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Loco fault tracking system

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***Abstract*— The fault in the loco is tracked and informed to the control station immediately and then the faults are captured by RS422 and sent to the mobile number of the substation railway authorities using SMS service. It involves data capturing which is a process of fault tracking with the help of sensors fitted to the various parts of the loco. The filter is a microcontroller programmed with the knowledge about the important faults and events that occur frequently in the loco. The incoming fault is compared to the programmed fault. The output of the microcontroller is data containing important faults in the loco This information is given to the SIM which will forward this fault data to authorities as such officials can track the fault and give solutions immediately. The main scope of this project is to minimize train delay due to occupancy of track by the fault loco.**

***Keywords* — data capturing, filtering, RS422, RS232, GSM SIM900, sensors.**

I. INTRODUCTION

Train is the safe and low cost mode of journey. And it is preferred for its arrival and departure timings are specified before. If one loco failed to move successfully from one station to other, then there is a minimum of one hour delay for all other trains in that track. If the fault information about the loco is delivered to the authorities in nearby loco shed (the loco arriving junction or substation authorities), the actions will be taken immediately and thus save the time of many.

The already existing system, which can display the faults in the loco to the loco pilot, has some drawbacks that certain important faults are displayed only for few seconds and are not even stored in the memory attached to it. The scope of this project is to capture the faults in the loco and send it as SMS to the phone numbers of officials who can track the fault and give solutions immediately

II. DIESEL LOCOMOTIVES

Wherever Diesel locomotive is a type of railway locomotive in which the prime mover is a diesel engine, a reciprocating engine operating on the Diesel cycle in which the prime mover's mechanical power is conveyed to the driving wheels (drivers).

III. FAULT INDICATING SYSTEM

The system as represented in the fig.1 which will indicate whether the system is healthy or not. And also, it will give information about the power supply condition, track, point faults etc.

Fig.1. LCD panel on the loco indicating fault

IV.DATA CAPTURING UNIT

The data capturing unit in fig 2. mainly consists of sensory module and the microprocessor. The sensors are connected to various parts of loco such as the control panel, motors etc which measures parameters like pressure, temperature etc. The fault parameters such as change in the temperature below a threshold level are sensed and stored in the microprocessor.

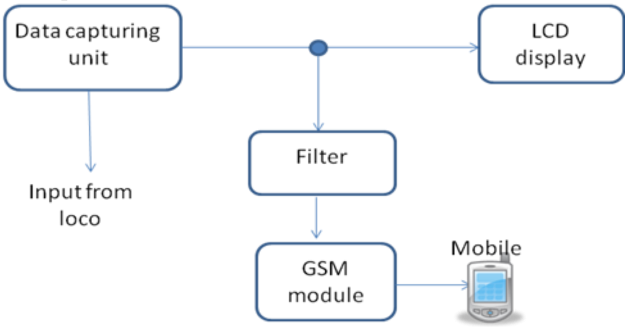

Fig 2. Block Diagram of Loco Fault Tracking System

V. SENSING MODULE

The sensing module consists of sensors which are attached to various part of the loco. Each sensor has a specific purpose and the type of sensor depends on the working of the part in which the sensor is fixed to detect faults. Some sensors such as Traction Motor speed sensors are used in more than one place.

A. Main Reservior Pressure Sensor

This sensor is used to sense the pressure in main compressor reservoir. The pressure is sensed and a feedback is given to the microprocessor. The MR sensor is mainly used for controlling loading/unloading of compressor. Thus the Main Reservoir pressure is maintained between 8 to 10 kg/ sq.cm.

B. Lube Oil Pressure Sensor

This sensor measures Engine lube oil pressure as shown in fig.3 and the feedback is given to the microprocessor. If the Lube oil pressure falls below the specified limit, the microprocessor will shut down the engine.

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Fig 3. LOP sensor

C. Fuel Oil Pressure Sensor

The fuel pressure must be above 2.5 kg/sq.cm. The FOP sensor as shown in fig 4. Measures fuel pressure for the diesel engine. If the pressure falls below the limit, the engine will stop cranking which will be controlled by the CPU.

Fig 4. FOP sensor

D. Independent Brake Pressure Switch

This switch is used to give feedback to the microprocessor whenever independent brakes are applied. This sensor is simply denoted as IBPS sensor as shown in fig 5.

Fig 5. Independent brake pressure switch

E. Barometric Pressure Sensor

The barometric pressure is measured to determine the altitude. For de-rating the engine, the microprocessor depends on BPS as shown in fig.6 and ambient temperature.

Fig 6. Barometric Pressure Sensor

F. Ambient Temperature Sensor

The ambient air temperature is measured using this AT sensor as shown in fig.7. This is used along with BPT to de-rate engine due to ambient condition.

Fig 7. Temperature sensor

G. Engine Water Temperature Sensor

The temperature sensor as shown in fig.8 monitors the engine water temperature. Based on the output, the CPU decides any actions such as running of radiator fan, removing traction power, etc. are required to maintain the engine water temperature under control.

