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Advanced Railway Automation and Its Application

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***Abstract:* - The objective of this project is to efficiently avoid the collision of automobile vehicles and to provide a greatest security to the users in adverse or in bad weather conditions by using Collision Avoidance System (CAS). The main aim of this paper is to make an automated place announcement system for Train using RFID's and vibrator. The radio frequency wireless card for tracking the station data. The paper consists of microcontroller with the RF receiver and the vibrator. The whole system is attached to the vehicle (BUS or Train). The encoded RFID tags are placed in the BUS stops or the railway stations. The microcontroller in the TRAIN is programmed in such a way that every station name is saved in the controller which is having a unique code. So whenever the bus or train reaches the station, the reader in the bus or in the train receives the codes, which are transmitted from the tag and the microcontroller receives this code and checks in the look up table, saved in the chip. Whichever matches, the controller will displays that station name on LCD and activates the respective seat vibrators. If fire happens in a particular train compartment, then respective compartments will be detached.**

***Keywords*-RFID and vibrator, collision**

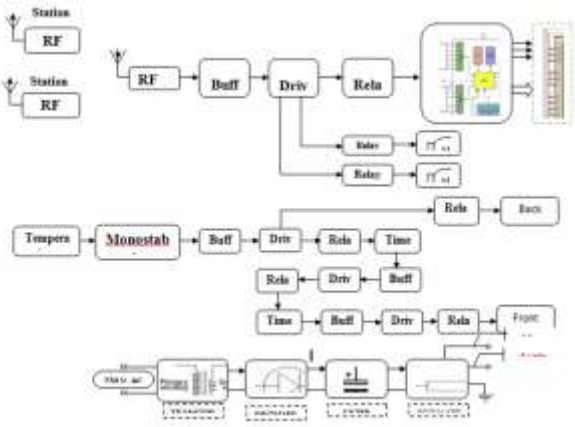
I. INTRODUCTION

The aim of the project is to develop an efficient train monitoring and protection system. A classification of accidents by their effects (consequences); e.g., head-on collisions, rear-end collisions, derailments. Head on collision; one type of train accident is when two trains collide front face with each other or train colliding on the same track from opposite ends called head on collision. Rear end collision; the other kind is when a train collides into the other that is in front of it, called a rear end collision. Derailments plain track; a train may derail on a simply straight track that may cause the train accident. Curves; derailment of a train is more common when there is a curve on the track causing an accident. Junctions; a train may also get derailed on a junction, which is the place where two tracks converge into one, or one diverges into two.

Accident contributors such as train visibility advance signs, active warning, driver behavior, driver distraction and risk taking have been identified as common human factors contributors to vehicle train grade crossing accident. Factor includes highway and railway characteristic are contributing factor to accident at RLC. The environmental factors are snow, heavy rain, fog, or blowing snow, which collision the train. The three main factors contributing to accidents at RLC is basic safety engineering studies, human factor, engineering factor, and environment factor. The taxonomy of railway intersection accident contributors was created to generate hypotheses and deduction about specific cases and common patterns of accident contributors.

The project presented here is an advanced system in the field of Automation of Railway Department. This project is going to facilitate us with various essential & critical features associated with Railways Safety & Monitoring.

II. BLOCK DAIGRAM



A. Block Diagram Explanation

❖ ***Power supply unit***

This section needs two voltages viz., +12 V & +5 V, as working voltages. Hence specially designed power supply is constructed to get regulated power supplies.

B. RF Transmitter and Receiver:

An **RF module** (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through Radio Frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry.

❖ ***Temperature Sensor:***

Thermistor: *A* ***thermistor*** is a type of resistor whose resistance varies signifICantly with temperature, more so than in standard resistors. The word is a portmanteau of thermal and resistor.

❖ ***Monostable Multivibrators***

Monostable Multivibrators have only ONE stable state (hence their name: "Mono"), and produce a single output pulse when it is triggered externally. Monostable Multivibrators only return back to their first original and stable state after a period of time determined by the time constant of the RC coupled circuit.

