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IDENTIFICATION OF FAULT DETECTION IN RAILWAY TRACK

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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 safe journey, reliable and also for low cost. The first preference must be for Railways though the cost is cheap, takes less time to deliver the product.This Monitoring System is for railways transportation to identify the cracks in the railway tracks earlier and prevent the Accidents. To simulate the program in Pic Microcontroller to detect the obstacles on the Railway Track.If some crack is detected on the track by using sensors, the device suddenly stop at respective point automatically and the information about crack or obstacle in crack would be given to control room.If the train starts to derail, the obtained obstacle is measured by using GSM and an alert is given to engine driver and on the other emergency brake is applied automatically. The Aim of the work is to avoid the train accidents without manual power.

***IndexTerm*—** Monitoring System, Accidents, Pic Microcontroller, Alert, Control Room.

I. 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 notify and informs to the corresponding trains it will takes more time informing those information [1].

The 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 equipment is that they are heavy which poses a practical limitation.

II. OBJECTIVE

Ultrasonic sensor was used as a proximity switch, in the sense that whenever there is obstacle in the way of ultrasonic sensor (in front of the train), it will automatically give an indication through the led which blinks red and the buzzer will continue sounding until the drivers stops the train for the object on the track to be removed. Similarly the rain sensor detects the presence of flood on the track up to a certain height, if the water level reaches the height on the track, the rain sensor sends a feedback to the train operator to stop the train and the rain sensor detects the water level and alerts the driver to slow the speed of the train to avoid the derailments With all this sensor installed on the train, we can reduce railway accident to a significant margin, which will lead to a

smooth operation of the railway and increase profitability of the railway company.

The core objective of this work is to:

- To implement this detection system to control the Derailment and avoid major train upsets
- To detect the crack on railway track and using digital cellular communications (GSM – SIM 900A)
- The robot gives more accuracy to detect the faults compared to other available sensor

It helps in reducing railway accidents with high margin, maximizing the profit margin and minimizing the laborcost.

III. PROBLEM DEFINITION

In the previous systems, the robots were designed by Arduino as theirprocessing unit and ultrasonic sensors for obstacle detection but a SD cardmodule is used for data storage which increased the complexity. In somesystems a simple 8bit microcontroller was used. In some systems theoverall size of the system was big and heavy which reduced the overallcompactness of the system. In some systems multiple ultrasonic or IRsensors were used for obstacle detection which has less accuracy whencompared to ultrasonic sensors. The algorithms used for obstacleavoidance also plays in important role in determining the complexity ofthe system. A system used fizzy algorithms for obstacle avoidance for therobots used in mines the algorithms were more complex and difficult tounderstand for the beginners it needs expert assistance. Some systemsused high accurate laser sensors for obstacle detection which increased theoverall cost of the system and increased complexity and reduces theoverall compactness of the system. Hence the system should have accurateobstacle detection and avoidance and also to provide some extra featureslike surveillance without reducing the overall compactness of the systemwith minimal cost.

IV. PROPOSED SYSTEM

Proposed solution is conceptually much simple. The idea behind it is, providing a low cost, less complex, highly reliable and most importantly user friendly to implement as well as handle for man. The proposed system consists of a PIC Microcontroller(16F877A) its brain and ultrasonic sensor for obstacle detection. The system consists of four motors and the motors are controlled by a motor driver. It uses H-bridge concept is implemented Which consists of four channels to produce equal current and voltage on all the four channels and is responsible for driving the motors. It uses SMPS Battery is used for Better Performing. And it also used GSM Module along with a SIM 800A to pass messages to the receiver. This idea in the project will definitely leads to a great change in avoiding derailment in the railway tracks.

