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Vigilance Control Device using Zig-bee and GPS Technology

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ABSTRACT

This paper is proposed for E-safety providence to prevent train accidents (due to UN-alertness of loco pilots) by designing engines with a new penalty braking system—Electronic VCD (Vigilance Control Device), a micro-controller based safety device which will enhance passenger's safety by cyclicallygenerating warnings and by applying precautionary brake for the train if the loco pilot is incapacitated or dead or fast asleep. This MCU (Micro-controller Unit) also intimates the position of the loco crew to the higher authorities who indeed called as a vigilance officer using Zig-bee IEEE 802.15.4 and traces the position of the train where the penalty brake is applied using Global Positioning System (GPS) technologies. The message will be sent to the vigilance officer through zig-bee if the loco pilot does not perform a regular task such as accelerating or decelerating for a stipulated period of time. Soon after the penalty brake applied, MCU in loco traces the exact co-ordinates of the train and the same will be sent to vigilance officer.

Key words: Loco pilot, vigilance officer, GPS, Zig-bee, MCU, E-safety, penalty braking system

1. INTRODUCTION

In the last 10 years (1994-2004) on Indian Railways, 62% of the accidents have been caused due to failure of Railway staff, 22% have been caused due to failure of other than Railway staff, failure of equipment has contributed 8%, and sabotage has contributed 3% and balance 5 % have been contributed by miscellaneous reasons. From the break-up, it is more than evident that human error from Railway Staff has been the major factor in causing the accidents on Indian Railways. Higher incidence of human failures surface as technical safeguards and backups do not always replace the human effort. Though an accident occurs only when both fail but it usually gets logged as 'human error' with a tendency of glossing over technical failure. Under optimum field conditions and with the best of intentions, a human being is likely to commit a mistake from time to time. This is the reason why operating rules included many redundancies in safety procedures and operating practices involve number of checks and balances. More and more automation is resorted to prevent human errors. Manpower is the most valuable asset on Indian Railways which is highly labour intensive with a work force of nearly 1.4 million. It is a challenge to create and maintain high motivation level andstress free environment for this large workforce encompassing several categories of staff. Skills of manpower suiting varied job requirements are suitably developed requiring adequate attention in training institutions. On Indian Railways, while front line staff is properly trained and their working closely monitored, staff involved in maintenance activities has also been on sharp focus since they also have important role to play in preventing accidents.

2. LITERATURE REVIEW

Vigilance Control Device (VCD) is a micro-controller based safety device which will automatically apply penalty brakes in case the loco pilot is incapacitated or dead. Similar operation is available in older locomotives in the form of Dead man's Lever. "The dead man's Manlever is a knob that has to be kept pressed at all times to keep the train running. This system was introduced to prevent accidents, even if the loco pilot died at his controls, hence the name. Unless a certain amount of pressure is maintained on the lever, brakes get automatically activated and the train slows down and comes to a stop. Another form of loco pilot safety system is "Dead Man System" which detects a continuous input from the loco pilot, e.g. by application of force to a pedal or handle [1]. In this system there is no facility to inform the action of the loco pilot and the position of the train to higher authorities to take any responsible decision.

3. PROPOSED METHOD

This paper provides a method to safety of the passengers in trains by alerting the loco pilot cyclically. Vigilance control device plays a major role to reduce the accidents that are caused by the pilot of the train. So in order to overcome this disadvantage and to make the loco pilot in alertness and to ensure safety to passengers the new system is proposed called Electronic vigilance control device. In this paper we are using P16F877A micro-controller, the heart of the system and JHD 16x2A LCD for displaying the actions and we are using GSM modem of SIM 300 for messaging the information to the higher authorities and GPS system for tracking the position of the train after the penalty brake is applied.

4. TECHNOLOGY

The block diagram consists of different components interfacing to a micro-controller. The block diagram is shown in Figure.1.