C. Microcontroller

❖ ***A microcontroller***

(sometimes abbreviated **µC**, **uC** or **MCU**) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

❖ **Buffers**

Buffers do not affect the logICal state of a digital signal (i.e. a logIC1 input results in a logIC1 output whereas logIC0 input results in a logIC0 output). Buffers are normally used to provide extra current drive at the output but can also be used to regularize the logic present at an interface.

❖ **Drivers**

This section is used to drive the relay where the output is complement of input which is applied to the drive but current will be amplified.

❖ **Relays**

It is an electromagnetic device which is used to drive the load connected across the relay and the o/p of relay can be connected to controller or load for further processing.

D. DC motor:

A DC motor relies on the facts that like magnet poles repels and unlike magnetic poles attract each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the centre of the coil. By switching the current on or off in a coil its magnetic field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°.

III. METHODOLOGY

In the above block diagram shows the setup Railway Automation using Temperature Sensor, Monostable Multivibrator, RF& Microcontroller. Station Name Display in train: As the station approaches, the station name will be displayed on the screen inside the train. There is a RF transmitter fitted in the station and the receiver is fitted in the train. The transmitter sends the code of the station and it is read in the train receiver Automatic Station alerter/vibrator:

As the station approaches, the respective station dropping passenger's seat vibrator/alerter starts activated inside the train. There is a transmitter fitted in the station and the receiver is fitted in the train. The transmitter sends the code of the station and it is read in the train receiver.

3. Fire and smoke detector in train:

There is a Temperature sensor in every bogi if any fire occurs to the bogi then this temperature sensor will senses the fire and activates one relay for Back Bogi Detachment and Timer 1 will activate then after the timer 1 time period another timer ie Timer 2 will activates to Detach the Front Bogi.

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IV. CIRCIUT DIAGRAM EXPLANATION

Power Supply Unit

The circuit needs two different voltages, +5V & +12V, to work. These dual voltages are supplied by this specially designed power supply.

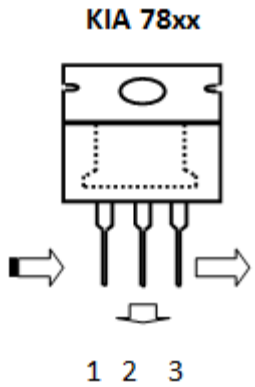
The power supply, unsung hero of every electronic circuit, plays very important role in smooth running of the connected circuit. The main object of this 'power supply' is, as the name itself implies, to deliver the required amount of stabilized and pure power to the circuit. Every typical power supply contains the following sections:

1. Step-down Transformer: The conventional supply, which is generally available to the user, is 230V AC. It is necessary to step down the mains supply to the desired level. This is achieved by using suitably rated step-down transformer. While designing the power supply, it is necessary to go for little higher rating transformer than the required one. The reason for this is, for proper working of the regulator IC(say KIA 7805) it needs at least 2.5V more than the expected output voltage

***2. Rectifier stage*:** Then the step-downed Alternating Current is converted into Direct Current. This rectification is achieved by using passive components such as diodes. If the power supply is designed for low voltage/current drawing loads/circuits (say +5V), it is sufficient to employ full-wave rectifier with centre-tap transformer as a power source. While choosing the diodes the PIV rating is taken into consideration.

3. Filter stage: But this rectified output contains some percentage of superimposed a.c. ripples. So to filter these a.c. components filter stage is built around the rectifier stage. The cheap, reliable, simple and effective filtering for low current drawing loads (say upto 50 mA) is done by using shunt capacitors. This electrolytic capacitor has polarities, take care while connecting the circuit.

4. Voltage Regulation: The filtered d.c. output is not stable. It varies in accordance with the fluctuations in mains supply or varying load current. This variation of load current is observed due to voltage drop in transformer windings, rectifier and filter circuit. These variations in d.c. output voltage may cause inaccurate or erratic operation or even malfunctioning of many electronICcircuits. For example, the circuit boards which are



Implanted by CMOS or TTL ICs

The stabilization of D.C. Output is achieved by using the three terminal voltage regulator IC. This regulator Incomes in two flavors: 78xx for positive voltage output and 79xx for negative voltage output. For example 7805 gives +5v output and 7905 gives -5v stabilized output. These regulator ICs have in-built short-circuit protection and auto-thermal cutout provisions. If the load current is very high the I needs 'heat sink' to dissipate the internally generated power.

