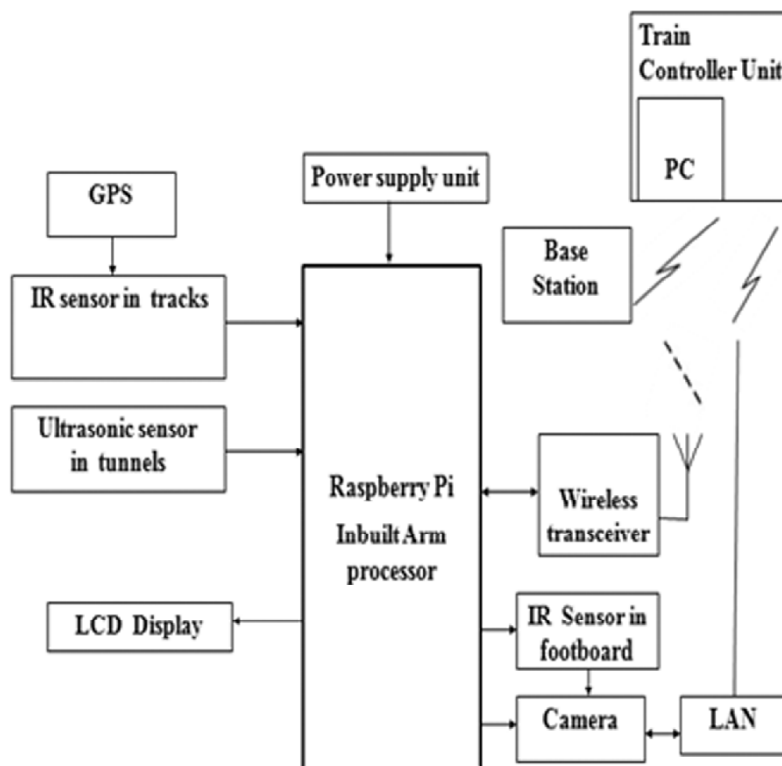

Figure 1: Proposed Block Diagram

the faults in tracks and tunnels by using WSN technology and also it helps to monitor the footboard travelling in train.

2.1. Effective Solution to Prevent Accidents due to Derailment and Fatalities

The conditioning of the tracks will be continuously monitored by using an IR sensor. The sensor will be attached to the advanced technology Raspberry pi board with an in-built ARM processor LPC2148. In this paper, the defects on the rail tracks are detected by using an IR sensor Testing methodology. To detect the cracks, an IR signals are injected into rail tracks. The transmitted signal propagates on the rail track and it will be received by the receiver. When the crack is detected, the information will be displayed using LCD and the defected location is tracked by using GPS. This acquired information will be passed to the control room of station through Wireless Transceiver and it will be continously updated in PC by using WSN.

2.2. Effective Solution to Prevent Accidents Due to Obstacles

In order to prevent the accidents on tunnels, an Ultrasonic sensor is used to detect the obstacles. The sensor will be placed on the inner side of the tunnels and it will be attached to the Raspberry pi board with an in-built ARM processor LPC2148 Microcontroller. When the obstacle is detected in tunnel, the distance of the obstacle will be displayed using LCD and also the location of the obstacle is tracked by using GPS. This acquired information will be passed to the station control room through Wireless Transceiver and it will be continously updated in PC by using WSN technology.

2.3. Effective Solution to Prevent Footboard Travelling on Train

The footboard travelling on train is strictly prohibited. But still the people are not following the rules even they know the punishments. This may lead to the risk of death and serious injuries. In order to prevent these kinds of accidents, the system is design to alert the persons travelling in footboard. In this paper, the persons travelling in footboards on train will be monitor by using an Infrared Sensor (IR) and the camera. These are attached to the Raspberry pi board and it will be fixed in the entry of the compartments. If the sensor detects the person travelling in footboard then the camera will automatically captures the images of the person and that will be passed as an E-Mail to the next station control room through a LAN.

3. RESULTS AND DISCUSSIONS

3.1. Simulation Result for Rail Track in Fault Condition

The result shown in Figure 2 clarifies that when the track is in fault condition then all the LED's will blink to notify that fault is found on rail track with the help of ultra-low power microcontroller ARM LPC2148. The sensed information will be displayed by using LCD. Finally, the collated information will be passed to the control room of the station through Wireless Transceiver and also the defected location is tracked by using GPS technology.

