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GSM Based Railway Bridge Damage and Track Failure Detection

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Abstract-The main objective of this project is to detect the fault location in the railway tracking system. In now-a-days there is a requirement for effective fault detection system in tracks. The railway bridge is damaged due to higher loads travelling on the bridge; accident may occur due to track failures is very difficult to continuous monitor. The faults are mainly caused by climatic changes, ineffective monitoring, and manual actions. These flaws in the detection system can be effectively overcome by our detection system which is developed using microcontroller. This is built by using AT89c52 micro controller, interfaced with LCD display system, relay and a buzzer to indicate fault, by taking feedback from the crack detection in tracks. We developed a computer automation system for above problem with the help of Piezo vibration sensors, track failure detection sensors along with the message sending to the phone.

Indexed Terms-AT89C52 Micro Controller, GSM, Piezo Vibration Sensor, Buzzer,and LCD.

1. INTRODUCTION

The electronics deals with electrical circuits that involve active electrical components such as vacuum tubes, transistors diodes and integrated circuits and associated passive interconnection technologies, the nonlinear behavior of active components and their ability to control electron flows makes amplification of week signals possible and electronics is widely used in information, telecommunication and signal processing.

The ability of electronic devices to act as switches makes digital information processing possible. Interconnection technologies such as circuit boards, electronics packing technology

And other varied forms of communication infrastructure complete circuit functionality and transform the mixed components into a regular working.

2. CRITERIA OF CHOOSING AT89C52 MICROCONTROLLER

TheAT89C52isalowpower,highperformanceCMOS8-bitmicrocontrollerwith8K bytes of in-systemprogrammableFlashmemory.Thedeviceismanufacturedusing Atmel's high-density non volatile memory technology And is compatible with the industry standard 80C51 instructionsetandpinout.Theon-chipFlashallowstheprogrammemorytobereprogrammed in-system or bya conventional nonvolatile memory programmer.In addition, the AT89C52is designed with static logic for operation down to zero frequencyandsupportstwosoftwareselectablepower savingmodes.TheIdleModestopsthe CPUwhileallowingtheRAM,timers/counters,serialport andinterruptsystemtocontinue functioning. The power-down mode saves the RAM contents but freezes the oscillators, disabling allother chip functions

2.1 features *of AT89C52*

- Compatible with MCS-51 products
- 8K bytes of in system reprogrammable flash memory.
- Endurance: 1,000 write/Erase cycles.
- Full static operation:0Hz to 24MHz
- Three level program memory lock
- 256*8 Bit Internal Ram
- 32 programmable I/O lines
- Three 16-bit Timer/counter
- Eight Interrupt Sources

3. PIN DIAGRAM

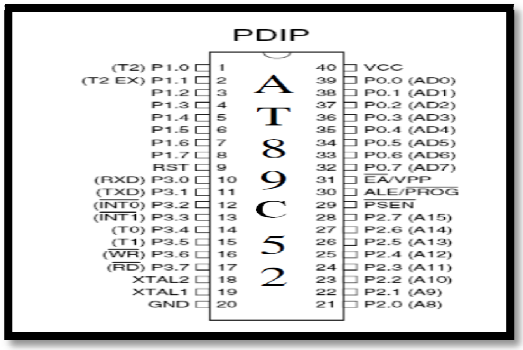

FIG.3.1.PIN DIAGRAM OF MICRO

CONTROLLER

3.1Description of pin diagram

(a) VCC: PIN 40 Provides Supply voltage to the chip. The voltage source is +5v.

(b) GND: Pin 20 to ground.

(c) PORT 0: Port 0 is an 8-bit open drain bidirectional I/O port.As an output port each pin can sinkeight TTL inputs.

(d)PORT 1: Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers cansink/source four TTL inputs.

(e)PORT 2: Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers cansink/source four TTL inputs.

(f)PORT 3: Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 3 output buffers cansink/source four TTL inputs.

(g)RST: RST means RESET. 89C52 uses an active high reset pin. It must go high for two machine cycles.

(h)ALE/PROG: ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction

(i)PSEN (Program store Enable): Program Store Enable is the read strobe to external program memory.

(j)EA/VPP (External Access): EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at OOOOH up to FFFFH.

(k)XTAL1 AND XTAL2: Xtal1 isInput to the inverting oscillator amplifier. Xtal2 is Output from the inverting oscillator amplifier.

(l)DATA POLLING: The AT89c52 features data polling to indicate the end of a write cycle.

(m)READY/BUSY: The progress of byte programming can be monitored by RDY/BSY.

