International Journal of Advanced Science and Research
ISSN: 2455-4227, Impact Factor: RJIF 5.12
www.allsciencejournal.com
Volume 2; Issue 4; July 2017; Page No. 141-144

Microcontroller based intelligent railway engine

*1 Mantu Kumar Das, 2 Goutam Kumar Maity

1 Department of Physics, Garhbeta College, Affiliated to Vidyasagar University, Paschim Medinipur, West Bengal, India
2 Department of Physics, Pingla Thana Mahavidyalaya, Affiliated to Vidyasagar University, Paschim Medinipur, West Bengal, India

Abstract
The railway network of India is the biggest in Asia and perhaps the most complicated in all over the World. There are so many different types of trains like local, fast, super-fast, passengers, goods etc. and their so many multiple roots. Although the time table is perfect it is not at all possible to maintain it. And that's why the train accidents are becoming more and more usual. So in this paper a little kind of intelligence is added to the train engines so that it tries to avoid train accidents. The idea is whenever any engine observes a red signal on its track, it will start decreasing its speed gradually and stops automatically at some distance from the signal pole. After that when it gets green signal the train will automatically gain speed and go on. In the mean time when the train has not stopped yet and a red signal becomes green then it crosses the signal pole with low speed and then the speed will increase gradually.

Keywords: DC motor, IR LED, microcontroller 89C51, PWM technique, speed controller, timer IC, TSOP

1. Introduction
The idea behind this paper is whenever any engine observes a red signal on its track it will start decreasing its speed gradually and stops automatically at some distance from the signal pole. After that when it gets green signal, the train will gain speed and go on. In the mean time when train is not stopped yet and a red signal becomes green then it crosses the signal pole with low speed and then the speed will increase gradually. So now before the driver observes the red signal the engine itself observes it and automatically starts decreasing speed and then stops.

2. Methodology
2.1 Planning and Approach
A transmitter is to be attached with signal pole which will start transmitting signals only when the red light is on. If there is green light no transmission. The engine has a receiver which catches these transmitted signals and takes desire actions.
Both the transmitter and receiver are of radio frequency (RF) type with minimum range of 2 Km. so that swapping distance of 100-200 metre. In this paper infra-red (IR) transmitter and receiver are used instead of RF for demonstration purpose. But same idea can be easily implemented with RF or GSM module also with an increased cost.

2.2 Literature Review
Bonta *et al.* [1] states that the Europian laws are more and more restrictive regarding the environment pollution: exhaust gases, noise etc. The authors present some modern solutions for improvement of the Diesel engine operation in railway traction. Using dedicated electronic systems for injection control and monitoring, the main advantages - economical, technical and environmental - are presented. The new control strategy is based on the general linearized model of the Diesel engine.
Jandaghian *et al.* [2] states that the railway transportation is a mono block system, smallest changes in a train movement cause many changes at timing program. Compensation of deviation from scheduling program in earliest time will cause optimal utilization from locomotive, wagon and line. Scheduling table contains information about arrival and dispatching and duration of stop time of each train in every station. This system proposes program has more adaptability with scheduling table of train movement. It must decide which train will have the preference to occupy the distance between stations and which must stop at a siding. This centralize fuzzy controller could be replaced instead of manpower. Gajdar *et al.* [3] deals with an intelligent railway vehicle system subjected to changing conditions of operation, embodied as vehicle velocity and track curvature parameter variations. The main purpose of control design therefore is to achieve robustness against parameter changes and at the same time to reject track disturbances. Generally such big parameters variations cannot be handled properly by a fixed gain controller, therefore the applicability of gain-scheduling control techniques are examined. To handle the problem a brand new method, the multi-model based gain-scheduling sliding mode control approach is proposed. Aguirre *et al.* [4] presented a sensor less torque control of permanent magnet synchronous machines (PMSM) in railway traction applications based on the flux estimation. In order to improve the algorithm performance in a wide speed range, some compensation loops are included. Special techniques for standstill and flying start are also proposed. The sensor less control strategy is validated in a railway simulation platform for a 120kW surface mounted PMSM tramway motor prototype.

2.3 Working Principle
The basic requirement to control the train according with the signal is the speed control of the motor of the train. Here in this paper the speed control of the DC motor is shown. Speed

control means intentional change of drive speed to a value required for performing the specific work process. This concept of speed control or adjustment should not be taken to include the natural change in speed which occurs due to change in the load on the shaft. The nature of the speed control requirement for an industrial drive depends upon its type. Some drives may require continues variation of speed for the whole of the range from zero to full speed or over a portion of this range, while the others may require two or more fixed speeds.
The speed of the DC motor is controlled here by using pulse width modulation (PWM) technique. The pulse width modulation can be achieved in several ways. In this paper, the concept of PWM generation using micro- controller is done.