Fig 8. Engine water temperature sensor

H. Lube Oil Temperature Sensor

The LOT sensor as shown in fig.9, located in Lube oil pipeline in expresser, will monitor the lube oil temperature for the protection of diesel engine

Fig 9. LOT Sensor

I. Diesel Engine Speed Sensor

The monitoring of diesel engine speed is done by this DES sensor as shown in fig.10 and a feedback is given to CPU for appropriate functioning.

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Fig 10. Engine Speed Sensor

J. Traction Motor Speed Sensors

There are totally 6 TM sensors used. These sensors used for measuring individual Traction Motor speed. These sensors output are used are used to detect wheel slip or slide and also to calculate the speed of the loco.

K. Position Sensors

These sensors as shown in fig.11 are interlocks which provide feedback to the microprocessor on status of the contactors i.e., whether they are open or close. For BKT it indicates motoring or braking.

Fig 11. Position Sensor

VI. LOCATION OF SENSORS

The sensors are located in different parts of the loco. The parts and the corresponding sensors are listed as follows:

Table.1 Location of sensors

LOCATION	SENSORS
NOSE COMPARTMENT	MR SENSOR LOP SENSOR FOP SENSOR
CONTROL PANEL	REAR END: BPT SENSOR FORE END: AT SENSOR
TRACTION MOTOR	TM SPEED SENSOR
EXPRESSOR ROOM	LUBE OIL PIPELINE: LOP SENSOR ENGINE WATER PIPELINE: EWT SENSOR
CONTACTORS	POSITION SENSORS

A. RS 232

The sensors are interconnected using RS 232 optical cable. The standards specified by RS 232 protocol is followed by these cables.

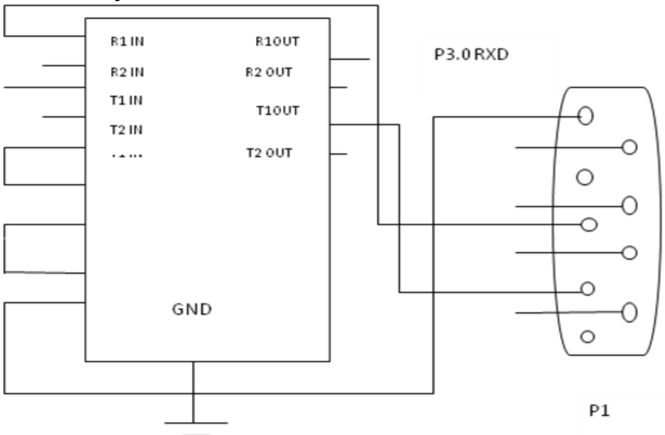

Fig 12. RS 232 Pin Diagram

RS232 as shown in fig.12 is an interface to connect one data terminal equipment to one data communication equipment at a maximum speed of 20 kbps with a maximum cable length of 50 feet. This was sufficient in the old days where almost all computer equipment were connected using modems, but soon after people started to look for interfaces capable of one or more of the following:

- Connect DATA TERMINAL EQUIPMENT's directly without need of modems
- Connect several DATA TERMINAL EQUIPMENT's in a network structure
- Ability to communicate over longer distances
- Ability to communicate at faster communication rates

B. Memory

The memory module is responsible for storing Fault data. It has 128K of memory. For selected faults, such as ground Relay, data is stored from each of the 5 seconds before the fault occurred. This information will assist shop personnel in determining the cause of defects, The memory module also stores some "operational data needed by the CPU. Some data must be retained even after power cut so that effective/aggressive wheel slip control can be maintained when the system reboots. The memory is a RAM memory, so it requires battery backup. Lithium batteries are used for battery backup. When battery voltage does begin to reach a critical level, a fault is logged archives.

C. Central Processing Unit

The Central Processing Unit is the central brain which controls the entire data capturing unit. This CPU consists of 68020 microprocessor which is a 32 bit, 16MHz processor. The CPU has a math co-processor which is for enhancing speed and efficiency. It also equipped with PROM to store operating routines, and loco characterization data. RAM is used for "scratchpad" purposes. The system has a memory

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storage named "Flash PROM" which can be easily reprogrammed with the help of Master Memory Board (MMB). The reprogrammable time for the Flash PROM is approximately 15 minutes.

D. Data Logger

The interfacing between data capturing unit and filtering unit is done with the help of equipment named data logger.

VII. FILTERING UNIT

The filtering unit consists of 8051 microcontroller which will filter the important faults from the list of fault data captured and send that important fault information to the GSM modul1e. The 8051 microcontroller uses P89V51RD2 as assistance.

A. Filtering Process

The filtering process is carried out once the fault data is received by the micro controller. The important fault and their codes are loaded in the microcontroller before it is used for implementation. The microcontroller will check whether the incoming code matches the previously loaded codes. The function of the microcontroller is to extract the important faults from a list of faults which is given as input. The microcontroller is loaded with the codes of important fault data. Once the input is received, the input fault code is compared with that of the loaded. If a match persists, the particular fault code is extracted and will be sent to GSM. Else, the comparison will be continued with another input until a match is found. If there is no input data to process, the filtering unit will stop and comes to halt condition where no filtering is done. The process of filtering will be described by the following flow chart as shown in fig.13.

