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An Efficient Accident Prevention System for Indian Railways

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Abstract: Railway Transport is indispensable in modern day life, both for business and private users. Nowadays, rail networks across the world are getting busier with trains travelling at higher speeds and carrying more passengers and heavier axle loads than ever before. The combination of these factors has put considerable pressure on the existing infrastructure, leading to increased demands in inspection and maintenance of rail assets. But nowadays, it is not that much safer as lot of accidents occur due to improper communication among the network like wrong signalling , worst weather condition, immediate route change, etc., The train driver doesn't get proper information on time and before time so that the hazardous condition can occur. While maritime and air transport are already benefiting from collision avoidance application based on infrastructure less communications. We propose this system to avoid train collision by using Ultrasonic Sensors to provide communication between trains and to avoid same track collisions.
Keywords: Microcontroller-Arduino ATmega328P, Ultrasonic Sensors, Driver unit, LCD (Liquid crystal display), Buzzer (Signalling device), Anti-collision system.

I. INTRODUCTION

Our project is fully concentrating on avoiding train collisions and ensures passengers safety through embedded system integrated with ultrasonic sensor based control system inbuilt in the train. However, Collision avoidance systems using IR sensor and anti-collision device are being used by the Railway sector is still facing some problems due to the consideration of some factors such as cost-effectiveness, despite it is increasing the amount spent on implementation of the devices. Currently, to some extent the Konkan Railways has put efforts to provide train safety through ZigBee and Infrared based sensor concepts. Even though it has the disadvantages such as limited range of signal covered and difficulty in their implementation in the real world it is still being used .This work is concentrated on predicting the major cause of railway accidents that is collision on the same track.

Implementation of an efficient embedded system integrated with ultrasonic sensor based Train Anti-Collision for railways is being proposed in this paper. A safe distance of 1 Km has been maintained between two trains after applying the emergency brake in case of collision detection.

Figure. 1 Head-on-Collision.

Figure. 2 Rear-end-Collision.

Based on the studies, it is observed that even for two trains travelling at 140kmph, the safe distance after

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automatic braking under normal conditions is approximately 920m. All sub modules have been designed and simulated using Proteus electronic simulation package and the prototype is implemented. The design cost is low and the use of the designed system reduces collision between opposite trains on the same track. It is expected that if this system is implemented widely, train collisions and accidents can be avoided.

II. METHODOLOGY USED

This project aims at providing a possible solution to this problem. In each train an ultrasonic sensor is fixed. This will sense the train coming on the opposite side of the same track. It will measure the distance between the host train and the object on the same track and it gives the signal to the microcontroller. After receiving the signal, it will process according to the received time duration and speed of the train to apply the break.

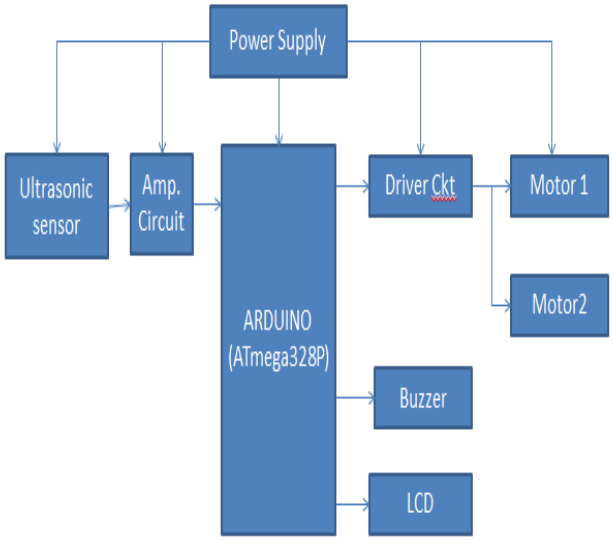

Figure. 3 Block diagram of railway accident prevention system.

A. Microcontroller – Arduino ATmega328P

The ATmega328P provides the following features:32K bytes of In System Programmable Flash with Read-While-Write capabilities, 1K bytes EEPROM, 2K bytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The ATmega328P AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

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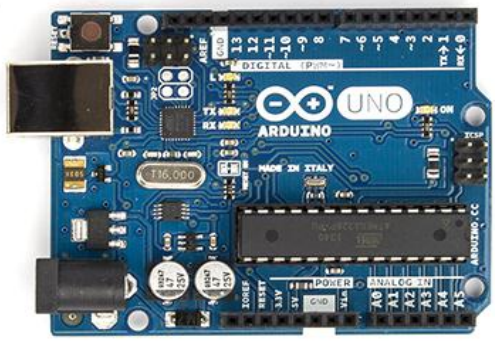

Figure. 4 Microcontroller - Arduino ATmega328P.

The core of any embedded system design is the micro-controller and the completeness of the model as well as its accuracy are therefore of primary importance. It should always be ensured that simulation models for micro-controllers not only support a peripheral that one wants to use but support the mode in which one wants to use the peripheral and to a satisfactory level of detail.

B. Ultrasonic Sensor

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar, which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Active ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions.

Figure. 5 Ultrasonic sensor.

An ultrasonic transducer is a device that converts energy into ultrasound, or sound waves above the normal range of human hearing. While technically a dog whistle is an ultrasonic transducer that converts mechanical energy in the form of air pressure into ultrasonic sound waves, the term is more apt to be used to refer to piezoelectric transducers or capacitive transducers that convert electrical energy into sound. Piezoelectric crystals have the property of changing size when a voltage is applied; applying an alternating current (AC) across them causes them to oscillate at very high frequencies, thus producing very high frequency sound waves.

