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Fabrication of Remote Controller Duct Cleaning BOT

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ABSTRACT: This paper presents a new type of autonomous air duct cleaning robot system, which consists of three devices: the monitor and control device, the remote robot and the dust collection device. The control principle and structure design of the proposed robot system are introduced. The guiding device is proposed and designed to ensure the remote robot to move in straight route and turn automatically at corner. The control mechanisms of the remote robot and the rotating brush device are described in detail. In this paper, the D model of the remote robot is created and the assembly analysis is accomplished using Pro/E. Finally, a prototype of the rotating brush device is made manually to test the cleaning effect of the proposed robot system

I. INTRODUCTION

In today's world of globalization and modernization, there is an increase in earth's temperature and has also demanded an increase in air conditioning and ventilation systems. Air conditioners are machines that alter the characteristics of surrounding air to condition more comfortable for humans by lowering temperature, eliminating humidity and distributing it to the required places. Nowadays As its need is increasing exponentially, the distribution process has also become diversified leading to the entire system as heat, ventilating, and air conditioning (HVAC) system. These distribution channels require inspection at regular intervals to maintain its high efficiency and to lower the losses of effects produced by the air conditioners [1].

With the advancement in technology, Robots are increasing day by day and get involved in the task that are either monotonous or dangerous for human life like in fields of applications not limited to office, military operations, hospitals, industrial automation, security systems, and agriculture [2]. Recent advancements in robotics are focusing more towards the safety of power plants, and special attentions given for inspecting them [3,4,5]. Also, more and more robots are being employed in cleaning of the power plants which is considered to be a tedious job [5,6]. A robot is a mechanical or some intelligent virtual agent that has the capability to work in an autonomous, semi-autonomous or remotely controlled way [7]. Some inspections and cleaning works requirement in hostile situations and some areas inaccessible to humans [8,9,10].

Our research focuses on non-invasive methods for cleaning and inspection of ducts using the robot. Usually, the ducts are of various sizes and shapes some includes rectangular, circular and square crosssections, so there is a requirement of a robot that is capable of working in different cross section ducts. One of the techniques available is vacuum pressure, but it is not capable enough to perform various attributes. Our research provides the optimized methods for cleaning and inspection of ducts by a wirelessly controlled robot having an array of sensors, actuators for working in horizontal and vertical directions. As the actuators are vital to the movement of the robot, so we have designed a unique conveyor mechanism in which the end user has the facility to change the track width for smooth

movement of the robot in varying cross sections. This robot helps to remove dust, bacteria, and fungi from the ducts by some non-destructive methods and inspection of cracks and carrion.

In buildings and kitchens, air is supplied or circulated through ducts with various facilities. Smoke and dust contained in the air passing through the duct in the enclosed space accumulate in the ducts and build up more in the flexions. These cause indoor air pollution and should be cleaned regularly. Especially, in case of kitchen ducts, dust and oil stain deposits prevent circulation or cause fire accidents due to high temperature air. Thermal efficiency of heating and cooling ducts for air conditioning and heating decreases when dust builds up. Duct cleaning are largely classified as dry and wet [1] methods. Since it is virtually impossible for humans to clean ducts themselves, the introduction of a duct-cleaning robot is required.

