

VIGILANCE CONTROL SYSTEM USING MCF5235 PROCESSOR

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Abstract

Vigilance control device in train loco is used to check the alertness of the loco pilot. It is the Microprocessor based multi-resettable device which is used to monitor the loco pilot's action. This device is used to apply the emergency brake automatically by cyclically generating the warning signals. It reduces the error caused by the loco pilot if the driver is unconscious, dead or fast asleep and ensures the safety to the passengers by automatically stopping the train. It stores the actions carried out by the loco pilot periodically which can be used as the reference to find out the courses of action done by the pilot. The information during the events can be used for future analysis.

Keywords: Loco pilot, Vigilance, Connector, MCF5235, Penalty brake system

1. INTRODUCTION

Rail transport is a commonly used mode of long distance transportation in India which connects even the remotest village. Rail transport is responsible for undertaking about 8 billion trips per annum in India. There are about 21 million people travelling in train per day. Therefore the work of loco pilot is demanding and full of responsibility. Who must be in charge of both safety and punctuality but annually 41.73 % accidents due to the failure of loco pilot, in order to maintain the loco pilot's vigilance and ensure the safety of passengers hence VCD system is used [3].

2. EXISTING SYSTEM

The VCD is used, considering the safety of the passengers in trains by checking the loco pilot's action cyclically. VCD plays a major role to reduce the accidents that are caused by the pilot of the train. The VCD using 8085 Microprocessor is a multi-resettable device which is used to apply the brake automatically. In case if the pilot fails to perform the defined actions in preset time limit. The limitations of using this device are that, the programming language used in 8085 is Assembly language programming and it is very difficult to program and interrupt by the human [1]. The processing speed is less which is about 6MHZ and failure events cannot be stored and hence diagnosis of the failure is impossible. The data's can be stored only in external memory. To verify the processor functionality the external interrupts are used in case of 8085 Microprocessor. The VCD systems are also based on AT89S52 [7], P16F877A [9], ATMEGA16 [8] Microcontrollers. The speed of processing, no of cycles required for executing an instruction and capacity for storage is limited. These limitations are overcome by using the new

generation Microprocessor which is a free scale MCF5235 and it is a family of a highly integrated 32 bit Microprocessor based on the version 2 Cold Fire Reduced instruction set computer with Micro-architecture. It consists of an isolated power supply along with the inbuilt memory and interrupts with the high processing speed of about 64MHZ. The existing systems consist of GSM and GPS system for monitoring the position of the train and communicating the authority. But practically it is possible to implement these systems in train because there is separate system called TPWS which is used for train monitoring. Therefore signals received from both the system leads to dilemma in decision making for railway staffs.

3. PROPOSED SYSTEM

Vigilance control device plays a major role to reduce the accidents that are caused by the loco pilot. To make the loco pilot alertness and to ensure the safety of passengers by cyclically generating warning signals, the new system has been proposed called Vigilance Control Device (MCF5235). It is a family of highly integrated 32-bit Microcontroller based on the version 2 Cold Fire Micro-architecture [2].

Benefits of MCF5235 Microprocessor

- 1) To download the data through Laptop/Personal computer using USB port.
- 2) Using LCD display the current cycle data and fault codes can be displayed.
- 3) It consist of the inbuilt memory.
- 4) System "Watchdog" logic with 200ms time out and "Life signal" detection logic used to enable the driving of the system outputs.
- 5) Inter-integrated circuit (I²C) bus controller.
- 6) Queued serial peripheral interface (QSPI) module

- 7) Two interrupt controllers capable of handling up to 126 interrupt sources.

4. BLOCK DIAGRAM

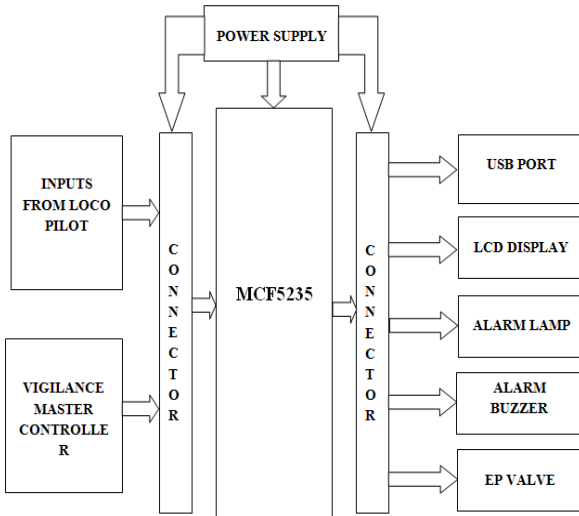


Fig -1: Block diagram of MCF5235

The various components in the block diagram are explained below

4.1 Power Supply

A DC input of about 110 V from the battery it is step down to 12 V by a step down transformer and this voltage is fed to a switch mode power supply to obtain pure constant DC voltage of 5V.