2.4 Speed control Using PWM speed control

Pulse-width modulation (PWM) or duty-cycle variation methods are commonly used in speed control of DC motors. The duty cycle is defined as the percentage of digital 'high' to digital 'low' plus digital 'high' pulse-width during a PWM period. Pulse width modulation technique (PWM) is a technique for speed control which can overcome the problem of poor starting performance of a motor. PWM for motor speed control works in a very similar way. Instead of supplying a varying voltage to a motor, it is supplied with a fixed voltage value (such as 12 V) which starts it spinning immediately. By continuing this voltage on/off cycle with a varying duty cycle, the motor speed can be controlled.
The wave forms in the Fig. 1 given below to explain the way in which this method of control operates. In each case the signal has maximum and minimum voltages of 12V and 0V respectively.
In wave form, the signal has a mark space ratio of 1:1.with the signal at 12v for 50% of the time, the average voltage is 6V, so the motor runs at half its maximum speed.
In wave form, the signal has mark space ratio of 3:1.which means that the output is at 12V for 75% of the time. This clearly gives an average output voltage of 9V, so the motor runs at three fourth of its maximum speed.
In wave form, the signal has mark space ratio is 1:3, giving an output signal that is 12V for just 25% o the time. The average output voltage of this signal is just 3V, so the motor runs at one fourth of its maximum speed.
By varying the mark space ratio of the signal over the full range, it is possible to obtain any desired average output voltage from 0V to 12V. The motor will work perfectly well, provided that the frequency of the pulsed signal is set correctly, a suitable frequency being 30Hz. The block diagram of the controller system is shown in Fig.2.

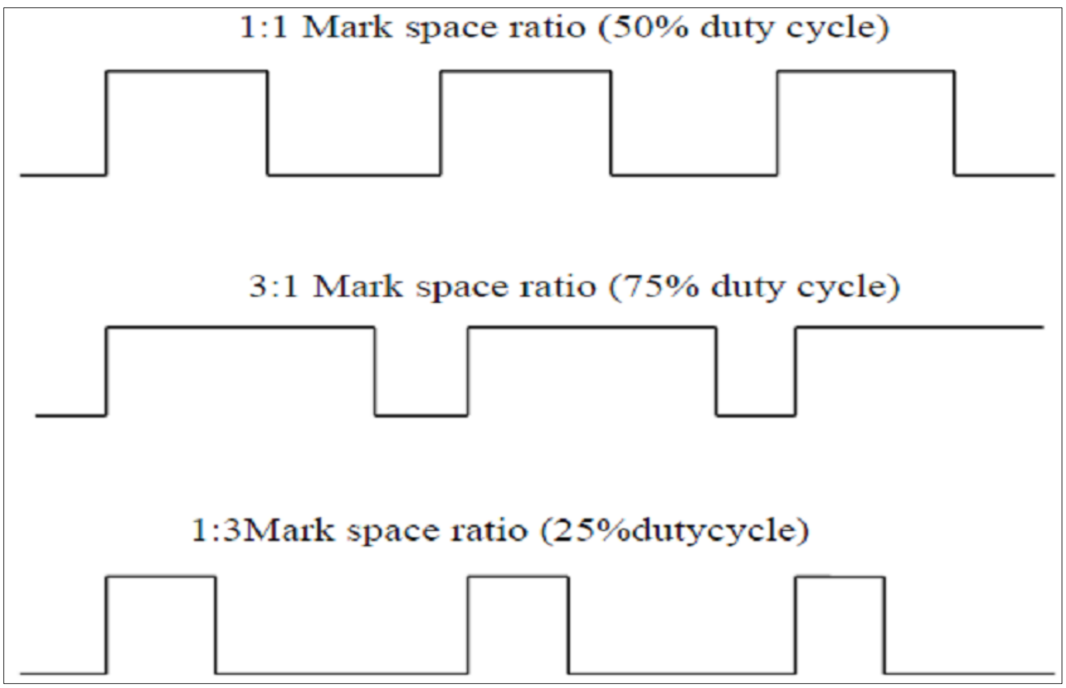

Fig 1: Pulse Width Modulation (PWM) Technique

In the signal post when the red signal will be on then the IR LED starts transmitting. The signal is detected by TSOP and the interrupt is sent to the microcontroller [5, 8]. A RF module is used to send the signal to the receiver. When an interrupt is entered into the microcontroller, the controller will act as its condition and the speed of the motor decreases gradually.
When the green LED is on in the signal post then the IR LED does not transmit, so the TSOP is off then and no interrupt is send to the microcontroller. So the speed of the train starts increasing.