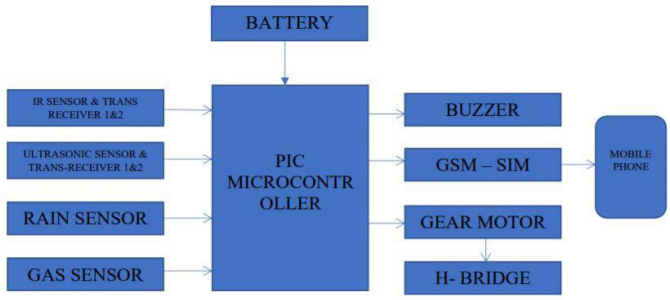


Fig.1.Experimental Setup

V. WORKING PRINCIPLE

The stator provides a rotating magnetic field that drives the armature to rotate and Works with the input supply of 4.6v to 36v and during simulation the applied voltage is 9v.All the objects radiate some form of thermal radiation which is detected by an infrared sensor.It has IR led and the detector is a simple IR photodiode that is sensitive to IR light with same wavelength as that emitted by IR led. So IR Sensor is the combination of an IR transmitter & receiver, then the receiver's wavelength must equal the transmitter.It works under propagation of sound waves in the range of 20KHzand it is not audible by human ears. So it sends the signal throughthe transmitter part and reflected by the receiver part. It is capable of detecting objects in the range of 2cm-400cm and the supply is 5v. It consists of 4 pins namely TRIG, ECHO, VCC and GND. The TRIG pin acts as the output and the ECHO pin acts as the input. It also helps to find the objects and obstacles in the track.

VI. HARDWARE DESCRIPTION

The hardware components used in the projects are described below.

A. PIC Microcontroller [PIC16f877a]

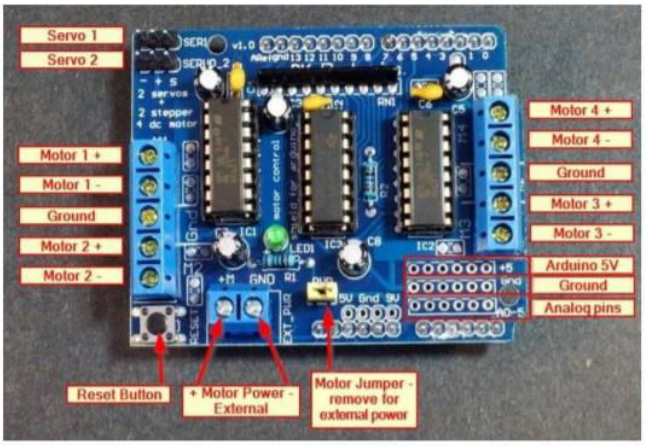
The PIC Microcontroller [PIC16f877a] is one of the most renowned microcontrollers in the industry. This microcontroller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output.

PIN CONFIGURATION OF PIC

PIN 1: The first pin is the master clear pin of this IC. It resets the microcontroller and is active low, meaning that it should constantly be given a voltage of 5V and if 0 V are given then the controller is reset. Resetting the controller will bring it back to the first line of the program that has been burned into the IC. PIN 2: PORTA consists of 6 pins, from pin 2 to pin 7, all of these 13 are bidirectional input/output pins. Pin 2 is the first pin of this port. This pin can also be used as an analog pin AN0. It is built in analog to digital converter. PIN 3: This can be the analog input 1. PIN 4: It can also act as the analog input2. Or negative analog reference voltage can be given to it. PIN 5: It can act as the analog input 3. Or can act as the analog positive reference voltage. PIN 6: To timer0 this pin can act as the clock input pin, the type of output is open drain PIN 7: This can be the analog input 4. There is synchronous serial port in the controller also and this pin can be used as the slave select for that port. PIN 8: PORTE starts from pin 8 to pin 10 and this is also a bidirectional input output port. It can be the analog input 5 or for parallel slave port it can act as a 'read control' pin which will be active low. PIN 9: It can be the analog input 6. And for the parallel slave port it can act as the 'write control' which will be active low. PIN 10: It can be the analog input 7, or for the parallel slave port it can act as the 'control select' which will also be active low just like read and write control pins. PIN 11 and 32: These two pins are the positive supply for the input/output and logic pins. Both of them should be connected to 5V. PIN 12 and 31: These pins are the ground reference for input/output and logic pins. They should be connected to 0 potential. PIN 13: This is the oscillator input or the external clock input pin. PIN 14: This is the oscillator output pin. A crystal resonator is connected between pin 13 and 14 to provide external clock to the 14 microcontroller. ¼ of the frequency of OSC1 is outputted by OSC2 in case of RC mode. This indicates the instruction cycle rate. PIN 15: PORTC consists of 8 pins. It is also a bidirectional input output port. Of them, pin 15 is the first. It can be the clock input of timer 1 or the oscillator output of timer 2. PIN 16: It can be the oscillator input of timer 1 or the capture 2 input/compare 2 output/ PWM 2 output. PIN 17: It can be the capture 1 input/ compare 1 output/ PWM 1 output. PIN 18: It can be the output for SPI or I2C modes and can be the input/output for synchronous serial clock. PIN 23: It can be the SPI data in pin. Or in I2C mode it can be data input/output pin. PIN 24: It can be the data out of SPI in the SPI mode. PIN 25: It can be the synchronous clock or USART Asynchronous transmit pin. PIN 26: It can be the synchronous data pin or the USART receive pin. PIN 19,20,21,22,27,28,29,30: All of these pins belong to PORTD which is again a bidirectional input and output port. When the microprocessor bus is to be interfaced, it can act as the parallel slave port. PIN 33-40: All these pins belong toPORTB.Out of which RB0 can be used as the external interrupt pin and RB6 and RB7.