(n)CHIP ERASE: The entire flash array is erased electrically by using the proper combination of control signals and by holding ALE\PROG low for 10ms.

4. EXPLANATION OF BLOCK DIAGRAM

The block diagram of Railway bridge damage and track fault notification usingalarm system consists of power supply, AT89C52 microcontroller,buzzer, buzzer driver, GSM modem, Quartz crystal oscillator, 16X2 LCD display.

The power supply consists of central tapped transformer, full wave rectifier and voltage regulator. The AC230V is given to the center tapped transformer. Center tapped transformer works step down transformer it works AC230V to 12V A.C. full wave rectifier converts bidirectional A.C into uni-directional pulsating d.c voltage regulator converts 16.8V (or) 12V A.C, into 5V d.c. It maintains both line and load regulations. The main function of power supply is AC 230V is converted into 12V& 5V. 5V DC is used to all logic sections i.e. Microcontroller, RS connector. MAX232 converter etc and 12V D.C. is used for buzzer etc.

Piezo vibration sensor transfers the information to the micro controller.P3.0 and P3.2 is connected to MAX 232 converter. Modem means transmission and reception is connected to D-type 9 connector. Dip 9 connector input is given to the modem. Modem checks the message and transfer to the MAX 232 converter.MAX232 converter follows at commands and information is given to micro controller.

The 16X2 dot matrix LCD display has 8data lines are connected to the port0.port2.7 is connected to RS, port 2.6 is connected to R\W and P2.5 is connected to enable.

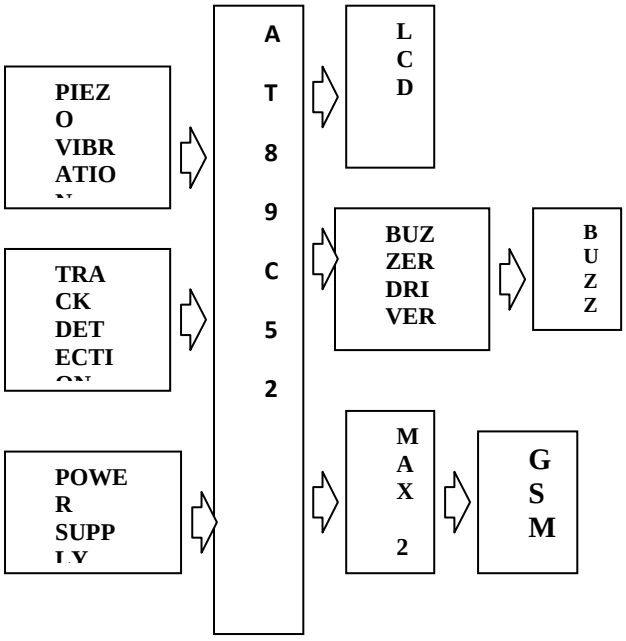

FIG.4.1.BLOCK DIAGRAM OF RAILWAY BRIDGE DAMAGE AND TRACK FAULT DETECTION

5. CIRCUIT DIAGRAM

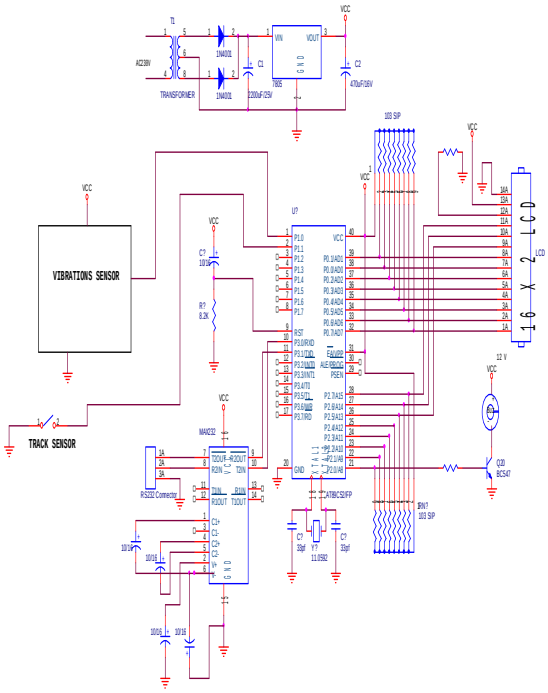

FIG.5.1.CIRCUIT DIAGRAM OF RAILWAY BRIDGE DAMAGE AND TRACK FAULT DETECTION

5.2. Description of circuit diagram

The GSM (Global system for Mobile) network is used to provide the communication from one place to another place. GSM module consists of the mobile station. The commands that are used to provide communication are AT commands. the instruction are AT commands. These instructions are used to control a modem. "AT" means "Attention". Every command starts with AT (or) at. That's why modem commands are called "AT commands". Actually AT commands are 200 but here we are using some extended AT commands to send the message by using GSM modem.