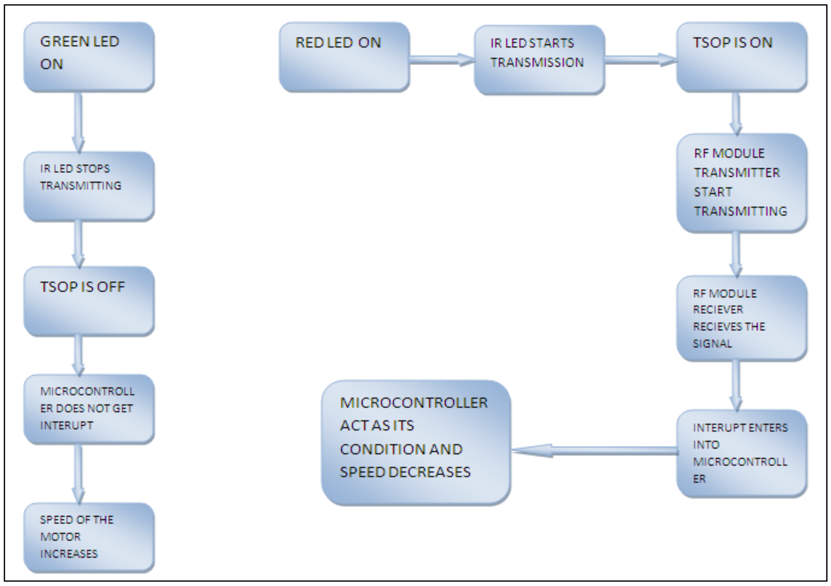

Fig 2: Block Diagram of the Controller System

3. Circuit Diagram and Working

3.1 Transmitter Circuit

As shown in Fig. 3 when SW1 is in position as shown the transmitter is ON and also the red LED is also ON. When switch changes its position the red LED and transmitter are off and only green LED will on. When the circuit is energized U2 will start generating high pulse at every 1 sec. as this pulse is fed to reset pin of U1 it will generate 38 KHz square wave and give it to IR LEDs. IR LEDs will generate IR beam of 38 KHz for the same time. Thus after every one second the IR beam of 38 KHz is generated for one second only. This cycle repeats till the red light is on.

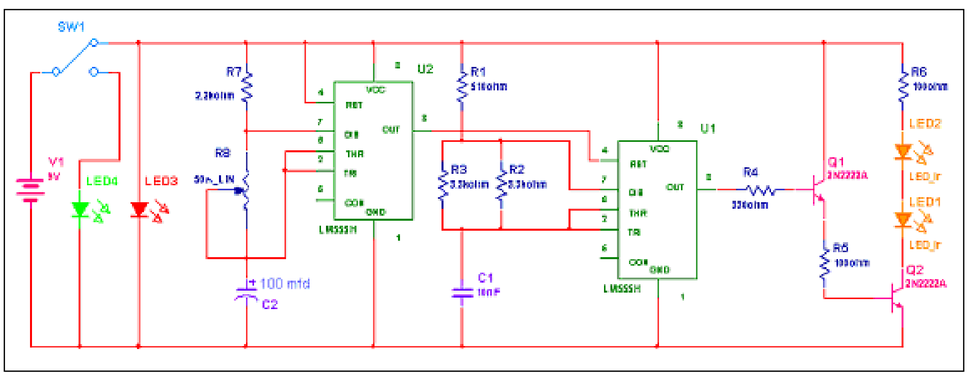

Fig 3: Circuit diagram of a Transmitter.

3.2 Receiver Circuit

The receiver circuit performs the single directional motor control. Separating the power supply of the motor and logic will reduce the possibility of damage to the control circuitry.