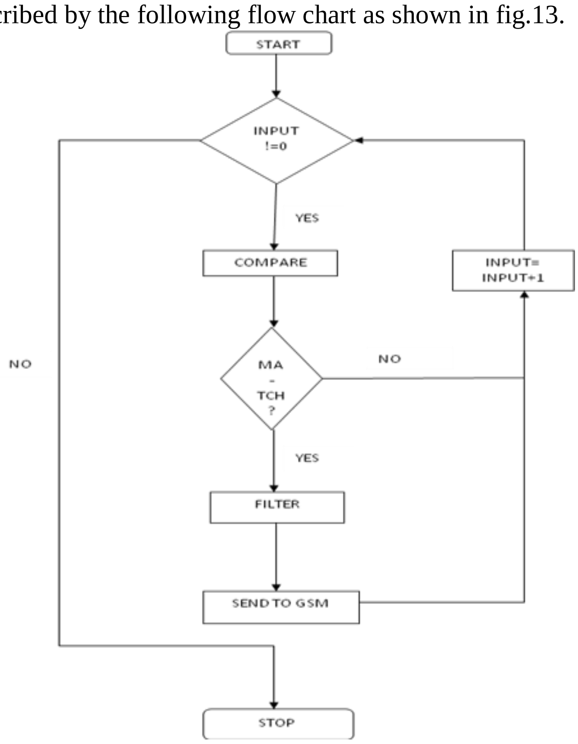

Fig 13. Flowchart for filtering process

B. RS422

RS-422 as shown in fig.14 is the name of the technical standard that specifies electrical characteristics of a digital signaling circuit. It is a standard for binary serial communications between devices.RS-422 is used as a splitter to capture the data passing to the LCD panel of the loco to the filtering unit.

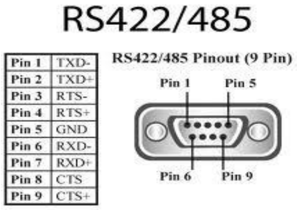

Fig 14. RS422

VIII. MESSAGING UNIT

The messaging unit consists of a GSM module which will get input from the filtering unit and transmits the important fault data to the authorities in loco shed as SMS.

C. GSM Module

Global System for Mobile Communications is a standard set developed by the ETSI to describe technologies for second generation (2G) digital system. The GSM standard originally described a digital, circuit switched network optimized for full duplex voice telephony. The standard was expanded over time to include first circuit switched data transport, then packet data transport via GPRS (General Packet Radio Services). Packet data transmission speeds were later increased via EDGE (Enhanced Data rates for GSM Evolution) referred as EGPRS. The GSM standard is more improved after the development of third generation (3G) UMTS standard developed by the 3GPP. GSM networks will evolve further as they begin to incorporate fourth generation (4G) LTE Advanced standards. "GSM" is a trademark owned by the GSM Association.

D. GSM Carrier Frequencies

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead. In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems. Most 3G networks in Europe operate in the 2100 MHz frequency band.

Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones to use. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots (or eight burst periods) are grouped into a TDMA frame. Half rate channels use alternate frames in the same timeslot. The

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channel data rate for all 8 channels is 270.833 kbit/s, and the frame duration is 4.615 ms.

The transmission power in the handset is limited to a maximum of 2 watts in GSM850/900 and 1 watt in GSM1800/1900.

E. Sim900

The sim900 is used as it is a quad-band modem which can operate in four different frequencies. This can operate in any part of the world.

F. Messaging Information

The SMS sent will contain the following information

- Train Number
- Fault Code
- Fault Description

IX. FINAL OUTPUT

The final output of the project, which is the SMS about fault details to phone number of loco shed authorities can be represented as in the fig.15.

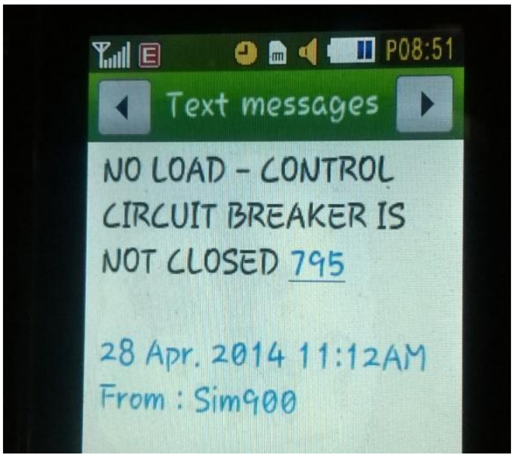

Fig 15. Final Output

X. CONCLUSION

The project mainly concentrated on making the loco authorities work easy by informing the fault information as and when it is occurred. By informing the faults in the loco immediately while occurring to the loco authority, the decision will be made quickly and the track clearance process will be faster. It is different from the existing system by the way that it will inform the loco authority about the fault occurred in loco when it is occurred while the existing system was able to inform about faults only when the loco comes to shed for fault rectification. For real time, we integrate the output of a number of 8051 ICs and get a net result to be sent to GSM.

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