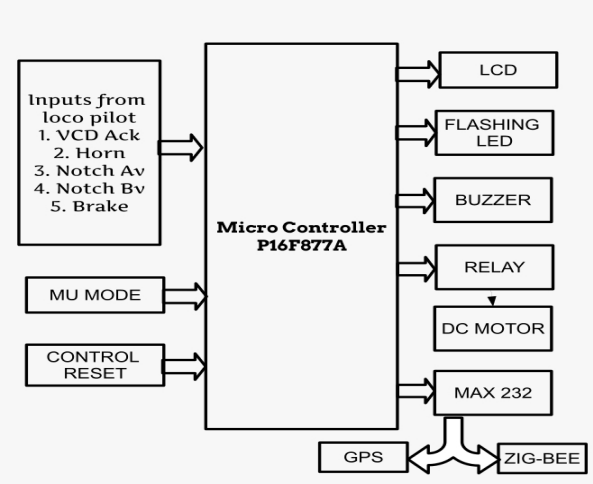

Figure 1: block diagram

The various components in the block diagram are mentioned below:
P16F877A Micro-controller, Inputs from Loco, MU Mode ,Control Reset,16x2 Liquid Crystal Display(LCD), LEDBuzzer , Relay, DC Motor ,MAX 232 , Zig-bee module, GPS Module

The P16F877A is a low-power, high performance CMOS 8-bit micro-controller with 14.3K bytes of programmable memory. The device is manufactured using Microchip high-density nonvolatile memory technology and is compatible with the industry standard PIC instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Microchip P16F877Ais a powerful micro-controller which provides a highly-flexible and cost-effective solution to

These are the inputs given by the loco pilot while driving to the micro-controller. The inputs are VCD Acknowledgement (VCD Ack), Horn, Notch AV, Notch BV, and Brake.

Mu mode is multiple unit mode to support the efficiency of the second engine. Control reset is to execute the entire VCD cycle from beginning.

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this JHD 16x2A LCD each character is displayed in 5x7 pixel matrix. The schematic diagram of 16x2 LCD is shown in Figure.2. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

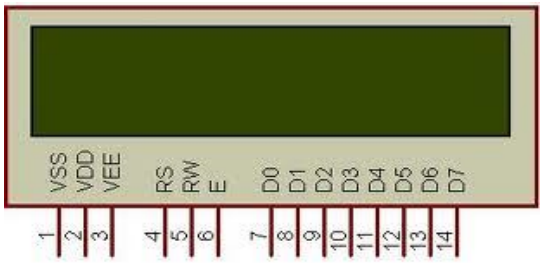

Figure 2: Schematic diagram of 16×2 LCD

The LCD display is connected to the output port of micro controller to display the cyclic operations of vigilance control device.

Light-emitting diodes are elements for light signalization in electronics. They are manufactured in different shapes, colors and sizes. For their low price, low consumption and simple use, they have almost completely pushed aside other light sources- bulbs at first place. They perform similar to common diodes with the difference that they emit light when current flows through them. Light emitting diodes (LEDs) are semiconductor light sources.

Based on semiconductor diode, LEDs emit photons when electrons recombine with holes on forward biasing. The forward voltage of LED (1.7V-2.2V) is lower than the voltage supplied (5V) to drive it in a circuit. Using an LED as such would burn it because a high current would destroy its p-n gate. Therefore a current limiting resistor is used in series with LED. The LED is interfaced to the output port of micro controller as the first indication to alert the loco pilot.

Buzzer is an audio signaling device, which may be mechanical, electro-mechanical or electronic that sounds a warning of continuous or intermittent sound. It is compact and produces high sound pressure levels with minimal power consumption. The range of operating voltages is from 1 to 30V whilst sound output may be as high as 75 dB at 1m. Normally, buzzers operate a buzzing noise in the frequency range 300 to 500 Hz. This is used to alert the loco pilot. The buzzer is connected to output port as a second indication to loco pilot.

A relay is an electrically controllable switch widely used in industrial controls, automobiles and appliances.A relay is able to control an output circuit of higher power than the input circuit. Relays are devices which allow low power circuits to switch a relatively high Current/Voltage ON/OFF. For a relay to operate a suitable pull-in & holding current should be passed through its coil. Generally relay coils are designed to operate from a particular voltage

often its 5V or 12V. The relay used is 5-pin relay to drive motor as an indication for movement of train.