B. e L298N motor driver Module

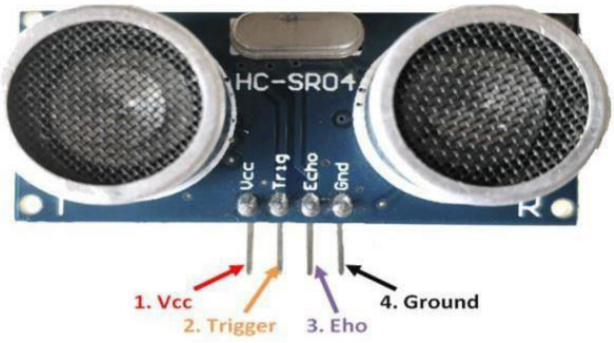
L298N is an integrated circuit multi watt 15 package and capable of giving high voltage. It is a high current dual full-bridge driver that is designed to accept standard TTL logic levels. It can drive inductive loads e.g. relays, solenoids, motors (DC and stepping motor), etc.
Its basic features are:
• Maximum supply voltage 46V
• Maximum output DC current 4A
• Low saturation voltage
• Over-temperature protection
• Logical "0" Input Voltage up to 1.5 V



C. Ultrasonic Sensor (HC-SR04)

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e., the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter Tx (which emits the sound using piezoelectric crystals) and the receiver Rx (which encounters the sound after it has travelled to and from the target). It works on the principle of propagation of sound waves. It uses ultrasonic sound waves which are in the range of 20 KHz 21 which is not audible to human ears. The ultrasonic waves are transmitted from the Tx part and it is reflected back to the Rx part by the obstacles in front of it, by this methodology ultrasonic sensor detects the objects. The

sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated. It is capable of detecting objects in the range of 2cm-400cm. It does not detect the objects when the angle of reflection is high. It works with a supply of 5v. It consists of 4 pins namely TRIG, ECHO, VCC and GND. The TRIG pin acts as the output and the ECHO pin acts as the input. The Pin configuration is shown below.



D. DC Motor

DC motor is used to refer to any rotary electrical machine that converts direct current electrical energy into mechanical energy. DC motors can vary in size and power from small motors in toys and appliances to large mechanisms that power vehicles, pull elevators and hoists, and drive steel rolling mills. DC motors include two key components: a stator and an armature. The stator is the stationary part of a motor, while the armature rotates. In a DC motor, the stator provides a rotating magnetic field that drives the armature to rotate. A simple DC motor uses a stationary set of magnets in the stator, and a coil of wire with a current running through it to generate an electromagnetic field aligned with the centre of the coil. One or more windings of insulated wire are wrapped around the core of the motor to concentrate the magnetic field. The windings of insulated wire are connected to a commutator (a rotary electrical switch), that applies an electrical current to the windings.The commutator allows each armature coil to be energised in turn, creating a steady rotating force (known as torque).When the coils are turned on and off in sequence, a rotating magnetic field is created that interacts with the differing fields of the stationary magnets in the stator to create torque, which causes it to rotate. These key operating principles of DC motors allow them to convert the electrical energy from direct current into mechanical energy through the rotating movement, which can then be used for the propulsion of objects.

