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AC DUCT MONITORING AND CLEANING VEHICLE FOR TRAIN COACHES

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Abstract - *A.C. [Air Conditioning] railway coaches have air duct for the conditioned air to flow to the passengers through it. This duct is very complex to monitor and clean. As Roof Molded Package unit for train is used now a day, they have molded duct and once it was designed, no one could ever clean the duct. This is the main problem faced by most of the railway workshops. The duct is deep and long but too small as a human could not get into it easily. The solution for the duct cleaning is done by using prototype model. This experimental setup is kept inside the duct of a railway coach and it can be monitored through the visual image from the wireless camera which is connected to the monitor display. The vehicle control can be achieved by making a call to the phone and it was attached to the DTMF [Dual Tone Multi Frequency] decoder. When a key press is made a different frequency is generated at the mobile phone and it is transmitted through the mobile communication network. Now the signal is received through the mobile phone attached to the DTMF decoder and the signal is converted in to a binary code by the DTMF decoder. According to the control strategy, the robot will move inside the duct which displays the dust. The cleaning operation carried out by switching on the vacuum cleaner by the same operation itself. In order to stop the cleaning process, the assigned key could be pressed in the mobilephone.*

Key Words *air duct, railway coach, DTMF decoder*

1. INTRODUCTION

Passengers in a train travel are affected by infiltration of air with dust due to open train windows. This is more so in case of high speed passenger carrying trains. Secondly for a tropical country like India, the temperature varies from 46^{o}C during summer to 2^{o}C during winter. Air conditioning of railway coaches is, therefore, necessary for the maximum comfort and wellbeing of passengers in a railway travel. In keeping with modern trend, air conditioning of coaches for upper class travelers and lately even for lower class traveler has been introduced by the Indian Railways. Available power, generally at 110V D.C. has to be utilized 415V, 50Hz, 3Ph; industrial power is available only on a few nominated trains like Rajdhani and Shatabdi Express. However, in such cases, the flexibility of attaching and detaching coaches is lost. Due to large number of passengers in small space, the space left for air circulation is limited. In the Railway coaches, where people move in and out at all hours of the day, to sudden changes in temperature, which may cause chill or heat are to be avoided. Rapidly changing ambient conditions as the train moves from one part of the country to another.

2. OVERVIEW

Cleaning the duct is the most serious problem and still no maintenance procedure is followed in any railway workshops. As RMPU have molded duct, once it was designed no one could ever clean that. This is the main problem faced by most of the railway workshops. The duct is deep and long but too small in size as a human could not get into it easily. So cleaning this duct is a serious challenge. The duct will have the dimension of 24cm x 10572cm x 66.7cm. So it makes complex for the human to clean it. So we need special way to clean that. We are giving a solution for this difficulty in air duct cleaning by a vehicle, so it could clean the duct [1][2]. The overall operation of the vehicle is explained as follows. The vehicle is kept inside the duct of a railway coach and now we could see the visual of the duct by the camera connected, through the monitor. Now we direct our vehicle by controlling them by using a mobile phone by making a call to the phone attached to the DTMF decoder [4][5]. When a key press is made a different frequency is generated at the mobile phone and it is transmitted through the mobile communication network. Now the signal is received through and the signal is converted in to a binary code by the DTMF decoder. Now according to the control the vehicle will move and now when we are seeing the dust in the duct we will clean it by switching on the air blower by the same operation itself. Now in order to make a stop, certain key assigned to it could be pressed and the vehicle will be stopped.

2.1. REQUIREMENT OF RAILWAY COACH AIR CONDITIONING SYSTEM

1. Supplying clean fresh air at a controlled uniform temperature.

2. Catering, within the confines of the Railway carriages to the continuously changing number of passengers.

3. Providing for heating as well as cooling on a train that travels through areas of widely differing climate during its journey.

2.2 CLASSIFICATION OF AIR CONDITIONED COACHES

1. Self generating coaches

2. End on generation coaches

2.3 DRIVING EQUIPMENT

Driving equipment consist of motors for driving the compressor, condenser impeller fans and the evaporator blower fans. The driving motors in self- generating type coaches are all of D.C. machines needing more care for attention of commutator and brushes. The E.O.G.[End On Generation] type coaches are provided with 3 phase A.C. squirrel cage induction motors for driving the A.C. equipment.