AT + CMGF - Message format
AT + CPMS - Preferred message format
AT + CMGW - Write message to memory
AT + CMD Write the information to modem
AT + CMSS - Send message from storage
AT + ERS - Erases the message
AT + CNMI - Nero message indication to TE

The max 232 gets the commands from the processor and is given to the modem. RS 232(Recommended Standard 232) is standard for serial binary single – ended data and control signals connecting between a DTE (Data terminal equipment) and a DCE (Data communication equipment) The RS 232 connector is also called Dip-9. It has 9pins, 2rows, but we used 3 pins only. These are TXD, RXD, and Ground because it performs both transmission and Reception. It gives information to the MAX 232 converter.

MAX 232 converter is a level shifter and it has 16 pins. MAX 232 is a converter which converts the TTL voltage levels to RS 232 voltage levels and vice versa. The TTL voltage levels are (0.5) V that is '0v' means logic '0' and '5v' means 'logic 1' and RS232 voltage levels are -12v to +12v. In this purpose '-12v' means 'logic1' and +12v means 'logic0'. The MAX 232 converter connected to the p3.0 and p3.1 of microcontroller.

The user's mobile numbers are predefined numbers. These predefined numbers are which are programmed in microcontroller. The LCD displays at the processor end, the entire process that is "SMS SENDING", "SMS RECEVING" will be display.

If Bridge vibration intensity is more than pre-determined level then immediately rises the alarm for nearest people, rises the red light indication to subsequent trains travelling through the bridge. After that the micro-controller transmits data to nearest base station via ASK modulation. Then, type of fault occurred at the base-station through 16*2 LCD display.

5.3 Technical specifications

1. Capacitors - 2200uF/25V - 1
 - 470uF/16V - 1
 - 10PF/50V - 6
 - 104PF - 1
 - 33PF - 2
2. Resistors - 10 kilo ohms - 2
 - 8.2 kilo ohms - 1
 - 1 kilo ohms - 1
3. Diodes - IN 4007 - 1
4. Transformer - (12-0-12) V - 1
5. Regulator - LM 7805 - 1
6. Transistors - NPN BC547 - 1
7. Microcontroller - AT89C52 - 1
8. Oscillator- 11.059MHZ - 1
9. Display - 16X2 LCD - 1
10. Connector- DIP 9 connector - 1
11. Converter- MAX 232 converter - 1

6. HARDWARE COMPONENTS

6.1. Power supply: The supply given is the +5V D.C. The incoming power is 230V A.C., there is a need to convert it into +5V D.C. The input A.C. supply is stepped down from 230V to 9-0-9V. The rectifier consists of diodes D1 and D2 makes the supply D.C.The output of ordinary power supply is fed to the voltage regulator which produces the final output.

6.2. Need of rps:In an ordinary power supply, the voltage regulation is poor i.e. D.C. output voltage changes with load current. Output voltage also changes due to variations in the input A.C. voltage. So for that purpose we need RPS.

6.3. Center tapped transformer:The center-tapped transformer has two sets of coils on either the primary or secondary side. To create the connections required for the full-wave rectifier circuit shown below, you will have to short the two middle pins on the secondary side together. Set the sine wave amplitude to 5V and the offset to 0V

6.4. Liquid crystal display: To understand the operation of an LCD, it is easiest to trace the path of a light ray from the backlight to the user. The light source is usually located directly behind the LCD, and can use either LED or conventional fluorescent technology. From this source, the light ray will pass through a light polarizer to uniformly polarize the light so it can be acted upon by the liquid crystal (LC) matrix. The light beam will then pass through the LC matrix, which will determine whether this pixel should be “on” or “off”. If the pixel is “on”, the liquid crystal cell is electrically activated, and the molecules in the liquid will align in a single direction. This will allow the light to pass through unchanged. If the pixel is “off”, the electric field is removed from the liquid, and the molecules with in scatter. This dramatically reduces the light that will pass through the display at that pixel.

6.5. Interfacing LCD to micro controller:This is the first interfacing example for the parallel port. We will star with something simple. This example does not use the Bi-directional feature found on newer ports, thus it should work with most, if not all Parallel Ports. It however does not show the use of the status port as an input.