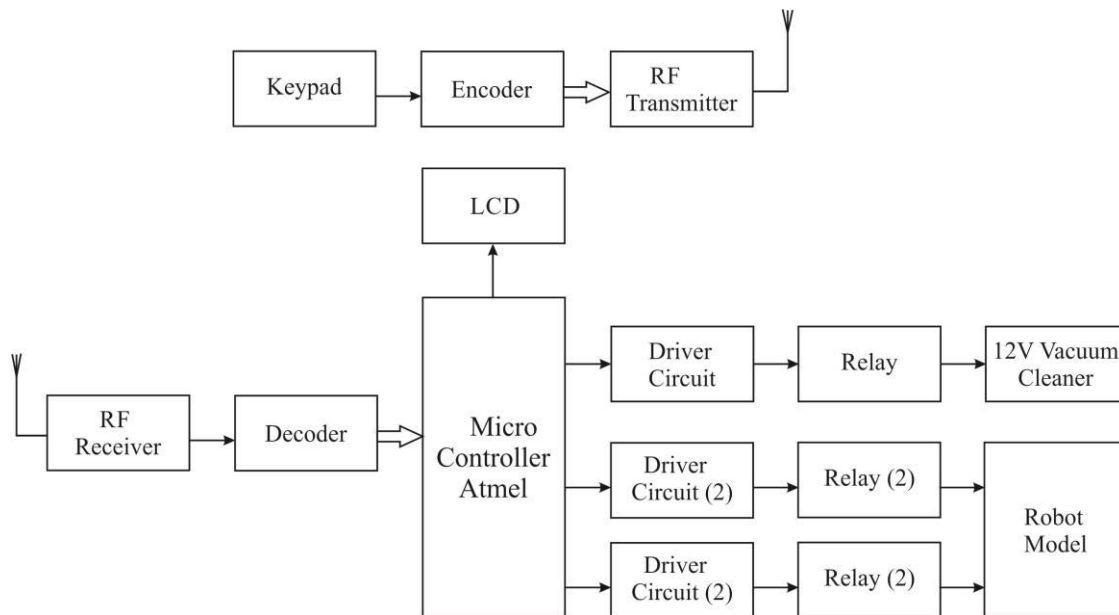


Fig 1: BLOCK DIAGRAM

The shape of the robot can be determined according to the method of cleaning the duct. Due to the nature of ducts, especially in the closed space, wire-twisting problems occur when using a wire driven robot. Thus, it is necessary to build a wireless-driven robot and develop a robot that can move autonomously along the ducts. At the same time, the location of the robot needs to be identified while moving along complex duct structure in order to monitor the operation. Meanwhile, existing duct cleaning robots [2-4] are difficult to cope with when the duct diameters vary by location. In general, air conditioning ducts are concealed and installed inside the ceiling. As the shape and dimensions of the air conditioner from the facility to the inlet and outlet of each chamber change, the flexions are formed, and the successful passing these flexions for the robot should be carried out even with flexions. Typical flexion is either L or T-shaped and the robot should be able to pass through this non-uniform shaped ducts.

II. LITERATURE REVIEW

Two categories of duct cleaning and climbing robots are reviewed. By these reviews, we seek to find answers for following concerns: Facilities, components and dexterity of available DCRs; available climbing structures and their potential to serve as the structure of a duct cleaner robot. 2.1 Literature review on duct cleaning robots There are lots of companies that perform duct cleaning process all around the globe. Most of these firms have employed robots to

do this tedious task. While numbers of DCRs have been designed by companies that are experts of robots design, others are designed by engineers of duct cleaning firms. This section aims to categorize structures, facilities and tools of DCRs. Unfortunately, these robots are not discussed in any scientific article, thus all the information presented in this section is gathered from robot designers' and duct cleaning companies' websites. Since most of the models available take advantage of similar structures and facilities, a set of 10 different robots is chosen to be representative of the others. Table 2.1 introduces names, manufacturers and pictures of the robots under review. Simplicity of the locomotion systems used in these robots proves their inability to climb vertical ducts. All the introduced models use either two wheeled, four wheeled or tracked differential drive locomotion system to transport robot's facilities. Some models are equipped with a manual or actuated one degree of freedom (DOF) arm to adjust position of duct cleaning tools

Literature review on climbing robots Because of their vast application area, climbing robots have been one of the prevalent research topics among categories of mobile robots. To date, many designs, approaches and prototypes are introduced in the literature. The importance of the topic has yielded a number of symposiums focusing on climbing robots (e.g. CLAWAR).