3.2. Simulation Result for Detecting Obstacles using Sensor

The result shown in Figure 3 clarifies that when the sensor detects the obstacles or any objects on the tunnels. Then the LED will blink constantly to notify that the obstacle is found and this information will be displayed as "critical!!!! Obstacle found" on the LCD display.

Finally, the collated data will be passed to the control room of the station through Wireless Transceiver to indicate that the obstacles found on the Railway Tunnel in order to prevent the accidents.
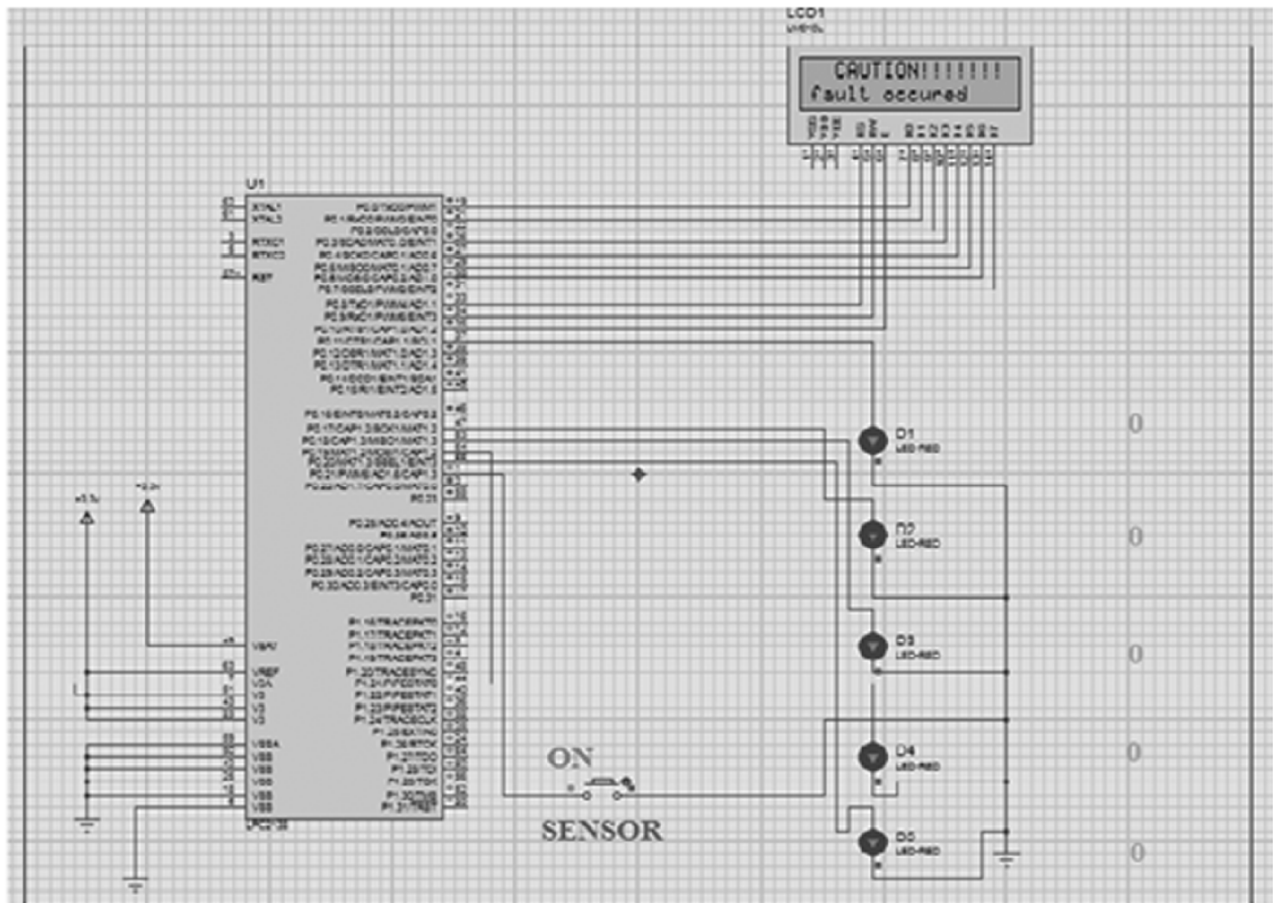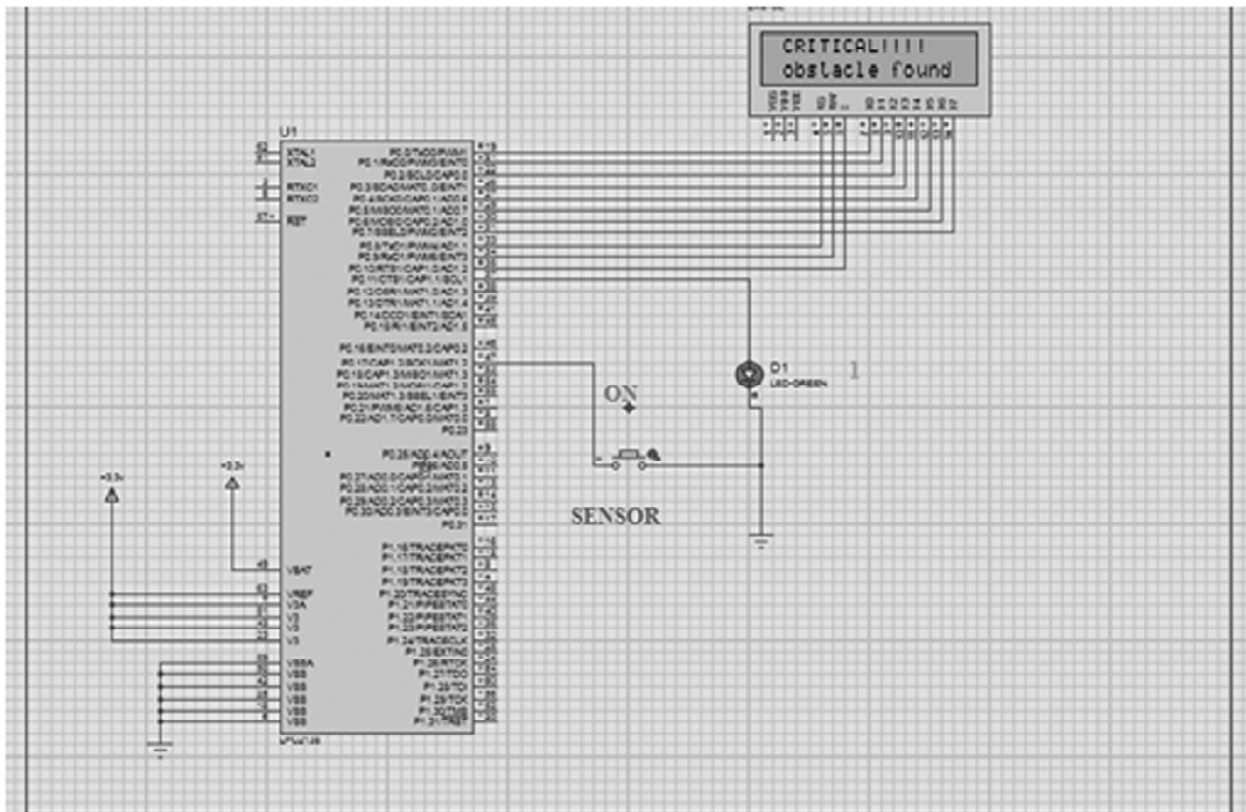
Figure 2: Simulation Result-1