Table -1: Details of batteries provided on S.G. coaches (under slung type)

Type of A.C. Coach	NO. OF SETS & CAPACITY	Relevant BIS specification
BG A.C. 2T Sleeper	1 set of 800 AH(56 cells)	IS:6848
BG A.C. Chair Car	1 set of 800 AH(56 cells)	IS:6848
BG A.C. Composite	1 set of 800 AH(56 cells)	IS:6848
BG. AC. 1st class.	1 set of 525 AH	IS:6848
MG.A.C.2T sleeper	1 set of 450 AH	IS:6848

3. MAINTENANCE SCHEDULE FOR AIR CONDITIONED COACHES

The following are the various maintenance schedules carried out on air-conditioned coaches.

1. Trip schedule.
2. Monthly schedule
3. Three monthly schedules
4. Production Over Head - One year

3.1 GENERAL CHECKS

1. Suction pressure gauge reading should be 2.6-2.8 Kg/Cm^2.

2. Delivery pressure gauge reading should be 10-12 Kg/Cm^2.

3. Oil pressure should be minimum 3 Kg/Cm^2 above suction pressure.

4. Feel temperature - Suction should be cold and sweaty. Delivery should be very hot and liquid line should be warm.

4. PROBLEMS IN A.C. COACHES

1. Gas leakage in pipeline from joints in the controlequipment.
2. Premature failure of shaft seal of compressor. High heat in condenser leading to leakage of refrigerant.
3. Difficulty in cleaning of condenser.
4. Difficulty in cleaning of Air Duct.
5. Vee belt failure.
6. Compressor motor failure.
7. Condenser motor failure.
8. Dehydrator defective.
9. PCB defective in regulator.

5. AIR DUCT

The air conditioning system includes three air ducts as follows:

1. Fresh (Inlet) air duct
2. Main air duct
3. Return air duct

5.1 SOLUTION FOR THE DIFFICULTIES IN AIR DUCT CLEANING

This is the most serious problem and still no maintenance procedure is followed in any railway workshops. As RMPU have molded duct, once it was designed no one could ever clean that. This is the main problem faced by most of the railway workshops. The duct is deep and long but too small in size as a human could not get into it easily. So cleaning this duct is a serious challenge. The duct will have the dimension of 24cm x 10572cm x 66.7cm. So it makes complex for the human to clean it. So we need special way to clean that.

5.2 SOLUTION FOR DUCT CLEANING

We have undergone a thorough study on the system and found a solution to clean that duct. So we have decided to monitor and clean the duct by using the vehicle controlled by DTMF. So when we are attaching a camera by that we could monitor the dust and other impurities. Then the vehicle will carry an air blower so that on seeing the dust or impurities on the duct through the camera we could on the air blower and the process will start. The whole process is controlled by the mobile phone [6]. So we name the solution

as the "A.C. duct monitoring and cleaning vehicle for A.C. coaches in train".

6. DUAL TONE MULTIPLE FREQUENCY DECODER

This DTMF (Dual Tone Multi Frequency) decoder circuit identifies the dial tone from the telephone line and decodes the key pressed on the remote telephone. Here for the detection of DTMF signaling, we are using the IC MT8870DE which is a touch tone decoder IC. It decodes the input DTMF to 5 digital outputs. The M-8870 DTMF (Dual Tone Multi Frequency) decoder IC uses a digital counting technique to determine the frequencies of the limited tones and to verify that they correspond to standard DTMF frequencies. The DTMF tone is a form of one way communication between the dialer and the telephone exchange. The whole communication consists of the touch tone initiator and the tone decoder or detector. The decoded bits can be interfaced to a computer or microcontroller for further application (For example, Remote control of home/office electrical appliances using a telephone network, Cell Phone controlled home appliances, Mobile phone controlled vehicle., etc.)

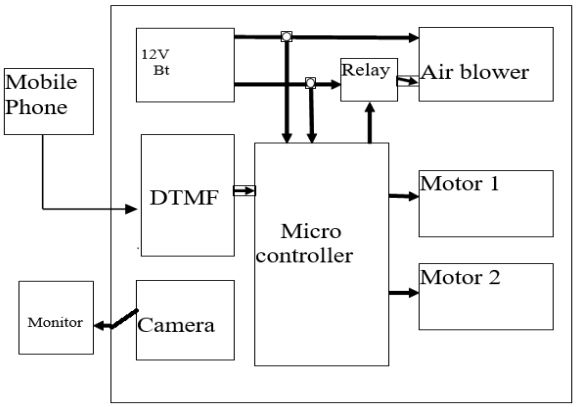

Fig -1: Block diagram of a duct cleaning vehicle

Fig -2: Hardware prototype

7. SOFTWARES USED

The above said blocks are connected together and the microcontroller is programmed by the above program by using the software "keil µvision-4" and loaded to the micro controller by using the "Flash magic" software. We have only RS 232 based pin for 8051 micro controller with us so we are using a USB converter and its driver to interface and program to microcontroller. For this we are using software called "PL-2303 USB to serial" driver

8. PROCEDURE FOR CONNECTIONS

Initially take a card board for the motor chase and to carry the circuit.