***Circuit Description*:** A D.C. power supply which maintains the output voltage constant irrespective of A.C. mains fluctuations or load variations is known as regulated D.C. power supply. It is also referred as full-wave regulated power supply as it uses four diodes in bridge fashion with the transformer. This laboratory power supply offers excellent line and load regulation and output voltages of +5V & +12 V at output currents up to one amp.

1. Step-down Transformer: The transformer rating is 230V AC at Primary and 12-0-12V, 1Ampers across secondary winding. This transformer has a capability to deliver a current of 1Ampere, which is more than enough to drive any electronic circuit or varying load. The 12VAC appearing across the secondary is the RMS value of the waveform and the peak value would be 12 x 1.414 = 16.8 volts. This value limits our choice of rectifier diode as 1N4007, which is having PIV rating more than 16Volts.

2. Rectifier Stage: The two diodes D1 & D2 are connected across the secondary winding of the transformer as a full-wave rectifier. During the positive half-cycle of secondary voltage, the end A of the secondary winding becomes

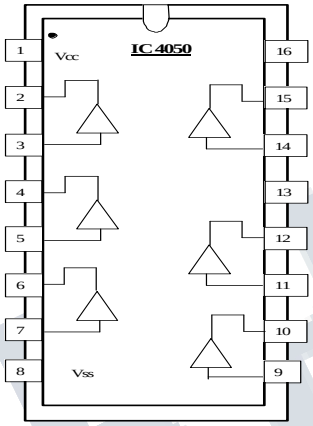
positive and end B negative. This makes the diode D1 forward biased and diode D2 reverse biased. Therefore diode D1 conducts while diode D2 does not. During the negative half-cycle, end A of the secondary winding becomes negative and end B positive. Therefore diode D2 conducts while diode D1 does not. Note that current across the centre tap terminal is in the same direction for both half-cycles of input a.c. voltage. Therefore, pulsating d.c. is obtained at point 'C' with respect to Ground.

3. Filter Stage: Here Capacitor C1 is used for filtering purpose and connected across the rectifier output. It filters the a.c. components present in the rectified d.c. and gives steady d.c. voltage. As the rectifier voltage increases, it charges the capacitor and also supplies current to the load. When capacitor is charged to the peak value of the rectifier voltage, rectifier voltage starts to decrease. As the next voltage peak immediately recharges the capacitor, the discharge period is of very small duration. Due to this continuous charge-discharge-recharge cycle very little ripple is observed in the filtered output. Moreover, output voltage is higher as it remains substantially near the peak value of rectifier output voltage. This phenomenon is also explained in other form as: the shunt capacitor offers a low reactance path to the a.c. components of current and open circuit to d.c. component. During positive half cycle the capacitor stores energy in the form of electrostatic field. During negative half cycle, the filter capacitor releases stored energy to the load.

4. Voltage Regulation Stage: Across the point 'D' and Ground there is rectified and filtered D.C. In the present circuit KIA 7812 three terminal voltage regulator IC is used to get +12V and KIA 7805 voltage regulator IC is used to get +5V regulated D.C. output. In the three terminals, pin 1 is input i.e., rectified & filtered D.C. is connected to this pin. Pin 2 is common pin and is grounded. The pin 3 gives the stabilized D.C. output to the load. The circuit shows two more decoupling capacitors C2 & C3, which provides ground path to the high frequency noise signals. Across the point 'E' and 'F' with respect to ground +5V & +12V stabilized or regulated D.C output is measured, which can be connected to the required circuit.

Note: While connecting the diodes and electrolytic capacitors the polarities must be taken into consideration. The transformer's primary winding deals with 230V mains, care should be taken with it.