DC (direct current) motors convert electrical pulses to mechanical movement.

The micro-controller can communicate with the serial devices using its single serial port. The logic levels at which this serial port operates is TTL logics. But some of the serial devices operate at RS 232 logic levels. So in order to communicate the micro-controller with modem, a mismatch between the logic levels occurs. In order to avoid this mismatch, in other words to match the Logic levels, a serial loco pilot is used. A MAX232 is a serial line loco pilot used to establish communication between modem and micro-controller. The interfacing of GSM modem with micro-controller using MAX 232 as a serial line loco pilot.

Zig-bee modules are designed with low to medium transmit power and for high reliability wireless networks. The modules require minimal power and provide reliable delivery of data between devices. The interfaces provided with the module help to directly fit into many industrial applications. The modules operate within the ISM 2.4-2.4835 GHz frequency band with IEEE 802.15.4 baseband.

Figure 3: Tarang Zig-bee module

Serial Interface

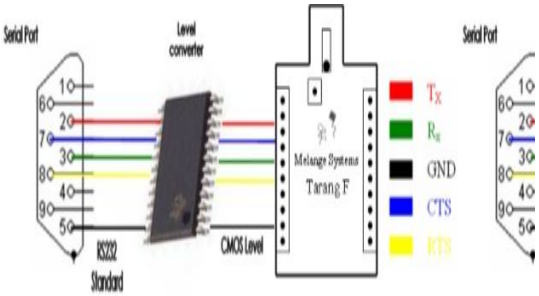

Figure 4: serial interfacing of zig-bee module to micro-controller.

Processing of GPS Signal

The Global Positioning System (GPS) is a satellite based navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides the user with information. Using GPS technology one can determine location, velocity and time, 24 hours a day, in any weather conditions anywhere in the world for free. GPS was formally known as the NAVSTAR (Navigation Satellite Timing and Ranging). The basis of the GPS technology is a set of 24 satellites that are continuously orbiting the earth. These satellites are equipped with atomic clocks and sent out radio signals as to the exact time and location. These radio signals from the satellites are picked up by the GPS receiver. Once the GPS receiver locks on to four or more of these satellites, it can triangulate its location from the known positions of the satellites. It is a higher performance, low power satellite based model. It is a cost effective and portable system which accurately detects the location. The GPS receiver used here is Sky Traq Venus 6 GPS module ST22 which is having TTL logics and also RS232 as option. The GPS receiver is shown in Figure.5. This GPS is used to track the position of the train after the emergency brake is applied in order to avoid the accidents. This application is used only after the train is stopped

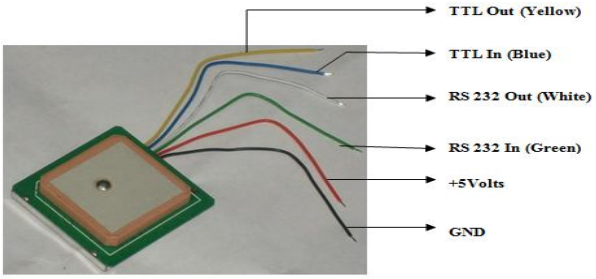

Figure 5: GPS Receiver

5. PRINCIPLE OF OPERATION

VCD is MC Unit based equipment designed and manufactured to enhance the safety of the locomotive operation by ensuring the alertness of the crew all the time. The system is resetting type and operates in a fail-safe manner. VCD will give cyclic warnings to the loco pilot. Based on the loco pilots reaction to these warnings (in terms of pre-defined set of actions to be done by the locopilot), the system will automatically reset the alerting cycle.

The locomotive loco pilot operates controls like applying or releasing the locomotive power application (or) applying the brakes (or) horning the locomotive. The VCD monitors whether these controls have been operated by the loco pilot in a 60-second time period. In case the loco pilot has not operated any of the controls, the VCD gives a visual warning by activating a flashing LED for 8 seconds.