III. METHODS

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

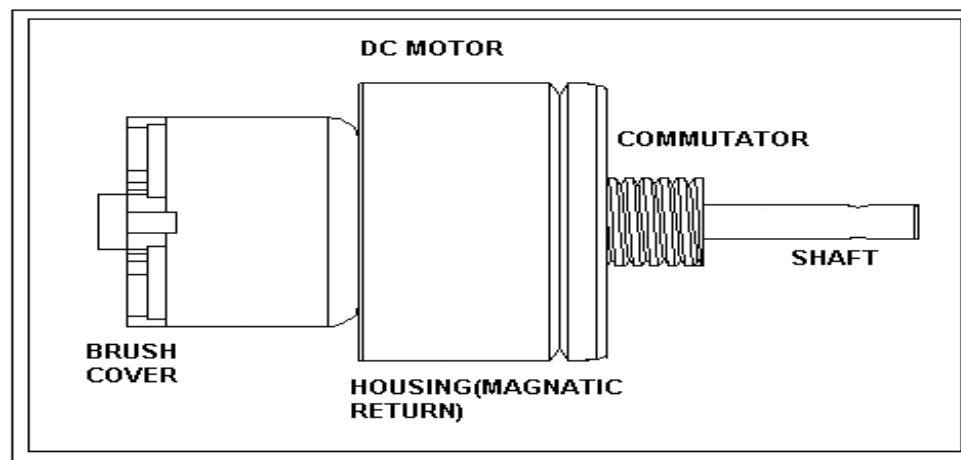


Fig 2: MOTOR

Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

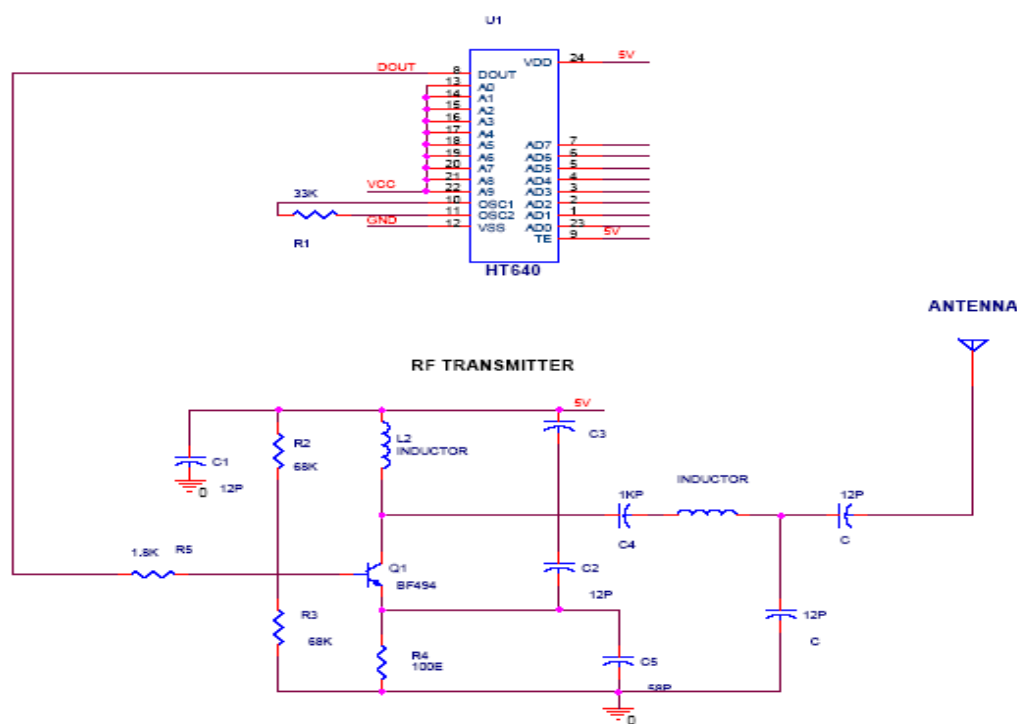
ENCODER WITH RF TRANSMITTER

Fig 3: ENCODER WITH RF TRANSMITTER

In this circuit HT 640 is used as encoder. The 318 encoders are a series of CMOS LSIs for remote control system application. They are capable of encoding 18 bits of information which consists of N address bit and 18-N data bits. Each address/data input is externally trinary programmable if bonded out. It is otherwise set floating internally. Various packages of the 318 encoders offer flexible combination of programmable address/data is transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal. The capability to select a TE trigger type further enhances the application flexibility of the 318 series of encoders.

In this circuit the input signal to be encoded is given to AD7-AD0 input pins of encoder. Here the input signal may be from key board, parallel port, microcontroller