4.2 Inputs

There are various types of input which is used to reset the Vigilance unit. They are shown in Fig -2



Fig -2: VCD input

- 1. Vigilance acknowledgement/Dead man’s foot pedal, Vigilance acknowledgement push button, Horn pressure switch input, Intermittent input from power controller

switch/sander foot switch. These inputs are used to reset the delay cycle and action/warning cycle.

2. There are 2 inputs which are given to the Microprocessor. It is used to reset the Vigilance system. They are Vigilance master controller switch and Vigilance reset these inputs are used to reset the penalty brake cycle.

3. When the train speed is less than the 2 Km/hr or when the train is in standstill condition and brake are applied the VCD is suppressed input is given by Vigilance pressure switch.

4.3 USB Port

In this system USB is designed to standardize the connection of Microprocessor peripherals such as Pen drives and personal computer. It is used for MMI (Man-Machine Interface), for transferring the fault codes, stored data, then it is used also for processor using personal computer, the inputs, outputs, internal faults and recorded in the data with date and time stamp is used for post analysis.

4.4 LCD Display

The LCD display is interfaced with 110V DC. It creates images by Polarizing light through liquid crystal pixels. A white back light or external light source is necessary to illuminate the image. It is 16 × 2 character line LCD module to the parallel port. Each character is displayed in 5×7 pixel matrix. It consists of a 4 digit alphanumeric dot matrix display with two push button to customize the functions. The MMI can be made through by these 2 push buttons. The two buttons are called P1, P2 and their functions change depending from display selected mode. There are 2 mode normal and function menu. The transition between the normal and the function mode takes place by push and hold pushed both P1, P2 button for 3seconds. The reverse transition takes place automatically when 3 minutes are passed without any other operation on buttons or by using the opposite menu return function [4].



Fig -3: Display in normal mode cycle info without minor faults present.

The first row shows the cycle that is running and will be one of the followings: (Fig -3) Delay cycle, Action/Warning cycle, Penalty brake cycle (Level: 1), Penalty brake cycle (Level: 2), Fault cycle. The second row shows: the remaining time before the cycle timeout both graphically by a bar and numerically by showing the remaining seconds (Fig -4).



Fig -4: Cycle remaining seconds.

Following are typical display messages which shall appear on LCD display exactly the same [5], they are

1. Power ON/Power OFF
2. Vigilance cycle/Warning cycle
3. Foot switch/Push button
4. IP problem
5. QVCD relay defective
6. VCD Bypass bit healthy
7. VCD Bypass and faulty
8. VCD Faulty
9. VCD Reactivated
10. PB applied
11. VCD suppressed
12. Data downloading
13. Downloading complex

4.5 Alarm Lamp

LED lamp is popular due to its efficiency. LED creates light by electro-luminescence in a semiconductor material. They are wide range of colours. It is interfaced with the output of Microprocessor. The alarm lamp is used to alert the loco pilot if the driver did not give any input to reset the delay cycle. The warning is given in the form of blinking of LED [yellow flashing light].

4.6 Buzzer

Buzzer is the audio signalling device. It is piezo-electric type buzzer and it is operated by 110 V DC from the battery. It is used to alert the driver, if the driver did not reset the warning cycle. Even at the end of the delay cycle the loco pilot has not given any input, an audible alarm shall begin in addition to flashing light. A buzzer with "75" dbm sound is provided for warning of the loco pilot. It is the second stage of warning cycle which interfaced with the output of the Microprocessor.