If acknowledgement is not received, an additional audio alarm is given for 8 sec. If loco pilot further fails to acknowledge the alarm, a report is sent to guard and to vigilance officer through Zig-bee module such as "LOCO PILOT IS NOT ALERT IN THE TRAIN NO: XXXXX". Here guard is provided with brake to stop the train. If guard is not applying the brake within 10 sec, then a report is sent to vigilance officer as "LOCO PILOT AND GUARD NOT ALERT IN TRAIN NO:XXXXX" and VCD will initiate the penalty application of brakes and specific co-ordinates of the train will be taken using GPS module and will be sent to the vigilance officer using Zig-bee module.

MU mode is the multiple unit used when the efficiency of the one engine is not sufficient for pulling the trains in hilly areas then it is provided for utilizing the efficiency of the second engine it is required to operate in mu mode. When VCD is operated in MU mode the above operation of the VCD cycle should not be activated in the second engine that is the loco pilot is provided only in one cabin so it is programmed that when VCD operates in MU mode the entire VCD cycle at second engine should not activate.

The flow chart in Figure.6 gives the clear explanation of the working of the Electronic vigilance control device. The source code is written in embedded C language.

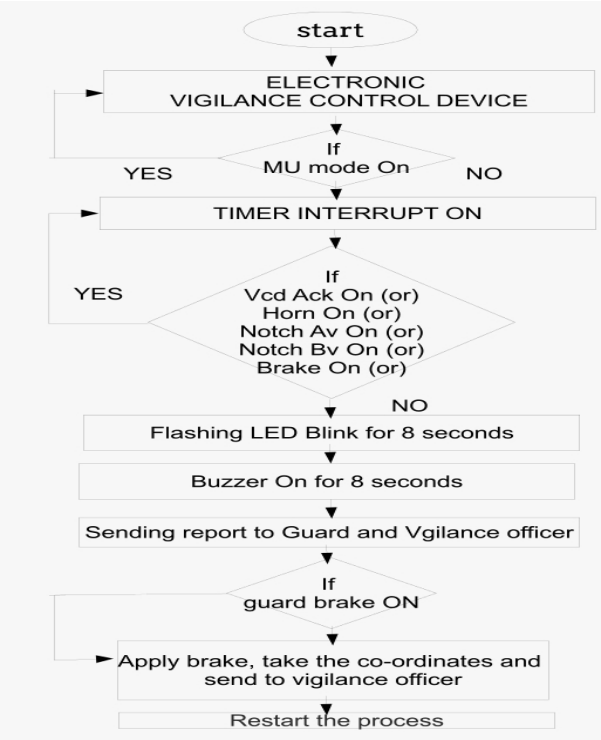

Figure 6: Flow chart of the System

6. CONCLUSION

Many people travel in trains and the number of people traveling is more when compared to any other like buses etc. In this paper the Electronic vigilance control device improves vigilance and provides warning and brake application signals in a predefined manner. So with the use of this device we can ensure safety to passengers. With this device we can analyze that whether the accident is due to loco pilot i.e., engine loco pilot or due to failure of locomotive. By using this device we can inform the action of the loco pilot to the higher authorities if he fails to respond the cyclic warnings and the position of the train can also be tracked to avoid the accidents. The high priority is given to the lives of people. Hence this paper provides a feasible solution to reduce accidents due to human failure.

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REFERENCES

[1] ITSR, loco pilot Safety Systems Discussion Paper, 2006, Australia/New South Wales Independent Transport Safety Regulator: Sydney, p.32.

[2] Whitlock, loco pilot vigilance devices: systems review (and RSSB response) 2002, Rail Safety and Standards Board/Quintec, p.105.

[3] Santosh B. Patil, Rupal M. Walli, "Design and Develop- ment of Fully Automatic AT89C52 Based Low Cost Embedded System For Rail Tracking", International Journals of Electronics, Communication and Soft Computing Science and Engineering (IJECSCSE), Vol.1,Issue 1,Pg 9-14.

[4] M. A. Mazidi , "The 8051 Microcontroller & Embedded Systems" (Pearson Education Asia, India, 2nd edition, 2008).

[5] Raj Kamal , "Embedded System- Architecture, Program-ming and Design" (Tata McGraw Hill Publisher, 2nd edition, 2008).

[6] Skytraq Venus 6 GPS Module ST22 Data