Figure 3: Simulation Result-2

3.3. Simulation Result for Capturing Images of Person

The result shown in Figure 4 indicates that if the sensor detects the person travelling in foot-board then the LED will blink constantly to alert the person and the images of that person will be captured by using camera. The captured image will be send as an E-mail to the next station control room.

4. HARDWARE IMPLEMENTATION

Figure 5 shows the experimental setup of this proposed work. In which there is a Raspberry Pi with an in-built ARM LPC2148, GPS module, Ultrasonic Sensor (HCSR04), IR Sensor, Power supply unit, LCD
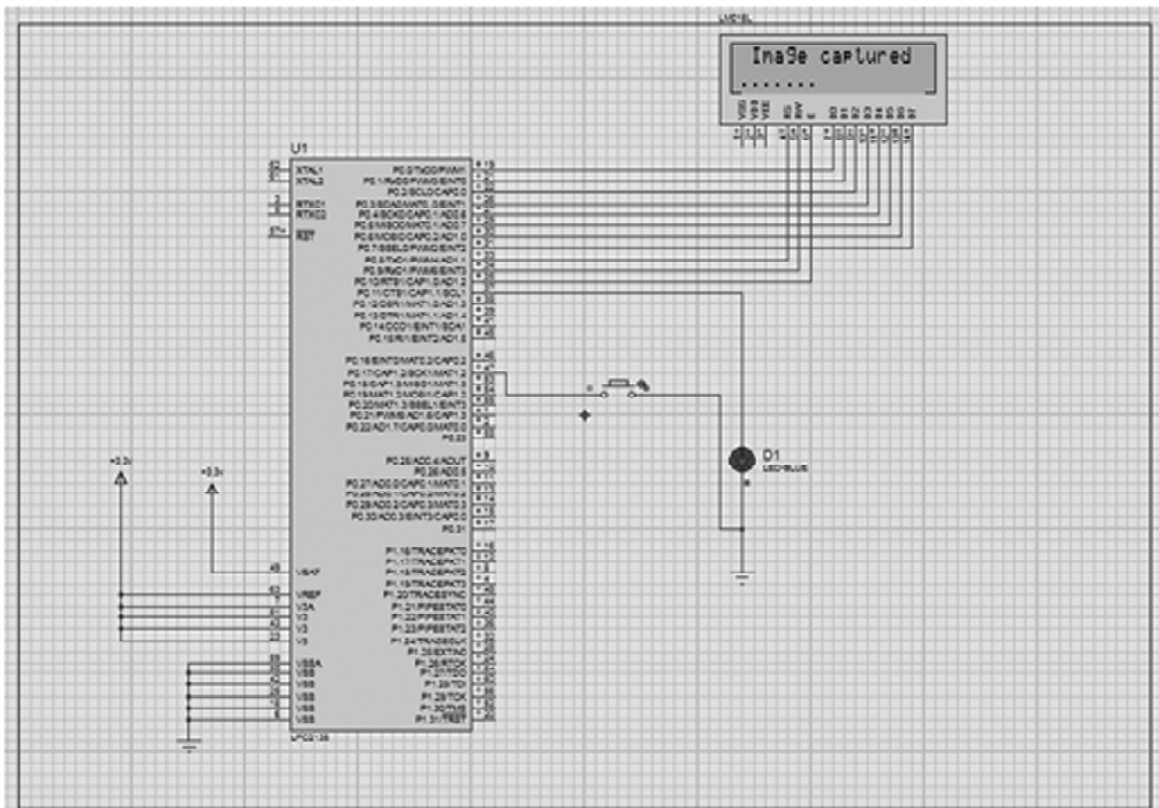

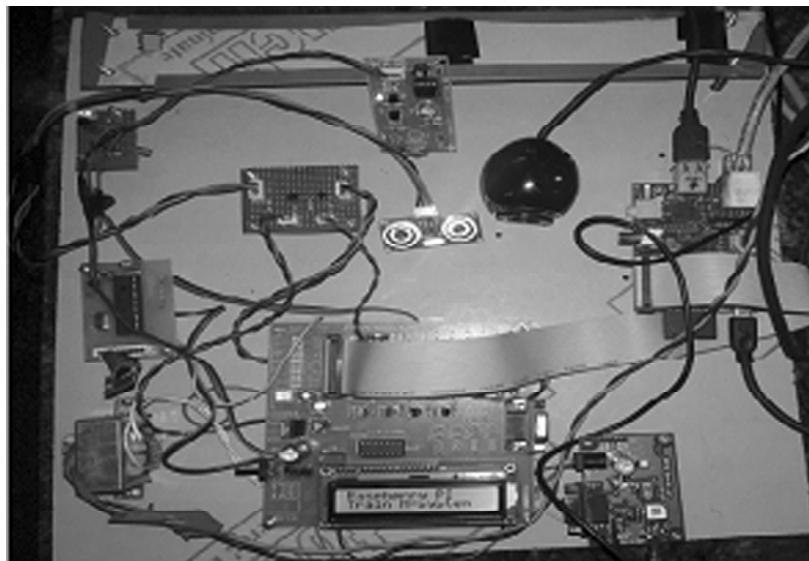
Figure 4: Simulation Result-3

Figure 5: Experimental Setup

Display, Wireless Transceiver (RSM75), PIC 16F72, Web Camera (Crystal Plus 2.0) and PC with LAN connection.