or any interfacing device. The encoder output address pins are shorted so the output encoded signal is the combination of (A0-A9) address signal and (D0-D7) data signal. The output encoded signal is taken from 8th which is connected to RF transmitter section.

DECODER WITH RF RECEIVER

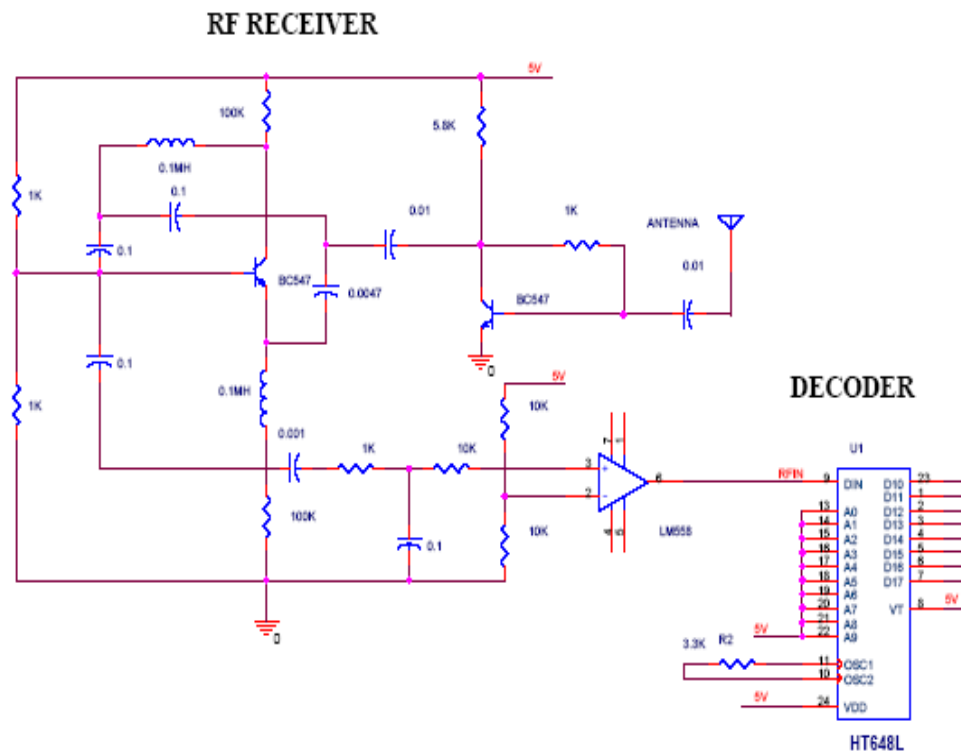


Fig 4: decoder

The RF receiver is used to receive the encoded data which is transmitted by the RF transmitter. Then the received data is given to transistor which acts as amplifier. Then the amplified signal is given to carrier demodulator section in which transistor Q1 is turn on and turn off conducting depends on the signal. Due to this the capacitor C14 is charged and discharged so carrier signal is removed and saw tooth signal is appears across the capacitor. Then this saw tooth signal is given to comparator. The comparator circuit is constructed by LM558. The comparator is used to convert the saw tooth signal to exact square pulse. Then the encoded signal is given to decoder in order to get the decoded original signal.