Features

- Interface with either 4-bit or 8-bit microprocessor.
- Display data RAM
- Character generator RAM
- Display data RAM and character generator RAM may be
- Clear Display, Cursor Home, Display ON/OFF, Cursor
- ON/OFF, Blink Character, Cursor Shift, Display Shift.
- Built-in reset circuit is triggered at power ON.

6.6. MAX 232:The **MAX232** is an IC, first created in 1987 by Maxim Integrated Products, that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The drivers provide RS-232 voltage level outputs from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supplydesign does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs to standard 5 V TTL levels.

6.7. PIEZO VIBRATION SENSOR:This project is an intelligent railway crossing device that detects the vibration in the railways, and activates a warning or gate closure when necessary. This will be done by using a piezoelectric sensor to take in the vibrational signals and convert them into an electric signal. We will be using a microprocessor to process these signals and output appropriately to external devices and further our goals of safe railways crossing. A piezoelectric sensor is a transducer which uses the piezoelectric effect to turn pressure and strain into an electronic signal. Piezoelectric sensors are very versatile and can be used for taking measurements after a certain time interval or in situations which require a fast response. They can also operate at very high temperatures ranging up to 500ºC.

6.8. BUZZER:The PS series are high-performance buzzers that employ anamorph piezoelectric elements and are designed for easy incorporation into various circuits. They feature extremely low power consumption in comparison to electromagnetic units. Because these buzzers are designed for external excitation, the same part can serve as both a musical tone oscillator and a buzzer

6.9. BUZZER DRIVER:

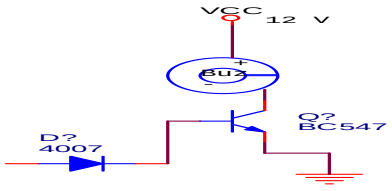

FIG: DIAGRAM OF BUZZER DRIVER

The circuit is designed to control the buzzer. The buzzer ON and OFF is controlled by the pair of switching transistors (BC 547). The buzzer is connected in the Q2 transistor collector terminal. When high pulse signal is given to base of the Q1 transistors, the transistor is conducting and close the collector and emitter terminal so zero signals is given to base of the Q2 transistor. Hence Q2 transistor and buzzer is turned OFF state.

When low pulse is given to base of transistor Q1, the transistor is turned OFF. Now 12V is given to base of Q2 transistor so the transistor is conducting and buzzer is energized and produces the sound signal.

7. GLOBALSYSTEM FOR MOBILE COMMUNICATION

7.1. ***Introduction:***Global SystemforMobilecommunications(GSM)isthemost popularstandardfor mobilephonesintheworld.GSMdiffersfromitsprede cessorsinthatbothsignalingandspeech channelsaredigitalcallquality,andthusisconsidereda secondgeneration(2G)mobilephone system.Thishasalsomeantthatdata communicationwaseasytobuildintothesystem..GSMals opioneereda low-cost alternative to voice calls, the Short message service (SMS, also called "text messaging"),whichisnowsupportedonothermobiles tandardsaswell.Oneofthekeyfeatures ofGSMistheSubscriberIdentityModule(SIM),com monlyknownasaSIMcard. This allowstheusertoretainhisorherinformationafterswit chinghandsets.

7.2. GSM architecture:

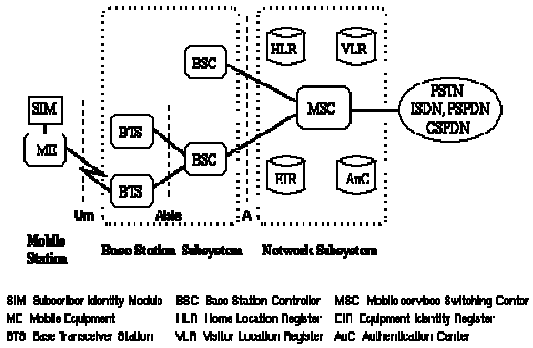

FIG: 7.3 ARCHITECTURE OF GSM NETWORK

A GSM network is composed of several functional entities, whose functions and interfacesarespecified.TheGSMnetworkcanbedivid edintothreebroadparts.TheMobile Stationiscarriedbythesubscriber.TheBaseStationSu bsystemcontrolstheradiolinkwith theMobileStation.TheNetworkSubsystem,themain partofwhichistheMobileservices SwitchingCenter(MSC),performstheswitching ofcallsbetweenthemobileusers,and betweenmobileandfixednetworkusers.TheMSCals ohandlesthe mobilitymanagement operations.NotshownistheOperationsandMaintena nceCenter,whichoverseestheproper operationandsetupofthenetwork.TheMobileStation andtheBaseStationSubsystem communicateacrosstheUminterface,alsoknownasth eairinterfaceorradiolink.TheBase Station SubsystemcommunicateswiththeMobileservicesSwitchi ngCenteracrossthe interface.