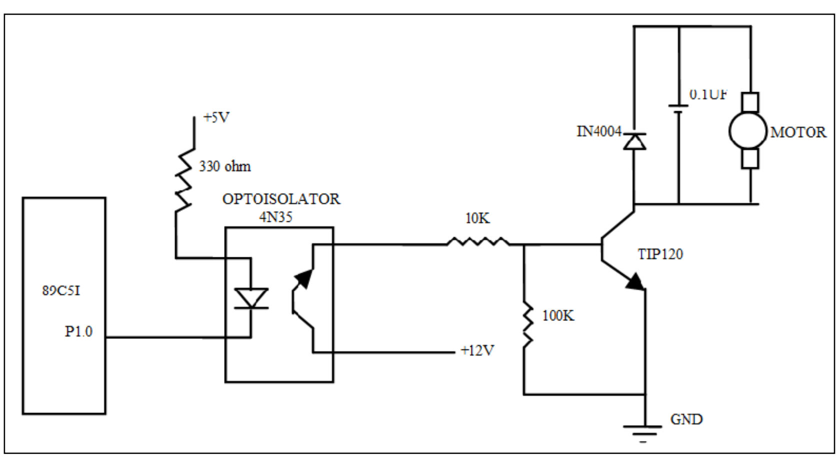

Fig 4: Circuit diagram of Receiver.

In the figure shown above the optoisolator provides the protection of the control circuit. In this circuit, the output of the microcontroller is fed to the anode of the diode contained in the optoisolator in the positive terminal of the diode a +5V supply is given so, when the output of the microcontroller from P1.0 turns low the optoisolator turns on, thereby providing the sufficient base drive to the transistor inside the optoisolator to turn on. The output of the optoisolator is fed to a power transistor TIP120 to boost up the current supplied by the circuit to the motor. The Microcontroller is duly progrramed for proper control of the motor using PWM technique [9, 12].

4. Results and Discussions

The desired results for controlling the speed of the motor, was obtained successfully. The train gained speed in equal intervals of 25%duty cycle. Each time the red LED of the transmitter end was ON, the microcontroller was interrupted from its normal mode of operation. The ISR (Interrupt Service Routine) contained the program to decrease the speed of the train, and if the red LED remains ON for a long duration the speed of the train decreased gradually and the train came to rest slowly.

The IR led range was too small that TSOP can detect the signal only when the distance is close enough. But at the time of implementation it was a kind of failure. So a RF module is used and the TSOP is kept near the IR LED. When TSOP detect the interrupt the RF transmitter starts transmitting and the signal is received by the receiver module and train speed goes slow gradually.

5. Conclusions

This work is related to a simplified, substantially self-contained railway signaling system. In manual system, a huge possibility of human error can be existed which leads to serious train accident. But these problems can be surely overcome by this automated system where human interaction with the system is least. Eventually it finds a vast application in the railways where speed is very high. As possibility of accident becomes higher with the increase of speed, so it is better to get the automatic system into act. Indian railway network is one of the largest networks of the world and it is being expanded day by day to provide the facility to more number of individuals. This automatic system is very useful from the safety point of view.

6. Acknowledgements

We wish to express to our heartfelt gratitude and thanks to Prof. (Dr.) Parasar Bandopadhyay, Principal MCKV Engineering College for his kind co-operation and for providing the department facilities. We are also thankful to Ms. Tanusri Bose and Mr. Arijit Sar without them it was impossible to complete the work.

7. References

1. Bonta D, Automation Quality, Testing Robotics. IEEE International Conference, 2006; 1:318-320,
2. Jandaghian M. Intelligent Transportation Systems, ITSC. 11th International IEEE Conference Beijing, 2008; 681-686.
3. Gajdar T. Inst. of Ind. Sci., Tokyo Univ., Japan, Korondi, P; Suda, Y, Intelligent Engineering Systems, INES '97. Proceedings, IEEE International Conference1997, 15-17.
4. Aguirre M. Fac. of Eng., Univ. of Mondragon, Mondragon, Spain Poza, J. ; Aldasoro, L. ; Nieva, T. Power Electronics and Applications EPE, 2013 15th European Conference, 2013, 1-10.
5. Hall DV. Microprocessor and Interfacing, 2nd Edition Tata McGraw Hill Publishing Company, 2006.
6. Mazidi MA, Mazidi JG, Rolin D, Mckinlay. The 8051 Microcontroller & Embedded Systems, using Assembly and C" 2nd Edition, Pearson Education, 2007.
7. Ray AK, Bhurchandi KM. Advanced Microprocessors & peripherals, 2nd Edition Tata Mc Graw Hill Publishing Company, 2004.
8. Raj Kamal. Microcontrollers Architecture, Programming, Interfacing and System Design, Pearson Education, 2005.
9. John B. Peatman. Design with PIC Microcontrollers - Pearson Education, 2005.
10. Deshmuk AV. Microcontrollers Theory & Applications – WTMH, 2005.
11. Ayala KJ. The 8051 Microcontroller Architecture, Programming and Applications, Penram International, 2007.
12. http://www.engineersgarage.com/contribution/dc-motor-speed-control-using-pwm-modulation.