Figure 6 and 7 shows the output for detecting cracks on rail tracks and obstacles on tunnels. An IR sensor and Ultrasonic sensor is interfaced with the Raspberry Pi module with an in-built ARM LPC2148. To detect the cracks on rail track, IR signals are injected into the track and it will be received by the IR receiver. When the crack is detected then the information is displayed in LCD and the location of the defected region is tracked by using GPS. When an obstacle on tunnel is detected by Ultrasonic sensor then the information and the distance of that obstacle will be displayed in LCD. Finally, the collected information will be passed to the control room through Wireless Transceiver and it will be continously updated on pc.

Figure 8 and 9 shows the output for scanning the person travelling in foot-board and the E-mail of the captured image. An IR sensor and a camera are interfaced with Raspberry Pi module with an in-built ARM LPC2148. When the sensor detects the person travelling in foot-board then the information will be displayed in LCD and automatically it activates the camera and the image of the person standing in door step will be captured. The captured image will be passed as an E-mail through a LAN to the next station control room.

Figure 10 shows the output for updating the collective information on PC at the receiver end. In that it will display the real-time information continously through a Wireless transceiver in order to prevent the railway accidents.

Figure 6: Output for Detecting Cracks   **Figure 7: Output for Detecting Obstacles**   **Figure 8: Output for scanning person**
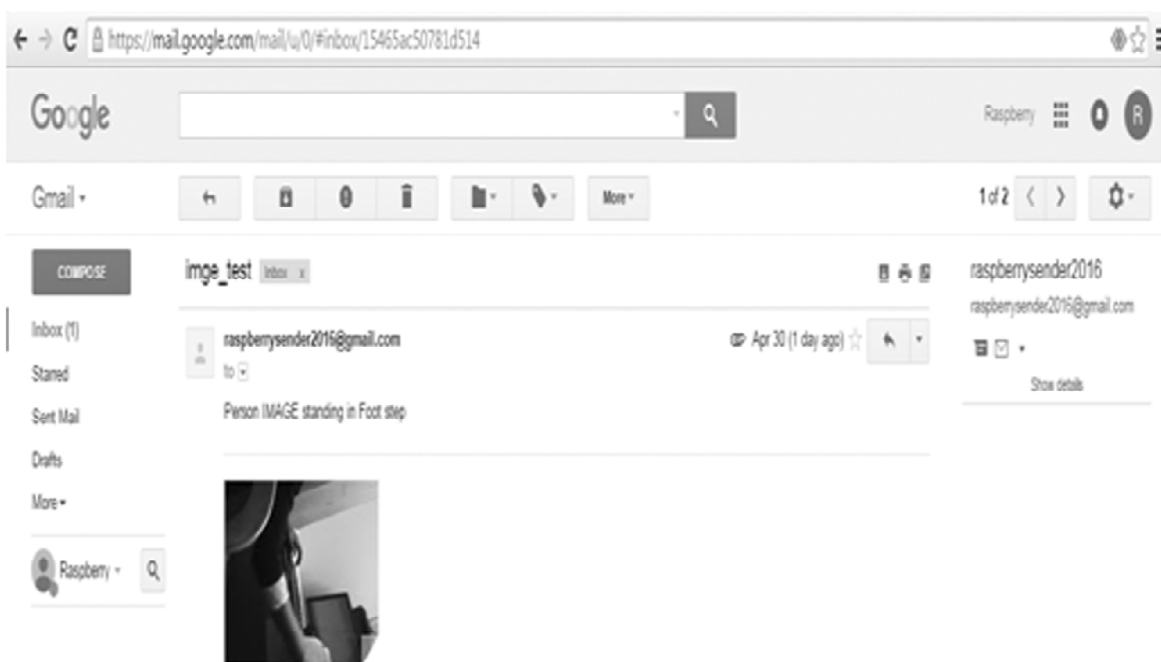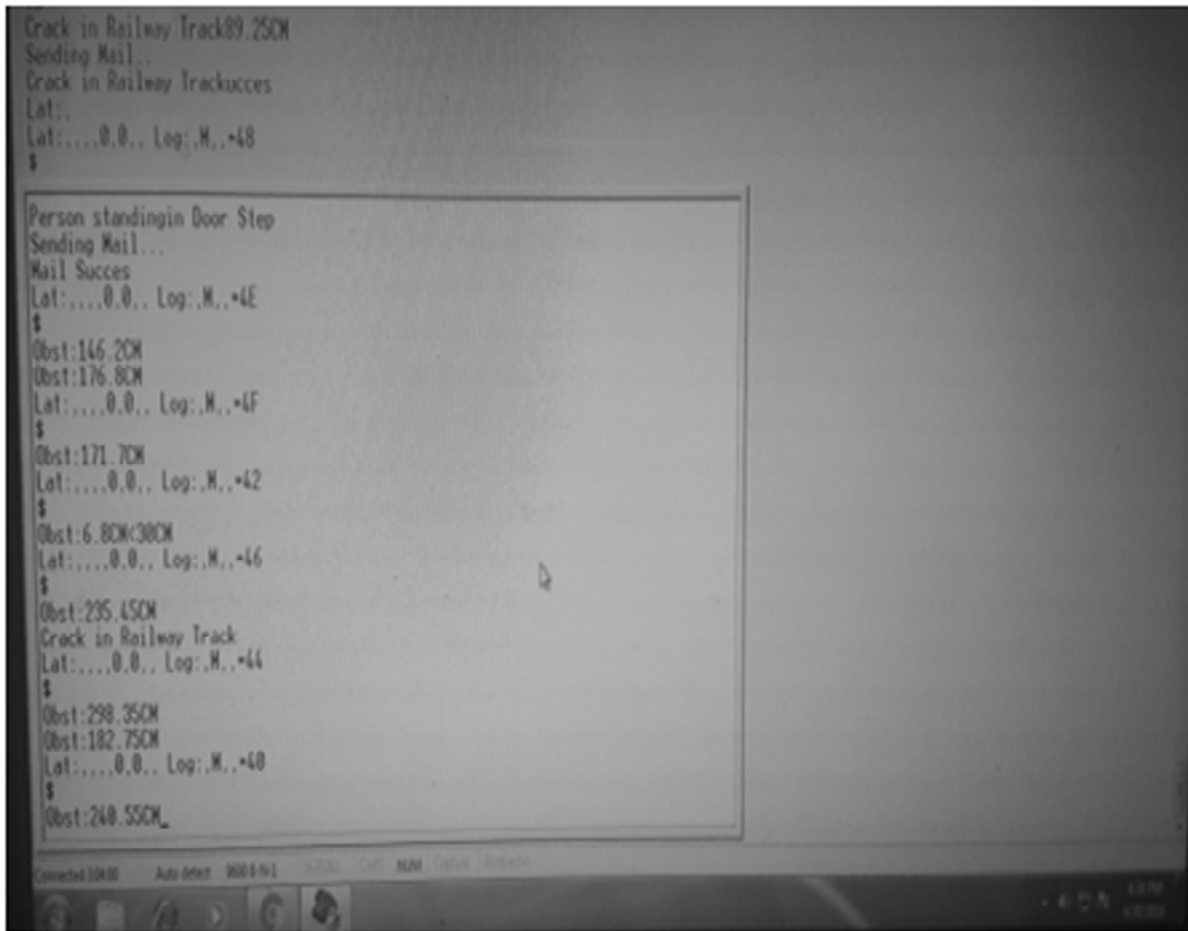

Figure 9: E-mail of Captured Image

Figure 10: Railway Station Control Room PC

5. CONCLUSION

The major involvement of this project is to avoid both the major and less frequent accidents on railway network by using WSN. In this proposed work in order to prevent the accidents, the conditioning of railway tracks, tunnels are monitored and footboard travelling is also continously monitored by using sensor devices and it has been successfully implemented. The hardware implementation of this project is more efficient and low-cost hence it provides a more affordable high performance on railway network. And by providing the information in real-time it will improves the safety and reliability of our railway network and helps to save the human life by preventing from train accidents.

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