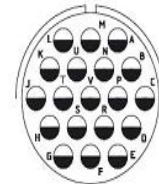
4.7 EP-Valve

The [Electro-Pneumatic] brake in which compressed air brake operation is controlled electrically by the driver. This is a considerable and successful technical advance, enabling a quicker and more sensitive response to the loco pilot's operation of brake controls. When a voltage of 110 DC is fed from the battery to the emergency voltage EP Valve. The valve is energised and the pressure is filled inside the valve. If the loco pilot does not give any positive acknowledgement at the expiry of the warning cycle then the valve is de-energised and the pressure inside the valve is released.

4.8 Connector

The VCD unit shall employ circular bayonet connectors of Gimota/Allied make to ensure modularity and easy replacement. (Fig -4) These connectors shall be complete with all required accessories.

Front view
to pins



Layout	22-14
Number of contacts	19
Size	16
Voltage-class	A

Fig -5: 19 Pin connector

5. WORKING

The VCD shall consist of two cab units. The construction and wiring of VCD ensures complete inter changeability of the VCD set consisting of two cab units of different makes without change in wiring. From the cab units, the inputs given by the loco pilot while driving, to the Microprocessor. The inputs are given in the form of digits either 1 or 0. The VCD equipment supplied from the power supply by 110 DC. This DC voltage is isolated and supplied to CPU and other peripherals.



Fig -6: VCD System

The working of the system is done by the following cycles

1. Delay cycle.
2. Action/Warning cycle.
3. Penalty brake cycle (Level: 1).
4. Penalty brake cycle (Level: 2).
5. Fault cycle.
6. Vigilance suppression.

5.1 Delay Cycle

When VCD system is energised the delay cycle is activated. This cycle has preset period normally set at 60 seconds. Each time when driver gives any vehicle control the delay cycle is resetted. The control functions include operation of the vigilance pedal foot, vigilance push button, operation of the sander, horn push/switch. If the driver fails to perform some positive action within the cycle period, the cycle period shall be elapsed. When such an event occurs, a next cycle called action cycle/warning cycle shall be initiated.

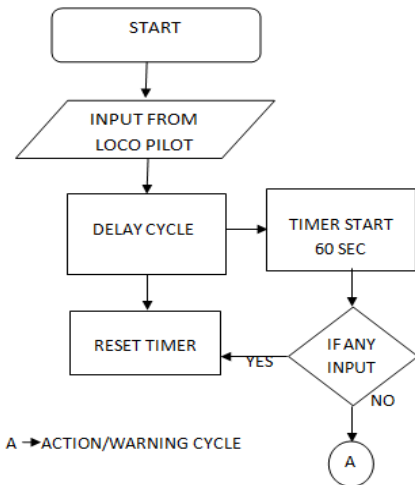


Chart -1: Delay cycle

5.2 Action/Warning Cycle

This cycle is initiated whenever the delay cycle elapsed due to positive driver action has not been detected.

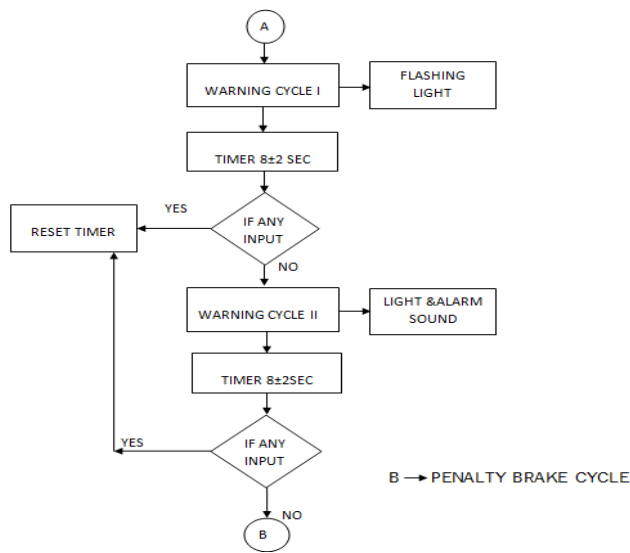


Chart -2: Action/Warning cycle

This cycle consist of two levels namely level 1(T1) and level (T2). During the level 1(T1) VCD shall begin flashing a yellow warning light for a time period 8 ± 2 seconds. If by end of this period, an acknowledgement by crew has not been actuated, an audible alarm for a time period 8 ± 2 seconds shall begin addition to flashing light. In order to maintain normal vehicle operation, the loco pilot shall operate the vigilance foot switch or push button or any other inputs, specified before the action cycle expires to prove positively that the pilot has not become incapacitated. Once the VCD is reset by the above action, system operation reverts to delay cycle and normal vehicle operation is remained. If for any reason, the action/warning cycle expires without being reset, the brake cycle is initiated to make an automatic brake application.