Take two 12 volt geared DC motor according to the speed requirement. Make sure the size of the vehicle should not exceed the duct size.

Connect the two motor below the card board as if the shaft are connected by the wheels with high friction.

Connect a 360 degree rotating mono wheel at the front bottom area, now the bottom area is completed.

Connect the wire from both the motor to the motor drive and make sure the motor driver circuit is given the power supply from the microcontroller.

The motor driver pins are noted as L+, L-, R+, R- and they are connected to the port P1.3, P1.2, P1.1, P1.0 as required.

The DTMF decoder is connected to a mobile with a head set and the output is connected to the port 0 pins.

The program is done according to the DTMF input and our output requirements

A 12 volt battery used to power all the devices used in our vehicle

Microcontroller will enable our port pins according to the command or program we given to it.

An air blower of 12 volt is connected through the relay circuit.

The relay will be connected to the microcontroller port 3 pin and the port pin will be enabled only when the input is given from the mobile we are using for the control.

Now the overall vehicle is connected with the camera and it is interfaced with the monitor to see the duct.

9. OPERATION

The overall operation of the vehicle is explained as follows. The vehicle is kept inside the duct of a railway coach and now we could see the visual of the duct by the camera connected, through the monitor. Now we direct our vehicle by controlling them by using a mobile phone by making a call to the phone attached to the DTMF decoder. When a key press is made a different frequency is generated at the mobile phone and it is transmitted through the mobile communication network. Now the signal is received through and the signal is converted in to a binary code by the DTMF decoder. Now according to the control the vehicle will move and now when we are seeing the dust in the duct we will clean it by switching on the air blower by the same operation itself. Now in order to make a stop certain key assigned to it could be pressed and the vehicle will be stopped.

10. CONCLUSION

This project gives about A.C. duct monitoring and cleaning will be the greater solution for the difficulties in monitoring and cleaning the duct in the train. The project not only focuses on monitoring and cleaning the duct but also could be used to monitor the remote areas where human could not interfere. We used dual tone multi frequency decoder to communicate between the remote and vehicle. The reason we used dual tone multi frequency method is that we could use the vehicle for a long distance. The main problem is the distance which is restricted to few meters due to the wireless camera's wavelength. We could also use the internet cameras which will neglect the distance factor and make the vehicle operate from any area. In this special concern of monitoring and cleaning of the train duct this wireless camera capable of 100m is fair enough and so we could get a cost effective camera for the project. This project will be used widely in all railway workshops all over India for monitoring and cleaning the duct as no such vehicle is used until now. We also suggest this project for all ducts cleaning by connecting a suitable blower or air blower to the remote vehicle. We hope that the project done by us will benefit the railway workshops to rectify these dirty duct problems.

REFERENCES

[1] D. Javale, M. Mohsin, S. Nandanwar, and M. Shingate, "Home Automation and Security System Using Android ADK", International Journal of Electronics Communication and Computer Technology, vol. 3, pp. 382-385, March 2013

[2] Holopainen R and Salonen EM, "Modelling the cleaning performance of rotating brush in duct cleaning", J. Energy Buildings vol. 34, issue 8, 845-852, 2002.

[3] Fanlin, "Cleaning of the air ducts of central air-conditioning Improves the indoor air quality", J. Cleaning World, volume 20, issue 4, 14-18, 2004.

[4] J.Y Park, B.H Cho, S.H Byun, and J.K Lee, "Development of Cleaning Robot System for Live-line Suspension Insulator Strings", International Journal of Control, Automation, and Systems, vol. 7, issue 2, 211-220, 2009.

[5] Y.C. Cho and J.W. Jeon. "Remote Robot Control System based on DTMF of Mobile Phone", 6th IEEE International Conference on Industrial Informatics, INDIN 2008, pp 1441-1446, 2008.

[6] J. S. Artal,_ J. Caraballo and R. Dufo, "DTMF technology applied to the identification and control of a small mobile robot", Technologies Applied to Electronics Teaching pp 1-6, 2018.