V. BUFFER&DRIVER



When the user programs the schedule for the automation using GUI [Graphical User Interface] software, it actually sends 5-bit control signals to the circuit. The present circuit provides interfacing with the Microcontroller and the controlling circuitry. This circuit takes the 5-bit control signal, isolates the CONTROLLER from this circuitry, boosts control signals for required level and finally fed to the driver section to actuate relay. These five relays in turn sends RC5 coded commands with respect to their relay position.

First the components used in this Module are discussed and then the actual circuit is described in detail.
HEX BUFFER / CONVERTER [NON-INVERTER] IC4050: Buffers does not affect the logical state of a digital signal (i.e. logIC1 input results into logIC1 output where as logIC0 input results into logIC0 output). Buffers are normally used to provide extra current drive at the output, but can also be used to regularize the logic present at an interface. And Inverters are used to complement the logical state (i.e. logIC1 input results into logIC0 output and vice versa). Also Inverters are used to provide extra current drive and, like buffers, are used in interfacing applications. This 16-pin DIL packaged IC4050 acts as Buffer as-well-as a Converter. The input signals may be of 2.5 to 5V digital TTL compatible or DC analogue the IC gives 5V constant signal output. The IC ac ts as buffer and provides isolation to the main circuit from varying input signals. The working voltage of Ices 4 to 16 Volts and propagation delay is 30

nanoseconds. It consumes 0.01 mill Watt power with noise immunity of 3.7 V and toggle speed of 3 Megahertz.

ULN 2003: Since the digital outputs of the some circuits cannot sink much current, they are not capable of driving relays directly. So, high-voltage high-current Darlington arrays are designed for interfacing low-level logic circuitry and multiple peripheral power loads. The series ULN2000A/L ICs drive seven relays with continuous load current ratings to 600mA for each input. At an appropriate duty cycle depending on ambient temperature and number of drivers turned ON simultaneously, typical power loads totaling over 260W [400mA x 7, 95V] can be controlled. Typical loads include relays, solenoids, stepping motors, magnetic print hammers, multiplexed LED and incandescent displays, and heaters. These Darlington arrays are furnished in 16-pin dual in-line plastic packages (suffix A) and 16-lead surface-mountable SOICs (suffix L). All devices are pinned with outputs opposite inputs to facilitate ease of circuit board layout.
The input of ULN 2003 is TTL-compatible open-collector outputs. As each of these outputs can sink a maximum collector current of 500 am, miniature Controller relays can be easily driven. No additional free-wheeling clamp diode is required to be connected across the relay since each of the outputs has inbuilt free-wheeling diodes. The Series ULN20x4A/L features series input resistors for operation directly from 6 to 15V CMOS or PMOS logic outputs.
1N4148 signal diode: Signal diodes are used to process information (electrical signals) in circuits, so they are only required to pass small currents of up to 100mA. General purpose signal diodes such as the 1N4148 are made from silicon and have a forward voltage drop of 0.7V.

ATMEL 89C51 Technical Description

The **Atmel 89C51** is a low-power, high-performance CMOS 8-bit mICrocomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The ATmel 89C51 devICe is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

The Atmel 89C51 provides the following standard features: 4K Bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the 89C51 is designed with statIClogICfor operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The AT89C51 Power-down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

- Compatible with MCS-51 Products
- 4K Bytes of In-System Reprogrammable Flash Memory
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM 32
- Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six Interrupt Sources Programmable Serial Channel
- Low-power Idle and Power-down Modes 40-pin DIP

This 89C51 I Chas four I/O ports and is discussed in detail: P0.0 TO P0.7

PORT0 is an 8-bit [pins 32 to 39] open drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs and configured to be multiplexed low order address/data bus then has internal pull ups. External pull ups are required during program verification.

P1.0 TO P1.7

PORT1 is an 8-bit wide [pins 1 to 8], bi-directional port with internal pull ups. P1.0 and P1.1 can be configured to be the timer/counter 2 external count input and the timer/counter 2 trigger input respectively.