5.3 Penalty Brake Cycle (Level 1)

The brake cycle is initiated if the loco pilot fails to respond to the audible buzzer and visual warnings before the expiry of the warning cycle. A brake application is immediately initiated. This ensures that the vehicle is brought to a complete stand still. Vigilance unit initiates penalty brake, which remain applied for a period 32 ± 2 seconds and cannot be reset once applied during this period.

5.4 Penalty Brake Cycle (Level 2)

VCD cannot be resetted when the penalty brake cycle is initiated. Hence the flashing continues till VCD reset. Only after the expiry of the brake cycle period and then only after the master controller switch has been set to the OFF position can make the vigilance unit be reset by using the reset push button. The brake application then gets released and then the audible and visual warning is suspended and normal vehicle operation can be re-established. Vigilance goes to the initial delay cycle.

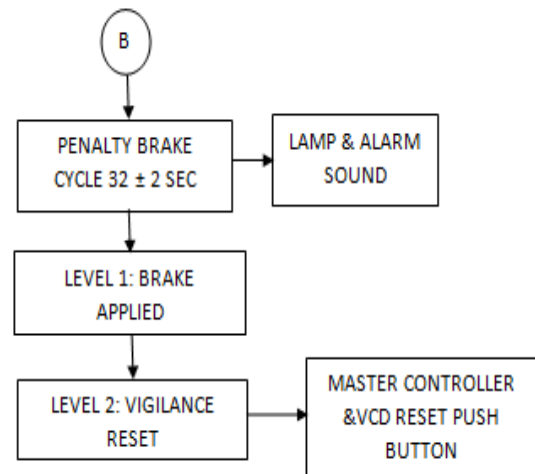


Chart -3: Penalty Brake Cycle

5.5 Fault Cycle

The operation of the vigilance unit is continuously monitored by its own inbuilt test routines. If at any time, a fault conditions is detected, a brake application is immediately initiated and a fault indication shall be given to loco pilot by flashing red LED and alarm buzzer suggesting driver to VCD. Only after the expiry of fault cycle and provided the master controller handle has to be set to OFF position an attempt can be made by the loco pilot to reset push button and normal locomotive operation. Such internal fault can be recorded inbuilt memory with date and time.

5.6 Vigilance Suppression

VCD system can be suppressed when the continuous proof of loco pilot's vigilance is not required. The suppression of the vigilance system shall be done in the following conditions.

1. Vehicle is stationary.
2. Speed is very low (less than 2Km/hr)
3. Brake application.

6. ALGORITHM

STEP1: Switch on the power supply.

STEP2: The program is executed and input is given such as [Vigilance foot pedal, Vigilance acknowledgement, Push button, Horn switch, Sander foot switch]

STEP3: Delay cycle is activated it last for about 60 seconds.

STEP4: The delay cycle is resetted if the driver gives any input to VCD. The delay cycle is expired if the loco pilot does not give any input. [If speed is less than 2 Km/h and vigilance pressure switch is de-energised the vigilance is suppressed].

STEP5: Warning cycle is activated it last for about 5 ± 2 seconds. The warning is given in the form of an alarm lamp and buzzer.

STEP6: If the loco pilot does not give any acknowledgement after 5 ± 2 seconds. The warning cycle is expired.

STEP7: The penalty brake cycle is activated it last for about 32 ± 2 seconds.

STEP8: And vigilance is resetted by setting master controller to OFF position and pressing VCD reset push button and the process from STEP 2 is repeated.

7. CONCLUSIONS

Each and every day the people who prefer to travel in train are increasing in a linear scale. In order to ensure the safety of the passenger this vigilance control device can be used by alerting the loco pilot of the train cyclically. This device records the events which the loco pilot carries throughout the journey which can be used for further analysis in case if any problem occurs. Thus utmost vigilance is safety in operations for the people travelling in train which is accorded by this device.

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