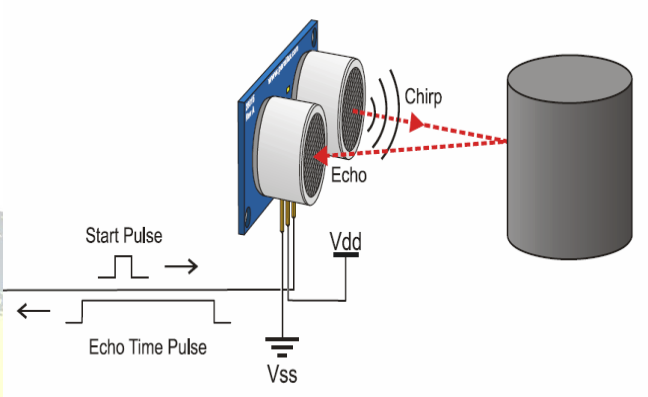

Figure. 6 Ultrasonic sensor operation.

The location at which a transducer focuses the sound can be determined by the active transducer area and outline, the ultrasound rate, and the sound velocity of the propagation medium. Since piezoelectric crystals generate a voltage when force is functional to them, the similar mineral can be used as an ultrasonic sensor. Various structures use separate transmitter and receiver components while others combine both in a single piezoelectric transceiver.

C. Buzzer

A buzzer or beeper (BUZZERS) is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button are pushed or a pre-set time has lapsed and usually illuminates a light on the appropriate button or control panel and sounds a warning in the form of continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell.

D. Power Supply

The input to the circuit is applied from the regulated power source. The microcontroller power is of 5V. The A.C. input i.e., 230V after the mains supply is step down by the transformer to 12V and is fed to a rectifier. The production gained from the rectifier is a pulsating D.C voltage. So in order to get a pure D.C voltage, the output voltage from the rectifier is fed to a filter to remove any A.C components present even after

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rectification. Currently, this power is given to a voltage regulator to obtain a pure continuous dc voltage. We are consuming an IC 7805 as voltage regulator to get a 5V output Voltage.

III. EXISTING SYSTEM

In the existing system Konkan railways have planned associate and enforced an opposed Collision System. The system failed to take any active inputs from existing Railway signal system, and additionally lacked in 2 ways of communication capability between the trains and also the management centres or stations, thence was later decommissioned.

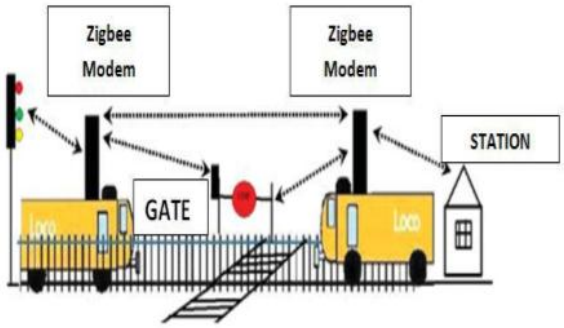

Figure. 7 Existing system.

The ACD system is also found to be ineffective because it does not considering any active inputs from existing Railway sign system, and additionally lacks 2 ways in which communication capability between the trains and also the management centers or stations, thence has been later decommissioned.

IV. PROPOSED SYSTEM

The proposed Train Anti-Collision System consists of a self-acting Arduino ATmega 328Pmicro-controller and ultrasonic sensor based train anti-collision detection system which works round-the-clock to avert train collisions. The ultrasonic sensor is fixed with microcontroller. Whenever the train coming in opposite direction on the track are monitored by the ultrasonic sensor which uses the sound waves travel to sense the object, the sensor will give the signal to the controller and apply the break automatically. It will need not require any manual actions to stop the train.

Thus enhances safety in train operations. As more relevant data are included, it is expected that the present system may assist loco drivers in averting accidents efficiently. As no change is necessary to be made to the infrastructure of the existing system, the cost of implementation of this system is also less. The system has been designed and simulated using Arduino real time simulation software. Models of the rail traffic systems has also been made and tested. Whenever a collision-like situation is detected by instinct, the system will automatically taking care and prevents the collision.

V. RESULT

The prototype of the railway accident prevention technique using ultrasonic sensors system has been shown in figure. 6. This system has been tested by implementing the collision avoidance environment in train on the same track. Ultrasonic sensor detects the presence of train on the same track and it sends a signal to the microcontroller. After that microcontroller send an active signal to other externally connected devices. The distance of two trains in the same opposite direction will be intimated by display on LCD screen and the buzzer indicates by sound. As a result train will be stopped.

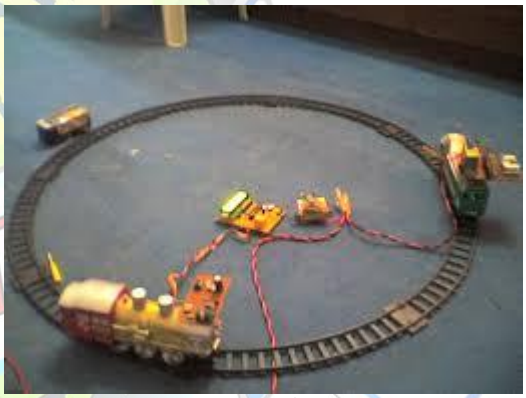

Figure.8 Prototype model of proposed system

VI. CONCLUSION

In our project, a design for automatically avoiding train collisions has been designed. This innovative technique of early sensing of any possible collision scenario and avoiding it, we demonstrate that it is possible to improve the overall safety of the railway system in India. We believe that success depends on both the railway industry and the regulator working together to achieve the common goal.

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