7.4. Track fault detection:

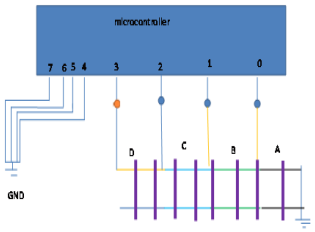

FIG: 7.5.PORT DIAGRAM OF TRACK FAULT DETECTION

From the figure if there is damage at port A then the information does not go to remaining ports. for example if there is damage at port B then the information does not go to port C and port D but the port A is normal. then the port A is 0 remaining are indicated as 1.Another example is if there is damage at port C then the information does not go to port D but port A and port B are normal then port C &D is 1 and A&B is 0 finally if there is damage at port D remaining A&B&C are normal i.e. 0 and the port D is treated as1.this can be explained by used table as follows.

7	6	5	4	3	2	1	0	Hexadecimal form	Track fail area
0	0	0	0	0	0	0	0	00	NO
0	0	0	0	1	1	1	1	0F	A
0	0	0	0	1	1	1	0	0E	B
0	0	0	0	1	1	0	0	0C	C
0	0	0	0	1	0	0	0	08	D

FIG: 7.6.DATA FROM PORT TO FAILURE AREAS

8. RESULTS

The Railway bridge damage and track fault notification using alarm system based on vibration of the bridge. The figure is as follows.

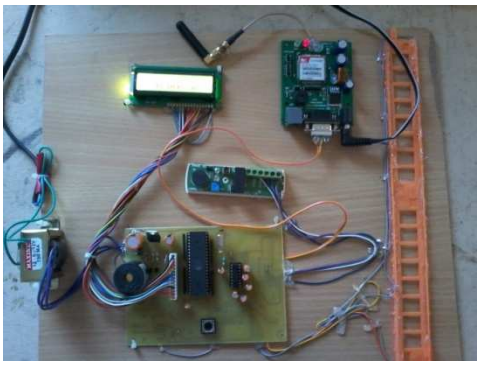

FIG.8.1.SNAPSHOT FOR RAILWAY BRIDGE DAMAGE AND TRACK FAULT NOTIFICATION

9. ADVANTAGES AND APPLICATIONS

9.1. *Advantages:*

- Very accurate detection
- It also checks surface and near surface of the cracking position
- Accidents is reduced

9.2. Applications:

- Wireless Applications
- Railway Track Damage Detection Applications
- Industrial and Access Control
- Other Remote Control System
- Navigation Systems

10. CONCLUSION

We have completed our project "GSM BASED RAILWAY BRIDGE DAMAGE DETECTION AND TRACK FAILURE DETECTION" Successfully. This project is very useful for us because we gained more knowledge in it.

We selected the Domain Embedded System. It's Hardware implementation is very much useful to understand the operation and performance of each component that we are using being as an Electronics Engineer. Our project is used in number of application mainly in Bridge damage and Track fault Notification. If the bridge vibration intensity is more than the pre-determined level then immediately give an SMS alert to nearest base station. We can implement this project by writing coding in embedded systems it automatically gives the signals to guide the people.

This project gives us more knowledge and benefit like we cooperated togetherand worked as a complete team and every person being responsible. We faced a few difficulties, but we understood how to solve and overcome it to complete our project.

11. FUTURE SCOPE

In Foreign Countries Track problems or accidents in railroad Adverse weather conditions railings are increasing day by day so this project is very useful in future. In our country Big Metropolitan cities only it was implemented. Further in future this project Railway Bridge Damage and Track Fault Notification will be drastically improve in various areas. It will also increase the security for trains.

12. REFERENCES

The information required for developing the project and presenting the report is gathered from:

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1. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J Ayala.

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13. AUTHORS BIBLOGRAPHY

K. V. V. Kumar born in India 1987. Obtained his B.Tech, from VRS&YRN College of Engineering and Technology Chirala. During 2007-2010. & M.Tech from K.L University in the Specialization of Communication and Radar systems during 2010-2012.He is having More than 4 years teaching experience and having 10 international and national journals / Conference papers He is Associate member of I.E.T.E and other bodies Like I.S.T.E. His research interested areas includes Image processing and Signal Processing.

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