IV. RESULT

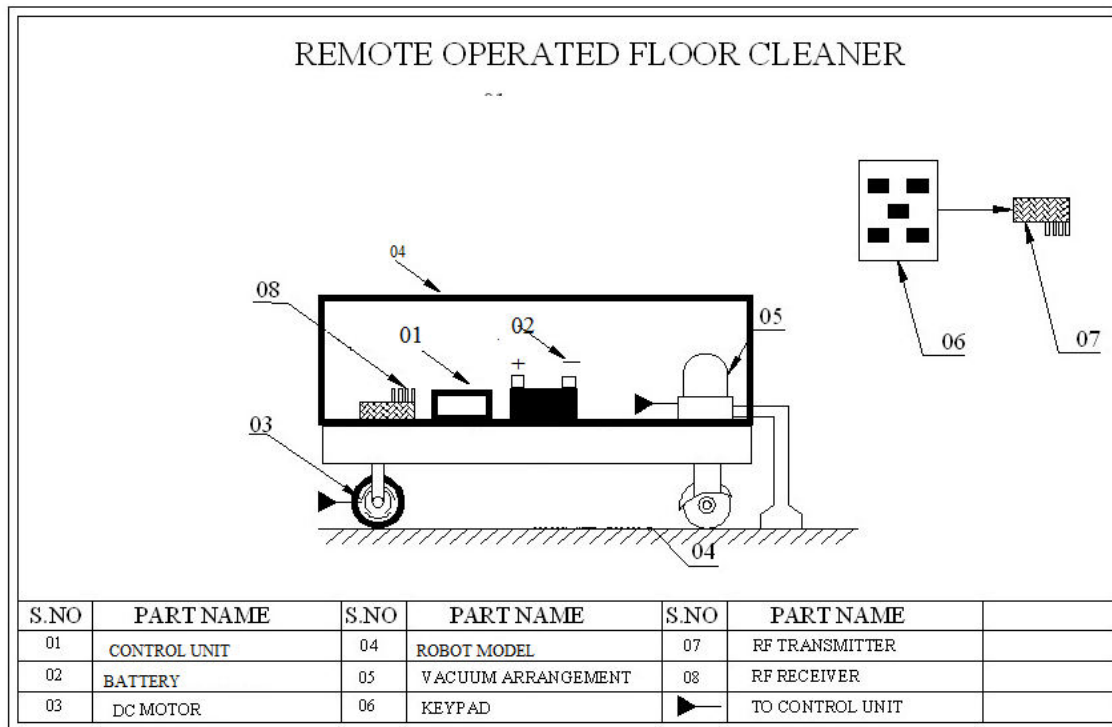


Fig 5: CONTROLLER DUCT CLEANING BOT

Monitor and control device consists of monitor unit and control unit. Operators can inspect the working conditions of the remote robot on monitor. The "before" and "after" cleaning condition of air ducts can also be recorded to be reviewed by the customer in future. The control unit has four buttons as shown in are used to drive the robot to move forward or backward by controlling the turning of the electromotor is used to drive the guiding wheels to rotate synchronously in the same speed but different direction; I is used to actuate the pneumatic rotating brush and the dust collection device.

V. CONCLUSION

In this paper, the new type of autonomous air duct cleaning robot system is proposed, which consists of three devices: the monitor and control device, the remote robot and the dust collection device. The control principle and structure design of each device of the proposed robot system are introduced. The guiding device is developed to ensure the remote robot to move in straight route and turn automatically at corner. The control mechanisms of the remote robot and the rotating brush device are introduced in detail. Also the 3D model of the remote robot is created and the assembly analysis is accomplished using Pro/E. Finally, a prototype of the rotating brush device is made manually to test the cleaning effect of the proposed robot system.



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