P2.0 TO P2.7

PORT2 is an 8-bit wide [pins 21 to 28], bi-directional port with internal pull ups. The PORT2 output buffers can sink/source four TTL inputs. It receives the

Pins	Description
1	Ground
2	Vcc
3	Contrast Voltage
4	"R/S" _Instruction/Register Select
5	"R/W" _Read/Write LCD Registers
6	"E" Clock
7 - 14	Data I/O Pins

high-order address bits and some control signals during Flash programming and verification.

P3.0 TO P3.7

PORT3 is an 8-bit wide [pins 10 to 17], bi-directional port with internal pull ups. The Port3 output buffers can sink/source four TTL inputs. It also receives some control signals for Flash programming and verification.

PSEN

Program Store Enable [Pin 29] is the read strobe to external program memory.

ALE

Address Latch Enable [Pin 30] is an output pulse for latching the low byte of the address during accesses to external memory.

EA

External Access Enable [Pin 31] must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH.

RST

Reset input [Pin 9] must be made high for two machine cycles to resets the device's oscillator. The potential difference is created using 10MFD/63V electrolytic capacitor and 20KOhm resistor with a reset switch.

LCD MODULE

LCDs can add a lot to any application in terms of providing an useful interface for the user, debugging an application or just giving it a "professional" look. The most common type of LCD controller is the Hitachi 44780 which provides a relatively simple interface between a processor and an LCD. Using this interface is often not attempted by inexperienced designers and programmers because it is difficult to find good documentation on the interface, initializing the interface can be a problem and the displays themselves are expensive.

The most common connector used for the 44780 based LCDs is 14 pins in a row, with pin centers 0.100" apart. The pins are wired as:

The interface is a parallel bus, allowing simple and fast reading/writing of data to and from the LCD.
The LCD Data Write Waveform will write an ASCII Byte out to the LCD's screen. The ASCII code to be displayed is eight bits long and is sent to the LCD either four or eight bits at a time. If four bit mode is used, two "nibbles" of data (Sent high four bits and then low four bits with an "E" Clock pulse with each nibble) are sent to make up a full eight bit transfer. The "E" Clock is used to initiate the data transfer within the LCD.

Sending parallel data as either four or eight bits are the two primary modes of operation. While there are secondary considerations and modes, deciding how to send the data to the LCD is most critical decision to be made for an LCD interface application. Most LCD displays have a 44780 and support chip to control the operation of the LCD. The 44780 is responsible for the external interface and provides sufficient control lines for sixteen characters on the LCD. The support chip enhances the I/O of the 44780 to support up to 128 characters on an LCD. From the table above, it should be noted that the first two entries ("8x1", "16x1") only have the 44780 and not the support chip. This is why the ninth character in the 16x1 does not "appear" at address 8 and shows up at the address that is common for a two line LCD.

The Character Set available in the 44780 is basically ASCII. It is "basically" because some characters do not follow the ASCII convention fully (probably the most significant difference is 0x05B or "\" is not available). The ASCII Control Characters (0x008 to 0x01F) do not respond as control characters and may display funny (Japanese) characters

The last aspect of the LCD to discuss is how to specify a contrast voltage to the Display. Experts typically use a potentiometer wired as a voltage divider. This will provide an easily variable voltage between Ground and VCC, which will be used to specify the contrast (or "darkness") of the characters on the LCD screen. You may find that different LCDs work differently with lower

voltages providing darker characters in some and higher voltages do the same thing in others.
Liquid crystal panel service life 100,000 hours minimum at 25 ^{o}C -10 ^{o}C

3.3 definition of panel service life

- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCK cell layer

Unusual operation occurs in display functions

Safety

If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

VI. ADVANTAGES AND DISADVANTAGES

Advantages

- Fully automatIC
- Low power consumption
- Low cost to design the circuit, maintenance of the circuit is good
- Easy convenience to handle.

Disadvantages

- One time investment cost.
- It has to be planted throughout the city.

VII. RESULT/CONCLUSION

This paper gives a defend way of approaching the problem. First it will give alert to the passengers with respect to stations by using RF technology. It will detach the compartments of the train if in case of fire.

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