E.MQ2 Gas Sensor

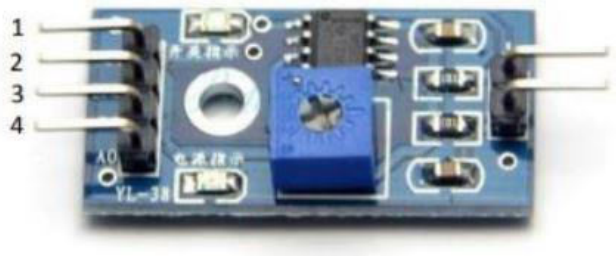
MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide.MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact withthe gas. This change in the value of resistance is used for the detection of gas.The voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high.

F. IR Sensor

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

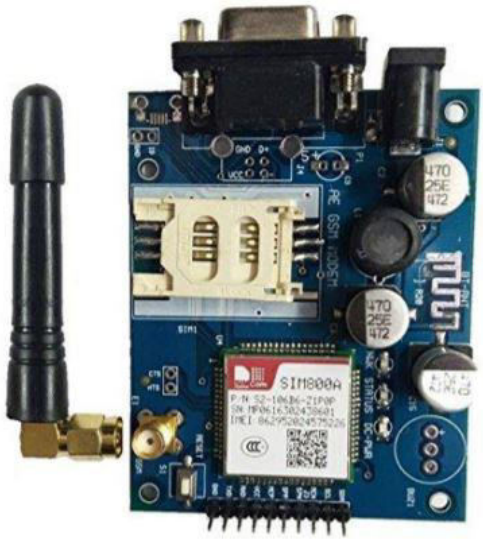
G. Rain Sensor

The Rain Sensor board includes nickel coated lines and it works on the resistance principle. This sensor module permits to gauge moisture through analog output pins & it gives a digital output while moisture threshold surpasses.This sensor is a resistive dipole, and based on the moisture only it shows the resistance. For example, it shows more resistance when it is dry and shows less resistance when it is wet.



H. GSM – SIM 800A

The SIM800A Quad-Band GSM/GPRS Module with RS232 Interface is a complete Quad-band GSM/GPRS solution in an LGA (Land grid array) type which can be embedded in the customer applications. SIM800A support Quad-band 850/900/1800/1900 MHz, it can transmit Voice, SMS and data information with low power consumption.



I. . Battery

A sealed lead acid battery or gel cell is a lead acid battery that has the sulfuric acid electrolyte coagulated (thickened) so it cannot spill out. They are more expensive than normal lead acid batteries, but they are also safer. They use different chemicals than dry cells, so they are rechargeable.

VII. CONCLUSION

All the components of the system are interfaced in the MP LAB software and the results are verified before entering into hardware testing. Now the robot is tested for accuracy and its object avoiding potential. The robot is in motion until the

SPEED OF THE ROBOT (cm/s)	DISTANCE FROM THE OBSTACLES (cm)	OUTCOMES
76.93	54	Robot is in motion
76.93	35	Robot is in motion
76.93	14	Robot is in motion
0	9	Robot is at rest

object comes to a distance of 15 cm. The robot can be further developed to increase the accuracy around corners. 41 Now out of 30 obstacles the robot detects and avoids 28 obstacles successfully within the given threshold distance of 15cm.

It is a cost effective and simple system which can be used in rescue and surveillance or spying operations. It reduces the overall risk taken by the people involved in the rescue missions as well as police or military personals involved in surveillance or spying missions. Here an attempt is made to construct an obstacle avoidance robot which is compact in size and a simple system which also transfers live video footage of the location where it is deployed. With this system new exploration can be made in disaster affected locations in search of any alive persons without taking much risks by the rescue people. There are highest chances of reducing the risks of the people involved in those works. The robot is constructed using simple components and simple algorithms for obstacle detection and avoidance which makes the robot simpler and more cost effective and compact in nature.

VIII. FUTURE SCOPE

In future the robot can be further enhanced by adding more advanced and higher accurate LIDAR sensor. Image processing techniques can be used to detect and differentiate between humans and objects. Any forms of alert systems like GSM or WIFI module can be added to send message to the rescue team if any human is detected and GPS module can be implemented to identify the exact location of the robot. Also, machine learning and artificial intelligence algorithms can be implement accurate detection of humans and more accuracy in object detection and avoidance.

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